Department of Environment Regulation – Department of Mines and Petroleum

GOVERNMENT OF WESTERN AUSTRALIA

# Applications for a clearing permit to be assessed under a Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Accredited Process

## Assessment bilateral agreement – Annex C7

The native vegetation clearing permit processes under Part V of the *Environmental Protection Act 1986* (EP Act) have been accredited by the Commonwealth under the EPBC Act and can be assessed under an assessment bilateral agreement.

To be assessed under the assessment bilateral agreement, the proposed clearing action must be referred to the Commonwealth under the EPBC Act prior to submitting this Annex C7 together with a permit application form (C1, C2 or C4).

## Part 1 Project name and identification

☐ EPBC Act Number: 2015/7449

☐ Short name for the project

SJ Roadworks/Mining/Lot 1 Southwest Highway, Boyanup/WA/Sand Extraction Project

☐ Provide 2 or 3 sentences to uniquely identify the proposed action and its location

SJ Roadworks (SJR) propose to clear up to 10.7 hectares (ha) of Lot 1 (29.45 ha) Southwest Highway, North Boyanup in the Shire of Capel for the purpose of sand extraction (subject to licensing). The Project is expected to provide materials for a number of projects as required over the next 20 years.

## Part 2 Proposed clearing action and impact assessment details

Where the proposed clearing action has been determined to be a controlled action by the Commonwealth Minister for the Environment, assessment of the clearing action under the assessment bilateral agreement can occur if the following information is provided and attached to this Annex and the clearing permit application form (C1, C2 or C4).

Please tick the boxes to indicate you have attached the required information:

☑ Description of the proposed clearing action.

☐ Detailed descriptions, including surveys reports and methodologies, of the matter/s of national environmental significance (matters of NES) prescribed through the EPBC Act controlled action decision and any other relevant matters:

- ☐ World heritage property
  Specify: N/A
- ☐ National heritage property
  Specify: N/A
- ☐ Wetlands of international importance (Ramsar)
  Specify: N/A
- ☑ Nationally listed threatened species and ecological communities including suitable habitat
  Specify: The Minister for the Environment has determined that the proposed action is a controlled action because it is likely to have a significant impact on:
  - Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) - Endangered
  - Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) - Vulnerable
  - Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – Vulnerable
  - Western Ringtail Possum (*Pseudocheirus occidentalis*) – Vulnerable
- ☐ Listed migratory species including suitable habitat
  Specify: N/A
- ☐ Commonwealth Marine
  Specify: N/A

☑ The likely relevant impacts of the action on matters of NES prescribed through the EPBC Act controlled action decision such as:

- a description of the relevant impacts, including environmental, social and economic impacts;
- a detailed analysis of the nature and extent of the likely direct, indirect, short or long term impacts;
- a statement whether any relevant impacts are likely to be unknown, unpredictable or irreversible;
- technical data and other information used to make the detailed assessment.

☑ Feasible alternatives to the proposed action such as:

- the alternative of taking no action;

- a comparative description of the impacts of each alternative;
- sufficient detail to make clear why any alternative is preferred to another.

☑ Detailed description and cost details of possible mitigation measures such as:
- avoidance and mitigation measures proposed to be undertaken to prevent or minimise the relevant impacts of the action on any matter of NES;
- a detailed outline of a plan for the continuing management, mitigation and monitoring of relevant matters of NES impacts of the action;
- details of the offset package to compensate for any significant residual impacts on matters of NES;
- an analysis of how the offset package meets the requirements of the EPBC Act Offsets Policy.

☑ Sources of information and references

## Part 3 Consultation

☐ The role and interest of Aboriginal peoples, as applicable, in promoting conservation and ecologically sustainable use of natural resources and knowledge of biodiversity and Aboriginal heritage are included. Not applicable

☐ Note: After the CEO has determined that the permit application is validly made under section 51E of the EP Act the application will be advertised for public comment. The applicant will be provided with submissions made by the public during the public comment period and must prepare and submit to the CEO a written response which summarises or takes into account the issues raised by the public in those submissions.

**If you need any assistance please contact the Department of Environment Regulation**
**Email**: nvp@der.wa.gov.au
**Telephone**: +61 8 6467 5020

# SJ Roadworks

## Sand Extraction Project

## Annex 7 Supporting Document

May 2015

# Table of contents

# 1. Introduction

## 1.1 Project description

SJ Roadworks (SJR) propose to clear up to 10.7 hectares (ha) of Lot 1 (29.45 ha) Southwest Highway, North Boyanup in the Shire of Capel for the purpose of sand extraction (subject to licensing).

The Project consists of the staged extraction of sand by SJR at intervals at a maximum of 2 ha per stage over six stages. The life of the sand pit is expected to be 20 years. The Project Area will be progressively rehabilitated as areas are decommissioned.

The Project Area is 13.20 ha of which 10.7 ha will be cleared for the Project (clearing area). The clearing area includes 9.5 ha of native vegetation and 1.2 ha of a previously cleared and disturbed area (Ekologica 2012b).This native vegetation supports habitat for the following Matters of National Environmental Significance (matters of NES) listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) listed:

- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) - Endangered
- Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) - Vulnerable
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) - Vulnerable.
- Western Ringtail Possum (*Pseudocheirus occidentalis*) – Vulnerable.

## 1.1 Project location

The Project is within Lot 1, Southwest Highway, Boyanup. The Project is located within the Shire of Capel and is approximately 4 kilometres (km) north of the Boyanup township.

## 1.2 Project background

An application for an area permit was made in 2012 by SJR to the then Department of Environment and Conservation (DEC - permit application number 5051/1). The application was refused under the *Environmental Protection Act 1986.* SJR has since amended its clearing impact area and undertaken several environmental assessments for the proposed clearing impact area in 2012 and 2013. A number of reports have been completed since 2012. These are:

- Department of Environment and Conservation, 2012b, Site Inspection report, Native Vegetation Conservation CPS 5051/1.
- Ekologica, 2012a, A Level 1 Flora Survey of Lot 1 Southeast Highway Boyanup, Unpublished report for SJ Roadworks.
- Ekologica, 2012b, A Vegetation and Dieback Survey of part Lot 1650, North Boyanup, Unpublished report for GHD Pty Ltd.
- Harewood, G, 2013, Western Ringtail Possum and Black Cockatoo Assessment of Lot 1 South Western Highway Boyanup, Unpublished report prepared for SJ Roadworks

On the 27th March 2015, SJR submitted a referral of the proposed sand extraction Project to the Department of the Environment (DotE). On the 1st May 2015, the DotE determined that the Project was a controlled action under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and will therefore require an assessment and approval under the EPBC Act before it can proceed. The relevant controlling provisions were concerning listed threatened species and communities (sections 18 and 18A). SJR submitted an application for a clearing

permit (CPS6554/1) under Part V Division 2 of the *Environmental Protection Act 1986*, to be assessed by the Department of Environmental and Regulation as a bilateral agreement.

This report provides the supporting documentation to the assessment bilateral agreement - form Annex C7 form.

## 1.3 Assumptions and limitations

This report has been prepared by GHD for SJR and may only be used and relied on by SJR for the purpose of supporting documentation to a bilateral agreement (form Annex C7 form) application in relation to clearing permit (CPS6554/1) at Lot 1 Southwest Highway, North Boyanup.

GHD otherwise disclaims responsibility to any person other than SJR arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report. GHD disclaims liability arising from any of the assumptions being incorrect.

GHD has prepared this report on the basis of information provided by SJR and others who provided information to GHD (including Government authorities), which GHD has not independently verified or checked beyond the agreed scope of work. GHD does not accept liability in connection with such unverified information, including errors and omissions in the report which were caused by errors or omissions in that information.

# 2. Proposed clearing action and impact assessment details

## 2.1 Proposed clearing action

SJR propose to clear up to 10.7 hectares (ha) of Lot 1 (29.45 ha) Southwest Highway, North Boyanup in the Shire of Capel for the purpose of sand extraction (subject to licensing). The Project is expected to provide sand for a number of projects as required over the next 20 years.

- The Project Area is 13.20 ha of which 10.7 ha will be cleared for the project (clearing impact area). The clearing area includes 9.5 ha of native vegetation and 1.2 ha of a previously cleared and disturbed area (Ekologica 2012b). The 9.5 ha of native vegetation to be cleared includes: 21 potential Black Cockatoo breeding trees (> 50 cm diameter at breast height) – none with suitable breeding hollows (Harewood 2013)
- 7.5 ha of moderate quality foraging habitat for Black Cockatoos (Harewood 2013)
- 9.5 ha of habitat for the Western Ringtail Possum consisting of predominantly poor habitat (approximately 7.5 ha), very poor habitat (approximately 2 ha) and four old dreys (Harewood 2013).

There will be a 40 m native vegetation buffer retained along the northern boundary, a 20 m buffer on the eastern boundary, a 50 m buffer from the edge of the 'sumpland' on the southern boundary and at least a 40 m buffer on the eastern boundary adjacent to the South West Highway.

## 2.2 Surveys reports and methodologies, of the matter/s of NES prescribed through the EPBC Act controlled action decision

A search of the EPBC Act Protected Matters Search Tool (DotE 2015) identified, without assessment, six EPBC listed fauna species that could potentially occur within 5 km of the Project Area. In February 2013, Harewood (2013) conducted a Western Ringtail Possum and Black Cockatoo Assessment within the Project Area. This assessment included a daytime survey of the site searching for dreys, obvious tree hollows, scats and individual Western Ringtail Possums and one night time survey to locate and record the distribution and abundance of Western Ringtail Possums within the Project Area (Harewood 2013). Harewood also surveyed for Black Cockatoos, which included a habitat tree survey (identifying trees with diameter breast height of over 50 centimetres (cm), Black Cockatoo foraging assessment (identifying chewed fruits) and a roosting habitat survey.

During the field survey, evidence was recorded for four of the EPBC listed fauna species from the Protected Matters Search, which included:

- Carnaby's Cockatoo Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) Baudin's Cockatoo
- Western Ringtail Possum.

The two remaining species (Chuditch *Dasyurus geoffroii* and Quokka *Setonix*) identified from the Protected Matters Search were not recorded during the field survey and considered unlikely to occur within the Project Area because of the lack of suitable habitat and presence of feral predator species including foxes (Harewood 2013).

A summary of the key findings from the survey by Harewood (2013) for the Western Ringtail Possum and three species of Black Cockatoo within the Project Area include:

- The survey confirmed that vegetation within the Lot is being used by Western Ringtail Possum as habitat, though the overall level of utilisation appears to be low with only one individual being observed during the night time survey.
- The quality of Western Ringtail Possum habitat within the proposed extraction area (Project Area) appears to be very low compared to other areas of the site that are to be retained. This is a consequence of the extraction area consisting mainly of highly degraded (dieback infested) banksia woodland that lacks canopy connectivity and the favoured foraging species for Western Ringtail Possum.
- The proposed extraction area also contains Black Cockatoo foraging and potential nesting habitat. Foraging habitat is mainly represented by the banksia woodland which also contains scattered jarrah trees.
- Evidence of both these resources being utilised by Black Cockatoos was observed during the field survey. Some of the jarrah trees, by definition, represent potential breeding habitat though no evidence of any being used for this purpose was seen.
- The probability of any one jarrah tree ever being used for nesting by Black Cockatoos can be considered to be low given previous survey work in other areas indicating they are rarely used for this purpose.
- The results of this survey would suggest that criteria relating to fauna used by the Department of Conservation and Environment (DEC) when assessing clearing permits are not likely to be compromised by the required vegetation removal given the degraded nature of the site and the presence of extensive areas of potential habitat in adjoining areas.

## 2.3 The likely relevant impacts of the action on matters of NES prescribed through the EPBC Act controlled action

The likely relevant impacts of the action on matters of NES, from the clearing of the Project Area are to listed threatened species and communities (sections 18 and 18A).

The proposed action (EPBC Ref: 2015/7449) is likely to have an impact on Black Cockatoos because it involves the removal of more than 1 ha of quality foraging and potential breeding habitat.

The proposed action is likely to have an impact on Western Ringtail Possums as it involves the clearing of supporting habitat. Any clearing of a remnant habitat patch that is greater than 0.5 hectares in size is deemed as likely to have a significant impact on this species.

## 2.4 Feasible alternatives to the proposed action

Currently there are no alternatives to the clearing of the 9.5 ha of native vegetation within the Project Area for the proposed sand extraction, however SJR will be retaining a 40 m native vegetation buffer along the northern boundary, a 20 m buffer on the eastern boundary, a 50 m buffer from the edge of the ‘sumpland’ on the southern boundary and at least a 40 m buffer on the eastern boundary adjacent to the South West Highway.

## 2.5 Description and cost details of possible mitigation measures

### 2.5.1 Mitigation measures

Strategen, on behalf of SJR, has completed an Offset Strategy (Strategen 2014). As part of the this strategy, Strategen completed a Level 1 flora and vegetation assessment of the proposed offset sites. Three zones were investigated as part of the environmental assessment. The Department of the Environment (DotE) Offset Calculator was used to determine the adequacies of the proposed direct offsets in meeting the 90% direct offset requirement.

Two options were investigated, however Option 2 – Land acquisition and revegetation was considered the most viable option and meets the DotE EPBC Act Environmental Offsets Policy. Option 1 – Land acquisition only, did not meet the target area (17 ha) suitable for Black Cockatoo foraging habitat determined through the Offset Calculator as the land to be acquired only contained 12.73 ha of Black Cockatoo foraging habitat.

Option 2 includes (Strategen 2014, p. 11):

- Utilisation of the entire 12.73 ha of suitable Black Cockatoo habitat within the proposed offset sites as part of the offset and provide funds to Department of Parks and Wildlife for the management of these areas
- Revegetate 4 ha within the proposed revegetation areas as displayed in Figure 2 with the goal of increasing the amount of Black Cockatoo habitat within these areas.

SJR has prepared a Rehabilitation and Decommissioning Programme and a Noise, dust and dieback management plans (Geolatry 2012).

These plans include management strategies for the following:

- Dieback Management
- Soil Management
- Weed and Pest Management
- Drainage
- Erosion and Sediment Control
- Dust Generation from sand extraction/haulage
- Noise Management
- Pit Rehabilitation
- Hydrocarbon/Construction Debris Management
- Monitoring of Rehabilitation

Development of the Project is proposed to take place in six stages, with the initial development to be located in the west of the Project Area and a maximum of 2 ha to be cleared at each stage. The rehabilitation of the disturbance area will also be undertaken in stages, as parts of the pit are decommissioned. Rehabilitation will include the areas previously used for sand extraction.

Progressive rehabilitation is expected to reduce impacts to surface water runoff and prevent dust lift and erosion where possible. It is proposed that 4.42 ha of the Project Area will be rehabilitated using dieback tolerant species which have been chosen for their suitability as Black Cockatoo foraging and Western Ringtail Possum habitat.

### 2.5.2 Cost details of possible mitigation measures

As detailed in section 2.5.1, Strategen, on behalf of SJR, has completed an Offset Strategy (Strategen 2014). No costs were determined in the Offset Calculator (Appendix 2 in Strategen 2014).

# 3. References

Department of the Environment (DotE) (2015) *Protected Matters Search Tool*, retrieved March, 2015, from: http://www.environment.gov.au/epbc/pmst/index.html

Ekologica, 2012a, A Level 1 Flora Survey of Lot 1 Southeast Highway Boyanup, Unpublished report for SJ Roadworks.

Ekologica, 2012b, A Vegetation and Dieback Survey of part Lot 1650, North Boyanup, Unpublished report for GHD Pty Ltd.

Geolatry, 2012, *Management Plans for Lot 1 South West Highway, Boyanup, Western Australia*.

Harewood, G, 2013, Western Ringtail Possum and Black Cockatoo Assessment of Lot 1 South Western Highway Boyanup, Unpublished report prepared for SJ Roadworks

Strategen, 2014, *Environmental Offset Strategy, Lot 1 South Western Highway, North Boyanup.* Draft report prepared for SJ Roadworks.

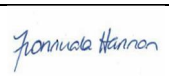
GHD

GHD House, 239 Adelaide Tce. Perth, WA 6004
P.O. Box 3106, Perth WA 6832
T: 61 8 6222 8222 F: 61 8 6222 8555 E: permail@ghd.com.au



\\ghdnet\ghd\AU\perth\Projects\61\30514\WP\150255.docx

Document Status

| Rev No. | Author | Reviewer | | Approved for Issue | | |
|---|---|---|---|---|---|---|
| | | Name | Signature | Name | Signature | Date |
| | G. Owen | C. Grabham | | F. Hannon |  | 27/5/2015 |
| | | | | | | |
| | | | | | | |

www.ghd.com

Australian Government
Department of Sustainability, Environment, Water, Population and Communities

# Referral of proposed action

## Project title: SJ Roadworks – sand extraction - Lot 1 South Western Highway

# 1 Summary of proposed action

### 1.1 Short description

SJ Roadworks (SJR) propose to clear up to 10.7 hectares (ha) of Lot 1 (29.45 ha) Southwest Highway, North Boyanup in the Shire of Capel for the purpose of sand extraction (subject to licensing). The Project is expected to provide materials for a number of projects as required over the next 20 years. The Project Area is displayed in Figure 1 (Attachment A).

The Project Area is 13.20 ha of which 10.7 ha will be cleared for the project (clearing impact area). The clearing area includes 9.5 ha of native vegetation and 1.2 ha of a previously cleared and disturbed area (Ekologica 2012). Of the 9.5 ha of native vegetation, 7.5 ha was identified as Black Cockatoo habitat (Harewood 2013).

There will be a 40 m native vegetation buffer retained along the northern boundary, a 20 m buffer on the eastern boundary, a 50 m buffer from the edge of the 'sumpland' on the southern boundary and at least a 40 m buffer on the eastern boundary adjacent to the South West Highway.

The Project is being referred to the Department of the Environment (DotE) as it may result in the loss of up to 7.5 ha of potential Black Cockatoo habitat. This habitat supports all three Black Cockatoo species in WA listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act):

- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) - Endangered
- Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) - Vulnerable
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) - Vulnerable.

1.2 Latitude and longitude

Latitude and longitude details are used to accurately map the boundary of the proposed action. If these coordinates are inaccurate or insufficient it may delay the processing of your referral.

| Location point | Latitude | Longitude |
|---|---|---|
| 0 | -33.44223347 | 115.7135175 |
| 1 | -33.44214546 | 115.7136413 |
| 2 | -33.44211049 | 115.7138924 |
| 3 | -33.4420881 | 115.7143209 |
| 4 | -33.44206174 | 115.7165047 |
| 5 | -33.44207364 | 115.7166157 |
| 6 | -33.44214118 | 115.7168141 |
| 7 | -33.44221547 | 115.7169398 |
| 8 | -33.44231017 | 115.7170175 |
| 9 | -33.4424788 | 115.7171111 |
| 10 | -33.44335305 | 115.7174614 |
| 11 | -33.44356645 | 115.7175517 |
| 12 | -33.44390162 | 115.7177633 |
| 13 | -33.44418761 | 115.718025 |
| 14 | -33.4442825 | 115.7180839 |
| 15 | -33.44433916 | 115.7181133 |
| 16 | -33.44441577 | 115.7181269 |
| 17 | -33.44447586 | 115.7181249 |
| 18 | -33.44453183 | 115.7180988 |
| 19 | -33.44457928 | 115.7180449 |
| 20 | -33.44461573 | 115.7179943 |
| 21 | -33.44461488 | 115.717913 |
| 22 | -33.44461176 | 115.7176109 |
| 23 | -33.44468182 | 115.7173164 |
| 24 | -33.444701 | 115.7172823 |
| 25 | -33.44482243 | 115.7171355 |
| 26 | -33.44561047 | 115.716983 |
| 27 | -33.44561424 | 115.7163621 |
| 28 | -33.44503558 | 115.7145337 |
| 29 | -33.44496395 | 115.7142899 |
| 30 | -33.44494322 | 115.7135088 |
| 31 | -33.44467606 | 115.7133244 |
| 32 | -33.4441802 | 115.7133477 |
| 33 | -33.44243071 | 115.7134677 |

1.3 Locality and property description

The Project Area is located within Lot 1, Southwest Highway, Boyanup, Western Australia (Figure 1). The Project Area is located within the Shire of Capel and is approximately 4 km north of the Boyanup township.

| | | |
|---|---|---|
| 1.4 | Size of the development footprint or work area (hectares) | The Project Area is the clearing impact area. The Project Area contains 10.7 ha, of which 9.5 ha is native vegetation, inclusive of 7.5 ha of Black Cockatoo habitat. |
| 1.5 | Street address of the site | Lot 1 - South Western Highway, Boyanup, Western Australia |

1.6 Lot description

Lot 1, Southwest Highway, Boyanup, Western Australia. Freehold. Zoned rural.

| | | | |
|---|---|---|---|
| 1.7 | Local Government Area and Council contact (if known)<br>Shire of Capel - 31 Forrest Road, Capel WA 6271<br>Monday to Friday (8.30 am - 4.30 pm). Phone: 08 9727 0222<br>Contact: Andrew Coulsen | | |
| 1.8 | Time frame<br>SJR propose to stage the extraction of sand which is expected to commence as soon as approval is granted. | | |
| 1.9 | Alternatives to proposed action<br>Were any feasible alternatives to taking the proposed action (including not taking the action) considered but are not proposed? | X | No alternatives |
| 1.10 | Alternative time frames etc<br>Does the proposed action include alternative time frames, locations or activities? | X | No alternative timeframes |
| 1.11 | State assessment<br>Is the action subject to a state or territory environmental impact assessment? | X | Yes - The Project will not be referred to the Western Australian Environmental Protection Authority (EPA). However, the proposed clearing of native vegetation has been assessed under the Environmental Protection (Clearing of Native Vegetation) Regulations 2004 by the Department of Environmental Regulation (DER). Although, the original Clearing Permit (CPS 5051/1) was rejected refused (10th October 2013), SJR is preparing another permit for submission to DER. |
| 1.12 | Component of larger action<br>Is the proposed action a component of a larger action? | X | No |
| 1.13 | Related actions/proposals<br>Is the proposed action related to other actions or proposals in the region (if known)? | X | No |
| 1.14 | Australian Government funding<br>Has the person proposing to take the action received any Australian Government grant funding to undertake this project? | X | No |
| 1.15 | Great Barrier Reef Marine Park<br>Is the proposed action inside the Great Barrier Reef Marine Park? | X | No |

# 2 Detailed description of proposed action

### 2.1 Description of proposed action

The Project is a 10.7 ha section of Lot 1 located on Southwest Highway, in the Shire of Capel. The Project consists of the staged extraction of sand by SJ Roadworks at intervals at a maximum of 2 ha per stage over six stages. The life of the sand pit is expected to be 20 years. The Project Area will be progressively rehabilitated as areas are decommissioned

The action shall involve activities including logging, clearing and mulching of cleared vegetation. The pit will be developed and rehabilitated in stages, where rehabilitation will include using dieback tolerant plant species.

Prior to the beginning of sand extraction activities in each stage, all vegetation will be removed and stock piled adjacent to the site to be mulched and used in rehabilitation processes. The top soil will be stock piled for later rehabilitation purposes. When climatic conditions allow after staged sand extraction is complete, all land forms within the site will either be rehabilitated with die back tolerant native plant species with 1 in 10 batters or established with a mix of annual and perennial pasture species.

Approximately 6.28 ha will be established with pasture species and 4.42 ha rehabilitated with native plant species. Vermin proof fencing will be installed to help with rehabilitation processes.

### 2.2 Alternatives to taking the proposed action

No alternatives to this proposal are practical. The availability of commercial sand supplies in the region are limited.

### 2.3 Alternative locations, time frames or activities that form part of the referred action

No alternative locations, time frames or activities form part of this referral.

### 2.4 Context, planning framework and state/local government requirements

Lot 1 has previously been used for sand extraction purposes which has subsequently expired.

The Shire of Capel, Local Planning Scheme No.7 (District Scheme) indicates the Project Area is zoned as “rural” (Western Australian Planning Commission (WAPC) 2013). All Project details including planning schedules and rehabilitation plans have been supplied to the Shire of Capel.

The clearing of any native vegetation is regulated by the Department of Environmental Regulation and requires a permit under Part V of the *Environmental Protection Act 1986* (EP Act). A Clearing Permit was refused by the DER for this Project (CPS 5051/1). SJR accepted the DERs decision and is currently completing an offset strategy as a requirement by the DER to be provided with the application to clear. The Project was considered to be at variance to three of the “10 Clearing Principles” and may be at variance with one other of the Principles.

The Project Area is within a groundwater (Bunbury Groundwater Area) area proclaimed under the *Rights in Water and Irrigation Act 1914* (RIWI Act). Should groundwater be required for construction activities, a licence will be applied for under the RIWI Act, however at this stage this is not expected.

### 2.5 Environmental impact assessments under Commonwealth, state or territory legislation

The Project is not expected to be referred to the EPA for assessment under Section 38 of the EP Act. Clearing will be undertaken in accordance with a permit under Part V of the EP Act. The following investigations have been undertaken for the Project:

- A Vegetation and Dieback Survey of part Lot 1650, North Boyanup. (Ekologica 2012a)
- A Level 1 Flora Survey of Lot 1 South West Highway Boyanup (Ekologica 2012b)
- Management Plans for Lot 1 South West Highway, Boyanup Western Australia including Noise Management, Dust Management and Dieback Management (Geolatry 2012)

### 2.6 Public consultation (including with Indigenous stakeholders)

The Project has been discussed with the Shire of Capel, the Water Corporation and the Department of Parks and Wildlife.

Consultation has also been undertaken with adjacent landowners. A letter describing all the proposed activities to take place at the rear of Lot 1 was posted/hand delivered to the neighbours on the 24th January 2013. A liaison officer has been employed to manage any concerns or issues that neighbours may have concerning the Project.

### 2.7 A staged development or component of a larger project

The Project is a stand-alone project and will be developed and rehabilitated in six stages over an estimated 20 years.

# 3 Description of environment & likely impacts

## 3.1 Matters of national environmental significance

3.1 (a) World Heritage Properties

Description - No World Heritage Properties were identified within 5 km of the Project Area.
Nature and extent of likely impact - Not applicable

3.1 (b) National Heritage Places

Description - No National Heritage Places were identified within 5 km of the Project Area.
Nature and extent of likely impact - Not applicable

3.1 (c) Wetlands of International Importance (declared Ramsar wetlands)

Description - No wetlands of International Importance were identified within 5 km of the Project Area.
Nature and extent of likely impact - Not applicable

3.1 (d) Listed threatened species and ecological communities

Description

*Threatened Ecological Communities*

The EPBC Act Protected Matters Search Tool (DotE 2015 - Attachment B) did not identify any Threatened Ecological Community (TEC) within 5 km of the Project Area.

Three TECs are known from the greater Boyanup region and have been considered as part of this assessment:

- *Corymbia calophylla* - *Xanthorrhoea preissii* woodlands and shrublands of the Swan Coastal Plain (Endangered)
- Claypans of the Swan Coastal Plain (Critically Endangered)
- Subtropical and Temperate Coastal Saltmarsh (Vulnerable)

No vegetation types were recorded within the Project Area that could be associated with these TECs, however Ekologia, 2012b did identify one vegetation type - *Melaleuca* Wet Shrubland (Possibly SWAFCT 09). This community is one of four associated with the Claypans of the Swan Coastal Plain (Critically Endangered) TEC. This community is associated with the wetland in the southern part of the Survey Area (outside of the Project Area). This wetland is classified as "Resource Enhancement" – these wetlands "have been partially modified but still support substantial wetland attributes and functions" (Waters and Rivers Commission, 2001).

This vegetation community is located outside the proposed Project Are in the south-east of Lot 1 (see Figure 3 of Ekologia, 2012b). The Project will not clear or remove any part of this community.

*Fauna*

A search of the EPBC Act Protected Matters Search Tool (DotE 2015 - Attachment B) identified, without assessment, six EPBC listed fauna species that could potentially occur within 5 km of the Project Area. During the field survey, evidence was recorded for four of the EPBC listed fauna species from the Protected Matters Search were identified, (Harewood 2013). These were:

- Carnaby's Cockatoo (*Calyptorhynchus latirostris*) – Endangered under EPBC Act
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – Vulnerable under EPBC Act
- Baudin's Cockatoo (*Calyptorhynchus baudinii*) – Vulnerable under EPBC Act
- Western Ringtail Possum (*Pseudocheirus occidentalis*) – Vulnerable under EPBC Act.

The two remaining species (Chuditch *Dasyurus geoffroii* and Quokka *Setonix*) identified from the Protected Matters Search not recorded during the field survey were considered unlikely to occur within the Project Area because of the lack of suitable habitat and presence of feral predator species including the fox.

A summary of the key findings from Harewood (2013) (Attachment C) Survey for the Western Ringtail Possum and three species of Black Cockatoo within the Project Area includes:

- The survey confirmed that vegetation within the Lot is being used by Western Ringtail Possum as habitat, though the overall level of utilisation appears to be low with only one individual being observed during the night time survey.
- The quality of Western Ringtail Possum habitat within the proposed extraction area (Project Area) appears to be very low compared to other areas of the site that are to be retained. This is a consequence of the extraction area consisting mainly of highly degraded banksia woodland that lacks canopy connectivity and the favoured foraging species for Western Ringtail Possum.
- The proposed extraction area also contains Black Cockatoo foraging and potential nesting habitat. Foraging habitat is mainly represented by the banksia woodland which also contains scattered jarrah trees.
- Evidence of both these resources being utilised by Black Cockatoos was observed during the field survey. Some of the jarrah trees, by definition, represent potential breeding habitat though no evidence of any being used for this purpose was seen.
- The probability of any one jarrah tree ever being used for nesting by Black Cockatoos can be considered to be low given previous survey work in other areas indicating they are rarely used for this purpose.
- The results of this survey would suggest that criteria relating to fauna used by the Department of Conservation and Environment (DEC) when assessing clearing permits are not likely to be compromised by the required vegetation removal given the degraded nature of the site and the presence of extensive areas of potential habitat in adjoining areas.

- Clearing for the proposal will compromise some of the Federal Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) criteria for what they would considere to be “likely significant impact” for both Western Ringtail Possum and Black Cockatoos.
-

*Flora*

The Protected Matters Search Tool identified 17 EPBC listed flora species that could potentially occur within 5 km of the Project Area (DotE 2015 - Attachment B). The field survey undertaken by Ekologica (2012a and b) of the Project Area did not record any of these species. It was determined that of the 17 species identified by the Protected Matters Search, 15 species were considered unlikely to occur within the Project Are based on habitat requirements and two species were identified as ‘possible’ to occur within the Project Area (*Drakaea micrantha* and *Drakaea elastic*) although neither were recorded during the Ekologica 2012b survey.

Nature and extent of likely impact

*Black Cockatoos*

Approximately 7.5 ha of vegetation containing moderate quality foraging habitat for Black Cockatoos was identified inside the Project Area (Harewood 2013 - Attachment C). This includes Eucalyptus species (particularly jarrah nuts) and Banksia species (including *Banksia attenuata* and *B. ilicifolia*). These species are regarded as high value foraging species for Black Cockatoos. Although evidence of foraging was found to be relatively common during the field survey no Black Cockatoos were observed within the Project Area during the survey (Harewood 2013 - Attachment C).

The Project Area is located within the known breeding range for the Carnaby's Cockatoo and predicted breeding range for Baudin's Cockatoo, and within the modelled distribution of Forest Red-tailed Black Cockatoo (DSEWPaC 2012). The timing of the field survey was undertaken toward the end of the breeding season of all three species of Black Cockatoos (February 27th 2013); and no records of breeding were noted during the field survey. The field assessment identified 51 suitable breeding trees (diameter at breast height of over 500 mm) throughout Lot 1 of which 21 were within the Project Area. According to Harewood 2013, Jarrah trees rarely produce hollows suitable for Black Cockatoos to use for nesting based on the results of surveys in other areas (Kirkby 2009), therefore the probability of breeding ever taking place within the Project Area can be considered to be low. (Harewood 2013 - Attachment C).

*Significance of potential impacts*

In order to determine if the proposed Project will have a significant impact on the three species of Black Cockatoos an assessment was undertaken against the Significant Impact Guidelines (DotE 2013), as presented in Table 1. The Significant Impact Criteria have been applied to all three species of Black Cockatoos, and include criteria for Endangered species (Carnaby's Black Cockatoo) and Vulnerable species (Baudin's and Forest Red-tailed Black Cockatoo).

For the purpose of this assessment a 'population of a species' for the Carnaby's Black Cockatoo is the population that occurs within the greater Bunbury region, within the Greater Bunbury Regional Scheme (GBRS) boundary. The scheme area covers the three local government areas, the City of Bunbury and the shires of Harvey, Dardanup and Capel and incorporates the nearby Boyanup State Forest.

An 'important population of a species' for both the Baudin's and the Forest Red-tailed Black Cockatoos includes the population of each species that occurs within the GBRS boundary. As defined by DotE (2013) an important population of a species is that which is necessary for a species' long-term survival and recovery. In the case for Baudin's and the Forest Red-tailed Black Cockatoos, the populations that occur in the GBRS area are important for each species long term survival as they are likely to be necessary for maintaining genetic diversity.

The outcome of this assessment concluded that the Project is Unlikely to have a significant impact on all three species of Black Cockatoos.

Table 1 Significant Impact Criteria for three species of Black Cockatoos

| Significant Impact Criteria | Impact Outcome |
|---|---|
| *An action is likely to have a significant impact on an endangered or vulnerable species if there is a real chance or possibility that it will:* | |
| Lead to a long-term decrease in the size of a population or important population of a species | Unlikely<br>The proposed Project is likely to result in removal of approximately 7.5 ha of suitable foraging habitat and 21 potential breeding trees for all three species of Black Cockatoo. The Project Area is located within the breeding range of the species.<br>The proposed Project, without the implementation of species specific mitigation measures, is unlikely to result in a long term decrease in the size of a population of this species as it is unlikely to substantially:<br>• Reduce the overall area of available habitat to the population<br>• Reduce the overall area of occupancy of the population<br>• Exacerbate existing barrier effects and create new barrier effects<br>• Disrupt the breeding cycle of part of the population<br>Therefore, it is considered that clearing of approximately 7.5 ha of |

| | |
|---|---|
| | suitable foraging including potential breeding habitat is unlikely to a long-term decrease in the size of the local population of any species of Black Cockatoo. |
| Reduce the area of occupancy of the species | Unlikely<br>The Project is unlikely to substantially reduce the area of occupancy of the population of Carnaby's Cockatoo within the local area or region. The species is known to occur throughout the Boyanup area.<br>The estimated area of suitable foraging habitat available within the greater Shire of Capel is estimated to be 18,348 ha1. The Project may reduce the overall area of habitat by less than 0.04% ha within the Shire of Capel locality as a result of direct loss of habitat from clearing. Therefore removal of approximately 7.5 ha of foraging habitat is not considered likely to be significant for the species, due to the presence of a large proportion of adjacent suitable habitat within the locality and region including the habitats within the nearby Boyanup State Forest. |
| Fragment an existing important population or population into two or more populations. | Unlikely<br>The Project is unlikely to fragment the population into two or more populations.<br>The Project proposes the removal of vegetation for sand extraction, and clearing of 10.7 ha of vegetation, which intersects known and potential Black Cockatoo habitat within the greater area. The Project is in close proximity to a regionally significant ecological linkage (the McLarty/Kemerton/Twin Rivers/Preston River/Gwindinup Ecological Linkage-Naturaliste) which extends north and south of the Project Area along the South Western Highway National Park (EPA 2000).<br>A large, continuous vegetation corridor is present to the east of the Project Area and includes the Boyanup State Forest and Jarrahdale State Forest further to the south. It is unlikely that the Project Area constitutes a significant proportion of this broader regional linkage. In addition, a vegetated buffer around the Project Area will retain habitat linkages (Figure 1 - Attachment A).<br>Based on the mobility of the three species of Black Cockatoo and the occurrence of habitats adjacent to the Project Area, fragmentation of a local population is considered unlikely. |
| Adversely affect habitat critical to the survival of a species | Unlikely<br>The Project is unlikely to affect habitat critical to the survival of the species. Approximately 7.5 ha of Carnaby's Cockatoo habitat in the Project will be cleared in stages of a maximum of 2 ha for this Project. Given that this habitat type is well represented adjacent to the Project Area and the greater locality, the impacts of this clearing are not considered significant. The habitat located within the Clearing Area does not consist of habitat described by a recovery plan as critical for the survival of the Carnaby's, Baudin's or the Forest Red-tailed Black Cockatoo (DEC 2008; DEC 2012), nor is it habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act (DotE 2013). |
| Disrupt the breeding cycle of a population or important population. | Unlikely<br>The works associated with the Project, are unlikely to disrupt the breeding cycle of the population of the Carnaby's Cockatoo.<br>The Project Area is located within the known breeding range for the Carnaby's Cockatoo and predicted breeding range for Baudin's Cockatoo, and within the modelled distribution of Forest Red-tailed Black Cockatoo |

[1] The area of suitable foraging habitat within the Shire of Capel is estimated at 18,348 ha. This area calculation is based on the extent remaining of Beard (1979) vegetation associations which contain flora species suitable for Carnaby's Cockatoo foraging (based on Groom (2011)).

| | |
|---|---|
| | (DSEWPaC 2012).<br>The timing of the field survey was undertaken toward the end of the breeding season of all three species of Black Cockatoos (February 27th 2013); however no records of breeding were noted during the field survey. The field assessment identified 51 suitable breeding trees (diameter at breast height of over 500 mm) throughout Lot 1 of which 21 were within the Project Area. According to Harewood 2013, Jarrah trees rarely produce hollows suitable for Black Cockatoos to use for nesting based on the results of surveys in other areas, therefore the probability of breeding ever taking place within the Project Area can be considered to be low. (Harewood 2013 - Attachment C).<br>Given that only 0.04% of potential habitat for this species within the Shire of Capel will be impacted by the Project, it is considered unlikely that the Project will disrupt the breeding cycle of the local population. |
| Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline | Unlikely<br>The works associated with the Project, may modify and destroy a small proportion (approximately 7.5 ha, or approximately 0.04% of the overall habitat within the Shire of Capel locality) of known and potential habitat for this species, but not to the point that this species would decline. Given that this habitat type is well represented adjacent to the Project and the greater locality (Boyanup State Forest), the impacts of this clearing are not considered significant.<br>The proposed Project is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline. |
| Result in invasive species that are harmful to an endangered species becoming established in the endangered species' habitat | Unlikely<br>The Project may potentially exacerbate existing invasive species (such as introduced predators) that already occur within the Project area and may result in the establishment of an invasive weeds species; however, these weed species are unlikely to significantly impact the habitat within the Project Area or Carnaby's Cockatoo individuals.<br>It is also worth noting that the Project Area is currently infested with dieback and as such the therefore the current value of the vegetation within the Project Area as foraging and potential breeding habitat is declining.<br>SJ Roadworks will rehabilitate the Project Area with dieback tolerant species which are suitable for use as foraging and potential breeding habitat. |
| Introduce disease that may cause the species to decline | Unlikely<br>The site was assessed in 2012 (Ekologica 2012) to identify the dieback status of the proposed sand extraction area. The survey identified that 10.3 ha of the then proposed Project Area was dieback infested with 2.29 ha unmappable and 0.54 ha considered to be uninfested by dieback (Attachment C). Dieback could reduce the density of the remaining foraging habitat for Carnaby's Cockatoo, however it is already present at the site and the impact of dieback on potential cockatoo habitat is already taking effect. The Project Area is proposed to be rehabilitated with dieback tolerant species suitable as Black Cockatoo species. |
| Interfere with the recovery of the species. | Unlikely<br>The Project is unlikely to interfere substantially with the recovery of Carnaby's, Baudin's or the Forest Red-tailed Black Cockatoo as it is unlikely to interfere with the recovery actions outlined in the recovery plans for each of these species (DEC 2008; DEC 2012). For Carnaby's these actions include: |

| | |
|---|---|
| | • Protect and Manage Important Habitat<br>• Conduct Research to Inform Management<br>• Undertake Regular Monitoring<br>• Manage Other Impacts<br>• Undertake Information and Communication Activities<br>• Engage with the Broader Community<br>For the Baudin's and Forest Red-tailed Black Cockatoos these include:<br>• Seek the funding required to implement future recovery actions.<br>• Determine and promote non-lethal means of mitigating fruit damage by Baudin's Cockatoo in orchards.<br>• Eliminate illegal shooting.<br>• Develop and implement strategies to allow for the use of noise emitting devices in orchards.<br>• Determine and implement ways to remove feral Honeybees from nesting hollows.<br>• Identify factors affecting the number of breeding attempts and breeding success and manage nest hollows to increase recruitment.<br>• Determine and implement ways to minimise the effects of mining and urban development on habitat loss.<br>• Determine and implement ways to manage forests for the conservation of Forest Black Cockatoos.<br>• Identify and manage important sites and protect from threatening processes.<br>• Map feeding and breeding habitat critical to survival and important populations, and prepare management guidelines for these habitats.<br>• Monitor population numbers and distribution.<br>• Determine the patterns and significance of movement.<br>• Maintain the Cockatoo Care program and use other opportunities to promote the recovery of Forest Black Cockatoos. |

Legend for Table 1 - For the purpose of this assessment,

For the purpose of this assessment:

'population of a species' is defined under the EPBC Act as an occurrence of the species in a particular area. In relation to an endangered species, occurrences include but are not limited to:

- a geographically distinct regional population, or collection of local populations, or
- a population, or collection of local populations, that occurs within a particular bioregion (DotE 2013, pp 9)

'important population of a species' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:

- key source populations either for breeding or dispersal
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

'invasive species'; is an introduced species, including an introduced (translocated) native species, which out-competes native species for space and resources or which is a predator of native species. Introducing an invasive species into an area may result in that species becoming established. An invasive species may harm listed Threatened species or ecological communities by direct competition, modification of habitat or predation (DotE 2013, pp 9).

'Habitat critical to the survival of a species or ecological community' refers to areas that are necessary:

- for activities such as foraging, breeding, roosting, or dispersal
- for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- to maintain genetic diversity and long term evolutionary development, or
- for the reintroduction of populations or recovery of the species or ecological community.

Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained

by the minister under the EPBC Act (DotE 2013, pp10).

Western Ringtail Possum

The Project Area provides predominantly poor (approximately 7.5 ha) and very poor (approximately 2 ha) habitat for the Western Ringtail Possum (Harewood 2013). Evidence of Western Ringtail Possums was recorded in the Project Area during the field survey, including four old dreys. One individual was seen within 500 m of the Project Area and a further seven old dreys were present in the vegetation that will be retained in Lot 1. It should be noted that the better quality habitat is located to the south west of the Project Area in Lot 1 where the vegetation is predominantly peppermint (*Agonis flexuosa*) with marri (*Corymbia calophylla*). There was limited evidence of current use within the Project Area during the field survey and as such the Project Area is likely to support a small number of transient individuals as 'dispersal habitat' (Harewood 2013 – Attachment C).

*Significance of potential impacts*

In order to determine if the proposed Project will have a significant impact on the Western Ringtail Possum, an assessment was undertaken against the Significant Impact Guidelines (DotE 2013), as presented in Table 2.

For the purpose of this assessment an 'important population' of a species refers to the Western Ringtail Possums located in the greater Bunbury region, specifically including the Bunbury and Binningup Management Zones determined by Shedley and Williams (2014). A summary of these management zones is provided by GHD (2014). This population is termed the 'greater Bunbury region important population' and includes the 'sparse population extending between Bunbury and Yallingup' population from the Species Profile and Threats database (SPRAT) by the DotE (DotE 2014).

Outcome – The Project is Unlikely to have a significant impact on Western Ringtail Possums.

Table 2 Significant Impact Criteria for The Western Ringtail Possum

| Significant Impact Criteria | Impact Outcome |
|---|---|
| *An action is likely to have a significant impact on a vulnerable species if there is a real chance or possibility that it will:* | |
| Lead to a long-term decrease in the size of a population of a species | Unlikely<br>For the purpose of this assessment 'population of a species' refers to the Western Ringtail Possum population within the greater Capel region including Boyanup State Forest.<br>The proposed project is likely to result in removal of approximately 9.5 ha of poor/very poor habitat for the Western Ringtail Possum.<br>Western Ringtail Possums are known to occur in the area and occur within 5 km of the Project Area, as identified on DPaW's NatureMap and EPBC Act Protected Matters Search Tool. The majority of the Project Area provides habitat of poor quality (approximately 7.5 ha) and very poor quality (approximately 2 ha) habitat for the Western Ringtail Possum.<br>The proposed Project, without the implementation of species specific mitigation measures, is unlikely to result in a long term decrease in the size of a population of this species as it is unlikely to substantially:<br>• Reduce the overall area of available habitat to the population<br>• Reduce the overall area of occupancy of the population<br>• Exacerbate existing barrier effects and create new barrier effects<br>• Disrupt the breeding cycle of part of the population<br>Therefore, it is considered that the proposed Project is unlikely to lead to a long-term decrease in the size of the local population of the Western Ringtail Possum. |
| Reduce the area of occupancy of an important population of a species | Unlikely<br>The Project is unlikely to substantially reduce the area of occupancy of the population of Western Ringtail Possums within the local area or region. The species is known to occur throughout the south-west region of Western Australia.<br>Therefore removal of 9.5 ha of poor/very poor quality dispersal habitat is |

| | |
|---|---|
| | not considered likely to be significant for the species, due to the presence of a large proportion of adjacent suitable habitat within the region.<br>The Project is unlikely to substantially reduce the area of occupancy of the population of Western Ringtail Possums that occurs in the local area greater Bunbury region. The species is known to occur throughout the south-west region of Western Australia.<br>Therefore removal of 9.5 ha of habitat for the Project is not considered to be substantial for the species in a regional context, due to the extent of habitat adjacent the Project Area as well as the availability of known and modelled suitable habitat within the locality and region (DPaW 2014 and Shedley and Williams 2014). |
| Fragment an existing important population into two or more populations | Unlikely<br>The Project is unlikely to fragment the population into two or more populations. The Project proposes clearing of 9.5 ha of habitat, which intersects known and potential habitat within the greater area.<br>The Project Area is small patch of vegetation with some connectivity to nearby remnant vegetation of the Preston River corridor and smaller patches of nearby adjoining vegetation.<br>The Project is in close proximity to a regionally significant ecological linkage (the McLarty/Kemerton/Twin Rivers/Preston River/Gwindinup Ecological Linkage-Naturaliste) which extends north and south of the Project Area along the South Western Highway National Park (EPA 2000).<br>A large, continuous vegetation corridor is present to the east of the Project Area and includes the Boyanup State Forest and Jarrahdale State Forest further to the south. It is unlikely that the Project Area constitutes a significant proportion of this broader regional linkage. It is unlikely that the Project Area constitutes a significant proportion of a local or regional linkage. In addition, a vegetated buffer around the Project will retain habitat linkages. |
| Adversely affect habitat critical to the survival of a species | Unlikely<br>The Project is unlikely to affect habitat critical to the survival of a species.<br>Up to 9.5 ha of Western Ringtail Possum habitat in would be cleared for this Project. Given that this habitat type is of poor/very poor quality and is located adjacent to better quality habitat (the south west section of Lot 1) and the greater locality ( the Boyanup State Forest), the impacts of this clearing are not considered significant.<br>The DPaW Recovery Plan (DPaW 2014) for the Western Ringtail Possum describes habitat critical to the survival of the species, including habitat critical to the survival of populations on the Swan Coastal Plain. Populations on the Swan Coastal Plain are associated with stands of myrtaceous trees (usually peppermint trees) growing near swamps, water courses or floodplains, and at topographic low points which provide cooler often more fertile conditions (de Tores et al. 2004 as cited in DPaW 2014). Studies have shown that locations of extant populations are related to the quality of habitat, principally high canopy continuity and high nutrient foliage, but also the number and type of refuges available (Jones et al. 1994, Wayne et al. 2006 – as cited in DPaW 2014).<br>Based on the Recovery Plan description, the habitat within the Clearing Area is unlikely to be considered habitat critical to the survival of the species. |
| Disrupt the breeding cycle of an important population | Unlikely<br>The works associated with the development and construction project are unlikely to disrupt the breeding cycle of the Western Ringtail Possum population. While this species is known to occur within both the Project |

| | |
|---|---|
| | Area and local area, the Project Area is not considered to contain core breeding habitat or habitat that is a component of or wholly habitat for an important population for this species. The Project Area does not consist of core breeding habitat for the greater Bunbury population. It is therefore considered unlikely that the project will disrupt the breeding cycle of an important population of the species. |
| Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline | Unlikely<br>The works associated with the Project, may modify and destroy a small proportion of known and potentially poor quality dispersal habitat for this species but not to the point that this species would decline.<br>Given that this habitat type is well represented adjacent to the Project Area and the greater locality, the impacts of this clearing are not considered significant.<br>The proposed Project is unlikely to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline. |
| Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat | Unlikely<br>The Project may potentially exacerbate existing invasive species (such as weeds and introduced predators) that already occur within the Project Area. A Fox (*Vulpes vulpes*) den with signs of recent activity was present within the Project Area. Foxes are a known threat to the Western Ringtail Possum.<br>Additionally to these vertebrate fauna species, the European Honey Bee was also recorded within the Project Area during the field survey. The bees were recorded utilising several hollows that would otherwise be suitable for native fauna such as the Western Ringtail Possum. European Honey Bees are listed as a threat to the Western Ringtail Possum because of hollow competition.<br>The Project is unlikely to significantly increase or introduce new invasive species to this area. |
| Introduce disease that may cause the species to decline | Unlikely<br>Western Ringtail Possums can be at a greater risk of disease due to human disturbance and exposure to exotic species and pathogens (de Tores et al. 2008). The Western Ringtail Possums that persist in the Project Area are unlikely to be exposed to any additional diseases (that do not currently occur in that environment) as a result of the Project. It is considered unlikely that the project would introduce diseases that may cause the Western Ringtail population to decline. |
| Interfere with the recovery of the species. | Unlikely<br>The DPaW Recovery Plan (DPaW 2014) for the Western Ringtail Possum describes the long term goals of the recovery program for the species as:<br>• To improve the population status, leading to future removal of the Western Ringtail Possum from the Threatened species list of the EPBC Act and the WC Act.<br>• To ensure that threatening processes do not impact on the ongoing viability of the Western Ringtail Possum.<br>The recovery plan identifies habitat loss and fragmentation from urban development as a key threatening process.<br>The 10 year goal identified in the recovery plan is to slow the decline in population size, extent and area of occupancy through managing major threatening processes affecting the subpopulations and their habitats, and allowing the persistence of the species in each of the identified key management zones (Swan Coastal Plain, southern forests and south coast).<br>DPaW has deemed that the recovery plan will be unsuccessful if, within a 10 year period, any of the following occur: |

| | |
|---|---|
| | • There is substantial loss of habitat and/or increasing threatening processes that result in a further contraction of the population size, extent or area of occupancy.<br>• An evidence-based management approach cannot be applied to all populations.<br>The Project is unlikely to improve the population status of the species. However, it is also unlikely to impact the population status of the species by contributing to a long-term decline of an important population of the species. It is therefore considered unlikely that the Project may be at risk of interfering with the recovery of an important population of the species. |
| Legend for Table 2 - For the purpose of this assessment,<br>'important population of a species' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans, and/or that are:<br>• key source populations either for breeding or dispersal<br>• populations that are necessary for maintaining genetic diversity, and/or<br>• populations that are near the limit of the species range (DotE 2013, pp 10).<br>'habitat critical to the survival of a species or ecological community' refers to areas that are necessary:<br>• for activities such as foraging, breeding, roosting, or dispersal<br>• for the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)<br>• to maintain genetic diversity and long term evolutionary development, or<br>• for the reintroduction of populations or recovery of the species or ecological community.<br>Such habitat may be, but is not limited to: habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community; and/or habitat listed on the Register of Critical Habitat maintained by the minister under the EPBC Act (DotE 2013, pp 10). | |

3.1 (e) Listed migratory species

Description
Five bird species recorded in the desktop searches were listed as Migratory under the EPBC Act.
A likelihood of occurrence was undertaken and identified that two of these species were unlikely to occur: the White-bellied Sea-Eagle, (*Haliaeetus leucogaster*) and the Fork-tailed Swift (*Apus pacificus*). The White-bellied Sea-Eagle and Fork-tailed Swift are highly unlikely to occur in the area due to lack of suitable habitat.

The field survey suggests there is no suitable wetland habitat within the Project Area for migratory wetland bird species. As such the Great Egret (*Ardea alba*) and Cattle Egret (*Ardea ibis*) (which are known to migrate to optimal wetlands at different times of the year), thus both species are considered highly unlikely to occur in the Project Area.

The Rainbow Bee-eater (*Merops ornatus*), which is a migratory terrestrial species, is likely to occur within the Project Area as there is suitable foraging and dispersal habitat, and potential loose sandy breeding habitat for this species. The Rainbow Bee-eater is widespread throughout Australia and occurs in a wide range of habitat types and is a reasonably common bird in the south-west of Western Australia. The species will utilise a wide-range of habitats to nest, and within the Project Area any areas with loose soils, banks or spoil provide potential breeding habitat for the species. However, given the previous disturbance throughout the Project Area, the value of this vegetation is likely to be limited for Rainbow Bee-eater breeding. All of the Clearing Area may provide potential habitat for the Rainbow Bee-eater, and as a result, clearing for the project will result in a loss of 9.5 ha of potential habitat. However, the Rainbow Bee-eater is unlikely to rely on the habitats present within the Project Area and clearing of habitat for the project is unlikely to significantly impact on individuals or a population of this species.

Nature and extent of likely impact

No important habitat for any of the EPBC Act Migratory species mentioned in this report would be substantially removed or modified as part of the proposed works. The proposed works are unlikely to disrupt the lifecycle of an ecologically significant proportion of a population of listed migratory species. The Project is unlikely to result in an invasive species that is harmful to a listed migratory species becoming established in an area of important habitat for listed migratory species. It is unlikely that these listed migratory species would be significantly impacted by the proposed works.

### 3.1 (f) Commonwealth marine area

(If the action is in the Commonwealth marine area, complete 3.2(c) instead. This section is for actions taken outside the Commonwealth marine area that may have impacts on that area.)

Description - None

Nature and extent of likely impact - Not applicable

### 3.1 (g) Commonwealth land

(If the action is on Commonwealth land, complete 3.2(d) instead. This section is for actions taken outside Commonwealth land that may have impacts on that land.)

Description - No commonwealth land is within the Project Area.

Nature and extent of likely impact – Not applicable

### 3.1 (h) The Great Barrier Reef Marine Park

Description - The Project is not within the Great Barrier Reef Marine Park

Nature and extent of likely impact - Not applicable

### 3.1 (i) A water resource, in relation to coal seam gas development and large coal mining development

Description - None
Nature and extent of likely impact - Not applicable

## 3.2 Nuclear actions, actions taken by the Commonwealth (or Commonwealth agency), actions taken in a Commonwealth marine area, actions taken on Commonwealth land, or actions taken in the Great Barrier Reef Marine Park

| | | | |
|---|---|---|---|
| 3.2 (a) | Is the proposed action a nuclear action? | X | No |
| | If yes, nature & extent of likely impact on the whole environment | | |

| | | | |
|---|---|---|---|
| 3.2 (b) | Is the proposed action to be taken by the Commonwealth or a Commonwealth agency? | X | No |
| | If yes, nature & extent of likely impact on the whole environment | | |

| | | | |
|---|---|---|---|
| 3.2 (c) | Is the proposed action to be taken in a Commonwealth marine area? | X | No |
| | If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(f)) | | |

| | | | |
|---|---|---|---|
| 3.2 (d) | Is the proposed action to be taken on Commonwealth land? | X | No |
| | If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(g)) | | |

| | | | |
|---|---|---|---|
| 3.2 (e) | Is the proposed action to be taken in the Great Barrier Reef Marine Park? | X | No |
| | If yes, nature & extent of likely impact on the whole environment (in addition to 3.1(h)) | | |

## 3.3 Other important features of the environment

3.3 (a) Flora and fauna

Flora
Vegetation within the Project Area was 67% degraded, 17.3% completely degraded and 15.7% as good. *Phytophthora cinnamomi* (dieback). The degradation of the flora within the Project Area is largely attributable to sand pit activity and over-grazing by kangaroos. There is low structural diversity throughout the Project Area as over-grazing has largely removed the understorey which now predominantly consists of agricultural weeds (*Ehrharta calycina*).

No conservation significant flora species protected under State legislation were recorded within the Project Area during the field survey. One species listed as a priority species by DPaW: *Acacia semitrullata* (Priority 4) was recorded outside of the Project Area in Lot 1 during the field assessment (Ekologica 2012).

### 3.3 (b) Hydrology, including water flows

The Project Area is located in the Capel River surface water allocation area and the Five Mile Brook surface water allocation sub-area.

A search of the DoW's (2013) Geographic Data Atlas and the EPBC Act's Protected Matters Search Tool databases did not identify any significant lakes, river or wetlands within the Project Area. However, there is a Resource Enhancement wetland located immediately to the south west of the Project Area. This wetland is not expected to be directly impacted by the sand extraction as they are not included within the Project Area. Drainage will be managed within the sand pit area by way of sumps and surface drainage. No surface water will be discharged from the pit area. Dust suppression will be utilised for this Project to prevent impacts to the adjacent wetlands (Geolatry 2012).

### 3.3 (c) Soil and Vegetation characteristics

The Project Area is located within the Swan Coastal Plain Physiographic Division. This Division is characterised by a generally subdued topography and is formed almost entirely of fluvial and aeolian depositional material. The majority of the Project Area is located within the Bassendean Dune System which is described as a gently undulating aeolian sand plain that has been leached of carbonate leaving mostly quartz sand (DPaW 2014).

The Geoview WA geological maps search tool (DMP 2013) determined that the Project Area consist of Bassendean sand, a layer of thin Bassendean sand over Guildford formation and the Guildford Formation. The Guildford Formation consist of alluvial sand and clay with shallow-marine and estuarine lenses and local basal conglomerate.

The Western Australian Interim Biogeographic Regionalisation of Australia (IBRA) divides Australia into 85 bioregions based on biological and geographic/geological attributes. The Project Area occurs within the Swan Coastal Plain IBRA region. The Swan Coastal Plain region is composed of loamy soils supporting Karri forest, laterites supporting Jarrah - Marri forest, leached sandy soils in depressions and plains supporting low Jarrah woodlands and paperbark/sedge swamps, and Holocene marine dunes with *Agonis flexuosa* and Banksia woodlands and heaths (Hearn, Williams and Comer 2002).

### 3.3 (d) Outstanding natural features

No outstanding natural features were identified.

### 3.3 (e) Remnant native vegetation

The amount of remnant vegetation present in the Project Area was assessed by assigning a Beard broadscale vegetation type. As identified by Beard (1979), the Project is in 'Medium forest; Jarrah (*Eucalyptus marginata*) –Marri (*Corymbia calophylla*)', Vegetation Association 1000.

Within the 10.7 ha Project Area, three vegetation types were recorded (Ekologica 2012):

- Banksia woodland
- Kunzea tall shrubland
- Disturbed

### 3.3 (f) Gradient (or depth range if action is to be taken in a marine area)

According to the Natural Resource Management Shared Land Information Platform, the Project has a slope of approximately 9 m from the north western to the western boundary.

### 3.3 (g) Current state of the environment

As described above

### 3.3 (h) Commonwealth Heritage Places or other places recognised as having heritage values

No heritage places were identified within 10 km of the Project.

3.3 (i) Indigenous heritage values

A search of the Department of Aboriginal Affairs (DAA) Aboriginal Heritage Inquiry System (DAA 2014) showed no registered heritage sites within the Project Area. The nearest 'Registered Aboriginal Site' is the Preston River (ID 19795) located approximately 0.7 km to the east of the Project Area (Attachment B).

3.3 (j) Other important or unique values of the environment

Approximately 0.7 km to the east of the Project Area, there is an Environmentally Sensitive Area (ESA) (ID 2272) this ESA is associated with the Preston River and will not be impacted by the Project.

3.3 (k) Tenure of the action area (eg freehold, leasehold)

Freehold

3.3 (l) Existing land/marine uses of area

The site was previously used on a smaller scale for sand extraction but has remained unused since 2010.

3.3 (m) Any proposed land/marine uses of area

No other proposed land uses.

# 4 Measures to avoid or reduce impacts

## Clearing of Vegetation

SJ Roadworks is committed to the Environmental Management of this Project and will undertake the Project in accordance with its existing Environmental Management Systems. The main impacts to Matters of National Environmental Significance will result from clearing of the Project Area and associated loss of habitats and ecological linkages. To mitigate this, SJ Roadworks will limit the clearing to the Project Area and have planned for a vegetation buffer around the cleared site. This will result in a reduced loss of habitat, and assist in maintaining ecological linkages in the area.

In addition, the following management plans have been developed for the Project Area:

- Rehabilitation and Decommissioning Programme (SJ Roadworks date) – Attachment D
- Noise, dust and dieback management plans (Geolatry 2012) – Attachment D

These plans include management strategies for the following:

- Dieback Management
- Soil Management
- Weed and Pest Management
- Drainage
- Erosion and Sediment Control
- Dust Generation from sand extraction/haulage
- Noise Management
- Pit Rehabilitation
- Hydrocarbon/Construction Debris Management
- Monitoring of Rehabilitation

Development of the Project is proposed to take place in six stages, with the initial development to be located in the west of the Project Area and a maximum of 2 ha to be cleared at each stage. The rehabilitation of the disturbance area will also be undertaken in stages, as parts of the pit are decommissioned. Rehabilitation will include the areas previously used for sand extraction.

Progressive rehabilitation is expected to reduce impacts to surface water runoff and prevent dust lift and erosion where possible. It is proposed that 4.42 ha of the Project Area will rehabilitated using dieback tolerant species which have been chosen on their future suitability as Black Cockatoo foraging and Western Ringtail Possum habitat. The remaining 6.28 ha will be revegetated with a mix of annual and perennial pasture species.

# 5 Conclusion on the likelihood of significant impacts

## 5.1 Do you THINK your proposed action is a controlled action?

| | |
|---|---|
| X | No, complete section 5.2 |
| | |

## 5.2 Proposed action IS NOT a controlled action.

The desktop and field assessments have assessed potential impacts on Matters of National Environmental Significance and determined that there are four EPBC Act-listed species that may be impacted by this Project:

- Carnaby's Cockatoo (*Calyptorhynchus latirostris*) – Endangered under EPBC Act
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – Vulnerable under EPBC Act
- Baudin's Cockatoo (*Calyptorhynchus baudinii*) – Vulnerable under EPBC Act
- Western Ringtail Possum (*Pseudocheirus occidentalis*) – Vulnerable under EPBC Act

The Department of Environment Policy Statement 1.1 (DotE 2013b) was referenced to determine whether the impacts of the proposed action are likely to be significant. The proposed Project may result in the loss of habitat for these species including:

- 21 potential Black Cockatoo breeding trees – no hollows considered suitable for nesting
- Up to 7.5 ha of Black Cockatoo foraging habitat of moderate quality
- Up to 9.5 ha which is also potential Western Ringtail Possum habitat

An assessment of the criteria was undertaken (see Section 3.1 (d)) and Tables 1 and 2) and it was determined that the proposed Project as described in Section 2 is unlikely to have a significant impact on the:

- Carnaby's Cockatoo (*Calyptorhynchus latirostris*) – Endangered under EPBC Act
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – Vulnerable under EPBC Act
- Baudin's Cockatoo (*Calyptorhynchus baudinii*) – Vulnerable under EPBC Act
- Western Ringtail Possum (*Pseudocheirus occidentalis*) – Vulnerable under EPBC Act

## 5.3 Proposed action IS a controlled action

| | Matters likely to be impacted |
|---|---|
| | World Heritage values (sections 12 and 15A) |
| | National Heritage places (sections 15B and 15C) |
| | Wetlands of international importance (sections 16 and 17B) |
| | Listed threatened species and communities (sections 18 and 18A) |
| | Listed migratory species (sections 20 and 20A) |
| | Protection of the environment from nuclear actions (sections 21 and 22A) |
| | Commonwealth marine environment (sections 23 and 24A) |
| | Great Barrier Reef Marine Park (sections 24B and 24C) |

| | |
|---|---|
| | A water resource, in relation to coal seam gas development and large coal mining development (sections 24D and 24E) |
| | Protection of the environment from actions involving Commonwealth land (sections 26 and 27A) |
| | Protection of the environment from Commonwealth actions (section 28) |
| | Commonwealth Heritage places overseas (sections 27B and 27C) |

# 6 Environmental record of the responsible party

Comment [A1]: Need info from SJ rdworks

| | | Yes | No |
|---|---|---|---|
| 6.1 | Does the party taking the action have a satisfactory record of responsible environmental management?<br><br>Provide details<br><br>• | X | |
| 6.2 | Has either (a) the party proposing to take the action, or (b) if a permit has been applied for in relation to the action, the person making the application - ever been subject to any proceedings under a Commonwealth, State or Territory law for the protection of the environment or the conservation and sustainable use of natural resources?<br><br>If yes, provide details | | X |
| 6.3 | If the party taking the action is a corporation, will the action be taken in accordance with the corporation's environmental policy and planning framework?<br><br>If yes, provide details of environmental policy and planning framework | | X |
| 6.4 | Has the party taking the action previously referred an action under the EPBC Act, or been responsible for undertaking an action referred under the EPBC Act?<br><br>Provide name of proposal and EPBC reference number (if known) | | X |

# 7 Information sources and attachments

(For the information provided above)

## 7.1 References


Beard, J. S. (1979) Vegetation Survey of Western Australia: Map and Explanatory Memoir 1:250,000 series. Perth, Vegmap Publications.

Department of Aboriginal Affairs (DAA) (2014) *Aboriginal Heritage Inquiry System.* Retrieved December 2014, from http://maps.dia.wa.gov.au/AHIS2/

Department of Mines and Petroleum (2013) *Interactive Geological Map (GeoVIEW.WA)* retrieved September 2013, from http://www.dmp.wa.gov.au/7113.aspx

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2012) *Environmental Protection and Biodiversity Conservation Act 1999* referral guidelines for three threatened Black Cockatoo species. Canberra, Australia.

Department of the Environment (DotE) (2014a) Protected Matters Search Tool. Retrieved December, 2014, from http://www.environment.gov.au/epbc/pmst/index.html

Department of the Environment (DotE) (2014b) Matters of National Environmental Significance: Significant impact guidelines 1.1. Retrieved December, 2014 from http://www.environment.gov.au/system/files/resources/42f84df4-720b-4dcf-b262-48679a3aba58/files/nes-guidelines_1.pdf

Department of Parks and Wildlife (DPaW) (2014a) *Swan Coastal Plain South draft management plan 2014*, Department of Parks and Wildlife, Perth.

Department of Parks and Wildlife (DPaW) (2014b) Native Vegetation Map Viewer. Retrieved December, 2014, from http://maps.dec.wa.gov.au/idelve/nv/index.jsp

Department of Water (DoW) (2013) Geographic Data Atlas. Retrieved October, 2013 from http://www.water.wa.gov.au/idelve/dowdataext

Keighery

Van Dyck S. and Strahan R. (2008) *The mammals of Australia*. 3rd Edition. Sydney: New Holland Publishers.

Western Australian Planning Commission (WAPC) (2012) *Shire of Capel Local Planning Scheme No. 7 (District Scheme) - Map No. 3 of 11*.


## 7.2 Reliability and date of information

Information supplied is both recent and reliable. The desktop searches were undertaken in 2014, and the field assessments were undertaken between March 2012 and March 2013.

## 7.3 Attachments

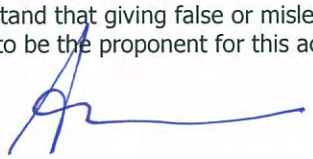
Attachment A – Figures
Attachment B – Desktop Searches
Attachment C – Supporting flora, vegetation and fauna surveys
Attachment D - Extractive Industry Licence application and conditions

| | | ✓ attached | Title of attachment(s) |
|---|---|---|---|
| You must attach | figures, maps or aerial photographs showing the project locality (section 1) | ✓ | Attachment A - Figure 1 |
| | GIS file delineating the boundary of the referral area (section 1) | ✓ | |
| | figures, maps or aerial photographs showing the location of the project in respect to any matters of national environmental significance or important features of the environments (section 3) | ✓ | |
| If relevant, attach | copies of any state or local government approvals and consent conditions (section 2.5) | ✓ | N/A |
| | copies of any completed assessments to meet state or local government approvals and outcomes of public consultations, if available (section 2.6) | ✓ | Attachment C |
| | copies of any flora and fauna investigations and surveys (section 3) | ✓ | Attachment C |
| | technical reports relevant to the assessment of impacts on protected matters that support the arguments and conclusions in the referral (section 3 and 4) | ✓ | Attachment C |
| | report(s) on any public consultations undertaken, including with Indigenous stakeholders (section 3) | | N/A |

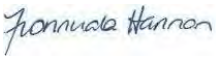
# 8 Contacts, signatures and declarations

Project title: SJ Roadworks – sand extraction - Lot 1 South Western Highway

## 8.1 Person proposing to take action

| | |
|---|---|
| Name | Albert Gorman |
| Title | Environmental Officer |
| Organisation | SJ Roadworks |
| ACN / ABN (if applicable) | 83 094 967 870 |
| Postal address | PO Box 207 Boyanup |
| Telephone | 0458 108 224 |
| Email | albertgorman.projects@gmail.com |
| Declaration | I declare that to the best of my knowledge the information I have given on, or attached to this form is complete, current and correct.<br>I understand that giving false or misleading information is a serious offence.<br>I agree to be the proponent for this action. |
| Signature |  Date 17/2/15 |

8.2 Person preparing the referral information (if different from 8.1)

| | |
|---|---|
| Name | Fionnuala Hannon |
| Title | Principal Environmental Consultant |
| Organisation | GHD |
| ACN / ABN (if applicable) | 39 008 488 373 |
| Postal address | 10 Victoria St Bunbury WA 6230 |
| Telephone | (08) 9721 0711 |
| Email | fionnuala.hannon@ghd.com |
| Declaration | I declare that to the best of my knowledge the information I have given on, or attached to this form is complete, current and correct.<br>I understand that giving false or misleading information is a serious offence. |
| Signature |  Date |

Attachment A
Figure 1 – Project Area

Attachment B
Desktop Assessments

Attachment C
Field Assessments

Attachment D
Management Plans

Australian Government

Department of the Environment

# EPBC Act Protected Matters Report

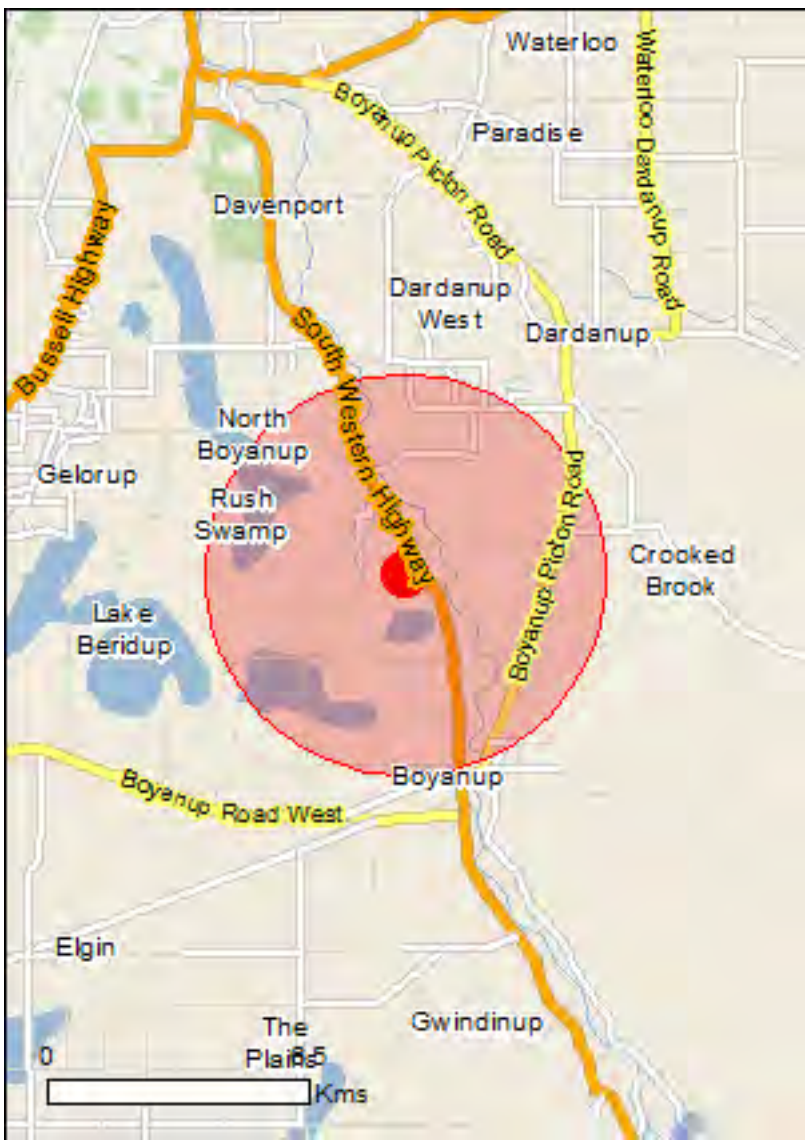
This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 17/12/14 12:32:39

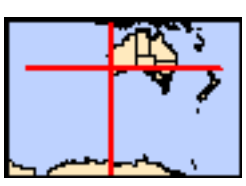





This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates

Buffer: 5.0Km



# Summary

## Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

| | |
|---|---|
| World Heritage Properties: | None |
| National Heritage Places: | None |
| Wetlands of International Importance: | None |
| Great Barrier Reef Marine Park: | None |
| Commonwealth Marine Areas: | None |
| Listed Threatened Ecological Communities: | None |
| Listed Threatened Species: | 23 |
| Listed Migratory Species: | 5 |

## Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

| | |
|---|---|
| Commonwealth Land: | 1 |
| Commonwealth Heritage Places: | None |
| Listed Marine Species: | 7 |
| Whales and Other Cetaceans: | None |
| Critical Habitats: | None |
| Commonwealth Reserves Terrestrial: | None |
| Commonwealth Reserves Marine | None |

## Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

| | |
|---|---|
| Place on the RNE: | None |
| State and Territory Reserves: | None |
| Regional Forest Agreements: | None |
| Invasive Species: | 30 |
| Nationally Important Wetlands: | None |
| Key Ecological Features (Marine) | None |

# Details

## Matters of National Environmental Significance

| Listed Threatened Species | | [ Resource Information ] |
|---|---|---|
| Name | Status | Type of Presence |
| Birds | | |
| Calyptorhynchus banksii naso | | |
| Forest Red-tailed Black-Cockatoo, Karrak [67034] | Vulnerable | Species or species habitat may occur within area |
| Calyptorhynchus baudinii | | |
| Baudin's Black-Cockatoo, Long-billed Black-Cockatoo [769] | Vulnerable | Breeding known to occur within area |
| Calyptorhynchus latirostris | | |
| Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523] | Endangered | Breeding likely to occur within area |
| Mammals | | |
| Dasyurus geoffroii | | |
| Chuditch, Western Quoll [330] | Vulnerable | Species or species habitat likely to occur within area |
| Pseudocheirus occidentalis | | |
| Western Ringtail Possum, Ngwayir [25911] | Vulnerable | Foraging, feeding or related behaviour likely to occur within area |
| Setonix brachyurus | | |
| Quokka [229] | Vulnerable | Species or species habitat may occur within area |
| Plants | | |
| Andersonia gracilis | | |
| Slender Andersonia [14470] | Endangered | Species or species habitat may occur within area |
| Banksia nivea subsp. uliginosa | | |
| Swamp Honeypot [82766] | Endangered | Species or species habitat may occur within area |
| Banksia squarrosa subsp. argillacea | | |
| Whicher Range Dryandra [82769] | Vulnerable | Species or species habitat may occur within area |

| Name | Status | Type of Presence |
|---|---|---|
| Brachyscias verecundus<br>Ironstone Brachyscias [81321] | Critically Endangered | Species or species habitat may occur within area |
| Caladenia huegelii<br>King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309] | Endangered | Species or species habitat likely to occur within area |
| Centrolepis caespitosa<br>[6393] | Endangered | Species or species habitat likely to occur within area |
| Chamelaucium sp. C Coastal Plain (R.D.Royce 4872)<br>Royce's Waxflower [86887] | Vulnerable | Species or species habitat may occur within area |
| Darwinia foetida<br>Muchea Bell [83190] | Critically Endangered | Species or species habitat likely to occur within area |
| Darwinia whicherensis<br>Abba Bell [83193] | Endangered | Species or species habitat may occur within area |
| Diuris drummondii<br>Tall Donkey Orchid [4365] | Vulnerable | Species or species habitat likely to occur within area |
| Diuris micrantha<br>Dwarf Bee-orchid [55082] | Vulnerable | Species or species habitat likely to occur within area |
| Diuris purdiei<br>Purdie's Donkey-orchid [12950] | Endangered | Species or species habitat may occur within area |
| Drakaea elastica<br>Glossy-leafed Hammer-orchid, Praying Virgin [16753] | Endangered | Species or species habitat known to occur within area |
| Drakaea micrantha<br>Dwarf Hammer-orchid [56755] | Vulnerable | Species or species habitat known to occur within area |
| Gastrolobium papilio<br>Butterfly-leaved Gastrolobium [78415] | Endangered | Species or species habitat may occur within area |
| Lambertia echinata subsp. occidentalis<br>Western Prickly Honeysuckle [64528] | Endangered | Species or species habitat may occur within area |
| Synaphea stenoloba<br>Dwellingup Synaphea [66311] | Endangered | Species or species habitat may occur within area |

| Listed Migratory Species | [ Resource Information ] |
|---|---|
| * Species is listed under a different scientific name on the EPBC Act - Threatened Species list. | |
| Name | Threatened | Type of Presence |
| Migratory Marine Birds | | |
| Apus pacificus<br>Fork-tailed Swift [678] | | Species or species habitat likely to occur within area |
| Migratory Terrestrial Species | | |
| Haliaeetus leucogaster<br>White-bellied Sea-Eagle [943] | | Species or species habitat known to occur within area |
| Merops ornatus<br>Rainbow Bee-eater [670] | | Species or species habitat may occur within |

| Name | Threatened | Type of Presence |
|---|---|---|
| | | area |
| Migratory Wetlands Species | | |
| Ardea alba | | |
| Great Egret, White Egret [59541] | | Breeding known to occur within area |
| Ardea ibis | | |
| Cattle Egret [59542] | | Species or species habitat likely to occur within area |

## Other Matters Protected by the EPBC Act

### Commonwealth Land [ Resource Information ]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

| Name |
|---|
| Commonwealth Land - |

### Listed Marine Species [ Resource Information ]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

| Name | Threatened | Type of Presence |
|---|---|---|
| Birds | | |
| Apus pacificus | | |
| Fork-tailed Swift [678] | | Species or species habitat likely to occur within area |
| Ardea alba | | |
| Great Egret, White Egret [59541] | | Breeding known to occur within area |
| Ardea ibis | | |
| Cattle Egret [59542] | | Species or species habitat likely to occur within area |
| Haliaeetus leucogaster | | |
| White-bellied Sea-Eagle [943] | | Species or species habitat known to occur within area |
| Merops ornatus | | |
| Rainbow Bee-eater [670] | | Species or species habitat may occur within area |
| Pandion haliaetus | | |
| Osprey [952] | | Species or species habitat likely to occur within area |
| Thinornis rubricollis | | |
| Hooded Plover [59510] | | Species or species habitat may occur within area |

## Extra Information

### Invasive Species [ Resource Information ]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

| Name | Status | Type of Presence |
|---|---|---|
| Birds | | |
| Anas platyrhynchos<br>Mallard [974] | | Species or species habitat likely to occur within area |
| Columba livia<br>Rock Pigeon, Rock Dove, Domestic Pigeon [803] | | Species or species habitat likely to occur within area |
| Passer domesticus<br>House Sparrow [405] | | Species or species habitat likely to occur within area |
| Passer montanus<br>Eurasian Tree Sparrow [406] | | Species or species habitat likely to occur within area |
| Streptopelia chinensis<br>Spotted Turtle-Dove [780] | | Species or species habitat likely to occur within area |
| Streptopelia senegalensis<br>Laughing Turtle-dove, Laughing Dove [781] | | Species or species habitat likely to occur within area |
| Mammals | | |
| Canis lupus familiaris<br>Domestic Dog [82654] | | Species or species habitat likely to occur within area |
| Felis catus<br>Cat, House Cat, Domestic Cat [19] | | Species or species habitat likely to occur within area |
| Feral deer<br>Feral deer species in Australia [85733] | | Species or species habitat likely to occur within area |
| Mus musculus<br>House Mouse [120] | | Species or species |

| Name | Status | Type of Presence |
|---|---|---|
| | | habitat likely to occur within area |
| Oryctolagus cuniculus<br>Rabbit, European Rabbit [128] | | Species or species habitat likely to occur within area |
| Rattus rattus<br>Black Rat, Ship Rat [84] | | Species or species habitat likely to occur within area |
| Sus scrofa<br>Pig [6] | | Species or species habitat likely to occur within area |
| Vulpes vulpes<br>Red Fox, Fox [18] | | Species or species habitat likely to occur within area |
| Plants | | |
| Anredera cordifolia<br>Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643] | | Species or species habitat likely to occur within area |
| Asparagus asparagoides<br>Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473] | | Species or species habitat likely to occur within area |
| Asparagus declinatus<br>Bridal Veil, Bridal Veil Creeper, Pale Berry Asparagus Fern, Asparagus Fern, South African Creeper [66908] | | Species or species habitat likely to occur within area |
| Asparagus plumosus<br>Climbing Asparagus-fern [48993] | | Species or species habitat likely to occur within area |
| Brachiaria mutica<br>Para Grass [5879] | | Species or species habitat may occur within area |
| Cenchrus ciliaris<br>Buffel-grass, Black Buffel-grass [20213] | | Species or species habitat may occur within area |
| Chrysanthemoides monilifera<br>Bitou Bush, Boneseed [18983] | | Species or species habitat may occur within area |
| Genista linifolia<br>Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800] | | Species or species habitat likely to occur within area |
| Genista sp. X Genista monspessulana<br>Broom [67538] | | Species or species habitat may occur within area |
| Lycium ferocissimum<br>African Boxthorn, Boxthorn [19235] | | Species or species habitat likely to occur within area |
| Olea europaea<br>Olive, Common Olive [9160] | | Species or species habitat may occur within area |
| Pinus radiata<br>Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780] | | Species or species habitat may occur within area |
| Protasparagus plumosus<br>Climbing Asparagus-fern, Ferny Asparagus [11747] | | Species or species habitat likely to occur within area |
| Rubus fruticosus aggregate<br>Blackberry, European Blackberry [68406] | | Species or species |

| Name | Status | Type of Presence |
| --- | --- | --- |
| | | habitat likely to occur within area |
| [Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii](#)<br>Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497] | | Species or species habitat likely to occur within area |
| [Solanum elaeagnifolium](#)<br>Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323] | | Species or species habitat likely to occur within area |

# Coordinates

-33.44402 115.71598

# Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

# Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.


Department of the Environment
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

380,000 380,500 381,000

6,299,500 6,299,000 6,298,500 6,298,000

Trezise Cl

South Western Hwy

Kilpatrick Rd

## LEGEND

State Highway — Project Area

Minor Road

Paper Size A3

0 25 50 100 150 200 250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 50

N

GHD

ROADWORKS powered by SLIP ENABLER

SJ Roadworks
Clearing Appeal: Boyanup

Job Number 61-30514
Revision 0
Date 17 Feb 2015

# Project Area

# Figure 1

N:\AU\Bunbury\Projects\61\30514\GIS\Maps\MXD\6130514_001_Rev0_Fig1.mxd

239 Adelaide Terrace Perth WA 6004 Australia T 61 8 6222 8222 F 61 8 6222 8555 E permail@ghd.com.au W www.ghd.com.au



Data source: Landgate: Roads, Imagery (Virtual Mosaic) - 20150217; SJ Roadworks: Project Area - 20150217. Created by: AF

# A Level 1 Flora Survey of Lot 1 Southeast Highway Boyanup

*Prepared for*
SJ Roadworks
6th November 2012

Russell Smith MPhil (Plant Ecology) BSc (Hons)

ekologica PTY LTD

Ekologica Pty Ltd
PO Box 207 Bunbury
WA 6230
Ph: (08) 9725 4014

## Summary

A Level 1 flora survey, targeting rare flora, was carried out over 26 ha of Lot 1, SW Highway, Boyanup. The client is proposing to develop a sand pit over about 13 ha of the site and is in the early stages of seeking an extractive industry license and DEC Clearing permit. As well as the rare flora survey, numbers of trees and shrubs within two 100 $m^2$ quadrats were counted as part of developing a rehabilitation plan for the proposed sandpit.

One hundred and eight species of flora were found in the Survey Area, this includes 15 introduced species. One Priority 4 species, *Acacia semitrullata*, was found in the eastern part of the road reserve and along the eastern boundary of Lot 1. All of the *A. semitrullata* plants were situated outside of the proposed sandpit area. No other rare flora or conservation significant flora were found within the Survey Area.

Eleven shrubs and two trees were found within the two 100 $m^2$ quadrats, with one tree (*Banksia attenuata*) and six shrubs occurring in both quadrats. For those species that occurred in both quadrats variation in numbers between the quadrats was generally high.

# Contents

## 1. Background

A vegetation survey, particularly with regard to rare flora was required of approx 26 ha of bushland (the "Survey Area"), forming Lot 1, SW Highway, Boyanup (Figure 1). The Survey Area lies 15.6 km south east of the port city of Bunbury. Much of the site has been disturbed by previous sand extraction activities as well as by tracks and the construction of buildings.

The client (SJ Roadworks) is proposing to develop a sand pit over about 13 ha of the site and is in the early stages of seeking an extractive industry license and DEC Clearing permit. In addition, floristic quadrats placed during a previous vegetation and dieback disease survey of the land (Smith, 2012) were to be re-visited and used to obtain an estimate of density of trees and shrubs to be used in developing a rehabilitation plan for the proposed sandpit.

## 2. Scope and Objectives

Carry out a spring survey flora and vegetation assessment that,

- Determines whether any Declared Rare Flora or Priority Flora occurs on Lot 1, South West Highway, Boyanup
- Determines the plant density of native species occurring within the two 100 $m^2$ quadrats previously installed on Lot 1.

## 3. Regional Setting, Landforms and Soils

The Survey Area lies on the Swan Coastal Plain approximately 16 km south east of the regional city of Bunbury. Elevation rises from about 28 m AHD at the northern and southern boundaries to 43 m AHD at the top of the low hill in the middle of the Study Area. The soils of most of the Survey Area belong to the Bassendean Dune System; B1a phase (Tille, 1996), which are described as;

> "Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m; *Banksia* dominant."

Small areas of Bassendean Dune System, B3 phase and Pinjarra Plain, P1a phase soils occur in the south part of the Survey Area, within and adjacent to the wetland.

## 4. Vegetation

The Survey Area falls within the area mapped as Bassendean System by Beard (1980). The previous survey (Smith, 2012) identified four vegetation communities, these being:

- *Banksia* Woodland (SWAFCT[1] 21b)
- *Kunzea* Tall Shrubland (Modified SWAFCT 21b)
- Flooded Gum-Marri-Peppermint-Paperbark Woodland or Open Forest (SWAFCT15)
- *Melaleuca* Wet Shrubland (Possibly SWAFCT 09, which is classified as a Threatened Ecological Community with the status of "Vulnerable"). (see Appendix B).

*Banksia* Woodland and *Kunzea* Tall Shrubland (which is a degraded version of the preceding) occur over most of the Survey Area. The other two communities are associated with the wetland in the southern part of the Survey Area. This wetland is classified as "Resource Enhancement" – these wetlands "have been partially modified but still support substantial wetland attributes and functions" (Waters and Rivers Commission, 2001).

## 5. Threatened and Priority Flora

Species of flora and fauna are defined as Declared Rare or Priority conservation status where their populations are restricted geographically or threatened by local processes. The Department of Environment and Conservation (DEC) recognises these threats of extinction and consequently applies regulations towards population and species protection.

Rare Flora species are gazetted under Subsection 2 of Section 23F of the Wildlife Conservation Act 1950 and therefore it is an offence to "take" or damage rare flora without Ministerial approval. Section 23F of the Wildlife Conservation Act 1950-1980 defines "to take" as "… to gather, pick, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means."

Priority Flora are under consideration for declaration as 'rare flora', but are in need of further survey (Priority One to Three) or require monitoring every 5-10 years (Priority Four). Table 1 presents the categories of Declared Rare and Priority Flora as defined by the Wildlife Conservation Act 1950 (Department of Environment and Conservation 2012a, 2012b).

Threats of extinction of species are also recognised at a Federal Government level and are categorized according to the Environment Protection and Biodiversity Conservation Act (EPBC Act), 1999 (Department of Sustainability, Environment, Water, Population and Communities, 2012).

A search was made of Naturemap (DEC, 2012c) for Declared Rare Flora and Priority Flora occurring within 5 km of the Survey Area. The sixteen taxa of DRF and PF occurring within this area are shown in Table 2. All of them would have been flowering, or at least visible at the time of survey.

[1] SWAFCT; "Swan Coastal Plain Floristic Community Type" (Gibson *et al*., 1994)

| Conservation Code | Category |
|---|---|
| R | "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.' |
| P1 | "Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey." |
| P2 | Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey." |
| P3 | "Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (ie. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey." |
| P4 | "Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years." |

**Table 1**. Categories of Declared Rare and Priority Flora as defined by the Wildlife Conservation Act 1950

# 6. Methods

## *6.1. Rare flora survey*

The Survey Area was searched on 15th October 2012 by walking transects at 20 to 40 m intervals. The road reserve along the northern boundary of the Survey Area was also searched because it was in good-very good condition, particularly at the eastern end and may have contained rare flora. A comprehensive list of vascular flora, including introduced species, was compiled during the search. Taxonomy was checked using DEC (2012d, and 2012e).

## *6.2. Species density in quadrats*

Numbers of shrubs and trees within the two 100m$^2$ quadrats previously installed within the Survey Area were counted. No attempt was made to count annual species, or species where it was difficult to distinguish individual plants.

| Taxon | Description |
|---|---|
| *Drakaea elastica* (DRF) | Tuberous, perennial, herb, 0.12-0.3 m high. Fl. red, green, yellow, Oct-Nov. White or grey sand. Low-lying situations adjoining winter-wet swamps. |
| *Drakaea micrantha* (DRF) | Tuberous, perennial, herb, 0.15–0.3 m high. Fl. red, yellow, Sep–Oct. White-grey sand. |
| *Eleocharis keigheryi* (DRF) | Rhizomatous, clumped perennial, grass-like or herb (sedge), to 0.4 m high. Fl. green, Aug–Nov. Clay, sandy loam. Emergent in freshwater: creeks, claypans |
| *Boronia humifusa* (P1) | Low-growing, wiry perennial, herb, 0.1–0.2 m high. Fl. pink, red, Jun/Sep. Gravelly clay loam over laterite. Jarrah-marri open forest. |
| *Synaphea odocoileops* (P1) | Tufted, compact shrub, 0.2–0.5 m high. Fl. yellow, Aug–Oct. Brown-orange loam & sandy clay, granite. Swamps, winter-wet areas. |
| *Leptomeria furtiva* (P2) | Lax, sprawling shrub, 0.2–0.45 m high. Fl. orange, brown, Aug–Oct. Grey or black peaty sand. Winter-wet flats. |
| *Leucopogon* sp. Busselton (D. Cooper 243) (P2) | Low sprawling shrub 40 cm high x 70 cm wide, Sep-Oct. Wet flats, grey sand. |
| *Boronia tetragona* (P3) | Perennial, herb, 0.3–0.7 m high, leaves sessile, entire, with papillate margins, branches quadrangular, sepals ciliate. Fl. pink, red, Oct–Dec. Black/white sand, laterite, brown sandy loam. Winter-wet flats, swamps, open woodland. |
| *Mitreola minima* (P3) | Slender, erect annual, herb, 0.025–0.04 m high. Fl. white, Oct–Dec. Grey sand. Peaty swampy areas. |
| *Thelymitra variegata* (P3) | Tuberous, perennial, herb, 0.1–0.35 m high. Fl. orange, red, purple, pink, Jun–Sep. Sandy clay, sand, laterite. |
| *Acacia flagelliformis* (P4) | Rush-like, erect or sprawling shrub, 0.3-0.75(-1.6) m high. Fl. yellow, May-Sep. Sandy soils. Winter-wet areas. |
| *Acacia semitrullata* (P4) | Slender, erect, pungent shrub, (0.1-)0.2-0.7(-1.5) m high. Fl. cream, white, May-Oct. White/grey sand, sometimes over laterite, clay. Sandplains, swampy areas. |
| *Aponogeton hexatepalus* (P4) | Rhizomatous or cormous, aquatic perennial, herb, leaves floating. Fl. green, white, Jul–Oct. Mud. Freshwater: ponds, rivers, claypans. |
| *Franklandia triaristata* (P4) | Erect, lignotuberous shrub, 0.2-1 m high. Fl. white, cream, yellow , brown, purple, Aug-Oct. White or grey sand. |
| *Ornduffia submersa* (P4) | Tuberous emergent aquatic perennial dwarf shrub, height to 35 cm; flowers white; leaves floating on surface of water. Fl. Sept-Oct. |
| *Pultenaea skinneri* (P4) | Slender shrub, 1-2 m high. Fl. yellow, orange, red, Jul-Sep. Sandy or clayey soils. Winter-wet depressions. |

**Table 2**. Declared Rare Flora and Priority Flora occurring within 5 km of the Survey Area

# 7. Results and Discussion

## 7.1. Flora, including rare flora

One hundred and eight species of flora were found in the Survey Area, this includes 15 introduced species (Appendix A). One Priority 4 species, *Acacia semitrullata*, was found in the eastern part of the road reserve and along the eastern boundary of Lot 1. All of the *A. semitrullata* plants were situated outside of the proposed sandpit area (Figure 2). No other rare flora or conservation significant flora were found within the Survey Area.

## 7.2. Plant density

Eleven shrubs and two trees were found within the two 100 $m^2$ quadrats, with one tree (*Banksia attenuata*) and six shrubs occurring in both quadrats (Table 3). For those species that occurred in both quadrats variation in numbers between the quadrats was generally high. The density of *B. attenuata* per hectare based on these figures is in the range of 200 - 1,200/ha. Research in *Banksia* woodland in the Perth area found an average of 334/ha of this species (Velentine *et al*., 2011). It appears that the time since the last fire within the part of the Survey Area that the quadrats were situated in explains the low numbers of the short-lived, post-fire germinating, *Acacia pulchella* present.

| Species | Life Form | Number Q1 | Number Q2 |
|---|---|---|---|
| *Acacia pulchella* | shrub | | 2 |
| *Adenanthos meisneri* | shrub | 1 | |
| *Banksia attenuata* | small tree | 2 | 12 |
| *Calytrix fraseri* | shrub | 3 | 5 |
| *Eucalyptus marginata* | large tree | 4 | |
| *Hibbertia racemosa* | shrub | | 3 |
| *Hibbertia vaginata* | shrub | 1 | 2 |
| *Hypocalymma robustum* | shrub | 7 | 1 |
| *Kunzea glabrescens* | shrub | 7 | 4 |
| *Macrozamia riedlei* | shrub | | 1 |
| *Melaleuca thymoides* | shrub | 13 | 2 |
| *Stirlingia latifolia* | shrub | 15 | 38 |
| *Xanthorrhoea gracilis* | shrub | 3 | |

**Table 3**. Number of trees and shrubs within the two 100 $m^2$ quadrats in the Survey Area.

## References


Department of Environment and Conservation (DEC) (2012a). Listing of species and ecological communities. http://www.dec.wa.gov.au/content/view/852/2010/

Department of Environment and Conservation (2012b). Priority Ecological Communities for Western Australia: Version 13 (13 April 2012). Department of Environment and Conservation. https://www.dec.wa.gov.au/content/view/849/2017/

Department of Environment and Conservation (DEC) (2012c). Naturemap, Western Australian Herbarium.

Department of Environment and Conservation (DEC) (2012d). Florabase, Western Australian Herbarium.

Department of Environment and Conservation (DEC) (2012e). Species Database Management Software (Max), updated 7th June 2012. Department of Environment and Conservation, Western Australian Herbarium.

Department of Sustainability, Environment, Water, Population and Communities. (2012). Threatened species under the EPBC Act. http://www.environment.gov.au/biodiversity/threatened/species.html

Smith, R.S. (2012). A Vegetation and Dieback Survey of part Lot 1650, North Boyanup. Report prepared for GHD, Bunbury.

Valentine, L., Wilson, B., Stock, W., Fleming, T., Hardy, G. and Hobbs, R. (2011) Carnaby's black-cockatoo, food resources and time since last fire. Research Findings 2011: Bulletin No. 19 .

Water and Rivers Commission. (2001). Planning for Waterways Management: Guidelines for Preparing a River Action Plan River Restoration Series, Water and Rivers Commission, Perth.

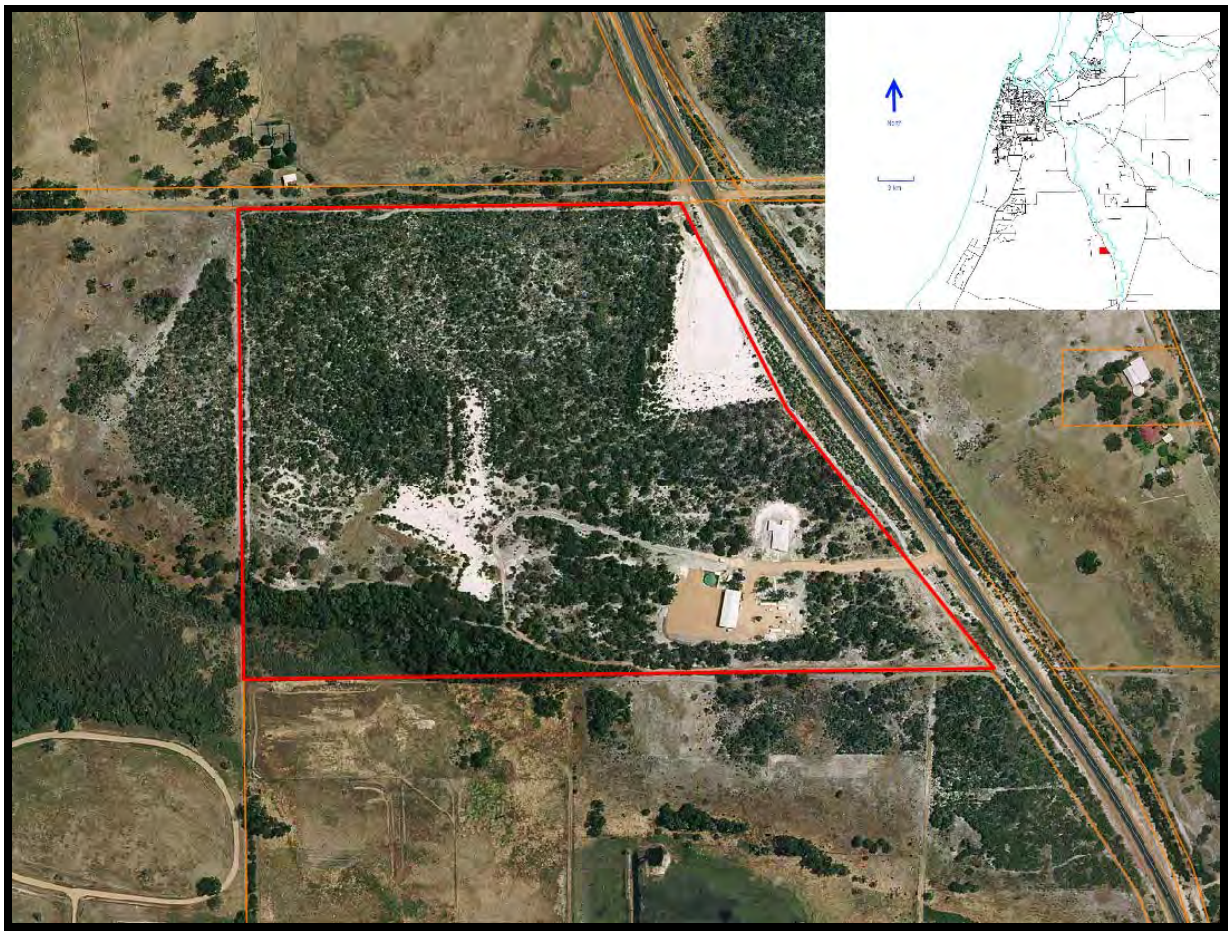


**Figure 1**. The Survey Area, Lot 1, South West Highway, Boyanup.


**Figure 2**. Location of *Acacia semitrullata* (Priority 4) shown by red crosses in relation to the proposed sandpit boundary (dashed line).

## Appendix A: List of vascular flora found within the Survey Area on Lot 1 South West Highway Boyanup.

| FAMILY | SPECIES | INTRODUCED | ROAD RESERVE | CONSV. CODE |
|---|---|---|---|---|
| Anarthriaceae | *Lyginia imberbis* | | | |
| Apiaceae | *Platysace filiformis* | | | |
| Apiaceae | *Xanthosia huegelii* | | | |
| Araliaceae | *Trachymene pilosa* | | | |
| Asparagaceae | *Chamaescilla corymbosa* | | | |
| | *Lomandra purpurea* | | | |
| | *Thysanotus patersonii* | | | |
| | *Thysanotus tenellus* | | | |
| Asteraceae | *Arctotheca calendula* | x | | |
| | *Asteridea pulverulenta* | | x | |
| | *Cotula turbinata* | x | | |
| | *Dittrichia graveolens* | x | | |
| | *Hypochaeris glabra* | x | | |
| | *Rhodanthe citrina* | | | |
| | *Sonchus oleraceus* | x | x | |
| | *Ursinia anthemoides* | x | | |
| Campanulaceae | *Wahlenbergia capensis* | x | | |
| Casuarinaceae | *Allocasuarina humilis* | | | |
| Celastraceae | *Stackhousia monogyna* | | | |
| Colchicaceae | *Burchardia congesta* | | | |
| Cyperaceae | *Lepidosperma leptostachyum* | | | |
| | *Lepidosperma longitudinale* | | | |
| | *Schoenus curvifolius* | | | |
| | *Tetraria octandra* | | | |
| Dasypogonaceae | *Dasypogon bromeliifolius* | | | |
| Dennstaedtiaceae | *Pteridium esculentum* | | | |
| Dilleniaceae | *Hibbertia racemosa* | | | |
| | *Hibbertia vaginata* | | | |
| Elaeocarpaceae | *Platytheca galioides* | | | |
| Ericaceae | *Conostephium pendulum* | | | |
| | *Leucopogon conostephioides* | | | |
| | *Leucopogon propinquus* | | | |
| Fabaceae | *Acacia extensa* | | | |
| | *Acacia huegelii* | | | |
| | *Acacia pulchella* | | | |
| | *Acacia semitrullata* | | | 4 |
| | *Bossiaea eriocarpa* | | | |
| | *Bossiaea* sp. Waroona (B.J. Keighery & N. Gibson 229) | | | |
| | *Callistachys lanceolata* | | | |
| | *Chorizema glycinifolium* | | | |
| | *Gompholobium tomentosum* | | | |
| | *Hardenbergia comptoniana* | | | |
| | *Hovea trisperma* | | | |
| | *Jacksonia furcellata* | | | |
| | *Trifolium glomeratum* | x | | |
| Goodeniaceae | *Dampiera linearis* | | | |
| Haemodoraceae | *Anigozanthos manglesii* | | | |
| | *Conostylis aculeata* | | | |
| | *Phlebocarya ciliata* | | | |
| Hemerocallidaceae | *Caesia occidentalis* | | | |
| | *Tricoryne elatior* | | | |

| FAMILY | SPECIES | INTRODUCED | ROAD RESERVE | CONSV. CODE |
|---|---|---|---|---|
| Iridaceae | *Patersonia occidentalis* | | | |
| | *Patersonia umbrosa* var. *xanthina* | | | |
| Juncaceae | *Juncus microcephalus* | x | | |
| Lamiaceae | *Hemiandra pungens* | | | |
| Loranthaceae | *Nuytsia floribunda* | | | |
| Myrtaceae | *Agonis flexuosa* | | | |
| | *Astartea scoparia* | | | |
| | *Babingtonia camphorosmae* | | | |
| | *Calytrix fraseri* | | | |
| | *Corymbia calophylla* | | | |
| | *Eremaea pauciflora* | | | |
| | *Eucalyptus marginata* | | | |
| | *Eucalyptus rudis* | | | |
| | *Hypocalymma angustifolium* | | x | |
| | *Hypocalymma robustum* | | | |
| | *Kunzea glabrescens* | | | |
| | *Melaleuca lateritia* | | | |
| | *Melaleuca preissiana* | | | |
| | *Melaleuca thymoides* | | | |
| | *Melaleuca viminea* | | | |
| | *Taxandria linearifolia* | | | |
| Orchidaceae | *Caladenia flava* | | | |
| | *Caladenia longicauda* | | | |
| | *Elythranthera brunonis* | | | |
| | *Pyrorchis nigricans* | | | |
| | *Thelymitra cornicina* | | | |
| | *Thelymitra crinita* | | | |
| Orobanchaceae | *Orobanche minor* | x | | |
| Papaveraceae | *Fumaria capreolata* | x | | |
| Poaceae | *Amphipogon turbinatus* | | | |
| | *Austrodanthonia setacea* | | | |
| | *Austrostipa campylachne* | | | |
| | *Austrostipa compressa* | | | |
| | *Briza maxima* | x | | |
| | *Briza minor* | x | | |
| | *Ehrharta calycina* | x | | |
| | *Lolium rigidum* | x | | |
| Podocarpaceae | *Podocarpus drouynianus* | | x | |
| Proteaceae | *Adenanthos meisneri* | | | |
| | *Banksia attenuata* | | | |
| | *Banksia ilicifolia* | | | |
| | *Hakea varia* | | | |
| | *Persoonia longifolia* | | | |
| | *Petrophile linearis* | | | |
| | *Stirlingia latifolia* | | | |
| Restionaceae | *Hypolaena exsulca* | | | |
| | *Hypolaena pubescens* | | | |
| | *Meeboldina roycei* | | | |
| Rutaceae | *Philotheca spicata* | | | |
| Stylidiaceae | *Stylidium ciliatum* | | | |
| | *Stylidium dichotomum* | | | |
| | *Stylidium diversifolium* | | | |
| | *Stylidium schoenoides* | | | |

| FAMILY | SPECIES | INTRODUCED | ROAD RESERVE | CONSV. CODE |
|---|---|---|---|---|
| Xanthorrhoeaceae | *Xanthorrhoea brunonis* | | | |
| | *Xanthorrhoea gracilis* | | | |
| Zamiaceae | *Macrozamia riedlei* | | | |

## Appendix B. Location of the *Melaleuca* Wet Shrubland in Relation to the Survey Area


Location of the *Melaleuca* Wet Shrubland (blue polygon) in relation to the Survey Area (dashed line)

# A Vegetation and Dieback Survey of part Lot 1650, North Boyanup

*Prepared for*
GHD

March 2012

Russell Smith MPhil (Plant Ecology) BSc (Hons)

Ekologica Pty Ltd
PO Box 207 Bunbury
WA 6230
Ph: (08) 9725 4014

# Contents

## Summary

A flora, vegetation and Dieback (*Phytophthora cinnamomi*) disease survey was carried out over approximately 13 ha of land on Lot 1650 North Boyanup Road in the Shire of Capel (the Survey Area). An application is being made to clear the Survey Area for sand extraction.

Because of the time of the survey few annual or annually-renewed species were identified. Species richness overall was relatively low, both because of the time of survey, and also because of the level of disturbance within the Survey Area. No Declared Rare Flora (DRF) or Priority Flora (*Wildlife Conservation Act, 1950*) or species listed as threatened under the Commonwealth *Environmental Protection and Biodiversity Act (1999)* were found. However, a spring survey will be required to ascertain whether any annual or annually-renewed rare species are present – such as two DRF orchids that potentially occur there.

Three vegetation types were identified and mapped, however one of these, *Kunzea* Tall Shrubland, is a degraded form of the *Banksia* Woodland that is the most extensive vegetation type. The *Banksia* Woodland appears to be identical with the Priority Three ecological community: "Southern *Banksia attenuata* woodlands" (SWAFCT 21b). The native vegetation of the Survey Area is mapped as "Bassendean Complex – Central and South". While the remaining area of this complex on the Swan Coastal Plain is 27%, its remaining area in secure tenure is only 0.7 percent.

Vegetation condition within the Survey Area ranged from "Completely Degraded" to "Good". All of it has degraded to some extent by past disturbance for construction of sandpits and tracks, disease caused by *Phytophthora cinnamomi* (Dieback) and heavy grazing by kangaroos. Only 15.7% of the Survey Area was classed as in "Good" condition, with by far the largest proportion (67%) classified as "Degraded".

Symptoms of *Phytophthora* Disease (Dieback) were widespread within the Survey Area, with 78.5% mapped as "infested". The uninfested vegetation forms an "island", covering only 4.1% of the Survey Area, on the highest ground. Signs of recent disease activity (recently dead *Banksia* trees) are also widespread. Three root tissue samples from recently killed *B. attenuata* were taken for testing for presence of the *Phytophthora* pathogen, the results for these were ….

Seventeen percent (2.3 ha) of the Survey Area was classed as having a "Severe" impact (i.e. 75% or more of susceptible species have been lost), and a further 40% of the Survey Area (5.2 ha) was classed as having a "High" impact. Only a small portion (5.3%) was assessed as having "Nil" impact; that is, there were no symptoms of disease expression.

## Project Background

A dieback and vegetation assessment was required of approx 13 ha of bushland (the "Survey Area"), forming part of Lot 1650 SW Highway Boyanup (Fig. 1). The client is proposing to develop a sand pit at the site and is at the early stages of seeking an extractive industry license and DEC Clearing permit. Ekologica Pty Ltd was engaged by GHD Australia to carry out the assessment.

## 1. Scope and Outputs

The scope of work is to:

- Assess the vegetation for dieback status and its protectability
- Assess and map the site in respect to vegetation type
- Assess and map the site in respect to vegetation condition
- List flora species present
- Identify the potential for threatened or priority flora

The output of the survey is to be a brief report on the methodology and outcomes of the site survey including:

- Assessment of the vegetation in respect to its local and regional representativeness based on Mattiske and Havel (1998) and Molloy et al (2007)
- Flora species list
- Plan showing vegetation type
- Plan showing vegetation condition
- Plan showing dieback status if appropriate
- Any other comments thought appropriate

## 2. Objectives

To survey and assess the Study Area to determine the;

- vegetation species composition and structure and likely relationship to plant communities determined for the southern Swan Coastal Plain,
- vegetation condition (using the scoring method of Keighery, 1994),
- presence and impact of disease caused by *Phytophthora cinnamomi* ("Dieback Disease"),
- likelihood of rare flora being found during a spring survey.

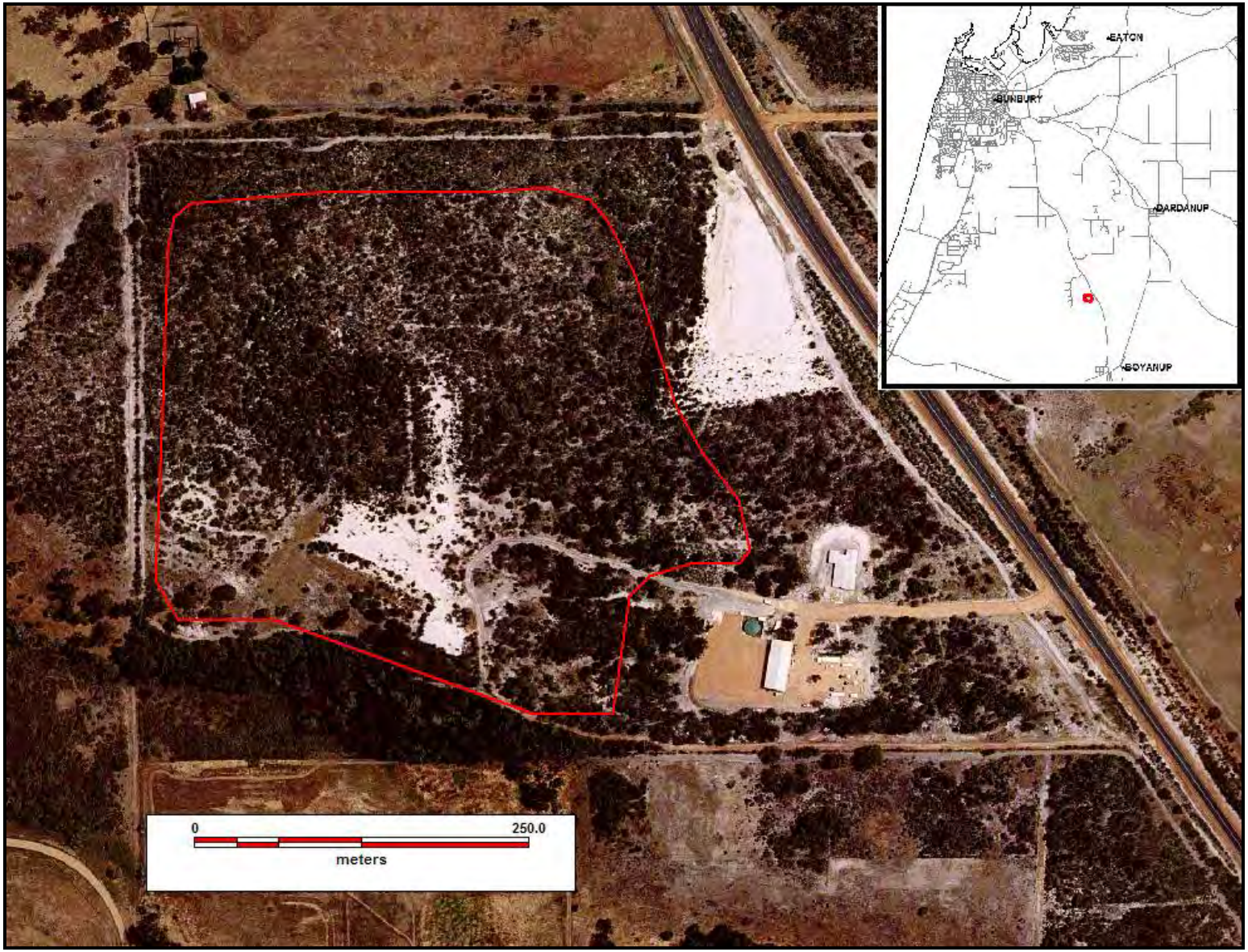



**Figure 1**. The Survey Area on Lot 1650, North Boyanup (shown by red boundary line).

## 3. Regional Setting, Landforms and Soils

The Study Area lies on the Swan Coastal Plain approximately 16 km south east of the regional city of Bunbury. Elevation rises from about 28 m AHD at the northern and southern boundaries to 43 m AHD at the top of the low hill in the middle of the Study Area. The soils belong to the Bassendean Dune System; B1a phase (Tille, 1996), which are described as;

> "Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2 m; *Banksia* dominant."

The Study Area is bounded to the north and south by the alluvial soils of the Pinjarra Plain System.

## 4. Vegetation

The Survey Area falls within the area mapped as Bassendean System by Beard (1980). The north-eastern half of the site is mapped as "Southern River Complex" and the south-western half as "Bassendean – Central and South" by Heddle *et al*., (1980). However, the boundaries of the broadscale mapping by Heddle *et al*. (1980) is not very accurate at a local scale and does not coincide with the more accurate mapping of soils by Tille (1996). The Study Area should actually be all mapped as "Bassendean – Central and South", which is described as;

> "Vegetation ranges from woodland of *E. marginata - C. fraseriana - Banksia* spp. to low woodland of *Melaleuca* species, and sedgelands on the moister sites."

The vegetation community types which occur on the Bassendean System tend to be those that occur in Super Group 3, as identified in Gibson *et al*. (1994). These communities are SWAFCT20, SWAFCT21a and 21b, SWAFCT22 and SWAFCT23. The most likely to occur in the Study Area is community SWAFCT21b.

> "Community 21b: structurally this community is naturally *Banksia attenuata* or *Eucalyptus marginata - Banksia attenuata* woodlands. It is also likely to contain *Acacia extensa, Jacksonia sp. Busselton, Laxmannia sessiliflora, Lysinema ciliatum* and *Johnsonia acaulis*."

## 5. Methods

The Study Area was surveyed on 19th and 20th March 2012.

## 5.1. Flora and Vegetation Type and Condition

A comprehensive list of vascular flora occurring within the Survey Area was compiled using data from two 100 $m^2$ quadrats and lists taken at 19 releves. Species taxonomic names were checked using the DEC database "Max". Vegetation type and condition was assessed at 32 releves situated within and just outside the Study Area. At each releve the following information was recorded;

- plant species occurring within approximately 10 m radius,
- a GPS waypoint,
- a photograph,
- the vegetation condition score (Keighery, 1994),

This information was used to derive broad vegetation types for mapping.

## 5.2. Dieback Disease Status

Initial and field interpretation was done according to the methods described in the "Detection, Diagnosis and Mapping Manual", Sections 2, 3, 4 (Department of Conservation and Land Management, 2001). Other methods employed were;

- All *P. cinnamomi* disease boundaries were mapped using a non-differential global positioning system (GPS) unit. Sample points were recorded as individual GPS waypoints within the Study Area,
- Strip widths were set according to manual specifications, dependent on vegetation density. In the Study Area 30 m strip width was used,
- Digital aerial photography was used to interpret infested area within the assessment area. The photography was used in conjunction with field assessment results,
- Field evidence points have been collected according to methods described in appendix 13 of the Detection Diagnosis and Mapping Manual.
- In addition within the infested areas evidence points signifying proportion of susceptible species death within 20 m of the observer with the purpose of producing an map of relative impact. Aerial photography (2004, 2011) was used to assist in the determination of impact class. The three impact classes used for this assessment were;
    - Severe – Determined to have lost more than 75% of susceptible species due to affects of the pathogen *P. cinnamomi*.

- High – Determined to have lost between 25% and 75% of susceptible species due to affects of the pathogen *P. cinnamomi*.

- Low-Moderate – Determined to have lost up to 25% of susceptible species due to affects of the pathogen *P. cinnamomi*.

The percentages for the impact classes refer to the proportion of susceptible plants (generally *B. attenuata* and *B. ilicifolia*) that have been killed or are dying from the effects of disease caused by *P. cinnamomi*.

### 5.2.1. Demarcation

The area infested by *Phytophthora cinnamomi* was demarcated using a single band of "Day-Glo orange" flagging tape. Knots in the tape are placed facing towards the infestation. A variable buffer width was applied to every infestation boundary as per the "Detection Diagnosis and Mapping Manual", Section 7 (Department of Conservation and Land Management, 2001). In general the buffer width was 15 m to 25 m. The areas determined to be "uninterpretable" were not demarcated.

### 5.2.2. Sampling

Three soil and tissue samples were taken according to the method described in the "Detection Diagnosis and Mapping Manual", Section 6 (Department of Conservation and Land Management, 2001).

### 5.2.3. Mapping

Mapping was carried out by overlaying data collected by GPS in the field (waypoints and tracks) on digital aerial photography in the office using a GIS software program. The categories mapped for the Survey Area were "unmappable", "infested", "uninfested" and "uninterpretable" (see the Glossary below). The definition of the terms "unmappable" (and its alternative "mappable") are not yet published by the Department of Environment and Conservation, but have been use by it for some time.

## 6. Results and Discussion

### *6.1. Vegetation Type*

Three vegetation types were identified and mapped within the Survey Area (Table 1, Fig. 2), however one of the vegetation types (*Kunzea* Tall Shrubland) was originally *Banksia* Woodland but has been severely degraded by *Phytophthora cinnamomi* disease. The remainder of the

Survey Area is mapped as "Disturbed" and is comprised of a former sandpit and partially cleared areas. These areas have scattered shrubs, mainly *K. glabrescens* and annual weeds, particularly **Ehrharta calycina*. A description of the vegetation types, using the structural method of Muir (1977) is given below.

| Vegetation Type | Ha | % |
|---|---|---|
| *Banksia* Woodland | 8.56 | 65.2 |
| Marri-Peppermint Woodland | 0.50 | 3.8 |
| *Kunzea* Tall Shrubland | 2.27 | 17.3 |
| Disturbed | 1.80 | 13.7 |
| | 13.13 | 100.0 |

**Table 1**. Areas and percentages of vegetation types in the Survey Area

***Banksia* Woodland**

Woodland of *Banksia attenuata* and *B. ilicifolia* (with occasional emergent *Eucalyptus marginata* and *Nuytsia floribunda*) over *Kunzea glabrescens* (± *Podocarpus drouynianus*) Low Scrub A over *Melaleuca thymoides*, *Stirlingia latifolia*, *Hypocalymma robustum*, *Calytrix fraseri*, *Macrozamia riedlei*, *Acacia pulchella* and *Jacksonia horrida* Heath B over *Adenanthos meisneri*, *Hemiandra pungens*, *Dasypogon bromeliifolius*, *Hibbertia racemosa* Dwarf Scrub C over *Patersonia occidentalis*, *Hypolaena exsulca* and *Lyginia barbata* Open Low Sedges. (Note: in places the shrub *P. drouynianus* dominates the understorey). [Fig. 3].

**Kunzea Tall Shrubland**

Low Woodland B to Scrub of *Kunzea glabrescens* (with occasional *B. attenuata*, *B. ilicifolia* or *N. floribunda*) over Low Scrub B of Calytrix fraseri, *Hypocalymma robustum*, *Melaleuca thymoides*, *Adenanthos meisneri* and *Stirlingia latifolia* over *Patersonia occidentalis*, *Hypolaena exsulca* and *Lyginia barbata* Open Low Sedges and **Ehrharta calycina* Open Tall Grass. [Fig.4].

**Marri-Peppermint Woodland**

Woodland of *Agonis flexuosa* with *Corymbia calophylla* (downslope) over sparse understorey of *Pteridium esculentum* Open Ferns, and **Ehrharta calycina* and **Briza maxima* Low Grass and other annual exotic species. [Fig. 5].

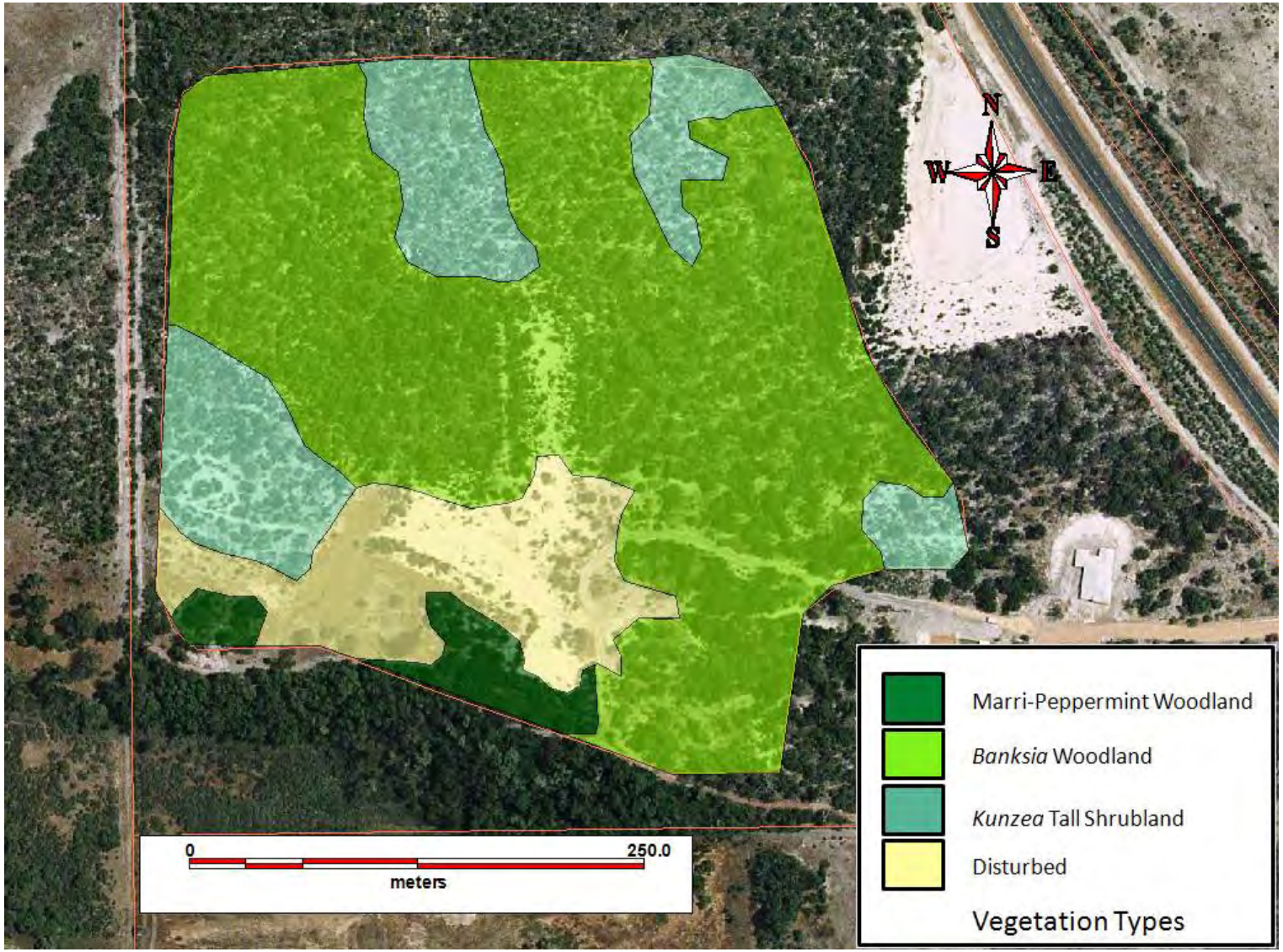



**Figure 2**. Vegetation Types in the Survey Area.

**Figure 3**. *Banksia* Woodland

**Figure 4**. *Kunzea* Tall Shrubland

**Figure 5**. Marri-Peppermint Woodland

The vegetation type mapped as *Banksia* Woodland is most similar to the floristic community type "Southern *Banksia attenuata* woodlands" (SWAFCT 21b) (Gibson *et al*., 1994). Among the "typical" species it shares with SWAFCT 21b are *Banksia attenuata, Calytrix fraseri, Hypocalymma robustum, Jacksonia horrida, Melaleuca thymoides, Stirlingia latifolia* and *Dasypogon bromeliifolius*). More than twenty of the "typical" and "common" species associated with SWAFCT 21b were found within the Survey Area. Floristic Community Type SWAFCT21b is recognised as a Priority Three ecological community (DEC, 2011b).

Originally the areas mapped as *Kunzea* Tall Shrubland would have would have been covered with the *Banksia* Woodland vegetation type. The effects of disease caused by *P. cinnamomi* root-rot have been to remove all or most of the susceptible species in these areas. Primarily the overstorey of *B. attenuata* and *B. ilicifolia* has been removed, or very much reduced. In addition other susceptible species from the mid and understorey have been removed by the disease, such as the highly susceptible *Xanthorrhoea brunonis* and *X. gracilis* and eventually other less susceptible species such as *Jacksonia horrida, Leucopogon cono*stephioides and *Podocarpus drouynianus* (Groves *et al*., 2008). The other vegetation type within the Survey Area, Marri-Peppermint Woodland is a degraded fragment of the Flooded Gum-Marri-Peppermint-Paperbark woodland/open forest that fringes the wet shrubland along the southern boundary of Lot 1650. This community probably belongs to floristic community type "Forest and woodlands of deep seasonal wetlands of the Swan Coastal Plain" (SWAFCT15).

## 6.2. Vegetation Condition

Vegetation condition within the Survey Area is quantified in Table 2 and mapped in Fig. 6. Most (67%) of the area was mapped as "Degraded". The main factors in degrading the vegetation have been *Phytophthora* disease ("Dieback"), previous disturbance related to construction of tracks and sandpits and heavy grazing pressure by kangaroos and rabbits. The areas classed as in "Good" condition are those where the canopy of *Banksia* is predominantly intact although there may be isolated dead or dying trees of these species.

Heavy grazing, particularly by kangaroos, is evident throughout the Survey Area, and this together with the effects of *Phytophthora* disease has led to a reduction in the density of the understorey over much of the area. The invasive perennial grass **Ehrharta calycina* is evident in many areas, particularly where heavy physical disturbance has taken place. It has also invaded some of the more intact *Banksia* woodland (Fig. 7).

| Status | Ha | % |
|---|---|---|
| Good | 2.06 | 15.7 |
| Degraded | 8.80 | 67.0 |
| Completely Degraded | 2.28 | 17.4 |
| | 13.13 | 100.0 |

**Table 2**. Vegetation Condition within the Survey Area

## 6.3. Phytophthora Disease (Dieback) Status and Distribution

The total area assessed was 13.1 ha, with 2.3 ha (the heavily disturbed areas) being classified as "unmappable" (Fig. 8). Of the 13.1 ha within the Survey Area, 10.3 ha (78.5%) was assessed as "infested" and 0.5 ha (4.1%) was assessed as "uninfested". The uninfested area forms an "island" on the highest ground near the middle of the Survey Area.

Three root tissue samples were collected from recently killed plants within the Survey Area (Fig. 8). The samples were sent to the Vegetation Health Service laboratory of the Department of Conservation and Land Management for analysis. The results are given in Table 3, below.

| Sample No. | Species Sampled | Result |
|---|---|---|
| 1 | *Banksia attenuata* | |
| 2 | *Banksia attenuata* | |
| 3 | *Banksia attenuata* | |

**Table 3**. Results of root tissue sample analysis for *Phytophthora*.

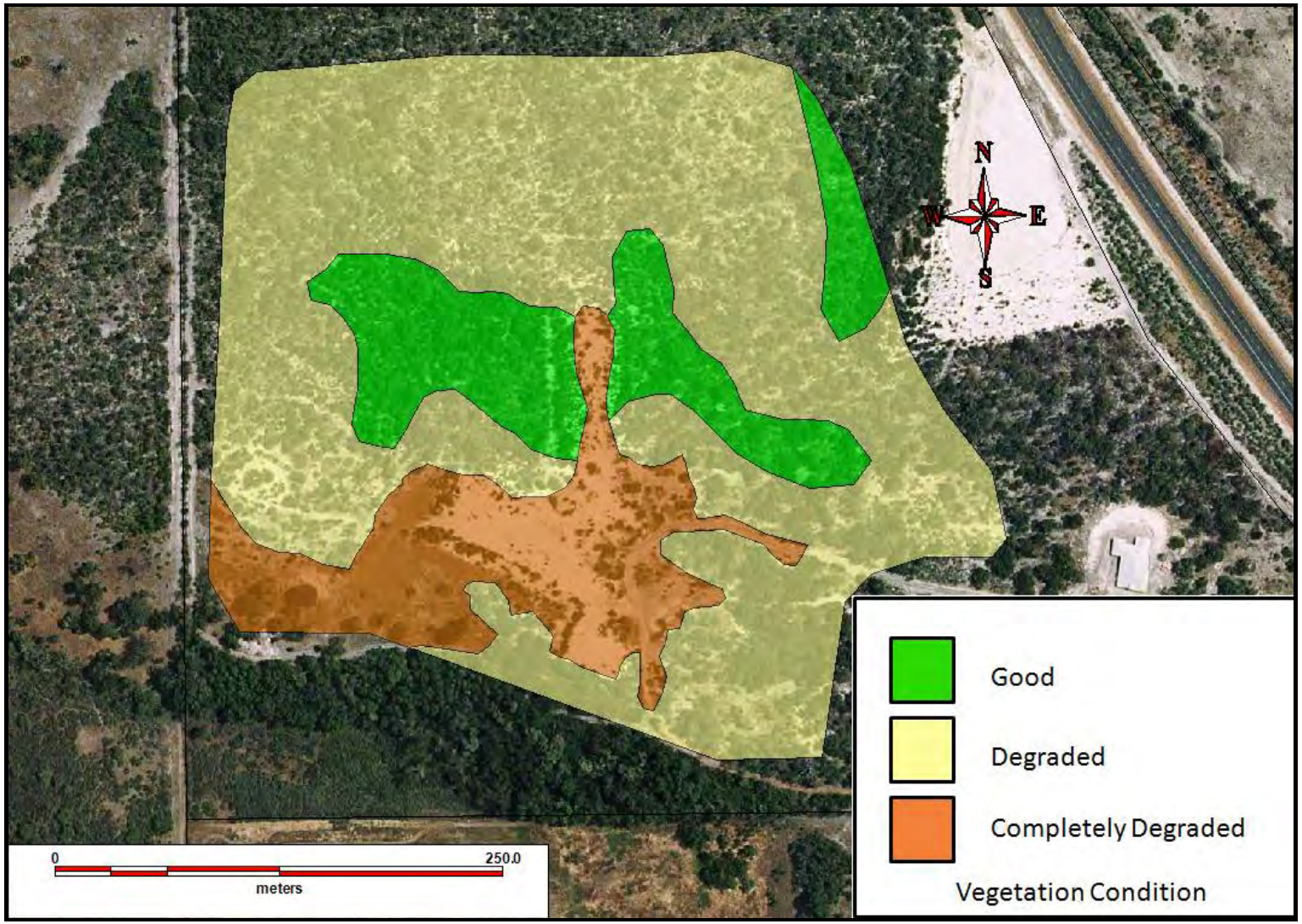



**Figure 6**. Vegetation Condition in the Survey Area.

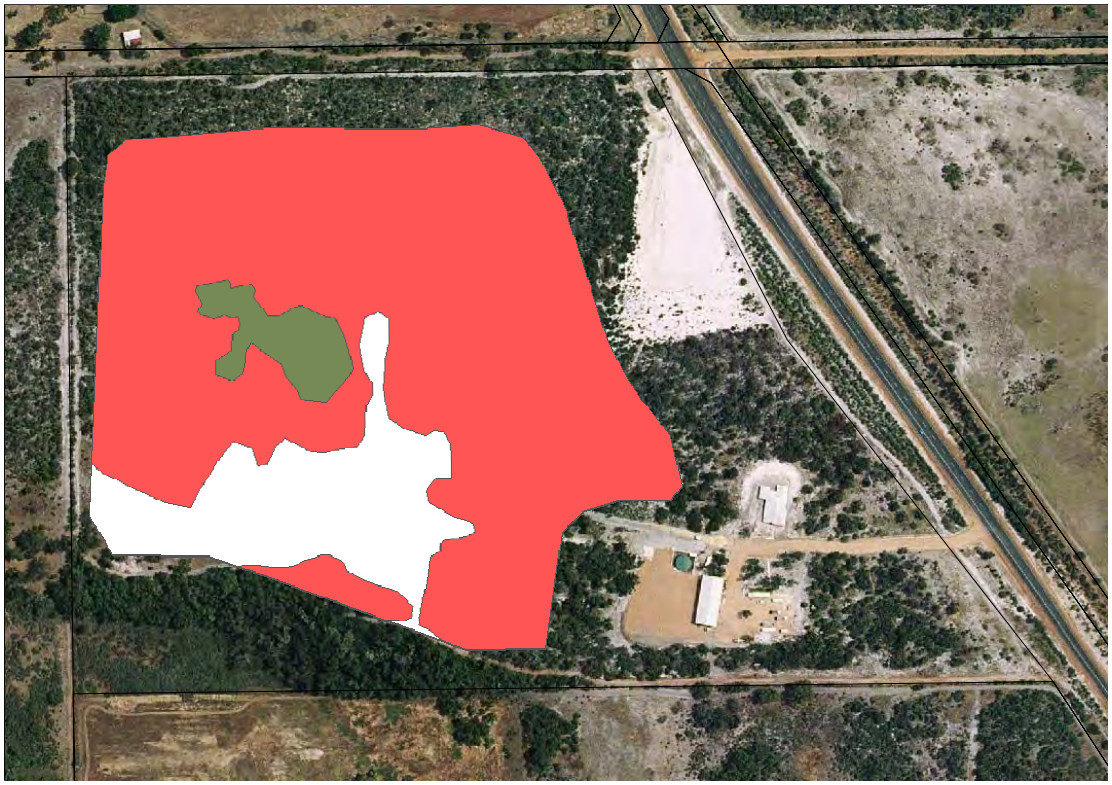
**Figure 7**. Invasion of *Banksia* woodland by *Ehrharta calycina* (Perennial Veldt Grass)

## 6.4. *Phytophthora cinnamomi* Disease Expression

The most common susceptible overstorey species within the Survey Area are *Banksia attenuata* and *Banksia ilicifolia*. Other susceptible species less commonly found in the survey area (Smith, 2008), mainly near the eastern and southern margins, are *Macrozamia riedlei*, *Podocarpus drouynianus* and *Xanthorrhoea brunonis and X. gracilis* (Groves, *et al*., 2008). The pattern of disease development appears to be that *Banksia attenuata*, *B. ilicifolia* and the *Xanthorrhoea* species succumb first, followed eventually by the other susceptible species once the disease is well established in an area. Although Jarrah (*E. marginata*) is susceptible to the disease few of this species within the Survey Area have died, although they all have dead "stags" on them.

The distribution of "recent deaths" of susceptible species (mainly *B. attenuata*) and also the locations where root tissue samples were taken in relation to the distribution of disease symptoms is shown in Fig. 9. "Recent deaths" were recorded if the plant was dead but still had most (> 90%) of its leaves still in place (Fig. 10). Most of these have almost certainly been caused by *P. cinnamomi*, but the possibility of drought as a cause of some deaths cannot be ruled out, particularly for isolated deaths in areas with no other symptoms. The pattern of recent deaths indicates the location of current disease activity. Dead and dying plants form "fronts" of disease expression is some areas (Fig. 11).

**Figure 8.** *Phytophthora* Disease (Dieback) Status and Distribution



0 100 200 300 400 metres

Lot 1650, North Boyanup Road, Shire of Boyanup-Capel-Dardanup

ekologica PTY LTD

N

**Infested** – Determined by a qualified interpreter to have plant disease symptoms consistent with the presence of the pathogen *P. cinnamomi*.

**Uninfested** – Determined by a qualified interpreter to be free of plant disease symptoms which indicate the presence of the pathogen *P. cinnamomi*.

**Unmappable** – Disturbed areas where susceptible plants are no longer present or are too few, or have been damaged so that interpretation is not possible.

**AGE LIMITS**

Boundaries should be checked before operations proceed if this map is more than 1-year-old, 21st March 2013.

This map should not be used if it is older than 3 years, 21st March 2015.

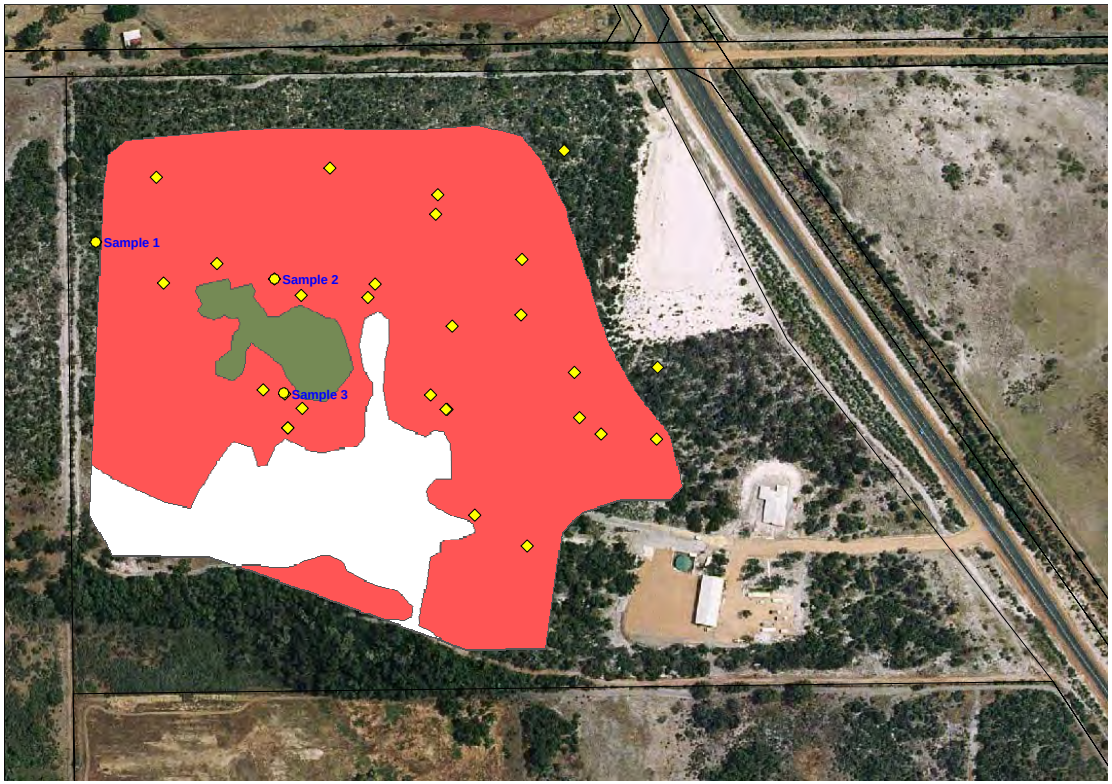
Areas that have had an soil disturbance operation in them become unreliable and should be checked prior to further or new activities.

**AREA STATEMENT**

| | |
|---|---|
| Infested | 10.30 ha |
| Uninfested | 0.54 ha |
| Unmappable | 2.29 ha |
| **Total Area** | **13.13 ha** |

Field interpretation and mapping by Russell Smith

**Figure 9.** Recent Deaths of Susceptible Species and Sample Points in Relation to *Phytophthora* Disease (Dieback) Status and Distribution




0 100 200 300 400 metres

N

Lot 1650, North Boyanup Road, Shire of Boyanup-Capel-Dardanup

ekologica

**Infested** – Determined by a qualified interpreter to have plant disease symptoms consistent with the presence of the pathogen *P. cinnamomi*.

**Uninfested** – Determined by a qualified interpreter to be free of plant disease symptoms which indicate the presence of the pathogen *P. cinnamomi*.

**Unmappable** – Disturbed areas where susceptible plants are no longer present or are too few, or have been damaged so that interpretation is not possible.

**Recent death** of a susceptible species.

**AGE LIMITS**

Boundaries should be checked before operations proceed if this map is more than 1-year-old, 21st March 2013.

This map should not be used if it is older than 3 years, 21st March 2015.

Areas that have had an soil disturbance operation in them become unreliable and should be checked prior to further or new activities.

**AREA STATEMENT**

| | |
|---|---|
| Infested | 10.30 ha |
| Uninfested | 0.54 ha |
| Unmappable | 2.29 ha |
| **Total Area** | **13.13 ha** |

Field interpretation and mapping by Russell Smith

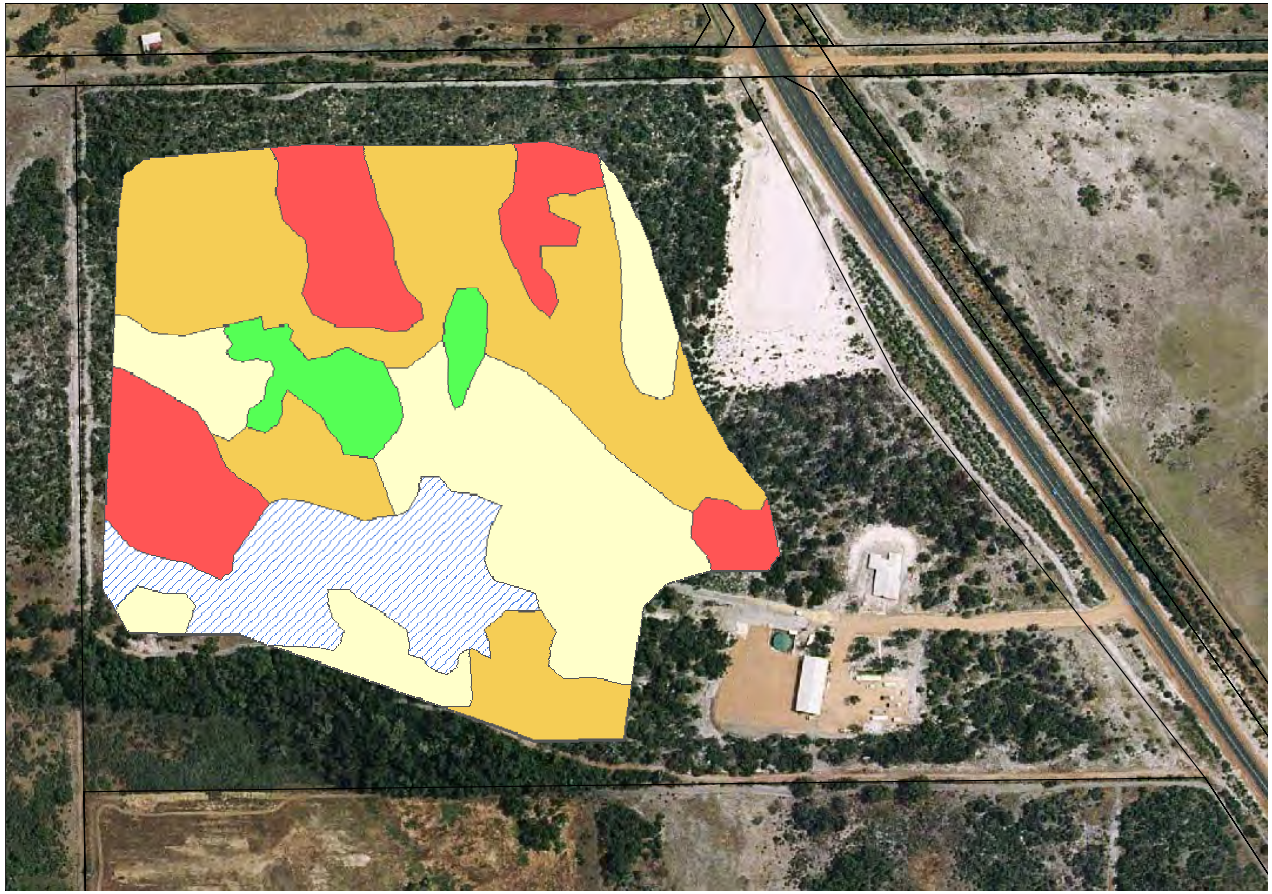
Figure 10. A “recent death” of a small *Banksia attenuata* tree. (Sample 1).

Figure 12. A *Phytophthora* disease “front” showing dying *Podocarpus drouynianus* plants.

## 6.5. Level of Impact by *Phytophthora cinnamomi* Disease

The level of impact by *Phytophthora cinnamomi* disease is mapped in Fig. 13. Seventeen percent (2.3 ha) of the Survey Area was classed as having a "Severe" impact (Fig. 14), and a further 40% of the Survey Area (5.2 ha) was classed as having a "High" impact. Only a small portion (5.3%) was assessed as having "Nil" impact. However, the high degree of physical disturbance over much of the Survey Area (13.7% was not assessable) and the invasion of weeds, particularly Perennial Veldt Grass (*E. calycina*) into the *Banksia* woodland coupled with loss of native species through heavy grazing has probably concealed the full impact of "dieback" overall.

**Figure 13**. Area of "High" impact with almost all susceptible species removed by the effects of disease caused by *Phytophthora cinnamomi*.



0 100 200 300 400 metres

**Severe** – Determined to have lost more than 75% of susceptible species due to effects of the pathogen *P. cinnamomi*

**High** – determined to have lost between 25% and 75% of susceptible species due to the effects of the pathogen *P. cinnamomi*.

**Low-Moderate** – Determined to have lost up to 25% of susceptible species due to the effects of *P. cinnamomi*.

**Nil** – No symptoms of disease expression and no loss of susceptible plant species due to effects of the pathogen *P. cinnamomi*.

**Not Assessed** – Heavily disturbed, much bare ground and few susceptible species. No signs of P. cinnamomi disease expression.

**Area Statement**

| | |
|---|---|
| Severe | 2.3 ha |
| High | 5.2 ha |
| Low-Moderate | 3.2 ha |
| Nil | 0.7 ha |
| Not Assessed | 1.8 ha |
| **Total Area** | **13.1 ha** |

Field interpretation and mapping by Russell Smith

Lot 1650, North Boyanup Road, Shire of Boyanup-Capel-Dardanup

**Figure 13**. The distribution of *Phytophthora cinnamomi* impact classes within the Survey Area

## 6.6. Flora and the Potential for Rare Flora in the Survey Area

A total of sixty six species of vascular flora were identified within and close to the boundary of the Survey Area. These species are listed in Appendix A. Species richness is relatively low, even allowing for the time of survey – this is probably due to the high level of disturbance in the Survey Area. Two 100 $m^2$ quadrats were placed and species occurring within them were listed. Information about the quadrats is given in Appendix 2. Few annual or annually-renewed species were identified within the Survey Area and a spring survey will be required to pick up these species, including those in the quadrats.

## 6.7. The Potential for Rare Flora to occur within the Survey Area

None of the species identified during the survey are Declared Rare Flora, Priority Flora or otherwise of conservation significance. However, as noted above a spring survey is required to ascertain whether any annual or annually-renewing rare flora occur within the Survey Area. A list of Declared Rare Flora and Priority Flora known to occur within 5 km of the Survey Area is provided in Table 4 (DEC, 2012). Of the species listed in Table 4, the two DRF orchids, which would not have been visible at the time of this survey, have a moderate likelihood of occurring within the Survey Area and a spring survey (October) would need to be conducted whether they occur there.

| Taxon | Priority | Habitat | Likelihood |
|---|---|---|---|
| *Drakaea elastica* | DRF | White/grey sand adjoining swamps | Moderate |
| *Drakaea micrantha* | DRF | White-grey sand. | Moderate |
| *Eleocharis keigheryi* | DRF | Freshwater: creeks, claypans. | None |
| *Boronia humifusa* | P1 | Gravelly clay loam over laterite. | Unlikely |
| *Synaphea odocoileops* | P1 | Swamps, winter-wet areas. | Unlikely |
| *Leptomeria furtiva* | P2 | Winter-wet flats. | Unlikely |
| *Mitreola minima* | P3 | Peaty swampy areas. | Unlikely |
| *Thelymitra variegata* | P3 | Sandy clay, sand, laterite. | Low |
| *Acacia flagelliformis* | P4 | Winter-wet areas. | Unlikely |
| *Acacia semitrullata* | P4 | White/grey sand. | Moderate |
| *Aponogeton hexatepalus* | P4 | Freshwater | None |
| *Franklandia triaristata* | P4 | White or grey sand. | Moderate |
| *Ornduffia submersa* | P4 | Freshwater. | None |
| *Pultenaea skinneri* | P4 | Winter-wet depressions. | Unlikely |

**Table 4**. Declared Rare (DRF) and Priority Flora occurring within 5 km radius of the Survey Area.

# 7. Conclusions

## *7.1. The Vegetation in the Survey Area with regard to its Regional and Local Representativeness*

As stated in Section 5, above, the native vegetation in the Survey Area lies with the "Bassendean Complex – Central and South". The remaining area of this complex is 27%, while its remaining area in secure tenure is only 0.7 percent (EPA, 2006). This is far below the desired reservation target of 15% (EPA, 2002).

The majority of the vegetation in the Survey Area (i.e. the *Banksia* Woodland and *Kunzea* Tall Shrubland) belongs to the "Southern *Banksia attenuata* woodlands" (SWAFCT 21b) floristic community type (Gibson *et al*., 1994). As noted in subsection 7.1, this floristic community is listed as Priority Three. The *Kunzea* Shrubland is a degraded form of the *Banksia* Woodland, most if not all of the characteristic overstorey species, *Banksia attenuata* and *B. ilicifolia* having been killed by "Dieback" disease and it is debatable whether it still qualifies as representative of this community. As stated in subsection 7.2, 67% of the native vegetation in the Survey Area is "Degraded", with a further 17% categorized as "Completely Degraded".

The 2 ha of *Banksia* woodland in "Good" condition within the Survey Area has value as an occurrence of the Priority Three ecological community SWAFCT21b. However, given its small size and relatively large boundary/area ratio it is at significant risk of further loss of species, particularly through Dieback disease. Given a conservative rate of advance ( c. 1 m/yr$^{-1}$)[1] for the Dieback fronts surrounding the pockets of *Banksia* Woodland in "Good" condition (currently uninfested or only lightly impacted) the current extent of 2 ha will probably have halved within 10 years.

## *7.2. Ecological Linkages*

The native vegetation within the Survey Area is classed as 1b under the schema of Molloy *et al*. (2009) for identifying regional ecological linkages. These areas represent native vegetation touching, or less than 100 m from vegetation classed as 1a. Vegetation classed as 1a touches or is within 100 m of a linkage. Under the ecological linkages analysis scheme "The landscape function of an ecological linkage will be considered impaired where the proposed development causes the proximity value of a level 1 patch of remnant vegetation to change to a level 2."

[1] Rates of advance for Dieback fronts in *Banksia* woodland have been measured at 1.0-4.0 m/yr-1; Hill *et al*., 1994; Shearer *et al*., 2004.

There is a small amount of vegetation of 1c class to the west of the Survey Area but after the proposed development this would still have a connection to the main linkage via a corridor of vegetation retained along the northern and southern edges of the Survey Area.

## *7.3. Rare Flora*

As stated in subsection 7.7 there are several rare flora species potentially occurring in the Survey Area that would not have been visible or identifiable at the time of the present survey. It is recommended that a spring survey be carried out to determine whether any rare flora occur within it.

## References


Beard, J.S. (1981). Vegetation survey of Western Australia, Swan 1:1,000,000. Vegetation series, explanatory notes to Sheet 7. UWA. Press, Perth.

Department of Conservation and Land Management (2001). *Phytophthora cinnamomi* and disease caused by it. Volume II, interpreter guidelines for detection, diagnosis and mapping. Forest Management Branch.

Department of Environment and Conservation (2006). Reservation levels of vegetation complexes and systems with reserve status as at June 2006. Excel spreadsheet.

Department of Environment and Conservation (DEC) (2010). Max Version 20101028. Department of Environment and Conservation.

Department of Environment and Conservation (DEC) (2012a). List of Threatened Ecological Communities on the (TEC) Database endorsed by the Minister for the Environment (August 2010). http://www.dec.wa.gov.au/content/view/849/2017/ts-tec-endorsed-by-minister-august-2010.pdf

Department of Environment and Conservation (DEC )(2012b). Priority ecological communities list (30 September 2011). Department of Environment and Conservation. http://www.dec.wa.gov.au/management-and-protection/threatened-species/wa-s-threatened-ecological-communities.html

Department of Environment and Conservation (DEC )(2012c). NatureMap. http://naturemap.dec.wa.gov.au./default.aspx

Environmental Protection Authority (2002). A Strategy for the EPA to identify regionally significant natural areas in its consideration of the Greater Bunbury Region Scheme portion of the Swan Coastal Plain. Greater Bunbury Region Scheme, Appendix 3.

Environmental Protection Authority (2006) Level of Assessment for Proposals affecting Natural Area within the System 6 Region and Swan Coastal Plain Portion of the System 1 Region. Guidance Statement No. 10, June 2006, Perth.

Groves, E., Hollick, P., Hardy, G., and McComb, J. (2008) Appendix 2: Western Australian Natives Susceptible to *Phytophthora cinnamomi*. http://www.dwg.org.au/files/Western%20Australian%20natives%20susceptible.pdf

Heddle, E. M., Loneragan, O. W. & Havel, J. J. (1980). Vegetation complexes of the Darling System, Western Australia. In: Atlas of Natural Resources, Darling System, Western Australia. Department of Conservation and Environment, Perth, 37-72.

Hill, T.C.J., Tippett, J.T. and Shearer, B.L. (1994). Invasion of Bassendean Dune *Banksia* Woodland by *Phytophthora cinnamomi*. *Australian Journal of Botany* 42(6) 725 – 738.

Keighery, B. J. (1994). Bushland Plant Survey: A guide to plant community survey for the community. Wildflower Society of Western Australia (Inc.), Nedlands.

Mattiske Consulting and Havel. J.J. (2002). Review of management options for poorly represented vegetation complexes. Report to the Conservation Commission of Western Australia.

Molloy, S., O'Connor, T., Wood, J. and Wallrodt, S. (2009). South West Regional Ecological Linkages Technical Report. Western Australian Local Government Association (WALGA) and the Department of Environment and Conservation (DEC). West Perth.

Muir, B.G. (1977). Biological Survey of the Western Australian Wheatbelt. Part II. Vegetation and habitat of Bendering Reserve. Records of the West Australian Museum, Supplement No. 3.

Shearer, B.L., Crane, C.E., Fairman, R.G. (2004). Phosphite reduces disease extension of a Phytophthora cinnamomi front in *Banksia* woodland, even after fire. *Australasian Plant Pathology*, 33, 249-254.

Smith, M.G. (2010). Declared Rare and Priority Flora List for Western Australia, 25 March 2010. Dept of Environment and Conservation. Como, W.A.

Tille, P. (1996).Wellington-Blackwood land resources survey. Resource Management Technical Report No. 162, Western Australian Department of Agriculture.

## Glossary

**Buffer width** : A zone adjacent to an infested area that, although disease symptoms are not yet evident, may be infested. Soil and the root systems of both susceptible and non-susceptible species adjacent to a visibly infested area may harbour the pathogen but not yet exhibit symptoms.

**Disease** : A combination of a pathogen, host and correct environmental conditions, which results in disease symptoms or death of a host.

**Disease expression** : The visible symptoms of the disease in susceptible plants.

**Host** : The plant which is invaded by a pathogen and from which the pathogen derives its energy.

**Impact**: The effects of disease on plant health.

**Pathogen** : Any organism (e.g. *P. cinnamomi*) or factor that causes disease in a host.

**Susceptible** : Influenced or harmed by *Phytophthora cinnamomi.*

**Rate of Spread (R.O.S):** Speed (usually measured in $m/yr^{-1}$) that a *Phytophthora* disease front moves into uninfested vegetation. Autonomous spread of the pathogen in *Banksia attenuata* woodland through root-root contact may occurs at 1.0-4.0 $m/yr^{-1}$.

**Risk** : The chance of an uninfested area becoming infested through the autonomous actions of the pathogen (*P. cinnamomi*) or the actions of people and animals or a combination of these factors, measured in terms of the magnitude of consequences of that event should it occur and the likelihood of the event and its consequences occurring and assessed in the context of existing controls.

**Uninfested** : An area that an accredited person has determined may be free of plant disease symptoms that indicate the presence of *P. cinnamomi*.

**Uninterpretable** : Lack of susceptible plant species precludes disease expression.

# Appendix A: List of vascular flora identified with and just outside the Survey Area.

Note: Species occurring within the two quadrats placed within the Survey Area are indicated.

| FAMILY_NAME | LATIN NAME | NATURALISED | VERNACULAR | Quadrat 1 | Quadrat 2 |
|---|---|---|---|---|---|
| Fabaceae | *Acacia extensa* | | Wiry Wattle | | |
| Fabaceae | *Acacia huegelii* | | | | |
| Fabaceae | *Acacia pulchella* | | Prickly Moses | x | x |
| Proteaceae | *Adenanthos meisneri* | | | x | |
| Myrtaceae | *Agonis flexuosa* | | Peppermint | | |
| Casuarinaceae | *Allocasuarina humilis* | | Dwarf Sheoak | | |
| Poaceae | *Amphipogon turbinatus* | | | | |
| Myrtaceae | *Astartea scoparia* | | | | |
| Poaceae | *Austrodanthonia setacea* | | | | x |
| Poaceae | *Austrostipa flavescens* | | | | x |
| Myrtaceae | *Babingtonia camphorosmae* | | Camphor Myrtle | | |
| Proteaceae | *Banksia attenuata* | | Slender Banksia | x | x |
| Proteaceae | *Banksia ilicifolia* | | Holly-leaved Banksia | | x |
| Fabaceae | *Bossiaea eriocarpa* | | Common Brown Pea | | |
| Poaceae | *Briza maxima* | * | Blowfly Grass | x | x |
| Colchicaceae | *Burchardia congesta* | | | | |
| Fabaceae | *Callistachys lanceolata* | | Wonnich | | |
| Myrtaceae | *Calytrix fraseri* | | Pink Summer Calytrix | x | x |
| Ericaceae | *Conostephium pendulum* | | Pearl Flower | | |
| Haemodoraceae | *Conostylis aculeata* | | Prickly Conostylis | x | x |
| Myrtaceae | *Corymbia calophylla* | | Marri | | |
| Dasypogonaceae | *Dasypogon bromeliifolius* | | Pineapple Bush | x | |
| Asteraceae | *Dittrichia graveolens* | * | Stinkwort | | |
| Poaceae | *Ehrharta calycina* | * | Perennial Veldt Grass | x | x |
| Myrtaceae | *Eucalyptus marginata* | | Jarrah | x | |
| Myrtaceae | *Eucalyptus rudis* | | Flooded Gum | | |
| Fabaceae | *Gompholobium tomentosum* | | Hairy Yellow Pea | | |
| Proteaceae | *Hakea varia* | | Variable-leaved Hakea | | |
| Fabaceae | *Hardenbergia comptoniana* | | Native Wisteria | | |

| FAMILY_NAME | LATIN NAME | NATURALISED | VERNACULAR | Quadrat 1 | Quadrat 2 |
|---|---|---|---|---|---|
| Lamiaceae | *Hemiandra pungens* | | Snakebush | | x |
| Dilleniaceae | *Hibbertia racemosa* | | Stalked Guinea Flower | | x |
| Dilleniaceae | *Hibbertia vaginata* | | | x | |
| Myrtaceae | *Hypocalymma robustum* | | Swan River Myrtle | x | |
| Restionaceae | *Hypolaena exsulca* | | | x | x |
| Restionaceae | *Hypolaena pubescens* | | | | |
| Fabaceae | *Jacksonia furcellata* | | Grey Stinkwood | | |
| Juncaceae | *Juncus microcephalus* | * | | | |
| Myrtaceae | *Kunzea glabrescens* | | Spearwood | x | |
| Myrtaceae | *Kunzea glabrescens* | | Spearwood | | |
| Cyperaceae | *Lepidosperma leptostachyum* | | | x | |
| Cyperaceae | *Lepidosperma longitudinale* | | Pithy Sword-sedge | | |
| Ericaceae | *Leucopogon conostephioides* | | | | |
| Ericaceae | *Leucopogon propinquus* | | | | |
| Anarthriaceae | *Lyginia barbata* | | | x | |
| Zamiaceae | *Macrozamia riedlei* | | Zamia | x | x |
| Restionaceae | *Meeboldina roycei* | | | | |
| Myrtaceae | *Melaleuca lateritia* | | Robin Redbreast Bush | | |
| Myrtaceae | *Melaleuca preissiana* | | Moonah | | |
| Myrtaceae | *Melaleuca thymoides* | | | x | x |
| Myrtaceae | *Melaleuca viminea* | | Mohan | | |
| Loranthaceae | *Nuytsia floribunda* | | Christmas Tree | x | |
| Orobanchaceae | *Orobanche minor* | * | Lesser Broomrape | | |
| Iridaceae | *Patersonia occidentalis* | | Purple Flag | x | x |
| Proteaceae | *Persoonia longifolia* | | Snottygobble | | |
| Proteaceae | *Petrophile linearis* | | Pixie Mops | | |
| Haemodoraceae | *Phlebocarya ciliata* | | | x | |
| Apiaceae | *Platysace filiformis* | | | | |
| Podocarpaceae | *Podocarpus drouynianus* | | Wild Plum | | |

| FAMILY_NAME | LATIN NAME | NATURALISED | VERNACULAR | Quadrat 1 | Quadrat 2 |
|---|---|---|---|---|---|
| Dennstaedtiaceae | *Pteridium esculentum* | | Bracken | | |
| Proteaceae | *Stirlingia latifolia* | | Blueboy | x | x |
| Myrtaceae | *Taxandria linearifolia* | | | | |
| Cyperaceae | *Tetraria octandra* | | | | |
| Asteraceae | *Ursinia anthemoides* | * | Ursinia | | |
| Xanthorrhoeaceae | *Xanthorrhoea brunonis* | | | | |
| Xanthorrhoeaceae | *Xanthorrhoea gracilis* | | Graceful Grass Tree | | |

## Appendix B. Floristic Quadrats Installed in the Survey Area

## Quadrat 1 – Lot 1650, North Boyanup Road, Boyanup

**Latitude**: -33.44378 deg **Longitude**: 115.71512 deg

**Landform**: Gentle ridge **Soil**: Light grey sand

**Vegetation**: *Eucalyptus marginata-Banksia attenuata-Nuytsia floribunda* woodland

| SPECIES | COVER | SPECIES | COVER |
|---|---|---|---|
| *Acacia pulchella* | 1 | *Hypolaena exsulca* | 1 |
| *Adenanthos meisneri* | 1 | *Kunzea glabrescens* | 3 |
| *Banksia attenuata* | 3 | *Lepidosperma leptostachyum* | 1 |
| *Briza maxima* | 1 | *Lyginia barbata* | 1 |
| *Calytrix fraseri* | 1 | *Macrozamia riedlei* | 1 |
| *Conostylis aculeata* | 2 | *Melaleuca thymoides* | 2 |
| *Dasypogon bromeliifolius* | 2 | *Nuytsia floribunda* | 1 |
| *Ehrharta calycina* | 1 | *Patersonia occidentalis* | 4 |
| *Eucalyptus marginata* | 3 | *Phlebocarya ciliata* | 4 |
| *Hibbertia vaginata* | 1 | *Stirlingia latifolia* | 3 |
| *Hypocalymma robustum* | 1 | | |

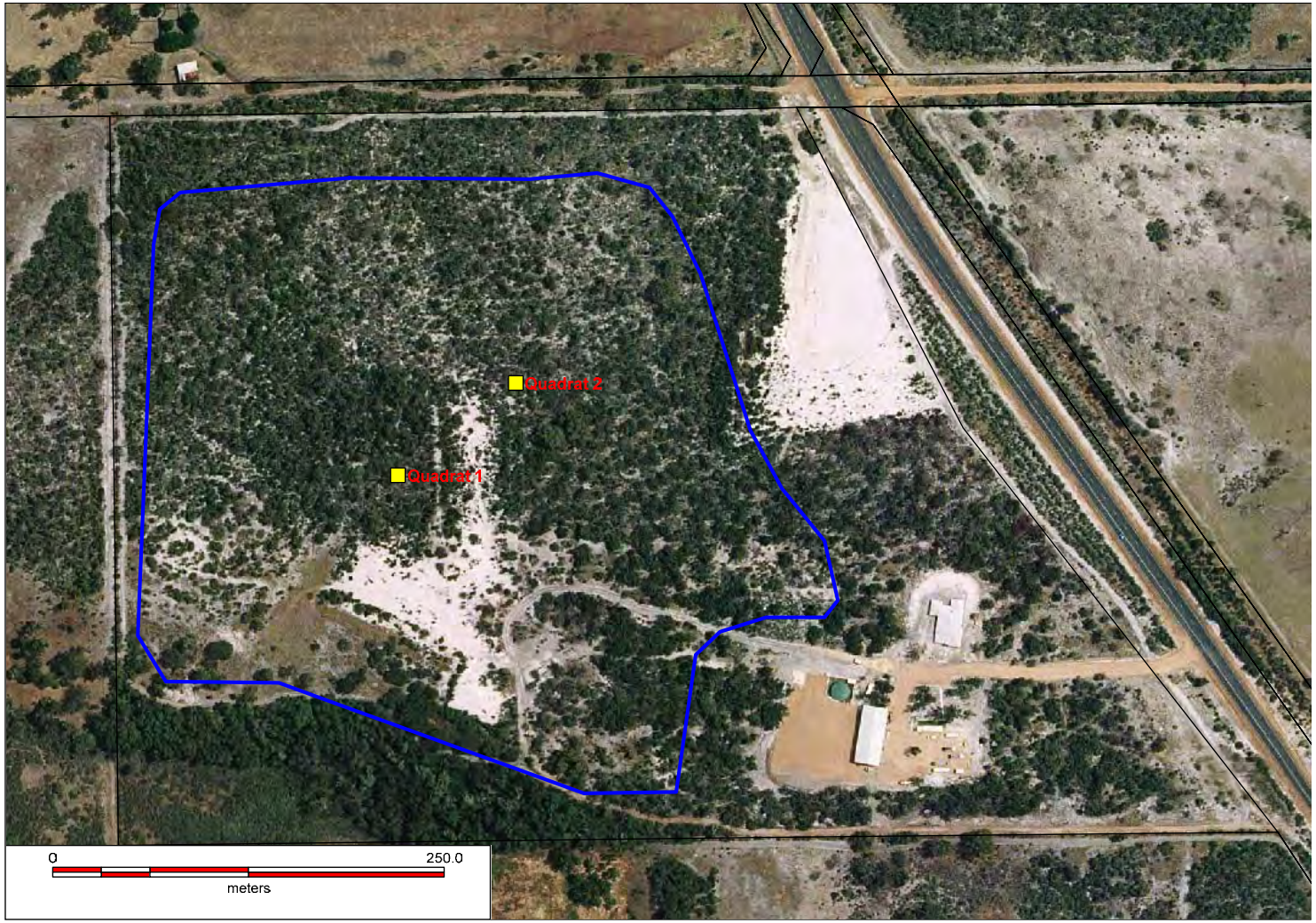
## Quadrat 2 – Lot 1650, North Boyanup Road, Boyanup

**Latitude**: -33.44325 deg **Longitude**: 115.71593 deg

**Landform**: Gentle ridge **Soil**: Light grey sand

**Vegetation**: *Banksia attenuata-B. ilicifolia* woodland

| SPECIES | COVER | SPECIES | COVER |
|---|---|---|---|
| *Acacia pulchella* | 1 | *Hypolaena exsulca* | 1 |
| *Austrodanthonia setacea* | 1 | *Macrozamia riedlei* | 1 |
| *Austrostipa flavescens* | 1 | *Melaleuca thymoides* | 1 |
| *Banksia attenuata* | 4 | *Patersonia occidentalis* | 1 |
| *Banksia ilicifolia* | 1 | *Stirlingia latifolia* | 3 |
| *Briza maxima* | 1 | | |
| *Calytrix fraseri* | 1 | | |
| *Conostylis aculeata* | 1 | | |
| *Ehrharta calycina* | 1 | | |
| *Hemiandra pungens* | 1 | | |
| *Hibbertia racemosa* | 1 | | |




Location of 100 m2 quadrats on Lot 1650

# Western Ringtail Possum

# &

# Black Cockatoo

# Assessment

# of

# Lot 1

# South Western Highway

# Boyanup

MARCH 2013

*Version 2*

*On behalf of:*
SJ Roadworks
PO Box 207
BOYANUP WA 6237
M: 0414315299
T: (08) 9731 5299

*Prepared by:*
Greg Harewood B.Sc.
A.B.N. 95 536 627 336
PO Box 755
BUNBURY WA 6231
M: 0402 141 197
T/F: (08) 9725 0982
E: gharewood@iinet.net.au

# TABLE OF CONTENTS

**TABLES**



**FIGURES**



**PLATES**



**APPENDICES**

# SUMMARY

This report details the results of a western ringtail possum (WRP) and black cockatoo assessment of Lot 1 South Western Highway, Boyanup. The site is located about 15 kms south east of the Bunbury and has a total area of approximately 26.4 hectares (ha) (Figure 1).

It is understood that the landowner (Shane Joynson) is proposing to extract sand from a ~10.7 ha section of the site. The progressive removal of some native vegetation will be required and issues relating to WRPs and black cockatoos need to be identified and managed.

Two vegetation types were identified and mapped within the proposed extraction area by Ekologica (Ekologica Pty Ltd 2012) (Figure 2). These being a:

- Woodland of *Banksia* (with occasional emergent jarrah (Eucalyptus marginata) and *Nuytsia floribunda*) over a low scrub dominated by *Kunzea glabrescens; and*
- Tall shrubland of *Kunzea glabrescens*

The table below summarises the area of each vegetation unit within the proposed pit area and its potential value as habitat for WRPs and black cockatoos based on plant species composition and structure.

**Summary of vegetation types, areas and habitat value within proposed extraction area**

| Vegetation Type | Area (ha) | % of total area | WRP Habitat Value | Black Cockatoo Habitat Value |
|---|---|---|---|---|
| Banksia Woodland | 7.5 | 70.1 | Poor | Moderate |
| Kunzea Tall Shrubland | 2.0 | 18.7 | Very Poor | Nil/Very Poor |
| Disturbed | 1.2 | 11.3 | Nil | Nil |
| **Total** | **10.7** | **100** | | |

It should be noted that the best quality western ringtail possum and black cockatoo habitat is located the south west corner of the site, outside of the proposed extraction area and largely comprised of a woodland of peppermint (*Agonis flexuosa*) with marri (*Corymbia calophylla*).

Based on mapping from the South West Biodiversity Project it is estimated that about 10,460 ha (~33%) of remnant native vegetation remains within 10km of the study area. The proposed sand extraction operation will require the removal of about 9.5 ha of existing native vegetation or about 0.091% of the area of vegetation remaining within 10km of the site.

The WRP survey confirmed that vegetation within the Lot is being used by WRPs as habitat, though the overall level of utilisation appears to be low with only one individual being observed during the night time survey. The quality of WRP habitat within the proposed extraction area appears to be very low compared to other areas of the site that are to be retained. This is a consequence of the extraction area consisting mainly of highly degraded banksia woodland that lacks canopy connectivity and the favoured foraging species for western ringtail possums.

The proposed extraction area also contains black cockatoo foraging and potential nesting habitat. Foraging habitat is mainly represented by the banksia woodland which also contains scattered jarrah trees. Evidence of both these resources being utilised by black cockatoos was observed during the field survey. Some of the jarrah trees, by definition, represent potential breeding habitat though no evidence of any being used for this purpose was seen. The probability of any one jarrah tree ever being used for nesting by black cockatoos can be considered to be low given previous survey work in other areas indicating they are rarely used for this purpose.

The results of this survey would suggest that criteria relating to fauna used by the Department of Conservation and Environment (DEC) when assessing clearing permits are not likely to be compromised by the required vegetation removal given the degraded nature of the site and the presence of extensive areas of potential habitat in adjoining areas.

Clearing for the proposal will compromise some of the Federal Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) criteria for what they would considered to be "likely significant impact" for both western ringtail possums and black cockatoos and it is therefore recommended that dialogue with the DSEWPaC regarding this project should be commenced to determine the need for a referral so as to ensure compliance with the *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act)*.

A series of other recommendations are provided for guidance during ongoing planning and for the formulation of management plans that maybe required as part of the ongoing approval process.

# 1. INTRODUCTION

This report details the results of a western ringtail possum (WRP) and black cockatoo assessment of Lot 1 South Western Highway, Boyanup. The site is located about 15 kms south east of the Bunbury central business district in south west Western Australia and is centred at approximately 33.443706°S and 115.716518°E (Figure 1). Lot 1 has a total area of approximately 26.4 hectares (ha).

It is understood that the landowner (Shane Joynson) is proposing to extract sand from a ~10.7 ha section of the site. The progressive removal of some native vegetation will be required and issues relating to WRPs and black cockatoos need to be identified and managed. It is anticipated that information gain as part of this assessment will be utilised by regulatory authorities during the approval process and will also allow the proponent to formulate management plans aimed at minimising impacts as required.

# 2. SCOPE OF WORKS & METHODS

The main scope of the survey work reported on here was obtain data on the distribution and abundance of WRPs across the site, in addition to providing information on the value of the area as habitat for black cockatoos.

Note: For the purposes of this report the term black cockatoo is in reference to Baudin's black cockatoo *Calyptorhynchus baudinii*, Carnaby's black cockatoo *Calyptorhynchus latirostris* and the forest red-tailed black cockatoo *Calyptorhynchus banksii naso*. All three species have the potential to frequent the general area at times to varying degrees.

## 2.1 VEGETATION ASSESSMENT

Mapping of vegetation communities within Lot 1 has been carried out by Russell Smith of Ekologica in 2012 (Ekologica Pty Ltd 2012) and this data has been used to provide a description of vegetation units with the proposed extraction area. The vegetation within the project area was also examined by the Author on the 27 and 28 February 2013 during the course of other survey work.

## 2.2 WESTERN RINGTAIL POSSUM ASSESSMENT

The WRP survey has included:

- Daytime survey of the site searching for dreys, obvious tree hollows (and other potential daytime refuge habitat), scats and individual WRPs;
- One night time survey to locate and record the distribution and abundance of WRPs with the boundary of Lot 1; and

The daytime survey of the site was carried out on the 27 February 2013. The nocturnal count was carried out on the 28 February 2013.

## 2.3 BLACK COCKATOO ASSESSMENT

The black cockatoo assessment has included a:

- Habitat tree survey: This involved the identification of all suitable trees species within the study area that have a Diameter at Breast Height (DBH) of over 50cm (irrespective of the presence/absence of suitable hollows – Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC 2012) criteria). The location of each tree identified was recorded with a GPS.

  Target tree species included marri and jarrah or any other suitable *Corymbia/Eucalyptus* species of a suitable size that may be present. Peppermints, banksia, sheoak and melaleuca tree species (for example) were not assessed as they typically do not develop hollows that are used by black cockatoos.

- Black cockatoo foraging assessment: The location and nature of black cockatoo foraging evidence (e.g. chewed fruits around base of trees) observed during the field survey was recorded.

- Roosting habitat survey: Direct and indirect evidence of black cockatoos roosting within trees on site was noted if observed (e.g. branch clippings, droppings or moulted feathers).

The daytime survey of the site was carried out on concurrent with the WRP daytime survey on the 27 February 2013.

# 3. SURVEY CONSTRAINTS

No seasonal sampling has been carried out as part of this fauna assessment. The conclusions presented are based upon field data and the environmental monitoring and/or testing carried out over a limited period of time and are therefore merely indicative of the environmental condition of the site at the time of the field assessments. It should be recognised that site conditions can change with time.

The number of WRPs observed during the nocturnal survey represents the minimum number present within the area surveyed at the time of the survey. Due to various survey limitations it is unlikely that every WRP present within the area was observed though the area was found to be easy to survey as the vegetation units present are generally sparse. It is therefore believed that the survey was conducted to a standard that provides adequate information on the use of the site by WRPs to allow for impacts on this species to be determined.

The location of habitat trees was recorded using a handheld GPS. The accuracy of the coordinates obtained cannot be guaranteed below a level of about 5 to 10 metres, though it in some circumstance the accuracy can be worse or better than this.

# 4. RESULTS

## 4.1 VEGETATION ASSESSMENT

Two vegetation types were identified and mapped within the proposed extraction area by Ekologica (Ekologica Pty Ltd 2012). The extent of each unit is shown in Figure 2. A description of the vegetation types, using the structural method of Muir (1977), is given below:

***Banksia* Woodland**

Woodland of *Banksia attenuata* and *B. ilicifolia* (with occasional emergent *Eucalyptus marginata* and *Nuytsia floribunda*) over *Kunzea glabrescens* (± *Podocarpus drouynianus*) Low Scrub A over *Melaleuca thymoides*, *Stirlingia latifolia*, *Hypocalymma robustum*, *Calytrix fraseri*, *Macrozamia riedlei*, *Acacia pulchella* and *Jacksonia horrida* Heath B over *Adenanthos meisneri*, *Hemiandra pungens*, *Dasypogon bromeliifolius*, *Hibbertia racemosa* Dwarf Scrub C over *Patersonia occidentalis*, *Hypolaena exsulca* and *Lyginia barbata* Open Low Sedges. (Note: in places the shrub *P. drouynianus* dominates the understorey) (Plate 1).

Western Ringtail Possum Habitat Value: The vast majority of this area has poor value as WRP habitat and it would, in the Author's opinion, be unable to support a population of the species though it at times may harbour a small number of transient individuals. Its main value is therefore seen as dispersal habitat.

This conclusion is based on the areas generally poor canopy connectivity and low density of WRPs favoured foraging plant species. The area contains some known food sources (i.e. jarrah (*E. marginata)* and *Nuytsia floribunda)* but these species are sparsely distributed across this vegetation unit. The area contains no peppermint (*Agonis flexuosa*) which is a major component of WRPs diet in most coastal plain sites. The Author has noted WRP foraging upon *Kunzea* in small quantities at some other locations but it does not seem to be utilised consistently which suggests specific conditions must prevail for it to be suitable to feed upon. At Lot 1 *Kunzea* does not appear to represent a significant food source.

A fox den showing recent activity was also found in this area which also lessens the likelihood of this area supporting WRPs.

Black Cockatoo Habitat Value: The banksia woodland represents moderate foraging habitat for black cockatoos given the presence of several species of banksia in addition to some jarrah trees, all of which are utilised by at least one of the three species of black cockatoo as a food source. Evidence of foraging was found to be relatively common during the field reconnaissance survey with numerous examples of banksii cones being utilised though most evidence appeared to be at least a few months old. The only fresh evidence observed were several sites where jarrah fruits had been foraged upon.

Some jarrah trees in this area represent "potential breeding habitat" based on criteria published by DSEWPaC (see section 4.3) though no evidence of actual breeding was observed. Jarrah trees rarely produce hollows suitable for black cockatoos to use for nesting based on the results of surveys in other areas (Kirkby 2009), so the probability of breeding ever taking place can be considered to be low.

The value of this area of vegetation to cockatoos is declining given the ongoing effects of dieback on banksia and jarrah trees (see Ekologica 2012 for details on the dieback status of the property).

**Kunzea Tall Shrubland**

Low Woodland B to Scrub of *Kunzea glabrescens* (with occasional *B. attenuata*, *B. ilicifolia* or *N. floribunda*) over Low Scrub B of *Calytrix fraseri*, *Hypocalymma robustum*, *Melaleuca thymoides*, *Adenanthos meisneri* and *Stirlingia latifolia* over *Patersonia occidentalis*, *Hypolaena exsulca* and *Lyginia barbata* Open Low Sedges and **Ehrharta calycina* Open Tall Grass (Plate 2).

Western Ringtail Possum Habitat Value: This section of the proposed extraction area has very poor value as WRP habitat given the low, sparse nature of most of the vegetation and almost complete lack of main foraging species. Individuals may utilise the area as dispersal habitat on rare occasions but they would be unlikely to reside for any length of time.

Black Cockatoo Habitat Value: This vegetation unit has almost no value has habitat for black cockatoos apart for occasional *B. attenuata* and *B. ilicifolia* specimens.

**Disturbed**

The remainder of the proposed extraction area is mapped as "Disturbed" and is comprised of a former sandpit, cleared tracks, temporary building and other partially cleared areas. Vegetation is limited to scattered shrubs, mainly *K. glabrescens* and annual weeds (Plate 3).

Western Ringtail Possum Habitat Value: This area has no value as habitat for WRPs as it is dominated by bare sand with only small scattered plants in early stages of regrowth. At best it represents very poor dispersal habitat.

Black Cockatoo Habitat Value: This area has no value as habitat for black cockatoos as it is dominated by bare sand with only small scattered plants in early stages of regrowth.

Table 1 summarises the area of each vegetation unit within the proposed pit area and its potential value as habitat for WRPs and black cockatoos based on plant species composition and structure.

**Table 1: Summary of vegetation types, areas and habitat value within proposed extraction area**

| Vegetation Type | Area (ha) | % of total area | WRP Habitat Value | Black Cockatoo Habitat Value |
|---|---|---|---|---|
| Banksia Woodland | 7.5 | 70.1 | Poor | Moderate |
| Kunzea Tall Shrubland | 2.0 | 18.7 | Very Poor | Nil/Very Poor |
| Disturbed | 1.2 | 11.3 | Nil | Nil |
| **Total** | **10.7** | **100** | | |

It should be noted that the best quality western ringtail possum and black cockatoo habitat is located the south west corner of the site, outside of the proposed extraction area.

This vegetation is quiet dense and is largely comprised of a woodland of peppermint (*Agonis flexuosa*) with marri (*Corymbia calophylla*) over sparse understorey of bracken fern (*Pteridium esculentum*) (Ekologica 2012) (Plate 4). Some areas also contain flooded gum (*E. rudis*), *Melaleuca preissiana* and *M. rhaphiophylla* in various densities.

The extent of native vegetation remaining in the vicinity of the study area is to a certain extent illustrated within Figure 1. Based on mapping from the South West Biodiversity Project it is estimated that about 10,460 ha (~33%) of remnant native vegetation remains within 10km of the study area. The proposed sand extraction operation will require the removal of about 9.5 ha of existing native vegetation or about 0.091% of the area of vegetation remaining within 10km of the site.

It is understood that subsequent to sand extraction that rehabilitation of sections of the site will be undertaken using primarily peppermint and marri as both these species are resistant to dieback and both represent suitable habitat for western rental possums and black cockatoos respectively.

## 4.2 WESTERN RINGTAIL POSSUM ASSESSMENT

### 4.2.1 DAYTIME SURVEY

Eleven western ringtail possum dreys were located within Lot 1 during the daytime site assessment, four of which were located within the proposed extraction area (Figure 3). No evidence of the dreys being occupied at the time of the survey was found and some appeared to be in poor/deteriorating

condition suggesting no recent maintenance, though this does not always indicate no recent use.

It should also be noted that WRPs often construct several dreys within their current home range and they can, if well-constructed and in a relatively secure location, persist for several years after construction so it is not possible to use the number of dreys observed to estimate the current distribution and abundance of WRPs at the site. The information only provides a guide to areas that WRPs have used (either permanently or temporarily).

No WRP scats were observed. In most other areas dense groundcover made searching for scats difficult and time consuming and therefore this method for determining WRP presence was abandoned at these locations. It is understood that the DEC located a small number of WRP scats under a peppermint tree in the southern section of Lot 1 (outside of the proposed extraction area) during a daytime inspection of the site (A. Gorman pers. comms.).

### 4.2.2 NOCTURNAL COUNT

A single WRP was observed during the night survey in vegetation in the southern section of Lot 1, outside of the proposed extraction area. A single common brushtail possum (*Trichosurus vulpecular*) was also observed (Figure 3).

## 4.3 BLACK COCKATOO ASSESSMENT

### 4.3.1 HABITAT TREES

The tree assessment identified a total of 51 specimens within Lot 1 that fit DSEWPaC's criteria for black cockatoo breeding habitat (i.e. suitable tree species with a diameter at breast height (DBH) of >50cms(DSEWPaC 2012)) (Figure 4). Twenty one of these trees fall within the proposed extraction area and were all jarrah. Thirty of the identified habitat trees are outside the proposed extraction area and were comprised of a combination of jarrah, marri and flooded gum.

No evidence of any tree within the proposed extraction area being used by black cockatoos for nesting purposes was observed and as previously mentioned, jarrah trees rarely produce hollows suitable for black cockatoos to use for nesting based on the results of surveys in other areas (Kirkby 2009), so despite the presence of this "potential breeding habitat" the probability of breeding ever taking place can be considered to be low. Bees were observed in small hollows within two trees which reduced the likelihood they would be used by native fauna for any purpose.

Additional details on the habitat trees observed can be found in Appendix A.

### 4.3.2 FORAGING HABITAT

Evidence of foraging was found to be relatively common during the field reconnaissance survey with numerous examples of banksii cones being utilised though most evidence appeared to be at least a few months old. The only fresh evidence observed were several sites where jarrah fruits had been foraged upon.

Evidence of foraging on marri was also observed outside of the proposed extraction area in the south west corner of the Lot and was the most extensive and recent activity noted. Marri is the favoured foraging plant species in this area of all three black cockatoo species in this area of their range. There is no marri within the proposed extraction area and therefore this resource will remain unaffected by the proposal. Marri has been chosen as one of the main plant species for the proposed revegetation plan given it is resistant to dieback and high value as foraging habitat.

### 4.3.3 ROOSTING HABITAT

No existing roosting trees (trees used at night by black cockatoos to rest) were observed during the survey period. Black cockatoos have been reported roosting about 5 km north west of the study area in vegetation bordering Lillydale Road and in Gelorup, 8 km west of the study area (CEM 2009).

# 5. LEGISLATIVE OBLIGATIONS

## 5.1 ENVIRONMENTAL PROTECTION ACT 1986

The purpose of the Environmental Protection Act (1986) (*EP Act*) is "...*to provide for an Environmental Protection Authority, for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection enhancement and management of the environment and for matters incidental to or connected with the foregoing*".

The powers of the Environmental Protection Act 1986 are administered by the DEC, which in relevant cases advises to the Environmental Protection Authority (EPA).

Legislation proclaimed on 8 July 2004 protects all native vegetation in Western Australia. Under the law, clearing native vegetation is prohibited, unless a

clearing permit is granted by the DEC, or the clearing is for an exempt purpose. These exemptions ensure that low impact day to day activities involving clearing can be undertaken. People that wish to clear are required to submit an application if an exemption does not apply.

Clearing applications are assessed against ten defined clearing principles related to native vegetation in the EP Act. These principles provide a guide for when native vegetation should not be cleared. The DEC must consider these principles in making a decision on whether or not to issue a clearing permit. The DEC has set out the minimum requirements and standards for addressing each of the ten principles in detail in its assessment methodology.

Any future clearing at the site, not covered by an exemption, will require a clearing permit, approval of which includes an assessment against the ten clearing principles related to native vegetation in the *EP Act*. These principles provide a guide for when native vegetation should not be cleared.

In assessing a clearing application, DEC assessors are to give consideration to each clearing principle and any planning instrument or other matter and note the extent to which they have been addressed. This includes the methodologies used, the limitations that apply to the assessment, and the relevance of the principle to the current application. The results of the assessment are documented in a decision report, which is published on DEC's website at https://secure.dec.wa.gov.au/cps_reports .

The DEC must consider the following principles in making a decision on whether or not to issue a clearing permit.

Native vegetation should not be cleared if:

(a) it comprises a high level of biological diversity;

(b) it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia;

(c) it includes, or is necessary for the continued existence of, rare flora;

(d) it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community;

(e) it is significant as a remnant of native vegetation in an area that has been extensively cleared;

(f) it is growing in, or in association with, an environment associated with a watercourse or wetland;

(g) the clearing of the vegetation is likely to cause appreciable land degradation;

(h) the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area;

(i) the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water; or

(j) clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

One purpose of the assessment reported on here is to provide some information relevant to principle (a) & (b).

**Native vegetation should not be cleared if it comprises a high level of biological diversity**

This principle aims to protect areas of high biodiversity. This principle protects intact natural systems with naturally occurring high levels of species diversity, ecosystem diversity or genetic diversity and natural systems that may be degraded but contain high levels of diversity compared with the remaining native vegetation of that ecological community.

With respect to fauna alone the site probably does not qualify as having a high level of biodiversity. While no assessment to determine the full fauna biodiversity of the site has been carried out it is clear from information gathered during the site surveys that the proposed extraction area is very unlikely to support a high degree of fauna diversity. This conclusion is largely based on the highly degraded state of most of the vegetation within the proposed extraction area, the areas small size (10.7 ha), the lack of habitat diversity (only two main natural habitats present) and the presence of feral predators (Fox den observed).

It is therefore considered unlikely that the proposal would be seen as being in variance to this principle by the DEC, though the assessment of this criterion also needs to take into account plant community and flora diversity which are beyond the scope of this report.

**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**

This principle aims to maintain indigenous fauna species and assemblages of species in their local natural habitat. This principle protects habitat for threatened fauna and significant habitat for meta-populations of fauna.

The study area contains habitat that is used or is potentially used for some purpose by all three species of black cockatoo and to a lesser extent the western ringtail possum. These factors suggest that clearing of the site may be in variance to this principle though it should be noted that the proposed clearing will only result in the loss of 0.091% of the area of native vegetation remaining within 10km of the site. While no assessment on the suitability of all this vegetation to the species in question has been made, it can be assumed that a significant proportion represents habitat at least comparable in value to that present within the proposed extraction area and that the loss of this vegetation is unlikely to have any measurable affect the status of any of the species in question.

The results of the assessment reported on here suggest that criteria relating to fauna used by the DEC when assessing clearing permits are not likely to be compromised by the required vegetation removal given the degraded nature of the site, the anticipated low fauna biodiversity, the areas small size, the lack of habitat variation and the presence of extensive areas of potential habitat in nearby areas. The value of vegetation within the proposed extraction area is also in serious decline, a consequence of the effects of dieback on the dominant plant species. The proposed revegetation of the site using dieback resistant species that are favoured refuge and foraging species for black cockatoos and western ringtails should therefore also be taken into consideration.

## 5.2 COMMONWEALTH ENVIRONMENT PROTECTION & BIODIVERSITY CONSERVATION ACT (1999)

All three species of black cockatoo and the western ringtail possum are listed as threatened under the Federal *Environment Protection and Biodiversity Conservation Act (1999) (EPBC Act)*. The objective of the *EPBC Act* is to provide for the protection of the environment, especially those aspects that are of national significance, promote ecologically sustainable development, the conservation of biodiversity and a cooperative approach to the protection and management of the environment.

If an action (i.e. clearing of native vegetation form parts of the site) is deemed to have a potential "significant impact" on listed species a referral to the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) is required to ensure compliance with the *EPBC Act*. Currently, for the species in question, "significant impact" is defined within one or more of the following four documents, these being:

- Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008). Background Paper to the *EPBC Act* Policy Statement 3.10 – Nationally Threatened Species and Ecological Communities. "Significant Impact Guidelines for the vulnerable western ringtail possum (*Pseudocheirus occidentalis*) in the southern Swan Coastal Plain, Western Australia".

- Department of the Environment, Water, Heritage and the Arts (DEWHA) (2009a). *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* Policy Statement 3.10 "Significant Impact Guidelines for the vulnerable western ringtail possum (*Pseudocheirus occidentalis*) in the southern Swan Coastal Plain, Western Australia; and

- Department of the Environment, Water, Heritage and the Arts (DEWHA) (2009b). Matters of National Environmental Significance. Significant Impact Guidelines 1.1, *EPBC Act 1999*.

- Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2012). EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered) *Calyptorhynchus latirostris*, Baudin's cockatoo (vulnerable) *Calyptorhynchus baudinii*, Forest red-tailed black cockatoo (vulnerable) *Calyptorhynchus banksii naso*.

An assessment of significant impact on federally listed threatened fauna species and the possible need to refer the project to DSEWPaC using criteria within the abovementioned documents are provided below.

### 5.2.1 WESTERN RINGTAIL POSSUMS

The DSEWPaC document titled "Significant Impact Guidelines for the vulnerable western ringtail possum (*Pseudocheirus occidentalis*) in the southern Swan Coastal Plain, Western Australia (DEWHA 2009a) summarises what scale of actions would be considered likely to have a significant impact on

WRPs in the southern swan coastal plain. This policy statement should be read in conjunction with Significant Impact Guidelines (DEWHA 2009b).

Within the policy statement an action is deemed likely to have a significant impact on the WRP in the southern Swan Coastal Plain Region if it:

- reduces the ability of the region to support the persistence of the western ringtail possum; or
- modifies, destroys, removes or isolates important remnant habitat patches, or decreases the availability or quality of remnant habitat patches; or
- adversely affects connections between important areas; or
- interferes substantially with the ability of the area to effectively contribute to the recovery of the species.

More specifically the guidelines have categorised certain areas between Bunbury and Dunsborough as "Core Habitat", "Primary Corridors" or "Supporting Habitat". The study area falls within the "Supporting Habitat" area (also referred to as Area 3).

Within areas of supporting habitat "significant impact" on WRPs is deemed as "likely" if there is a real chance or possibility that an action will result in:

- any clearing of a remnant habitat patch that is greater than 0.5 hectares in size;
- the clearing of more than 50% of a remnant habitat patch that is between 0.2 and 0.5 hectares in size;
- the fragmentation of any existing habitat linkages.

While utilisation of the proposed extraction area by WRPs appears to be low given the apparent poor quality of the habitat to be impacted upon, clearing at the site at any scale is likely to be seen as compromising the first criteria and will therefore be seen by DSEWPaC as being "likely to have a significant impact" on WRPs.

In reality this impact can be argued as unlikely to be significant given the results of the assessment provided here, however it is nonetheless recommended that dialogue with DSEWPaC regarding this project be initiated to assess the need

for a referral with respect to potential impacts on WRPs.

### 5.2.2 BLACK COCKATOOS

The recently released DSEWPaC document titled "EPBC Act referral guidelines for three threatened black cockatoo species" (DSEWPaC 2012) summarises what scale of actions would be considered likely to have a significant impact on listed endangered and vulnerable fauna species.

The following points provide general guidance on what, in DSEWPaC's view, may be at high and low risk of requiring a referral to ensure compliance with the *EPBC Act* as well as providing some guidance on uncertainty.

Actions that have a high risk of significant impacts

- Clearing of any known nesting tree.
- Clearing or degradation of any part of a vegetation community known to contain breeding habitat.
- Clearing of more than 1 ha of quality foraging habitat.
- Clearing or degradation (including pruning the top canopy) of a known night roosting site.
- Creating a gap of greater than 4 km between patches of black cockatoo habitat (breeding, foraging or roosting).

Actions that have and uncertain risk of significant impacts

- Degradation (such as through altered hydrology or fire regimes) of more than 1 ha of foraging habitat. Significance will depend on the level and extent of degradation and the quality of the habitat.
- Clearing or disturbance in areas surrounding black cockatoo habitat that has the potential to degrade habitat through introduction of invasive species, edge effects, hydrological changes, increased human visitation or fire.
- Actions that do not directly affect the listed species but that have the potential for indirect impacts such as increasing competitors for nest hollows.

- Actions with the potential to introduce known plant diseases such as Phytophthora spp. to an area where the pathogen was not previously known.

Actions that have a low risk of significant impacts

- Actions that do not affect black cockatoo habitat or individuals.
- Actions whose impacts occur outside the modelled distribution of the three black cockatoos

As detailed in *Section 4.3.1*, 21 trees with a DBH of greater than 50cm were identified within the proposed extraction area. All these trees, by DSEWPaC's definition of the term, are potential black cockatoo breeding habitat (i.e. DBH >50cm). The "clearing or degradation of any part of a vegetation community known to contain breeding habitat" has the potential to be deemed by DSEWPaC as having a "high risk of significant impacts". The study area also contains black cockatoo foraging habitat. The removal or degradation of more than 1.0ha of this vegetation will also be seen by DSEWPaC as having "high risk of significant impacts".

It is therefore recommended that dialogue with DSEWPaC regarding this project be initiated to assess the need for a referral with particular reference to black cockatoo habitat loss that may occur as a result as a consequence of the project proceeding.

It is difficult to predict if the project will be considered a controlled action as a range of factors besides the above-mentioned criteria are taken into consideration when assessing a developments likely impact. For example, the referral guidelines (DSEWPaC 2012) also state that: "In determining the potential significance of your action, the department will consider the particular circumstances of your case. This may include factors such as the suitability of the habitat, its connectivity, and the amount of habitat remaining in the region".

It has been demonstrated during other studies that jarrah trees have a low probability of being used by black cockatoos as breeding habitat (Kirkby 2009) and therefore the significance of these trees may be regarded as relatively low. Also, as mentioned within *Section 4.1*, there are over 10,000 ha of remnant native vegetation within a 10km radius of the study area, a significant proportion of which would also represent potential breeding and foraging habitat for black cockatoos. The existence of this vegetation within close proximity to the study area will reduce substantially any possible impacts the loss of some habitat (~7.5 ha) from within the study area will have on black cockatoos in the general area and this fact will need to be taken into consideration by the DSEWPaC

when assessing the project.

# 6. RECOMMENDATIONS

The following recommendations are provided for guidance during ongoing planning and for the formulation of management plans that maybe required as part of the ongoing approval process. This listing is not exhaustive and management plans and offsets (if required) will need to be finalised after liaison with relevant regulatory advisers/authorities (e.g. DEC and DSEWPaC). It is recommended that:

- Dialogue with the DSEWPaC regarding this project should be commenced to determine the need for a referral so as to ensure compliance with the *EPBC Act;*

- Planning and ongoing operation of the proposed sand extraction should aim to avoid the need to clear as much of the existing vegetation as possible;

- During site works areas requiring clearing should be clearly marked and access to other areas restricted to prevent accidental clearing of areas to be retained;

- No dead, standing or fallen timber should be removed unnecessarily. Logs (hollow or not) and other debris resulting from land clearing should be used to enhance fauna habitat in untouched and rehabilitated areas if possible;

- During clearing operations a suitably experienced "fauna spotter" should be employed to inspect trees for dreys, logs and hollow trees (where possible) before clearing to reduce likelihood of injury to fauna. If feasible any fauna encountered should be relocated to retained suitable habitat;

- Implementation of the proposed rehabilitation/revegetation plan with the aim of recreating black cockatoo and western ringtail possum habitat that is self-sustaining in the long term. It should be noted that this plan includes the installation of a vermin proof fence surrounding the property;

- All staff working on site should be made aware that native fauna is protected; and

- Native fauna injured during clearing or normal site operations should be taken to a designated veterinary clinic or a DEC nominated wildlife carer.

# 7. CONCLUSION

The targeted fauna assessment at Lot 1 was undertaken for the primary purpose of obtaining information on the sites utilisation by western ringtail possums and black cockatoos. This information will be utilised by environmental regulators during the ongoing assessment and approval process.

The WRP survey confirmed that vegetation within the Lot is being used by WRPs as habitat, though the overall level of utilisation appears to be low with only one individual being observed during the night time survey, outside of the proposed extraction area. The quality of WRP habitat within the proposed extraction area appears to be very low compared to other areas of the site that are to be retained. This is a consequence of the extraction area consisting mainly of degraded banksia woodland that lacks canopy connectivity and favoured foraging species for western ringtail possums.

The proposed extraction area also contains black cockatoo habitat. Foraging habitat is mainly represented by the banksia woodland which also contains scattered jarrah trees. Evidence of both these resources being utilised by black cockatoos was observed during the field survey. Some of the jarrah trees, by DSEWPaC's definition represent "potential breeding habitat" though no evidence of any being used for this purpose was seen. The probability of any one jarrah tree ever being used for nesting by black cockatoos can be considered to be low given previous survey work in other areas indicate they are rarely used for this purpose.

The results of this survey would suggest that criteria relating to fauna used by the Department of Conservation and Environment (DEC) when assessing clearing permits are not likely to be compromised by the required vegetation removal given the degraded nature of the site and the presence of extensive areas of potential habitat in adjoining areas.

Clearing for the proposal will however compromise some DSEWPaC criteria for what they would considered to be "likely significant impact" for both western ringtail possums and black cockatoos and it is therefore recommended that dialogue with the DSEWPaC regarding this project should be commenced to determine the need for a referral so as to ensure compliance with the *EPBC Act*.

A series of other recommendations are provided for guidance during ongoing planning and for the formulation of management plans that maybe required as part of the ongoing approval process.

# 8. BIBLIOGRAPHY

(not necessarily cited)

Burbidge A.A, & de Tores P. (1997). Western Ringtail Possum Interim Recovery Plan 1997-1999. Department of Conservation and Land Management, Perth Western Australia.

Burbidge, A. (1997-98). Endangered: Western Ringtail Possum. LANDSCOPE 13(2): 49.

Cale, B. (2003). Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan 2002-2012. CALM, Wanneroo.

CALM (2005). Fauna Note No. 05/2005 Carnaby's Cockatoo, Written by Tamra Chapman, Belinda Cale and Marion Massam. CALM, Wanneroo.

Centre for Ecosystem Management (CEM) (2009). Black Cockatoo Study of the ECU South West Campus in Bunbury (August-September 2009) Marieke Weerheim & William Stock CEM Report No. 2009-13. Unpublished report for ECU.

de Tores, P. (2008). Western Ringtail Possum *Pseudocheirus occidentalis* pp 253-255 in Van Dyck, S. & Strahan R. (eds). (2008). The Mammals of Australia. Queensland Museum / Reed Books.

de Tores, P., Rosier, S. & Paine, G. (1998). Conserving the Western Ringtail Possum. LANDSCOPE 13(4): 28.

de Tores, P., Hayward, M. W. & Rosier, S.M. (2004). The western ringtail possum *Pseudocheirus occidentalis* and the quokka, *Setonix brachyurus*, case studies: Western Shield review- February 2003. Conservation Science W. Aust 5 (2): 235-257.

de Tores, P., Rosier, S. Jackson, J., Clarke, J & Aravidis, L. (2008). Working to Conserve the Western Ringtail Possum. LANDSCOPE 25(4): 55-60.

Dell, J., & Hyder-Griffiths, B. (2002). A Description of the Fauna Values of the Muddy Lakes Area of the South Bunbury to Capel Coastal Corridor. Department of Environmental Protection, Perth.

Department of Environment and Conservation (2001). Karrak-watch: A summary of information about the Forest red-tailed black cockatoo, http://science.calm.wa.gov.au/articles/2001-10-04/.

Department of Environment and Conservation (2007). Forest Black Cockatoo (Baudin's Cockatoo - *Calyptorhynchus baudinii*) and Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) Recovery Plan. DEC.

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2008). Background Paper to the EPBC Act Policy Statement 3.10 – Nationally Threatened Species and Ecological Communities. "Significant Impact Guidelines for the vulnerable western ringtail possum (*Pseudocheirus occidentalis*) in the southern Swan Coastal Plain, Western Australia".

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2009a). Environment Protection and Biodiversity Conservation Act (1999) (EPBC Act) Policy Statement 3.10 "Significant Impact Guidelines for the vulnerable western ringtail possum (*Pseudocheirus occidentalis*) in the southern Swan Coastal Plain, Western Australia".

Department of the Environment, Water, Heritage and the Arts (DEWHA) (2009b). Matters of National Environmental Significance. Significant Impact Guidelines 1.1, *EPBC Act 1999*.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (2012). *EPBC Act* referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered) *Calyptorhynchus latirostris*, Baudin's cockatoo (vulnerable) *Calyptorhynchus baudinii*, Forest red-tailed black cockatoo (vulnerable) *Calyptorhynchus banksii naso*.

Ekologica Pty Ltd (2012). A Vegetation and Dieback Survey of part Lot 1650, North Boyanup. Unpublished report for GHD. March 2012.

Environmental Protection Authority (2002). Terrestrial Biological Surveys As An Element of Biodiversity Protection. Position Statement No. 3. EPA, Perth.

Environmental Protection Authority (EPA) and Department of Environment and Conservation (DEC) (2010). Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessments (eds B.M. Hyder, J. Dell and M.A. Cowan), Perth Western Australia.

Harewood G (2006a). Fauna Assessment (Level 1) and Western Ringtail Possum Survey, Bunbury Cathedral Grammar School. Unpublished report for TME.

Harewood, G. (2006b). Western Ringtail Possum Assessment Survey, Brittain Road Extension Project. Unpublished report for City of Bunbury.

Harewood, G. (2007a). Western Ringtail Possum Assessment Survey, Port Access Road Stage 1, Bunbury. Unpublished report for GHD.

Harewood, G. (2007b). Western Ringtail Possum Assessment Survey, College Grove. Series of unpublished reports for RPS Environmental.

Harewood, G. (2008a). Western Ringtail Possum Assessment Survey, Somerville Drive Extension, College Grove. Unpublished report for RPS Environmental/City of Bunbury.

Harewood, G. (2008b). Fauna Assessment Survey (Level 2) Lot 187 Stratham. Unpublished report for MBS Environmental.

Harewood G (2008c). Western Ringtail Possum Assessment Survey. Lots 1-3 and 10-14 Bussell Highway, Gelorup. Unpublished report for EndPlan Environmental Planning.

Harewood, G. (2010). Terrestrial Fauna Survey (Level 1) of Lot 930 (part) College Grove, Bunbury. Unpublished report for ENV Australia.

Johnstone, R.E. and Storr, G.M. (1998). Handbook of Western Australian Birds: Volume 1 – Non-passerines (Emu to Dollarbird). Western Australian Museum, Perth Western Australia.

Johnstone, R. E. and Storr, G.M. (2004). Handbook of Western Australian Birds: Volume 2 – Passerines (Blue-winged Pitta to Goldfinch). Western Australian Museum, Perth Western Australia.

Johnstone, R. E. (2008). Assessment of Potential Impact to Carnaby's Cockatoo and Baudin's Cockatoo for Southern Seawater Desalination Plant Binningup to Harvey. Prepared for URS Australia Pty Ltd.

Johnstone, R. E. & Kirkby, T. (2008). Distribution, status, social organisation, movements and conservation of Baudin's Cockatoo (*Calyptorhynchus baudinii*) in South-west Western Australia. Records of the WA Museum 25: 107-118 (2008).

Johnstone, R. E. & Kirkby, T. (2011). Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Baudin's Cockatoo (*Calyptorhynchus baudinii*) and the Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) on the Swan Coastal Plain (Lancelin–Dunsborough), Western Australia. Studies on distribution, status, breeding, food, movements and historical changes. Report for the Department of Planning, Western Australia.

Johnstone R.E. & C, Kirkby, T. & Biota Environmental Sciences Pty Ltd (2006) Perth – Bunbury Highway (Kwinana Freeway Extension and Peel Deviation). Targeted Threatened Fauna Survey. Unpublished report for Main Roads Western Australia.

Johnstone, R.E. & C (2004). Review of Baudin's Cockatoo and Forest Red-Tailed Black Cockatoo in South Western Australia with Special Reference to Collie Area – In Bluewater's Power Station PER May 2004 – Appendix C.

Jones, B.A,. R.A. How & D.J. Kitchener (1994a) A field study of *Pseudocheirus occidentalis* (Marsupialia: Petauridae). II. Distribution and habitat. Population studies in *Wildlife Research* 21: Page(s) 175-187.

Jones, B.A., R.A. How & D.J. Kitchener (1994b) A field study of *Pseudocheirus occidentalis* (Marsupialia: Petauridae). II. Population studies in *Wildlife Research* 21: Page(s) 189-201.

Jones, B. (1995). Western Ringtail Possum. In R. Strahan (Ed.) The Mammals of Australia. Australian Museum and Reed Books. Chatswood, NSW.

Kirkby, T. (2009) Results of Black Cockatoo Survey at Lot 2 Dawesville. Unpublished report for WA Limestone.

Molloy, S., Wood, J., Hall, S., Wallrodt, S., and Whisson, G., (2009) South West Regional Ecological Linkages Technical Report, Western Australian Local Government Association and Department of Environment and Conservation Perth.

Muir, B.G. (1977). Biological Survey of the Western Australian Wheatbelt. Part II. Vegetation and habitat of Bendering Reserve. Records of the West Australian Museum, Supplement No. 3.

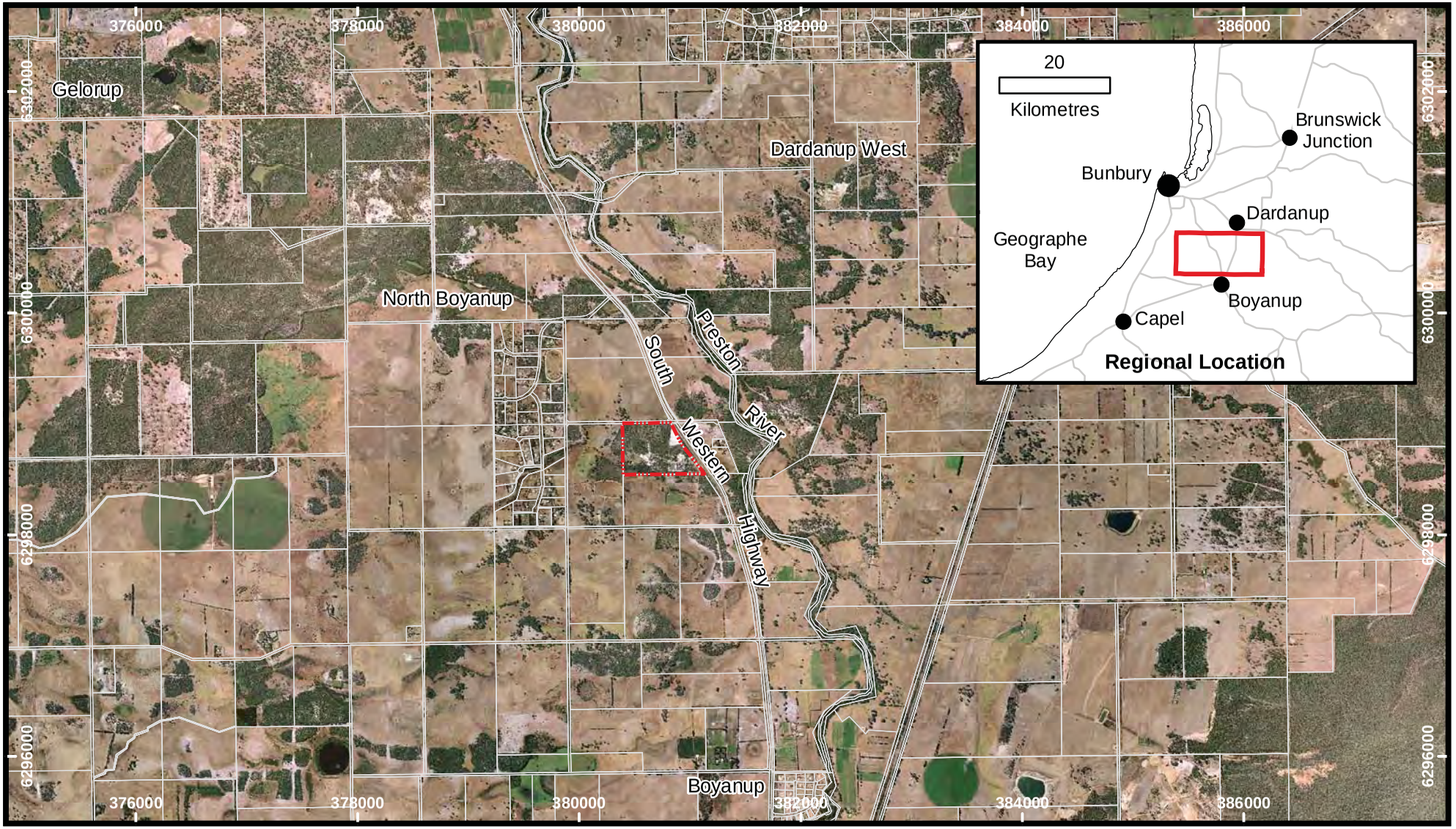
Saunders, D. (1980) Food and Movements of the Short-billed Form of the White-tailed Black Cockatoo. Aust. Wildl. Res. 7(1980) pp. 257-269.

Shah, B. (2006) Conservation of Carnaby's Black Cockatoo on the Swan Coastal Plain, Western Australia. Birds Australia, Perth.

Van Dyck, S. & Strahan, R. Eds (2008) The Mammals of Australia. Third edition Queensland Museum.

Wayne, A.F., Rooney J. F., Ward C. G., Vellios V.C., and Lindenmayer D.B. (2005). The life history of *Pseudocheirus occidentalis* (Pseudocheiridae) in the jarrah forest of south-western Australia. Australian Journal of Zoology 53, 325-337.

# FIGURES




## Legend

Lot 16580 Boundary

0 1 2 3 4 5

Kilometres

MGA Zone 50

Fauna Assessment

DRAWN:G Harewood

DATE : March 2013

SCALE: 1:50,000

**Lot 16580**
**South Western Highway**
**Boyanup**

# Study Area & Surrounds

Figure: 1


## Legend

- Lot 16580 Boundary
- Proposed Extraction Area
- Banksia Woodland
- Kunzea Tall Shrubland
- Disturbed

0 50 100 150 200

Metres

MGA Zone 50

Fauna Survey

DRAWN:G Harewood

DATE : March 2013

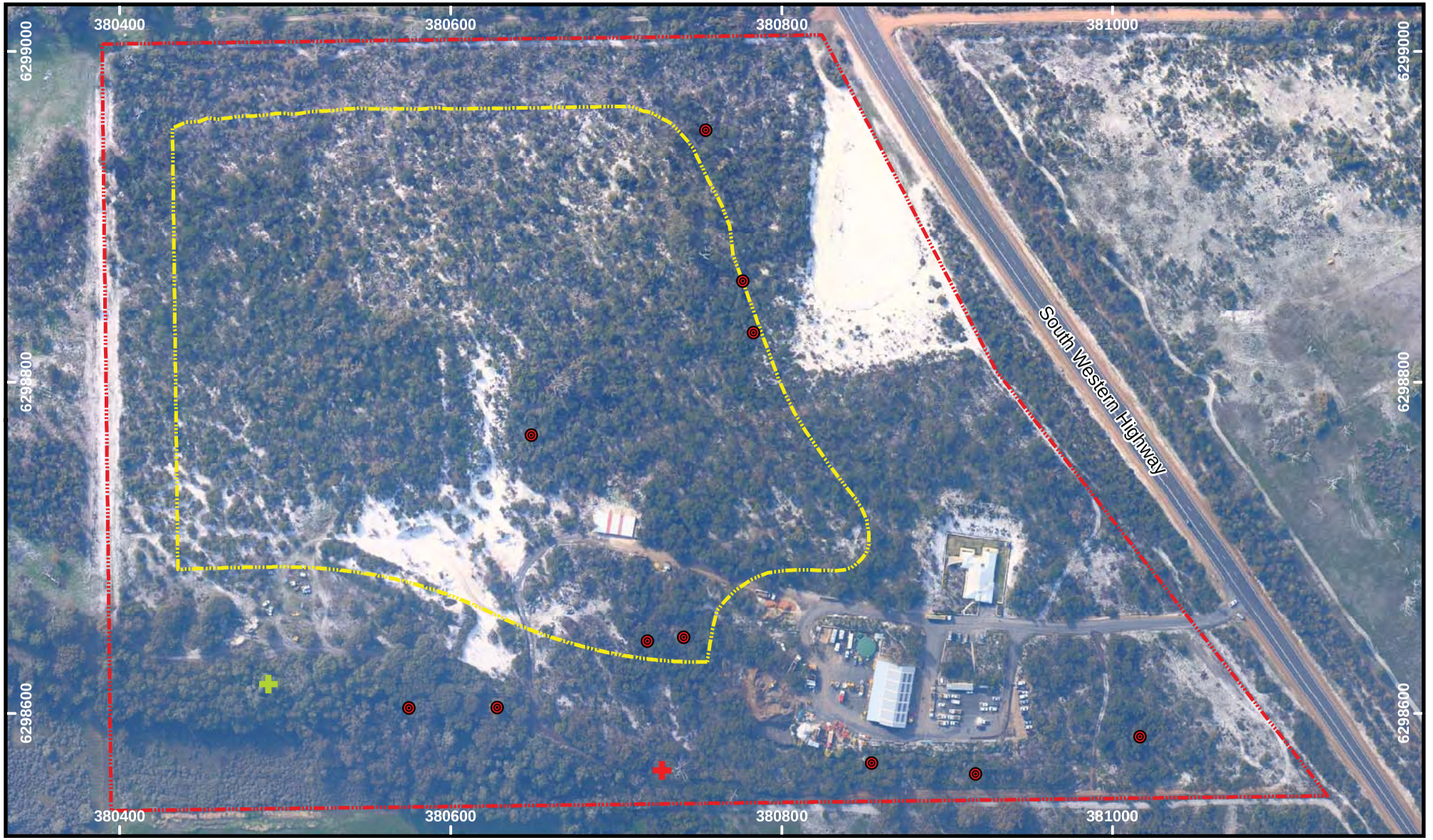
SCALE: 1:3,250

**Lot 16580**
**South Western Highway**
**Boyanup**

# Vegetation Units

Modified from Ekologica (2012)

Figure: 2




## Legend

- Lot 16580 Boundary
- Proposed Extraction Area
- Western Ringtail Possum Drey
- Western Ringtail Possum
- Common Brushtail Possum

0 50 100 150 200

Metres

MGA Zone 50

Fauna Survey

DRAWN:G Harewood

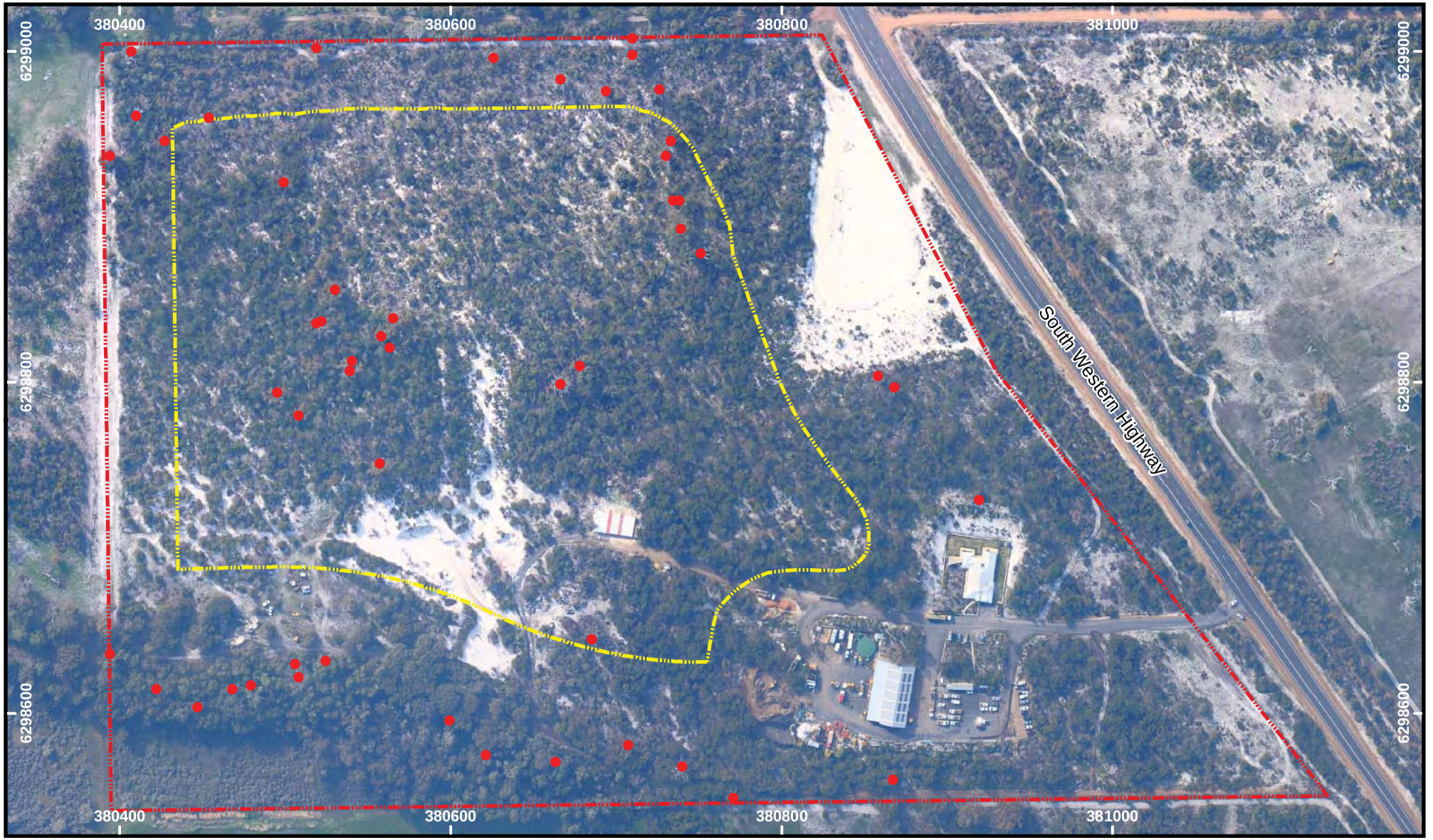
DATE : March 2013

SCALE: 1:3,250

**Lot 16580**
**South Western Highway**
**Boyanup**

# WRP Observations

Figure: 3




## Legend

- Lot 16580 Boundary
- Proposed Extraction Area
- Habitat Tree (DBH>50cm)

0 50 100 150 200

Metres

MGA Zone 50

Fauna Survey

DRAWN:G Harewood

DATE : March 2013

SCALE: 1:3,250

**Lot 16580**
**South Western Highway**
**Boyanup**

# Habitat Trees (DBH>50cm)

Figure: 4

# PLATES

Plate 1: Banksia Woodland

Plate 2: *Kunzea* Tall Shrubland

Plate 3: Previously Disturbed

Plate 4: Marri-Peppermint Woodland (outside proposed extraction area - to be retained)

# APPENDIX A

## HABITAT TREE DETAILS

Habitat Trees
Datum: GDA 94

| Waypoint Number | Zone | mE | mN | Tree Species |
|---|---|---|---|---|
| wpt001 | 50H | 380919 | 6298729 | Dead Jarrah |
| wpt002 | 50H | 380858 | 6298804 | Jarrah |
| wpt003 | 50H | 380868 | 6298797 | Jarrah |
| wpt005 | 50H | 380751 | 6298878 | Jarrah |
| wpt006 | 50H | 380739 | 6298893 | Jarrah |
| wpt007 | 50H | 380738 | 6298910 | Jarrah |
| wpt008 | 50H | 380734 | 6298910 | Jarrah |
| wpt009 | 50H | 380730 | 6298937 | Jarrah |
| wpt010 | 50H | 380733 | 6298946 | Jarrah |
| wpt011 | 50H | 380726 | 6298977 | Jarrah |
| wpt012 | 50H | 380710 | 6298998 | Jarrah |
| wpt013 | 50H | 380710 | 6299008 | Jarrah |
| wpt014 | 50H | 380694 | 6298976 | Jarrah |
| wpt015 | 50H | 380666 | 6298983 | Jarrah |
| wpt016 | 50H | 380626 | 6298996 | Jarrah |
| wpt017 | 50H | 380519 | 6299002 | Jarrah |
| wpt018 | 50H | 380407 | 6299000 | Dead Unknown |
| wpt019 | 50H | 380410 | 6298961 | Dead Unknown |
| wpt020 | 50H | 380427 | 6298946 | Jarrah |
| wpt021 | 50H | 380454 | 6298960 | Jarrah |
| wpt022 | 50H | 380394 | 6298937 | Jarrah |
| wpt023 | 50H | 380394 | 6298636 | Marri |
| wpt024 | 50H | 380422 | 6298615 | Marri |
| wpt025 | 50H | 380447 | 6298604 | Marri |
| wpt026 | 50H | 380468 | 6298615 | Marri |
| wpt027 | 50H | 380479 | 6298617 | Marri |
| wpt028 | 50H | 380506 | 6298630 | Marri |
| wpt029 | 50H | 380508 | 6298622 | Marri |
| wpt030 | 50H | 380524 | 6298632 | Marri |
| wpt032 | 50H | 380599 | 6298596 | Dead Unknown |
| wpt034 | 50H | 380621 | 6298575 | Dead Flooded Gum |
| wpt035 | 50H | 380663 | 6298571 | Marri |
| wpt036 | 50H | 380707 | 6298581 | Jarrah |
| wpt037 | 50H | 380740 | 6298568 | Dead Unknown |
| wpt038 | 50H | 380771 | 6298549 | Jarrah |
| wpt040 | 50H | 380867 | 6298560 | Jarrah |
| wpt051 | 50H | 380678 | 6298810 | Jarrah |
| wpt052 | 50H | 380666 | 6298799 | Jarrah |
| wpt055 | 50H | 380530 | 6298856 | Jarrah |
| wpt056 | 50H | 380522 | 6298837 | Jarrah |
| wpt057 | 50H | 380519 | 6298836 | Jarrah |
| wpt058 | 50H | 380540 | 6298813 | Jarrah |
| wpt059 | 50H | 380558 | 6298828 | Jarrah |
| wpt060 | 50H | 380539 | 6298807 | Jarrah |
| wpt061 | 50H | 380565 | 6298839 | Jarrah |
| wpt062 | 50H | 380563 | 6298821 | Jarrah |
| wpt063 | 50H | 380557 | 6298751 | Jarrah |
| wpt064 | 50H | 380508 | 6298780 | Jarrah |
| wpt065 | 50H | 380495 | 6298794 | Jarrah |
| wpt066 | 50H | 380499 | 6298921 | Jarrah |
| wpt067 | 50H | 380685 | 6298645 | Jarrah |

**DISCLAIMER**

This fauna 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 Greg Harewood ("the Author"). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints. In accordance with the scope of services, the Author has relied upon 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.

The conclusions are based upon field data and the environmental monitoring and/or testing carried out over a limited period of time and are therefore merely indicative of the environmental condition of the site at the time of preparing the report. Also it should be recognised that site conditions, can change with time.

Within the limitations imposed by the scope of services, the field assessment 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, expressed or implied, is made.

In preparing the report, the Author has relied upon 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, the Author has not verified the accuracy of 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 part on the data, those conclusions are contingent upon the accuracy and completeness of the data. The Author will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to the Author.

The report has been prepared for the benefit of the Client and no other party. The Author 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 the Author or for any loss or damage suffered by any other party relying upon 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.

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

Geolatry

*land use planning services*

**Management Plans for Lot 1 South West Highway, Boyanup, Western Australia including;**

- **Noise Management**
- **Dust Management**
- **Dieback Management**

*Compiled by;*
*Lisa Edwards,*
*Environmental & Town Planner*
*B/Sc Sustainable Development*
*Post Grad Cert Urban & Regional Planning*
*Corporate Member Planning Institute of Australia*

## Noise Management – Lot 1 South West Highway Boyanup

### Introduction

Environmental Protection Authority 2005, Guidance Statement No.3 Separation Distances between Industrial and Sensitive Land Uses provides recommended separation distances between the proposed extractive industry (sand mining) and a dwelling. This document provides generic buffer (separation) distances referred to in the State Industrial Buffer Policy (Government of Western Australia 1997).

Whilst the proposed extractive industry provides industry accepted separation distances the proponent will take all reasonable and practical measures to prevent or minimise emissions from the site.

### Noise Management Procedures;

Policies and Guidelines include:

- Environmental Protection (Noise) Regulations 1997
- EPA 2007 draft Guidance Statement No.8 Environmental Noise

The pit will operate between the hours of 6am to 6pm six days per week being Monday to Saturday.

It is acknowledged that noise can impact on the amenity of sensitive premises and this can be addressed by reducing the noise generated from the extractive industry site. It is also noted that the nearest dwelling is in excess of 500m from the site and is in accordance with the recommended 300-500m buffer for separation distances between extractive industries (sand) and sensitive land uses (EPA 2005).

Noise impact from industry including extractive industries is regulated by the Environmental Protection (Noise) Regulations 1997.

The proposed Noise Management on the site includes:

- Providing a physical separation between the subject Lot and other adjoining properties by maintaining vegetation screening within the site.
- Applying noise suppression devices on machinery, if required
- Turning off when not in use
- Operating occurring between the hours of 6am and 6pm Monday-Saturday
- Requiring any noise complaints to be recorded with follow up action to be immediately commenced

In summary, noise management will be provided through suppression measures and activities being conducted in accordance with the Environmental Protection (Noise) Regulations 1997.

**Dust Management - Lot 1 South West Highway, Boyanup**

Policies and Guidelines include:

- EPA 2000 Guidance Statement No 18- Prevention of Air Quality Impacts from Land Development Sites
- NEPM 2003, National Environmental Protection (Ambient Air Quality) Measures
- Department Environment and Conservation, A Guideline for managing the impacts and associated contaminants from land development sites, contaminated sites remediation and other related activities, 2011

The potential for dust generation can occur when extractive operations occur including the removal of topsoil, extraction of sand, stockpiling of sand and transportation. Generally this occurs when wind frequency and velocity causes particles to lift from the surface of the environment.

Dust has the potential to impact on human health and amenity and the natural environment if not managed appropriately.

Proposed management of potential dust includes:

- Pushing overburden dumps into areas to form barriers for screening purposes
- Operational areas will be accessible to either sprinkler systems or a water cart made available onsite at all times to prevent dust generation from the site
- Requiring exiting loaded vehicles to be covered
- Maintaining traffic areas to minimise dust
- Routine wetting of exposed areas in dry period to mitigate potential dust
- Maintaining haul roads
- Minimising the area of extraction open at any one time to 2ha
- Follow up with rehabilitation programme for revegetation in a timely manner to suppress dust from exhausted sources
- Clearing to occur when weather conditions minimise dust exposure

Sand extraction can be achieved by implementing dust management techniques and mitigations strategies. The nearest dwelling is in excess of 500m from the site and is in accordance with the recommended 300-500m buffer for separation distances between extractive industries (sand) and sensitive land uses (EPA 2005).

Further the proposal, as assessed under the DEC guidelines for managing the impacts of dust and associated contaminants from land development sites, contaminated sites remediation and other related activities indicates that the site (scored under 199) is considered a negligible risk whereby no provisions or contingency arrangements are required.

With this said the Proponent will commit to best practise with regards to dust management as indicated above.

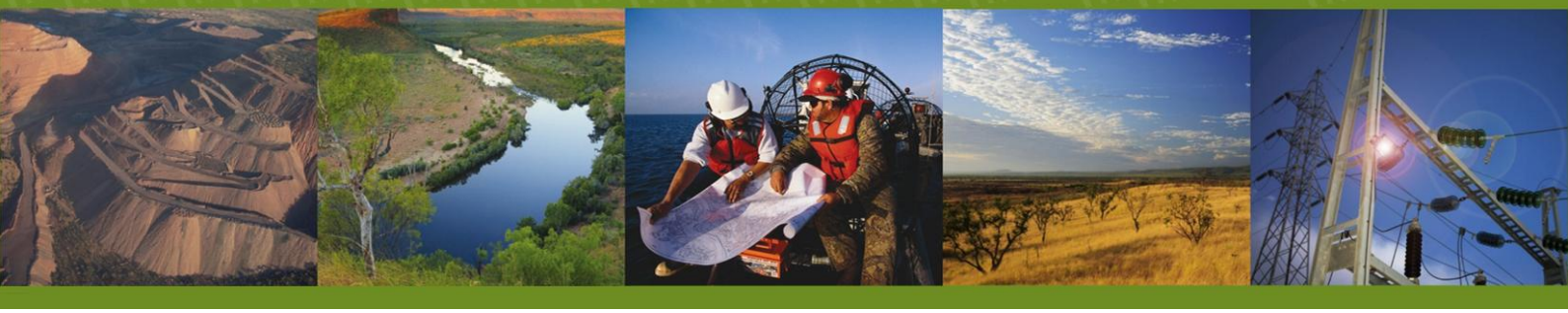
References; Environmental Protection Authority 2005, Guidance Statement No.3 Separation Distances between Industrial and Sensitive Land Uses EPA, Perth.

**Dieback Management - Lot 1 South West Highway, Boyanup**

Given that the large majority of the site is affected *by Phytophthora cinnamomi,*(see Flora Report, Russell Smith for Lot 1 South West Highway, Boyanup), the Dieback Management will concentrate on mitigating the spread of dieback from the site by implementing measures to ensure that operating practises occur in accordance with best practice guidelines, Management of Phytophthora Dieback in Extractive Industries.

| Issue | Action |
|---|---|
| Ensure Hygiene – clean on exit | Provide vehicle wash down facilities on exit of site |
| Site Demarcation | Allow for loading zone identified outside of vegetated area and include hardstand loading site typically consisting on limestone hardstand. Identify locations for extraction, processing, turn around points, wash-down areas, stockpile areas, water sources and water collection areas. |
| Barrier System | Ensure that clean equipment does not come into contact with infested soil or unclean equipment |
| Land Clearing Activities | To include burning of pushed up vegetation<br>Clearing to be undertaken when soil dry to limit soil being picked up and moved by vehicles |
| Persons On-site | Provide training and education to Staff and provide hygiene controls |
| Drainage of Water | Provide drainage management on site to ensure that the dieback is contained on site |
| Rehabilitation | Ensure replanted species are dieback tolerant |
| Signage | Inform entering personnel that dieback is present on site and precautions are required to ensure that dieback is not spread from the site. |

References: Dieback Working Group, Best Practice Guidelines, Management of Phytophthora Dieback in Extractive Industries



# Environmental Offset Strategy

## Lot 1 South Western Highway, North Boyanup

Prepared for
SJ Roadworks
by Strategen

December 2014

STRATEGEN
environmental consultants

# Environmental Offset Strategy

## Lot 1 South Western Highway, North Boyanup

Strategen is a trading name of
Strategen Environmental Consultants Pty Ltd
Level 2, 322 Hay Street Subiaco WA
ACN: 056 190 419

December 2014

## *Limitations*

**Scope of services**

This report ("the report") has been prepared by Strategen Environmental Consulting Pty Ltd (Strategen) in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Strategen. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

**Reliance on data**

In preparing the report, Strategen has relied upon data 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 expressly stated in the report, Strategen 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 part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Strategen has also not attempted to determine whether any material matter has been omitted from the data. Strategen will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Strategen. The making of any assumption does not imply that Strategen has made any enquiry to verify the correctness of that assumption.

The report is based on conditions encountered and information received at the time of preparation of this report or the time that site investigations were carried out. Strategen disclaims responsibility for any changes that may have occurred after this time. This report and any legal issues arising from it are governed by and construed in accordance with the law of Western Australia as at the date of this report.

**Environmental conclusions**

Within the limitations imposed by the scope of services, the preparation of this report has been undertaken and performed in a professional manner, in accordance with generally accepted environmental consulting practices. No other warranty, whether express or implied, is made.

**Client: SJ Roadworks**

| Report Version | Revision No. | Purpose | Strategen author/reviewer | Submitted to Client | |
|---|---|---|---|---|---|
| | | | | Form | Date |
| Draft Report | Rev A | For review by client | D Panickar / K Usher / R Banks | Electronic | 3 Nov 2014 |
| Final Draft Report | Rev B | For review by client | D Panickar / R Banks | Electronic | 9 Dec 2014 |
| **Final Report** | **Rev 0** | **For submission to DER and DotE** | **D Panickar / R Banks** | **Electronic** | **18 Dec 2014** |

Filename: SJO14236_01 R002 Rev 0 - 18 December 2014

## Table of contents



## List of tables



## List of figures



## List of appendices

# 1. Introduction

## 1.1 Background

Lot 1 South Western Highway, Boyanup is owned by SJ Roadworks (SJR) who is proposing to clear approximately 10 ha of native vegetation to develop a sand extraction resource to facilitate provision of sand to the land development sector in Bunbury and surrounds (the Proposal). SJR has previously consulted with the Department of Regulation (DER) and Department of Parks and Wildlife (Parks and Wildlife) in regard to clearing this site; however, the previous clearing permit applications have been unsuccessful and the proposal has been formally withdrawn.

SJR has identified three sites in close proximity to Lot 1 (Figure 1) that have the potential to be used to offset the environmental impacts of the proposed native vegetation clearance. On this basis, SJR has engaged Strategen to prepare an environmental offset strategy, including assessment of the potential offset sites and recommendations for their retention and protection.

SJR have also requested that Strategen respond to *CPS 5051/1 – Refusal of application to clear native vegetation under the Environmental Protection Act 1986.* Issues raised by DER in CPS 5051/1 have been discussed in section 4.

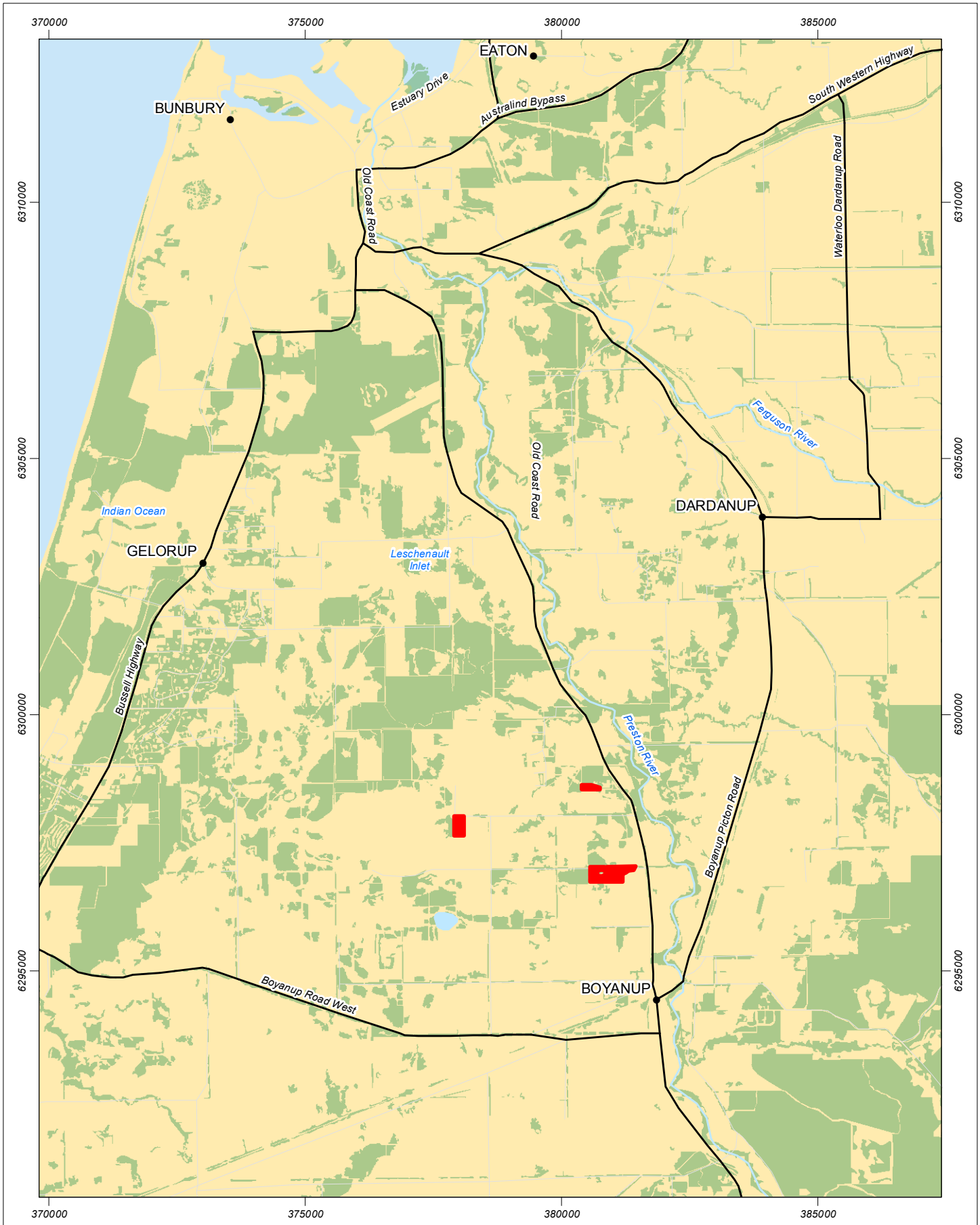
## 1.2 Offsets policy

Offsets are actions to address significant residual environmental impacts of a development or activity. Where a significant residual environmental impact has been identified, both the WA Government and the Australian Government have policies regarding offsets which aim to achieve a net environmental benefit, or at a minimum maintain environmental values (DSEWPaC 2012a; Government of Western Australia 2011, 2014). There are two categories of environmental offsets, recognised by both the WA Government and the Australian Government:

- direct offsets are those actions that provide a measurable conservation gain related to the significant residual impact that has been identified and provide for restoration or rehabilitation of existing degraded ecosystems, improved management, implementation of agreed recovery plans for species and/or conservation of habitat
- indirect offsets or 'other compensatory measures' are actions aimed at benefiting the affected environmental asset through improving scientific knowledge or community awareness and may include research, management planning or education that leads to the improved understanding of management of the environmental value.

Australian Government policy specifies direct offsets should make up at least 90% of the required offset package (DSEWPaC 2012a). Deviation from this 90% will be considered where it can be demonstrated that there will likely be a greater benefit to the protected matter, through increasing the proportion of indirect offsets or where scientific uncertainty is so high that it is not possible to determine a direct offset likely to benefit the protected matter.

Advanced offsets are a supply of offsets for potential future use, transfer or sale, which provide a means to better manage the risk associated with time delay in realising the conservation gain for a protected matter. This reduces the risk profile of an offset not succeeding by providing a conservation gain at an earlier point in time. The Offsets Assessment Guide places a higher value on offsets that deliver a conservation gain over a shorter period (DSEWPaC 2012b). Proponents should monitor and record baseline data associated with the establishment of the offset and improvements over time, and advanced offsets must satisfy all requirements in the EPBC Act Environmental Offsets Policy (DSEWPaC 2012a).




## Figure 1 Regional location

Scale 1:100,000 at A4

0 0.5 1 1.5 2 2.5 km

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 16/10/2014
Author: JCrute
Source: Topography: Geoscience Australia 2011.


**Legend**

- Town
- Major road
- Minor road
- Major river
- Water areas
- Proposed offset areas
- Native vegetation

STRATEGEN
info@strategen.com.au
www.strategen.com.au

Path: Q:\Consult\2014\SJO\SJO14236\ArcMap_documents\R001\RevA\SJO14236_01_R001_RevA_F001.mxd

# 2. Offset requirements

## 2.1 Site description

### 2.1.1 Flora

Flora surveys of Lot 1 Southeast Highway Boyanup were undertaken by Ekologica in 2012. Surveys identified 108 discrete flora species including 15 introduced (exotic) species. Two vegetation types were identified as described below:

- woodland of Banksia (with occasional emergent Jarrah (*Eucalyptus marginata*) and *Nuytsia floribunda*) over a low shrub dominated by *Kunzea glabrescens*
- tall shrubland of *Kunzea glabrescens.*

One Priority 4 species, *Acacia semitrullata*, was found in the eastern part of the road reserve and along the eastern boundary of Lot 1. All recordings of *A. semitrullata* were situated outside of the Lot and proposed clearing area. No other conservation significant flora species were recorded within Lot 1.

The condition of the vegetation on site ranged from Completely Degraded to Good (Keighery 1994).

### 2.1.2 Fauna

During a site inspection by the former Department of Environment and Conservation in 2012 (DEC 2012), suitable habitat for Carnaby's Black-Cockatoo, Baudin's Black-Cockatoo and Western Ringtail Possum (WRP) were identified in the southwest corner of Lot 1. Following this, SJ Roadworks removed the area of WRP habitat from the clearing proposal (approximately 2.4 ha), reducing the clearing application from 13.1 ha to 10.7 ha to reduce the overall environmental impact of the Proposal.

Harewood (2013) undertook a WRP and black cockatoo assessment in March 2013 to further define the habitat for each species within the Proposal area. Each vegetation type (as identified by Ekologica 2012) was assessed for its potential value as habitat for WRP and black cockatoos based on plant species composition and structure. Approximately 7.5 ha of black cockatoo habitat (Banksia woodland) was identified within the 10.7 ha Proposal area. No suitable WRP habitat was identified within the Proposal area. A summary of the habitat value for the Proposal area is shown in Table 1.

Table 1: Summary of vegetation types, areas and habitat value within the proposed extraction area

| Vegetation type | Area (ha) | % of total area | WRP habitat value | Black cockatoo habitat value |
|---|---|---|---|---|
| Banksia woodland | 7.5 | 70.1 | Poor | Moderate |
| Kunzea tall shrubland | 2.0 | 18.7 | Very poor | Nil/very poor |
| Disturbed | 1.2 | 11.3 | Nil | Nill |
| **Total** | **10.7** | **100** | | |

Source: Harewood (2013)

Results from the fauna survey, as detailed by Harewood (2013) are as follows:

- WRP were using the vegetation within Lot 1 as habitat, although the overall level of utilisation appears low, with only one individual observed during the night time survey
- the quality of WRP habitat within the Proposal area appears very low compared to other areas on Lot 1 that are to be retained
- the Proposal area consists mainly of highly degraded banksia woodland that lacks canopy connectivity and the favoured foraging species for WRP
- the Proposal area contains black cockatoo foraging and potential nesting habitat, mainly represented by the banksia woodland which also contains scattered Jarrah trees
- evidence of black cockatoo foraging was observed during the survey
- by definition, some of the Jarrah trees represent potential breeding habitat though no evidence of any being used for this purpose was seen
- the probability of any one Jarrah tree being used for nesting by black cockatoos is considered low.

## 2.2 Residual environmental impact

The residual environmental impact of the proposal is expected to be clearing of 7.5 ha of foraging habitat (Banksia woodland) for Carnaby's Black-Cockatoo and Baudin's Black-Cockatoo.

# 3. Proposed offset

Strategen undertook a Level 1 flora and vegetation assessment of the proposed offset sites (Figure 1) as described in section 1.1 (Strategen 2014; Appendix 1). The offset sites have been divided into three zones as described below and displayed in Appendix 1:

- Zone 1: adjacent to the southern boundary of the proposal area (2.97 ha)
- Zone 2: located at the intersection of Brookdale Road and Southwestern Highway, Boyanup (19 ha)
- Zone 3: located at the western extremity of Kilpatrick Road, North Boyanup (7.32 ha).

## 3.1 Habitat value of the proposed offset sites

Five Vegetation Types (VTs) were identified within the proposed offset sites as described in Table 2. Table 3 identifies which VTs occur within each Zone of the proposed offset sites. Three VTs (VTs 1, 3 and 4) were identified as containing potential habitat for black cockatoos due to the nature of the vegetation contained within (i.e. *Banksia attenuata, Corymbia calophylla* and *Eucalyptus rudis* woodlands). Vegetation within VTs 2 and 5 are not considered to provide habitat for black cockatoos.

Vegetation condition within VTs 1, 3 and 4, ranged from Degraded (VT 4) to Very Good-Excellent (VTs 1 and 3). The total area which each VT covers is displayed in Table 4. The total area of VTs 1, 3 and 4 (i.e. 12.73 ha) has been used in determining the offset suitability calculations as outlined in section 0 and displayed in Appendix 2 and Appendix 3.

Table 2: Vegetation Types

| Vegetation Type | Description |
|---|---|
| 1 | *Agonis flexuosa, Eucalyptus rudis* and *Melaleuca preissiana* woodland over *Pteridium esculentum*, *Gastrolobium ebracteolatum* and other mixed shrubs over exotic herbs and forbs in drainage lines |
| 2 | Open *Agonis flexuosa* woodland over pasture on flats and slight rises |
| 3 | Open *Banksia attenuata* woodland over *Kunzea glabrescens* over *Xanthorrhoea gracilis* and mixed shrubs over exotic herbs and forbs on sandy flats |
| 4 | Open *Corymbia calophylla* woodland (cleared parkland) over *Banksia attenuata* and *Kunzea glabrescens* over exotic grasses, herbs and forbs on flats and slight rises |
| 5 | *Melaleuca preissiana* wetlands in standing water |
| C* | Cleared areas (Proposed revegetation) |

* Cleared areas have been mapped but are not counted as unique VTs

Table 3: Summary of Vegetation Types within each Zone of the proposed offset sites

| Zone | VT | Area (ha) |
|---|---|---|
| Zone 1 | VT 1 | 2.48 |
| | VT 5 | 0.67 |
| Zone 2 | VT 1 | 2.37 |
| | VT 2 | 4.16 |
| | VT 4 | 3.72 |
| | VT 5 | 2.46 |
| Zone 3 | VT 2 | 1.56 |
| | VT 5 | 3.25 |

Table 4: Area (ha) covered by each Vegetation Types within the proposed offset sites

| VT | Area (ha) | Percentage of the site (vegetated areas) |
|---|---|---|
| 1 | 4.85 | 19.58 |
| 2 | 1.56 | 6.31 |
| 3 | 4.16 | 16.80 |
| 4 | 3.72 | 15.01 |
| 5 | 10.48 | 42.29 |
| **TOTAL** | **24.78** | **100** |

While the Proposal is not considered to have a significant impact on WRP, it is worth highlighting that the proposed offset sites, particularly Zones 1 and 3 (VTs 1 and 2) contain excellent habitat for the species (i.e. *Agonis flexuosa* woodland). These Zones can be further improved by revegetation and/or environmental management practices including weed control which would increase the value of these areas for the species.

### 3.1.1 Ecological value

The proposed offset sites contain a range of biodiversity values similar to those within Lot 1. Zone 2 in particular contains *Banksia* woodland vegetation resembling that within Lot 1. This proposed offset area meets the requirement for a "like-for-like" offset as defined in Government of Western Australia (2014). Revegetation within proposed areas will provide additional areas of *Banksia* woodland vegetation which will also satisfy the "like-for-like" offset requirement.

The proposed offset sites will also act as an ecological linkage for flora and fauna in the local area. Once vested as a conservation reserve, the proposed offset areas will act as an "island" of native vegetation within an area containing large amounts of privately owned land which have been extensively cleared for agricultural purposes.

## 3.2 Calculation of habitat quality

Proposed direct offsets have been assessed via the DotE Offset Calculator to determine their adequacy in meeting the minimum 90% direct offset requirement.

### 3.2.1 Option 1 – Land acquisition only

To meet the minimum direct offset target through land acquisition only, an area of approximately 17 ha of habitat acquisition is required. Offset calculator values used to determine this offset calculation are presented in Table 5 and are based on environmental investigations undertaken by Strategen (2014). These values have been input into the Offsets Assessment Guide spreadsheet available on the Department of the Environment (DotE) website.

Table 5: Land acquisition – offset calculator values

| Offset parameter | Value used in calculator | Justification of value |
|---|---|---|
| Start quality (proposed action) | 4 | The Proposal Area contains suitable foraging habitat for Carnaby's Black-Cockatoo (CBC) and Baudin's Black-Cockatoo (BBC) (Harewood 2013). Approximately 7.5 ha of CBC and BBC foraging habitat will be cleared as a result of the proposal. The majority of this habitat is in Completely Degraded to Good condition (Keighery 1994).<br><br>No evidence of black cockatoos utilising potential breeding trees was observed within the Proposal Area and the probability of the trees within the Proposal Area being utilised for such a purpose was deemed to be low (Harewood 2013). Evidence of black cockatoo foraging was recorded in the Proposal Area.<br><br>The Proposal Area is located in close proximity to stands of native vegetation containing suitable foraging habitat for CBC and BBC, including the proposed offset sites. As such the proposal will not create a gap of more than 4 km between patches of habitat. |
| Time over which loss is averted | 20 | The time over which the measures for securing the site for conservation purposes are intended to last - the offset site will be protected in perpetuity as a Nature Reserve. |
| Time until ecological benefit | 1 | Ecological benefit would be realised immediately as a direct offset would be provided. |
| Start quality | 7 | Suitable foraging habitat within the proposed offset sites comprises Vegetation Types (VTs) 1, 3 and 4 (Strategen 2014). VTs 1 and 3 (total of 9.01 ha) are in Very Good-Excellent condition, while VT 4 (total of 3.72 ha) is in Degraded condition. Several of the Marri trees within VT 4 are approaching a diameter at breast height of 500 mm which would classify them as potential breeding trees for black cockatoos. |
| Risk of loss (%) without offset | 30% | If this site was not utilised as an offset there would be no formal protection mechanisms or active conservation management (i.e. weed control, fire management and access management). There would also be a clear risk the site could be developed for agricultural or other purposes in the future. |
| Future quality without offset | 6 | With no active management the future quality of the site is likely to be reduced. No formal protection mechanisms are in place nor any rehabilitation planned. The majority of surrounding land has already been cleared for agricultural purposes and contains exotic species which would likely become prolific within the proposed offset sites if left unmanaged. |
| Risk of loss (%) with offset | 10% | Formal protection of the offset site will ensure that the risk of loss is minimised as much as possible. |
| Future quality with offset | 7 | Formal protection of the offset and provision of capped funds to DPaW to engage in active management of the offset will maintain the quality of the offset. |
| Confidence in result (habitat quality) | 90% | Protection mechanisms, once established, will provide a higher level of certainty that the offset will be conserved and enhanced through active management. |

| Offset parameter | Value used in calculator | Justification of value |
|---|---|---|
| Confidence in result (averted loss) | 90% | Proposed management options provide a high level of certainty that the offset will be conserved, averting the level of loss that would likely occur should no formal protection measures be implemented. |

### 3.2.2 Option 2 – Land acquisition and revegetation

To meet the minimum direct offset target through a combination of land acquisition (using the total area of suitable habitat for black cockatoos within the proposed offset sites [12.73 ha]) and revegetation, an area of approximately 4 ha will be required to be revegetated. Offset calculator values used to determine this offset calculation are presented in Table 5 (value of the 12.73 ha of black cockatoo habitat within the proposed offset sites) and Table 6 (habitat value of revegetated areas). These values have been input into the Offsets Assessment Guide spreadsheet available on the Department of the Environment (DotE) website.

Table 6: Revegetation – offset calculator values

| Offset parameter | Value used in calculator | Justification of value |
|---|---|---|
| Start quality (proposed action) | 4 | The Proposal Area contains suitable foraging habitat for Carnaby's Black-Cockatoo (CBC) and Baudin's Black-Cockatoo (BBC) (Harewood 2013). Approximately 7.5 ha of CBC and BBC foraging habitat will be cleared as a result of the proposal. The majority of this habitat is in Completely Degraded to Good condition (Keighery 1994).<br><br>No evidence of black cockatoos utilising potential breeding trees was observed within the Proposal Area and the probability of the trees within the Proposal Area being utilised for such a purpose was deemed to be low (Harewood 2013). Evidence of black cockatoo foraging was recorded in the Proposal Area.<br><br>The Proposal Area is located in close proximity to stands of native vegetation containing suitable foraging habitat for CBC and BBC, including the proposed offset sites. As such the proposal will not create a gap of more than 4 km between patches of habitat. |
| Time over which loss is averted | 20 | The time over which the measures for securing the site for conservation purposes are intended to last - the offset site will be protected in perpetuity as a Nature Reserve. |
| Time until ecological benefit | 5 | Rehabilitation of the offset site is required, therefore time until ecological benefit will be up to 5 years. |
| Start quality | 3 | The proposed revegetation areas are highly degraded and contain limited to no suitable habitat for CBC or BBC. |
| Risk of loss (%) without offset | 40% | No maintenance to area. The site is likely to be subject to further degradation if no rehabilitation is undertaken. |
| Future quality without offset | 3 | With no active management the future quality of the site is likely to remain constant. No formal protection mechanisms are in place nor any rehabilitation planned. The majority of surrounding land has already been cleared for agricultural purposes and contains exotic species. |

| Offset parameter | Value used in calculator | Justification of value |
|---|---|---|
| Risk of loss (%) with offset | 10% | Formal protection of the offset site will ensure that the risk of loss is minimised as much as possible. |
| Future quality with offset | 5 | Rehabilitation will considerably improve foraging habitat quality to black cockatoos |
| Confidence in result (habitat quality) | 80% | Protection mechanisms, once established, will provide a higher level of certainty that the offset will be conserved and enhanced through active management. |
| Confidence in result (averted loss) | 80% | Proposed management options provide a high level of certainty that the offset will be conserved, averting the level of loss that would likely occur should no formal protection measures be implemented. |

# 4. Discussion in response to CPS 5051/1 – Refusal of application to clear native vegetation under the EP Act

Strategen has provided responses to issues raised by DER in DER (2013) based on the values of proposed offsets identified in this report in Table 7. Lot 1 is referred to as 'the application area' by DER.

Table 7: Responses to issues raised by DER in CPS 5051/1

| DER comment | Response |
|---|---|
| *Banksia* and *Corymbia* species within the application area were identified as significant foraging habitat for Carnaby's Cockatoo.<br>A known Carnaby's Cockatoo roost site is located 8 km south of the application area. Therefore, the vegetation under application may provide important feeding habitat for this species. | Harewood (2013) identified the foraging habitat within the application area as 'Moderate.' The scope of this investigation was extensive and results more accurately represent the value of the proposed clearing area in terms of foraging quality for Carnaby's Black-Cockatoos.<br>The known roost site is located 8 km from the application area. DSEWPaC (2012c) identifies that gaps greater than 4 km from breeding sites have been shown to prevent breeding birds reaching resources. As the application area is located twice this distance from the known roost site, it is highly unlikely that birds from the roost site utilise this vegetation as a foraging resource. Additionally, proposed offset areas south of the application area will provide a larger amount of foraging habitat for black cockatoos in the local area. |
| Rehabilitation of the application area is considered best practice and does not constitute an offset. | Rehabilitation of the application area does not form part of the offset calculations. |
| An appropriate offset proposal could incorporate the proposed revegetation and retention of vegetation within Lot 1, however the area must be retained for long term benefit. | Rehabilitation of Lot 1 does not currently form part of the offset calculations however this area is available should it be required. |
| Banksia woodland is the most extensive vegetation type within the application area. The Banksia woodland appears to be identical with the PEC "Southern *Banksia attenuata* woodlands.' The application area shares more than twenty 'typical' and 'common' species associated with this PEC. | Strategen (2014) shows the known mapped extent of the PEC (SCP 21b) which occurs approximately 2 km north and 3 km southeast of the application area. Additionally, vegetation within Vegetation Type (VT) 3 as mapped by Strategen (2014) is defined as *Banksia* woodland. Species within this vegetation type are similar to those within the application area and are proposed to be conserved as an offset site. |
| Vegetation within the application area occurs within a regionally significant ecological linkage identified in the Greater Bunbury Regional Scheme and in close proximity to a major ecological linkage identified in the South West Regional Ecological Linkage Technical Report. | This argument was used to infer that the proposed clearing is at variance to clearing principle (a):<br>*Native vegetation should not be cleared if it comprises a high level of biological diversity.*<br>Both ecological linkages identified by DER are not classified as such due to levels of biological diversity. As such, the argument that the proposed clearing will result in degradation or disruption of these is not relevant to the clearing principle in this situation.<br>Additionally, portions of the proposed offset areas contain similar levels of biological diversity to the application area and areas proposed to be revegetated will ultimately end up with levels of biological diversity similar to the application area. |
| The proposal is at variance to clearing principle (e):<br>*Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.* | Revegetation and retention of the proposed offset areas will result in a net increase in vegetation within extensively cleared areas. Additionally, as the proposed offset areas are proposed to be retained in the conservation estate for the long-term, there is a high level of certainty surrounding this benefit. |

# 5. Conclusion

Based on the assessment of the proposed offset sites, the total area of suitable foraging habitat for black cockatoos within the proposed offset sites (12.73 ha) does not meet the minimum area of land acquisition required to achieve 90% of the required offset package (i.e. 17 ha). As such, option 2 as detailed in section 3.2.2 is likely to be the most viable option to achieve the minimum offsets requirements for black cockatoos. Specifically, option 2 entails:

- Utilisation of the entire 12.73 ha of suitable black cockatoo habitat within the proposed offset sites as part of the offset and provide funds to DPaW for the management of these areas
- revegetate 4 ha within the proposed revegetation areas as displayed in Figure 2 with the goal of increasing the amount of black cockatoo habitat within these areas.

The calculations used to derive these outcomes are displayed in Appendix 2 and Appendix 3.

When compared to the key provisions of the DotE EPBC Act Environmental Offsets Policy, the proposed direct offsets described above address the key offset requirements in the policy as shown in Table 8.

Table 8: Comparison of Black Cockatoo offset requirements with proposed offsets

| Offset requirements | Proposed offsets |
|---|---|
| Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environmental that is protected by national environmental laws and affected by the proposed action | The proposed offset for Carnaby's Black-Cockatoos (CBC) and Baudin's Black-Cockatoos (BBC) will result in an improved overall conservation outcome, ensuring protection and enhancement of key habitat for the species.<br>The 12.73 ha of vegetation to be retained within Zones 1 and 2 provides potential foraging and future breeding habitat within the range of CBC and BBC. The conservation of these areas will increase the ecological resilience, linkage and therefore viability of the habitat.<br>Furthermore, the revegetation of 4 ha adjacent to the retained vegetation as described above will provide additional foraging and future breeding habitat for black cockatoos within the local area. |
| Suitable offsets must be built around direct offsets but may include other compensatory measures | The site will be managed by Parks and Wildlife for conservation. |
| Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter | The offsets proposed are consistent with DotE policy and the offset calculator in relation to the level of statutory protection that applies to listed black cockatoos. |
| Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter | The extent of habitat to be subject to maintenance as a result of the offsets will be proportionate to the residual impacts on habitat within the proposal area. The proposed action will result in the clearing of approximately 7.5 ha of potential foraging habitat for CBC and BBC.<br>The proposed offset (12.73 ha within Zones 1 and 2 and revegetation of 4 ha of degraded land as displayed in Figure 2) is of a size and scale proportionate to the residual impacts on the protected matter. The combined offset package provides for greater than 90% of the impact offset as identified through the offset calculator. |
| Suitable offsets must effectively account for and manage the risk of the offset not succeeding | The risk of the offset option not fulfilling the aims for which it is designed is considered to be very low and confidence levels of 90% (direct land acquisition) and 80% (revegetation) have been used in the offset calculator. The offset properties will be managed in perpetuity by Parks and Wildlife which will ensure that the offset measures undertaken are enduring in terms of their improvement of the habitat values. |
| Suitable offsets must be additional to what is already required, determined by law or planning regulations or agreed to under other schemes or programs (this does not preclude the recognition of state or territory offsets that may be suitable as offsets under the EPBC Act for the same action) | The proposed offsets package for CBC and BBC is to satisfy the requirements of the Commonwealth EPBC Act only. |

| Offset requirements | Proposed offsets |
|---|---|
| Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable | The proposed offsets will be efficiently managed in a transparent manner by Parks and Wildlife. |
| Suitable offsets must have transparent governance arrangements, including being able to be readily measured, monitored, audited and enforced | Performance for the improvement of the direct offset habitat is readily measurable through the development of a baseline position and ongoing monitoring and reporting in terms of improvements being undertaken. This can be readily undertaken in an audited manner and enforced through conditions which can be applied to the approval decision. |

The proposed offset is also consistent with the requirement for a “like-for-like” offset as defined in Government of Western Australia (2014). Additionally, the value of the proposed offset sites as an ecological linkage for flora and fauna in the local area surrounded by large amounts of privately owned land which has been extensively cleared for agricultural purposes should be taken into consideration during assessment.

In addition these offsets mitigate a number of concerns raised in DER (2013) and SJ Roadworks are keen to progress this further with DER.

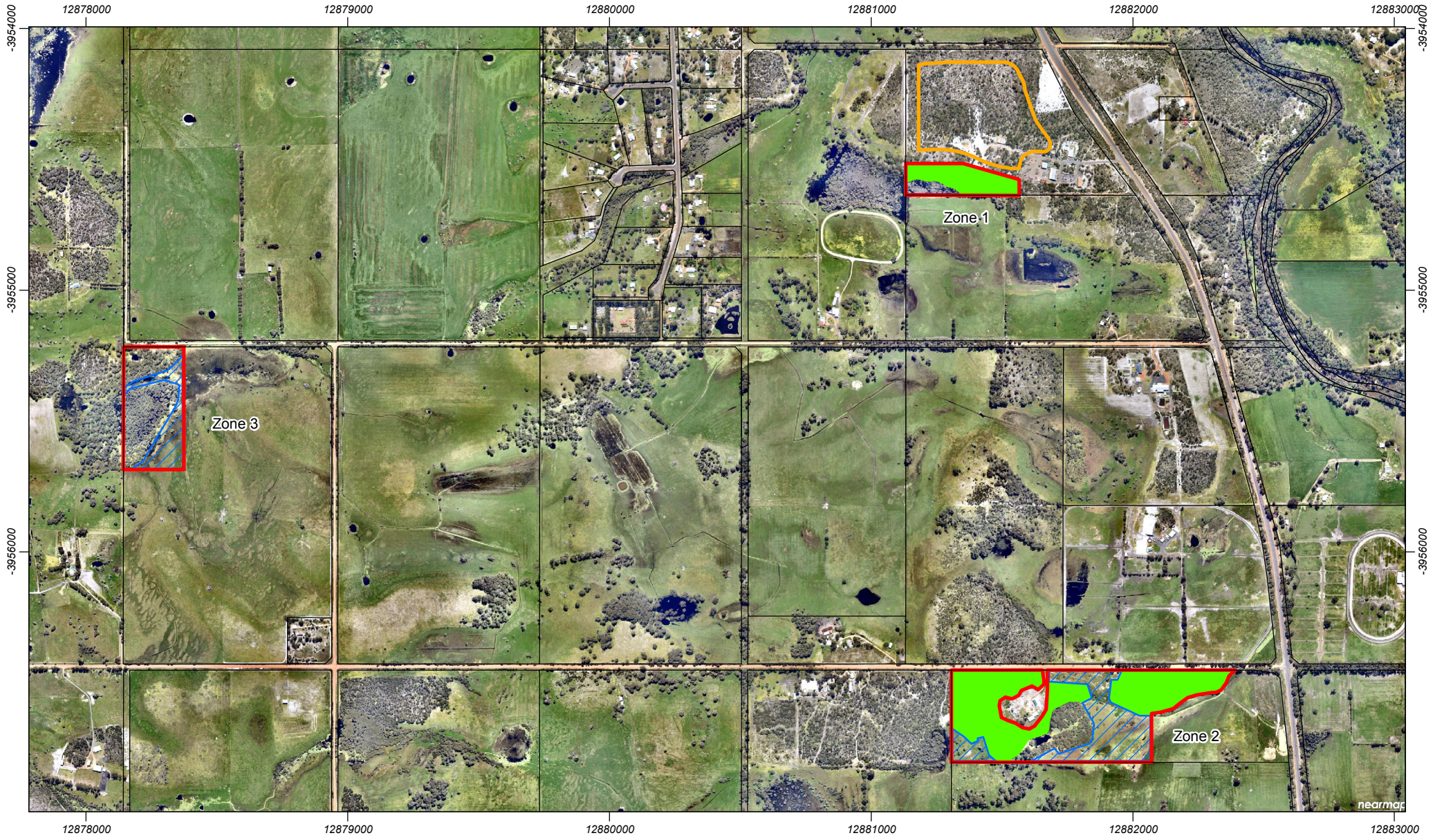



**Figure 2: Proposed offset and revegetation areas**

Scale 1:20,000 at A4

0 200 400 m

Coordinate System: WGS 1984 Web Mercator

Note that positional errors may occur in some areas

Date: 3/11/2014

Author: JCrute

Source: Aerial and offset sites: Client 2004

**Legend**

- Existing cadastre
- Proposed offset areas
- Excavation extent
- Potential revegetation areas
- Potential black cockatoo habitat

STRATEGEN

info@strategen.com.au www.strategen.com.au

Path: Q:\Consult\2014\SJO\SJO14236\ArcMap_documents\R002\Rev A\SJO14236_01_R002_RevA_F002.mxd

# 6. References

Department of Environment and Conservation (DEC) 2012, *Site Inspection Report for Clearing Permit Application CPS 5051/1. Lot 1 on Diagram 43421, North Boyanup,* report prepared for Department of Environment and Conservation, 2012.

Department of Environment Regulation (DER) 2013, *Refusal of application to clear native vegetation under the Environmental Protection Act 1986 (CPS 5051/1),* Government of Western Australia, October 2013.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2012a, *Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy*, Commonwealth of Australia, October 2012.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2012b, *How to use the offsets assessment guide,* Commonwealth of Australia, October 2012.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2012c, *EPBC Act referral guidelines for three threatened black cockatoo species,* [Online], Australian Government, Available from: *http://www.environment.gov.au/system/files/resources/895d4094-af63-4dd3-8dff-ad2b9b943312/files/referral-guidelines-wa-black-cockatoo.pdf* [18 December 2014].

Ekologica 2012, *A Level 1 Flora Survey of Lot 1 Southeast Highway Boyanup,* report prepared for SJ Roadworks, 2012.

Government of Western Australia 2011, *WA Environmental Offsets Policy*, [Online], Government of Western Australia, Available from: *http://www.epa.wa.gov.au/EPADocLib/WAEnvOffsetsPolicy-270911.pdf* [30 October 2014].

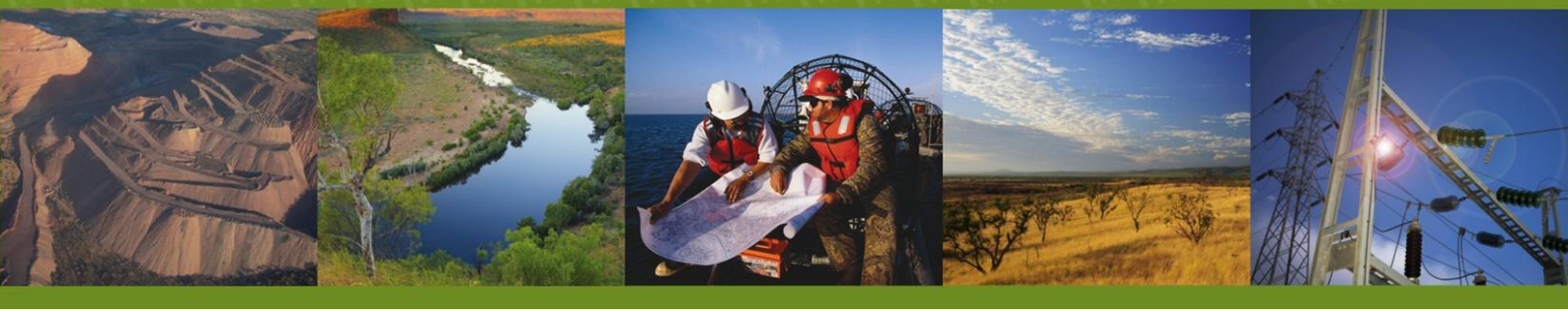
Government of Western Australia 2014, *WA Environmental Offsets Guidelines*, [Online], Government of Western Australia, Available from: http://www.epa.wa.gov.au/EPADocLib/WA%20Environmental%20Offsets%20Guideline%20August%202014.pdf [30 October 2014].

Harewood G 2013, *Western Ringtail Possum & Black Cockatoo Assessment of Lot 1 South Western Highway Boyanup*, report prepared for SJ Roadworks, 2013.

Keighery B 1994, *Bushland Plant Survey: A Guide to Plant Community Survey for the Community*, Wildflower Society, Floreat.

Strategen 2014, *SJ Roadworks proposed offset sites – Environmental Investigations*, report prepared for SJ Roadworks, 2014.

# Appendix 1
# Level 1 Flora and Vegetation Survey
# (Strategen 2014)



# SJ Roadworks proposed offset sites

## Environmental Investigations

## DRAFT

Prepared for
SJ Roadworks
by Strategen

November 2014

STRATEGEN
environmental consultants

# SJ Roadworks proposed offset sites

## Environmental Investigations

## DRAFT

Strategen is a trading name of
Strategen Environmental Consultants Pty Ltd
Level 2, 322 Hay Street Subiaco WA
ACN: 056 190 419

November 2014

## *Limitations*

**Scope of services**

This report ("the report") has been prepared by Strategen Environmental Consulting Pty Ltd (Strategen) in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Strategen. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

**Reliance on data**

In preparing the report, Strategen has relied upon data 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 expressly stated in the report, Strategen 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 part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Strategen has also not attempted to determine whether any material matter has been omitted from the data. Strategen will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Strategen. The making of any assumption does not imply that Strategen has made any enquiry to verify the correctness of that assumption.

The report is based on conditions encountered and information received at the time of preparation of this report or the time that site investigations were carried out. Strategen disclaims responsibility for any changes that may have occurred after this time. This report and any legal issues arising from it are governed by and construed in accordance with the law of Western Australia as at the date of this report.

**Environmental conclusions**

Within the limitations imposed by the scope of services, the preparation of this report has been undertaken and performed in a professional manner, in accordance with generally accepted environmental consulting practices. No other warranty, whether express or implied, is made.

**Client: SJ Roadworks**

| Report Version | Revision No. | Purpose | Strategen author/reviewer | Submitted to Client | |
|---|---|---|---|---|---|
| | | | | Form | Date |
| Draft Report | Rev A | Client Review | D Panickar / R Banks | Electronic | 3 Nov 2014 |
| Final Report | | | | | |

Filename: SJO14236_01 R001 Rev A - 3 November 2014

## Table of contents



## List of tables

## List of figures



## List of appendices

# 1. Introduction

## 1.1 Background

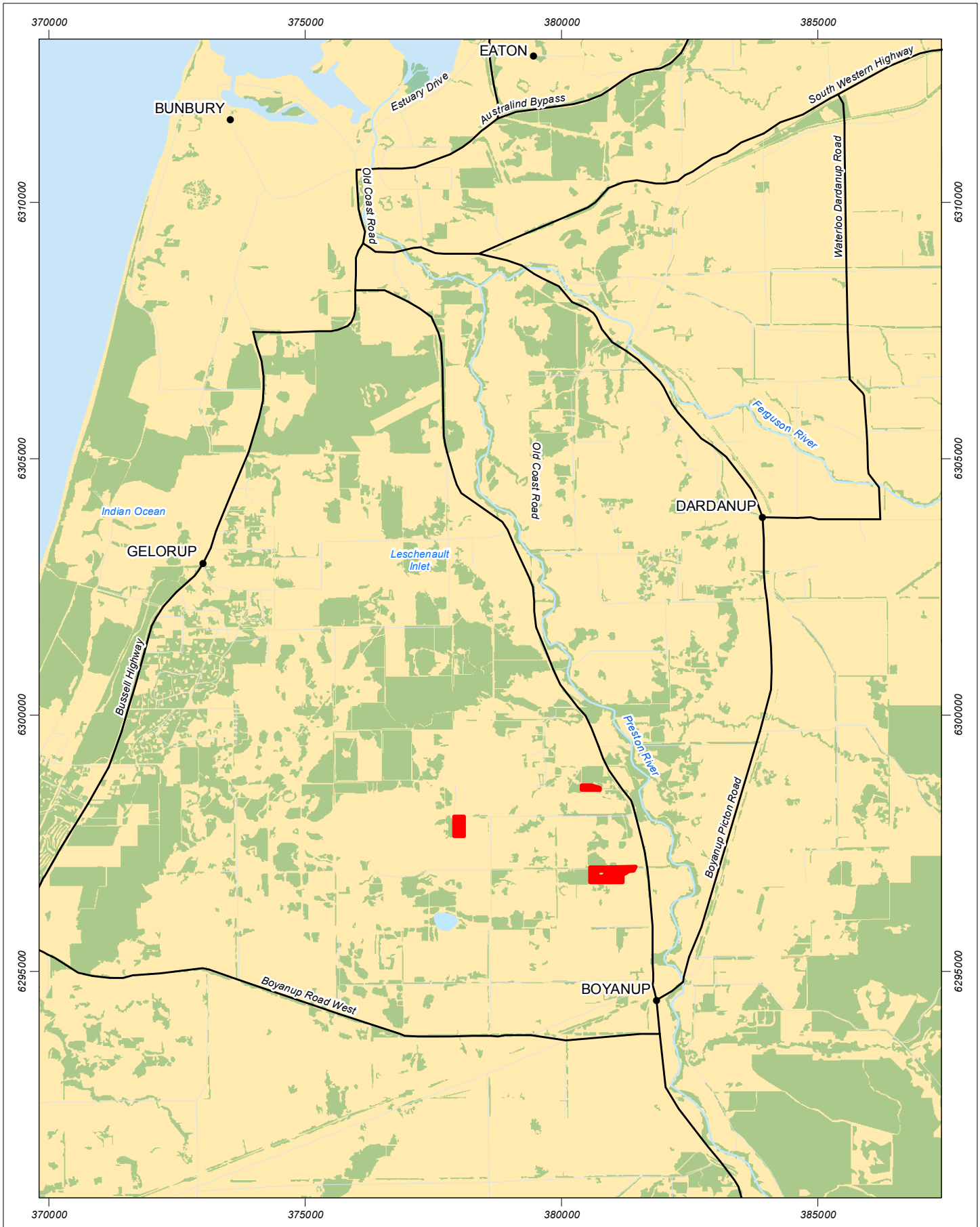
SJ Roadworks (SJR) proposes to clear approximately 10 ha of native vegetation within Lot 1 South Western Highway, North Boyanup, to develop a sand extraction resource. In order to offset potential environmental impacts associated with the proposed clearing, SJR has identified three sites which, if retained as conservation estate, may obtain a net gain for the environment.

## 1.2 Scope

Strategen was commissioned to undertake a flora and vegetation assessment and significant fauna habitat assessment by SJR within the proposed offset sites in October 2014 (Figure 1).

The aims of the assessment were to:

- undertake a Level 1 flora and vegetation survey
- identify any potential conservation significant flora
- identify potential habitat for conservation significant fauna.




## Figure 1 Regional location

Scale 1:100,000 at A4

0 0.5 1 1.5 2 2.5 km

N

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 16/10/2014
Author: JCrute
Source: Topography: Geoscience Australia 2011.


**Legend**

- Town
- Major road
- Minor road
- Major river
- Water areas
- Proposed offset areas
- Native vegetation

STRATEGEN
info@strategen.com.au
www.strategen.com.au

Path: Q:\Consult\2014\SJO\SJO14236\ArcMap_documents\R001\RevA\SJO14236_01_R001_RevA_F001.mxd

## 1.3 Environmental setting

### 1.3.1 Climate

The proposed offset sites are located within the Swan Coastal Plain 2 (SWA2 – Swan Coastal Plain subregion) of Western Australia (Mitchell et al. 2002). Beard (1990) described the climate within this district as warm Mediterranean, with 600–1000 mm of winter rainfall and five to six dry months a year. Figure 2 shows climate statistics for Bunbury (BOM 2014).

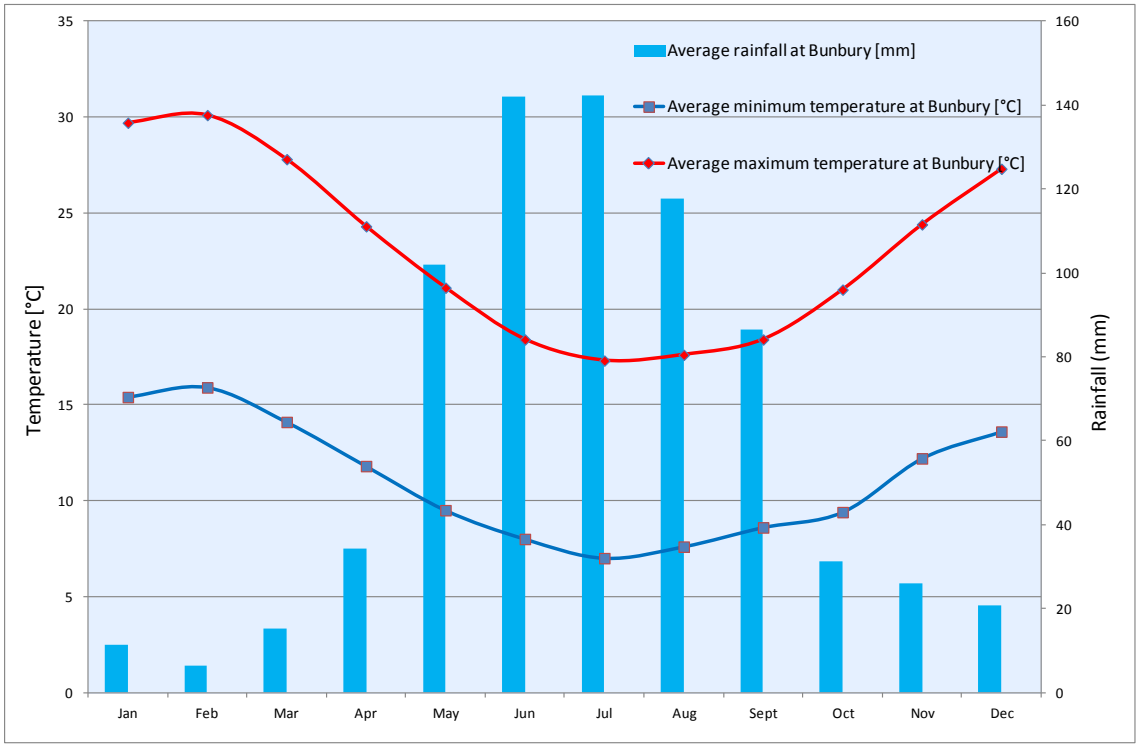



Figure 2: Mean monthly climatic data (temperature and rainfall) for Bunbury

### 1.3.2 Soils and topography

The Swan Coastal Plain comprises five major geomorphological systems that lie parallel to the coast, namely (from west to east) the Quindalup Dunes, Spearwood Dunes, Bassendean Dunes, Pinjarra Plain and Ridge Hill Shelf (Churchward & McArthur 1980; Gibson et al. 1994). Each major system is composed of further subdivisions in the form of detailed geomorphological units (Churchward & McArthur 1980; Semeniuk 1990; Gibson et al.1994).

From a botanical viewpoint, the proposed offset sites fall within the Drummond Botanical Subdistrict as mapped by Beard (1990). This subdistrict is described as a low-lying coastal plain, often swampy, with sandhills which also contains dissected country rising to the duricrusted Dandaragan plateau on Mesozoic, mainly sandy, yellow soils (Beard 1990).

### 1.3.3 Regional vegetation

Vegetation occurring within the region was initially mapped at a broad scale (1:1 000 000) by Beard during the 1970s. This dataset has formed the basis of several regional mapping systems, including physiographic regions defined by Beard (1981); the biogeographical region dataset (Interim Biogeographic Regionalisation for Australia, IBRA) for Western Australia (DotE 2014a); and vegetation system associations which are currently used to determine extents of clearing since European arrival (DEC 2013). At a finer scale (1:250 000), vegetation complexes of the region were mapped by Heddle *et al* (1980). This mapping is regularly used as the basis to determine the extent of clearing on the Swan Coastal Plain as well as identifying any potentially restricted or endangered vegetation complexes.

#### *IBRA subregion*

The proposed offset sites occur within the Swan Coastal Plain 2 IBRA subregion which is dominated by *Banksia* or Tuart on sandy soils, *Casuarina obesa* on outwash plains and paperbark (*Melaleuca*) in swampy areas (Mitchell et al. 2002).

#### *Beard (1990) Botanical Subdistrict*

The proposed offset sites occur within the Drummond Botanical Subdistrict which is characterised by low *Banksia* woodlands on leached sands; *Melaleuca* swamps on poorly-drained depressions; and *Eucalyptus gomphocephala* (Tuart), *Eucalyptus marginata* (Jarrah) and *Corymbia calophylla* (Marri) woodlands on less leached soils (Beard 1990).

#### *Heddle et al. 1980 vegetation complexes*

The proposed offset sites occur near the interface of four vegetation complexes as mapped by Heddle *et al.* (1980) and described below and displayed in Figure 3:

Southern River Complex: an open woodland of *Eucalyptus* (now *Corymbia*) *calophylla – E. marginata – Banksia* spp. on the elevated areas and a fringing woodland of *E. rudis – Melaleuca rhaphiophylla* along the streams

Bassendean Complex (Central and South): *Eucalyptus marginata – Allocasuarina fraseriana – Banksia* spp. woodland with fringing woodland of *E. rudis – Melaleuca rhaphiophylla* along creek beds

Swan Complex: Fringing woodland of *Eucalyptus rudis – Melaleuca rhaphiophylla* with localised occurrence of low open forest of *Casuarina obesa* and *M. cuticularis*

Guildford Complex: a mixture of open forest of *Eucalyptus* (now *Corymbia*) *calophylla – E. wandoo – E. marginata* and woodland of *E. wandoo* (with rare occurrences of *E. lane-poolei*). Minor components include *E. rudis – Melaleuca rhaphiophylla.*

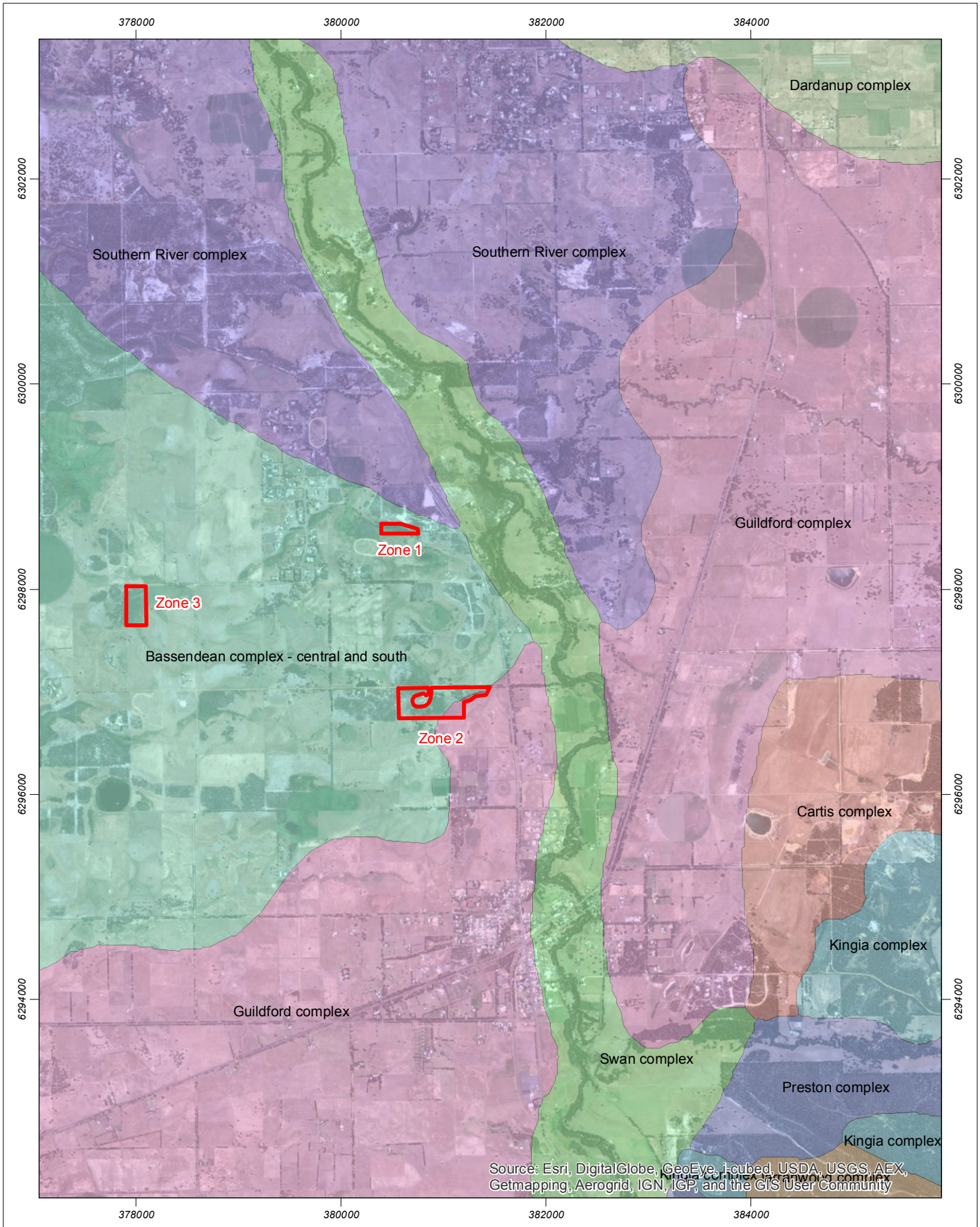



**Figure 3: Vegetation complexes (Heddle et al 1980)**

Scale 1:50,000 at A4

0 500 1,000 m

N

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 16/10/2014
Author: JCrute
Source: Aerial image: ESRI online 2006. Vegetation: DEC 2012.

**Legend**

- Proposed offset sites

**Vegetation complexes**

- Bassendean complex - central and south
- Cartis complex
- Dardanup complex
- Guildford complex
- Jarrahwood complex
- Kingia complex
- Preston complex
- Southern River complex
- Swan complex

STRATEGEN
info@strategen.com.au
www.strategen.com.au

Path: Q:\Consult\2014\SJO\SJO14236\ArcMap_documents\R001\RevA\SJO14236_01_R001_RevA_F003.mxd

# 2. Objectives

The general aim of this survey was to undertake an environmental investigation of the site. The objectives were to:

- conduct a desktop survey for Threatened and Priority flora which have been identified as being present in or around the site
- collect and identify the vascular plant species present within the site
- search areas of suitable habitat for Threatened and/or Priority flora
- define and map the native vegetation communities present within the site
- provide recommendations on the local and regional significance of the vegetation communities
- identify habitat for any conservation significant terrestrial fauna species
- prepare a report summarising the findings.

# 3. Methods

## 3.1 Desktop Assessment

A desktop assessment was conducted using Florabase, Department of Parks and Wildlife (DPaW), and Department of the Environment (DotE) databases to identify the possible occurrence of Threatened Ecological Communities, Priority Ecological Communities, Threatened and Priority flora, and conservation significant fauna species potentially occurring within the site. Reports that document regional flora, vegetation and fauna within the surrounds of the site were also reviewed prior to the field assessment.

A database search request was also submitted to the Threatened Communities Branch of DPaW to identify any potential Threatened Ecological Communities or Priority Ecological Communities within 5 km of the site.

## 3.2 Field assessment

### 3.2.1 Flora and vegetation

Assessment of flora and vegetation within the site was undertaken by an experienced ecologist (Table 1) from Strategen on 8 October 2014. Five vegetation mapping sites were surveyed along with three wetland areas containing standing water and isolated trees (Appendix 1; Appendix 2). The field survey was conducted according to standards set out in Guidance Statement 51 (EPA 2004).

Table 1: Personnel

| Name | Project involvement | Flora collection permit |
|---|---|---|
| Mr D Panickar (Experienced Ecologist) | Planning, fieldwork, plant identification, data interpretation and report preparation | SL010993 |

Site selection for vegetation mapping was based on differences in structure and species composition of the communities present within the proposed survey area. Vegetation mapping sites were determined from aerial photographs and opportunistic sites were selected in the field where a change in vegetation structure or composition was observed.

Flora and vegetation was described and sampled systematically at each survey site and additional opportunistic collecting was undertaken wherever previously unrecorded plants were observed. At each site the following floristic and environmental parameters were noted:

- GPS location
- topography
- soil type and colour
- outcropping rocks and their type
- percentage cover and average height of each vegetation stratum
- presence of significant trees.

For each vascular plant species, the average height and percent cover (both live and dead material) were recorded.

All plant specimens collected during the field surveys were dried and fumigated in accordance with the requirements of the Western Australian Herbarium. The plant species were identified through comparisons with pressed specimens housed at the Western Australian Herbarium where necessary. Nomenclature of the species recorded is in accordance with DPaW/WAHERB (2014a).

### 3.2.2 Fauna habitat assessment

The assessment of potential conservation significant terrestrial fauna habitat was undertaken simultaneously with the flora and vegetation assessment. Habitat for conservation significant terrestrial fauna, such as significant trees (diameter at breast height >500 mm and/or presence of hollows in relevant species), foraging habitat and significant habitat features (i.e. mounds, nests) identified during the flora and vegetation assessment were recorded.

#### *Black cockatoo habitat*

DotE does not currently provide formal guidance for the assessment of habitat quality, but defines foraging habitat for Carnaby's Black-Cockatoos as native shrubland dominated by proteaceous plant species such as *Banksia* spp., and can also include individuals or small stands of such species (DotE 2014b). Habitat quality was assessed informally based on this description, by observing the relative densities of suitable black cockatoo foraging species within the survey area (i.e. *Banksia* spp., *Allocasuarina fraseriana*, *Eucalyptus* spp. and *Corymbia calophylla*). An area with few to no proteaceous species present, or with proteaceous species in poor health, would be considered to be of lower quality, while an area containing abundant proteaceous species with individual plants in healthy condition would be considered to be of higher quality.

## 3.3 Data analysis and vegetation mapping

Due to the uniform distribution of vegetation within the proposed offset sites, quadrat data were grouped into a species by site matrix to delineate individual vegetation types (VTs) present within the site. Aerial photography interpretation and field notes taken during the survey were then used to develop VT mapping polygon boundaries over the site. These polygon boundaries were then digitised using Geographic Information System (GIS) software.

VT descriptions (though floristic in origin) have been adapted from the National Vegetation Information System (NVIS) Australian Vegetation Attribute Manual Version 6.0 (ESCAVI 2003), a system of describing structural vegetation units (based on dominant taxa). This model follows nationally-agreed guidelines to describe and represent vegetation types, so that comparable and consistent data is produced nation-wide. For the purposes of this report, a VT is considered equivalent to a NVIS sub-association as described in ESCAVI (2003).

Vegetation condition was recorded at all quadrats, and also opportunistically within the site during the field assessment where required. Vegetation condition was described using the vegetation condition scale for the South West Botanical Province (Keighery 1994). Vegetation condition polygon boundaries were developed using this information in conjunction with aerial photography interpretation, and were digitised as for vegetation type mapping polygon boundaries.

## 3.4 Flora and vegetation assessment limitations and constraints

Table 2 displays the evaluation of the flora and vegetation assessment against a range of potential limitations that may have an effect on that assessment. Based on this evaluation, the assessment has not been subject to constraints that would affect the thoroughness of the assessment and the conclusions reached.

Table 2: Flora and vegetation assessment potential limitations and constraints

| Potential limitation | Impact on assessment | Comment |
|---|---|---|
| Sources of information and availability of contextual information (i.e. pre-existing background versus new material). | **Not a constraint.** | The study has been undertaken in the Drummond Botanical Subdistrict on the Swan Coastal Plain which has been well studied and documented with ample literature available (Beard 1990). |
| Scope (i.e. what life forms, etc., were sampled). | **Not a constraint.** | Due to the degraded nature and uniform distribution of vegetation within the site, most life forms are likely to have been sampled adequately during the time of the survey. Additionally, annual species (herbs and forbs) were observed to be in flower at the time of survey and were recorded when observed. |
| Proportion of flora collected and identified (based on sampling, timing and intensity). | **Not a constraint.** | The proportion of flora surveyed was adequate. The entire site was traversed and all species observed were recorded in accordance with a Level 1 survey. |
| Completeness and further work which might be needed (i.e. was the relevant survey area fully surveyed). | **Not a constraint** | The information collected during the survey was sufficient to assess the vegetation that was present during the time of the survey. |
| Mapping reliability. | **Not a constraint.** | Aerial photography of a suitable scale was used to map the survey area. Sites were chosen from these aerials to reflect changes in community structure. Opportunistic sites were also used if differences were observed during on ground reconnaissance. Vegetation types were assigned to each site based on topography, soil type, presence/absence and percent foliage cover of vegetation. |
| Timing, weather, season, cycle. | **Not a constraint.** | Flora and vegetation surveys are normally conducted following winter rainfall in the South-West Province, ideally during spring (EPA 2004). The field assessment was conducted in October and as such, is compliant with best-practice recommendations. |
| Disturbances (fire flood, accidental human intervention, etc.). | **Not a constraint.** | The site and regional surrounds have been subject to disturbance over a significant period of time (agriculture). Given the wide range of this disturbance, this is not considered to be a limitation within the site. |
| Intensity (in retrospect, was the intensity adequate). | **Not a constraint.** | The entire site was traversed on foot and differences in vegetation structure were recorded appropriately. |
| Resources (i.e. were there adequate resources to complete the survey to the required standard). | **Not a constraint.** | The available resources were adequate to complete the survey. |
| Access problems (i.e. ability to access survey area). | **Not a constraint.** | Existing tracks enabled adequate access to survey the vegetation within the survey area. Where access was not available by car, the area was easily traversed by foot. |
| Experience levels (e.g. degree of expertise in plant identification to taxon level). | **Not a constraint.** | All survey personnel have the appropriate training in sampling and identifying the flora of the region. |

# 4. Results

## 4.1 Desktop assessment results

### 4.1.1 Flora and vegetation

A total of 289 native vascular plant taxa from 58 plant families have the potential to occur within the vicinity of the proposed offset sites (DPaW 2007-). The majority of taxa were from within the Fabaceae (38 taxa), Orchidaceae (33 taxa), and Poaceae (22 taxa) families (Appendix 3).

#### *Threatened and Priority Ecological Communities*

A Threatened Ecological Community (TEC) is defined under the *Environmental Protection Act 1986* (EP Act) as an ecological community listed, designated or declared under a written law or a law of the Australian Government as Threatened, Endangered or Vulnerable. There are four State categories of TECs (DEC 2010)[1]:

- presumed totally destroyed (PD)
- critically endangered (CR)
- endangered (EN)
- vulnerable (VU).

A description of each of these TEC categories is presented in Appendix 4. TECs are gazetted as such (DPaW 2014a) and some Western Australian TECs are listed as Threatened under the Australian Government *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Under the EPBC Act, a person must not undertake an action that has or will have a significant impact on a listed TEC without approval from the Australian Government Minister for the Environment, unless those actions are not prohibited under the EPBC Act. A description of each of these categories of TECs is presented in Appendix 4. The current EPBC Act list of TECs can be located on the DotE (2014c) website.

Ecological communities identified as threatened, but not listed as TECs, are classified as Priority Ecological Communities (PECs). These communities are under threat, but there is insufficient information available concerning their distribution to make a proper evaluation of their conservation status. DPaW categorises PECs according to their conservation priority, using five categories, P1 (highest conservation significance) to P5 (lowest conservation significance), to denote the conservation priority status of such ecological communities. Appendix 4 defines PECs (DEC 2010). A list of current PECs can be viewed at the DPaW (2014b) website.

No TECs or PECs were identified as having the potential to occur within the proposed offset sites (Figure 4). The closest TEC identified was SCP 1b (*Eucalyptus calophylla* [now *Corymbia calophylla*] woodlands on heavy soils of the Southern Swan Coastal Plain) which is located approximately 2 km north of the proposed offset sites. Two PECs are also located within proximity to the proposed offset sites:

- SCP 21b (Southern *Banksia attenuata* woodlands) – recorded in 2 locations, approximately 2 km north and 3 km southeast of the proposed offset sites
- Whicher Scarp Jarrah woodland of deep coloured sands (Whicher Scarp woodlands of coloured sands and laterites community C2) – located approximately 3 km southeast of the proposed offset sites.

[1] The Department of Environment and Conservation is still listed as the author of all TEC and PEC databases and have been referred to as such in this document instead of the Department of Parks and Wildlife (DPaW).

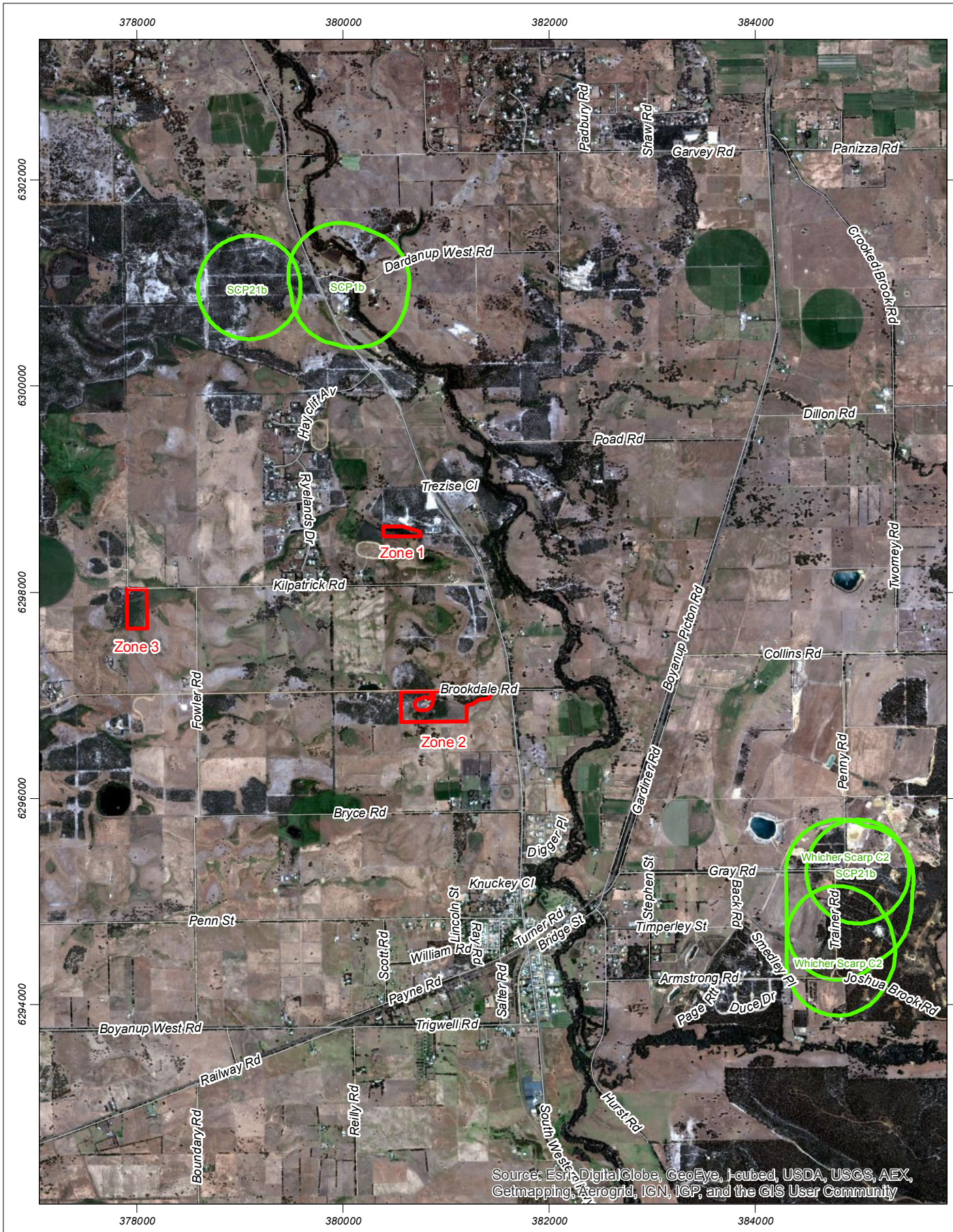



**Figure 4: TECs and PECs within 5km of the site**

Scale 1:50,000 at A4

0 500 1,000 m

N

**Legend**

- Proposed offset sites
- TECs and PECs

Coordinate System: GDA 1994 MGA Zone 50
Note that positional errors may occur in some areas
Date: 16/10/2014
Author: JCrute
Source: Aerial image: ESRI online 2006. TECs & PECs: DPaW 10/2014.

Path: Q:\Consult\2014\SJO\SJO14236\ArcMap_documents\R001\RevA\SJO14236_01_R001_RevA_F004.mxd

STRATEGEN
info@strategen.com.au
www.strategen.com.au

### *Threatened and Priority flora*

A desktop survey for Threatened and Priority flora that may potentially occur within the site was undertaken using NatureMap (DPaW 2007-), the Western Australian Herbarium (DPaW/WAHERB 2014a), and the DotE Protected Matters Search Tool (DotE 2014d).

Flora within Western Australia that is considered to be under threat may be classed as either Threatened flora or Priority flora. Where flora has been gazetted as Threatened flora under the *Wildlife Conservation Act 1950* (WC Act), the taking of such flora without the written consent of the Minister is an offence. The WC Act defines "to take" flora as to gather, pluck, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means.

Priority flora are considered to be species which are potentially under threat, but for which there is insufficient information available concerning their distribution and/or populations to make a proper evaluation of their conservation status. DPaW categorises Priority flora according to their conservation priority using five categories, P1 (highest conservation significance) to P5 (lowest conservation significance), to denote the conservation priority status of such species. Priority flora species are regularly reviewed and may have their priority status changed when more information on the species becomes available. Appendix 4 defines levels of Threatened and Priority flora (DPaW/WAHERB 2014b).

At the national level, the EPBC Act lists Threatened species as extinct, extinct in the wild, critically endangered, endangered, vulnerable, or conservation dependent. Appendix 4 defines each of these categories of Threatened species. The EPBC Act prohibits an action that has or will have a significant impact on a listed Threatened species without approval from the Australian Government Minister for the Environment. The current EPBC Act list of Threatened flora may be found on the DotE (2014c) website.

Table 3 shows the Threatened and Priority flora potentially occurring within the proposed offset sites. The desktop assessment identified 18 Threatened flora species and 15 Priority flora species that have the potential to occur within proximity to the proposed offset sites. Of these, based on specific habitat requirements, 10 Threatened flora species were considered to have the potential to occur:

- *Andersonia gracilis*
- *Brachyscias verecundus*
- *Caladenia huegelii*
- *Centrolepis caespitosa*
- *Chamelaucium* sp. C Coastal Plain (R.D. Royce 4872)
- *Diuris micrantha*
- *Drakaea elastica*
- *Drakaea micrantha*
- *Eleocharis keigheryi*
- *Synaphea stenoloba.*

Additionally, 11 Priority flora species were also considered to have the potential to occur:

- *Boronia humifusa*
- *Synaphea odocoileops*
- *Leptomeria furtiva*
- *Boronia tetragona*
- *Caustis* sp. Boyanup (G.S. McCutcheon 1706)
- *Thelymitra variegata*
- *Acacia flagelliformis*
- *Acacia semitrullata*
- *Aponogeton hexatepalus*
- *Pultenaea skinneri*
- *Franklandia triaristata.*

Table 3: Threatened and Priority flora potentially occurring within the site

| Species | Conservation status | | Description | Potential to occur |
|---|---|---|---|---|
| | EPBC Act | WC Act | | |
| *Andersonia gracilis* | **Threatened** - Endangered | Threatened | A slender shrub to 50 cm tall with few, spreading branches. Flowers are pink to pale mauve. Habitat for this species occurs within seasonally damp, black sandy clay flats near swamps (DotE 2014e, DPaW/WAHERB 2014a). | **Possible –** Preferred soil type/habitat may occur within the proposed offset sites. |
| *Banksia nivea* subsp. *uliginosa* | **Threatened** - Endangered | Threatened | A mounded shrub up to 1.5 m tall and 1.5 m across (Brown *et al.* 1998). This species is confined to the base of the Whicher Range, on orange clay loam over laterite and sandy areas within winter-wet southern ironstones (DotE 2014e). | **Unlikely –** Preferred habitat for the species does not occur within the proposed offset sites. |
| *Banksia squarrosa* subsp. *argillacea* | **Threatened** - Vulnerable | Threatened | An erect, open, non-lignotuberous shrub to 1.2 – 4 m tall. Habitat for the species occurs within the Whicher Range in winter-wet clay over ironstone in open to dense tall shrubland (DotE 2014e). | **Unlikely –** Preferred habitat for the species does not occur within the proposed offset sites. |
| *Brachyscias verecundus* | **Threatened** – Critically Endangered | Threatened | An annual (or ephemeral) glabrous herb to 120 – 220 cm tall. The species is endemic to ironstone soils in the Busselton region. It grows in winter-wet clay over ironstone in open to tall shrubland (DotE 2014e). | **Possible –** Preferred soil type/habitat may occur within the proposed offset sites. |
| *Caladenia huegelii* | **Threatened** – Endangered | Threatened | A slender orchid from 30 to 50 cm tall. One or two striking flowers characterised by a greenish-cream lower petal with a maroon tip. Other petals are cream with red or pink suffusions. Habitat for this species occurs within well-drained, deep sandy soils in low mixed Banksia, Allocasuarina and Jarrah woodlands (DotE 2014e, DPaW/WAHERB 2014a). | **Possible –** Preferred soil type/habitat may occur within the proposed offset sites. |
| *Centrolepis caespitosa* | **Threatened** – Endangered | Priority 4 | A diminutive, densely tufted, glabrous annual herb. Flowers are red/brown and are singular. Habitat for this species is relatively unknown. Brown *et al.* (1998) identified that this species occurs within winter-wet claypans dominated by low shrubs and sedges. | **Possible –** Preferred soil type/habitat may occur within the proposed offset sites. |
| *Chamelaucium* sp. C Coastal Plain (R.D. Royce 4872) | **Threatened** - Vulnerable | Threatened | An intricately branched spreading shrub up to 120 cm tall and 60 cm across. It has inconspicuous greenish-white flowers and young branches are coloured fawn to reddish (Brown et al. 1998). Habitat for this species is confined to swamp margins in open *Dryandra* (now *Banksia*) shrubland on winter-wet sandy clays. | **Possible –** Preferred soil type/habitat may occur within the proposed offset sites. |
| *Darwinia foetida* | **Threatened** – Critically Endangered | Threatened | An erect, spreading shrub to 70 cm tall. Green flowers, visible from October to November. Habitat for this species occurs within wet/winter-damp clay under Myrtaceous shrubland (DotE 2014e). | **Highly unlikely –** Preferred habitat is unlikely to occur within the proposed offset sites and both DPaW/WAHERB (2014a) and DotE (2014e) list this species' distribution to be highly restricted within the Muchea area (approximately 70 km north of Perth). |

| Species | Conservation status | | Description | Potential to occur |
|---|---|---|---|---|
| | EPBC Act | WC Act | | |
| *Darwinia whicherensis* | **Threatened** – Endangered | Threatened | An erect or sometimes spreading shrub, to 70 cm tall by 40 cm wide, often using other shrubs for support. Flowers are enclosed by red and green bracts that are arranged in several rows. Habitat for the species is known to occur in three locations at the base of the Whicher Range, in a winter-wet area of shrubland over shallow red clay over ironstone (DotE 2014e). | **Unlikely –** Preferred habitat for the species does not occur within the proposed offset sites. |
| *Diuris micrantha* | **Threatened** – Vulnerable | Threatened | A slender orchid to 60 cm tall. Yellow flowers with reddish-brown markings measuring 1.3 cm across. Habitat for this species occurs within clay-loam substrates in winter-wet depressions or swamps (DotE 2014e). | **Possible –** Preferred soil type/habitat may occur within the proposed offset sites. |
| *Diuris purdiei* | **Threatened** – Endangered | Threatened | A slender orchid to 45 cm tall. Unusually flattened flowers, marked with brown blotches on their under surface. Habitat for this species occurs in areas subject to winter inundation within dense heath with scattered Myrtaceous trees (DotE 2014e). | **Unlikely –** Preferred habitat does not occur within the proposed offset sites. |
| *Drakaea elastica* | **Threatened** – Endangered | Threatened | A slender orchid to 30 cm tall with a prostrate, round to heart shaped leaf. Singular, bright green, glossy flower. Habitat for this species is within bare patches of white sand over dark sandy loams on damp areas (DotE 2014e). | **Possible –** Preferred soil type/habitat occurs within the proposed offset sites. |
| *Drakaea micrantha* | **Threatened** – Vulnerable | Threatened | A tuberous, terrestrial orchid to 30 cm tall. Silvery-grey heart shaped leaf with prominent green veins. Red and yellow singular flower. Habitat for this species occurs within cleared, open sandy patches (Brown et al. 1998). | **Possible –** Preferred soil type/habitat occurs within the proposed offset sites. |
| *Eleocharis keigheryi* | **Threatened** – Vulnerable | Threatened | A rhizomatous, tufted/clumped perennial herb, to a maximum diameter of 40 cm. Flowers are colourless or very pale green and occur at the end of the branches. Habitat for the species occurs in a substrate of clay or sandy loam. This species is emergent in freshwater creeks, and transient waterbodies such as drainage lines and claypans in water to approximately 15 cm deep (DotE 2014e). | **Possible –** Preferred soil type/habitat occurs within the proposed offset sites. |
| *Gastrolobium papilio* | **Threatened** – Endangered | Threatened | A shrub with wiry stems forming tangled clumps ascending to 1.5 m, often climbing through other shrubs. Flowers are pale red to cream. The species is known from only one population in the Busselton area in shallow, peaty grey-brown sandy clay or very shallow red sandy-clay soil (Brown et al. 1998) over ironstone in winter-wet flats (DotE 2014e). | **Unlikely –** Preferred habitat does not occur within the proposed offset sites. |

| Species | Conservation status | | Description | Potential to occur |
|---|---|---|---|---|
| | EPBC Act | WC Act | | |
| *Lambertia echinata* subsp. *occidentalis* | **Threatened** – Endangered | Threatened | A prickly, non-lignotuberous shrub to 3 m tall with many branches at the base and a few long, erect floral branches. The species has yellow flowers which are crowded at the ends of branchlets, visible from October to December. Habitat for the species occurs at the base of the Whicher Range on shallow soils over sheet ironstone and white sandy soils over laterite (Brown et al. 1998; DotE 2014e). | **Unlikely –** Preferred habitat does not occur within the proposed offset sites. |
| *Petrophile latericola* | **Threatened** – Endangered | Threatened | A multi-stemmed or single-stemmed erect open shrub that grows from 0.4–2 m high. Flowers are bright yellow, hairy, and approximately 20 mm long. Habitat for the species occurs in tall and low heath on winter-wet flats of red sandy-clay over ironstone (DotE 2014e). | **Unlikely –** Preferred habitat does not occur within the proposed offset sites. |
| *Synaphea stenoloba* | **Threatened** – Endangered | Threatened | A compact shrub to 50 cm tall. The inflorescences are yellow and borne above the leaves to a height of 15 cm. Habitat for the species occurs on loamy soils in low lying areas that are occasionally inundated (DotE 2014e). | **Possible –** Preferred soil type/habitat occurs within the proposed offset sites. |
| *Boronia humifusa* | Not listed | Priority 1 | A low-growing, wiry perennial herb to 20 cm tall. Flowers are pink/red, visible from June to September. Habitat for the species occurs in gravelly clay loam over laterite in Jarrah-Marri open forest (DPaW/WAHERB 2014a). | **Possible –** Preferred soil type/habitat may occur within the proposed offset sites. |
| *Synaphea odocoileops* | Not listed | Priority 1 | A tufted, compact shrub to 50 cm tall. Flowers are yellow and visible from August to October. Habitat for the species occurs in brown-orange loam & sandy clay with granite within swamps or winter-wet areas (DPaW/WAHERB 2014a). | **Possible –** Preferred soil type/habitat may occur within the proposed offset sites. |
| *Gastrolobium whicherense* | Not listed | Priority 2 | A slender, open shrub to 1.6 m tall. Flowers are orange – yellow – red and visible in October. Habitat for the species occurs in red-grey sandy clay over quartzite on steep westerly slopes (DPaW/WAHERB 2014a). | **Unlikely –** Preferred habitat does not occur within the proposed offset sites. |
| *Leptomeria furtiva* | Not listed | Priority 2 | A lax, sprawling shrub to 45 cm tall. Flowers are orange - brown, visible in August to October. Habitat for the species occurs in grey or black peaty sand in winter-wet flats (DPaW/WAHERB 2014a). | **Possible –** Preferred soil type/habitat may occur within the proposed offset sites. |
| *Leucopogon* sp. Busselton | Not listed | Priority 2 | Belongs to the Ericaceae family. No other public information available (DPaW/WAHERB 2014a). | **Unlikely –** Not recorded within the City of Bunbury. |
| *Adelphacme minima* | Not listed | Priority 3 | Belongs to the Loganiaceae family. No other public information available (DPaW/WAHERB 2014a). | **Unlikely –** Not recorded within the City of Bunbury. |
| *Boronia tetragona* | Not listed | Priority 3 | A perennial herb to 70 cm tall. Flowers are pink – red and visible from October to December. Habitat for the species occurs in black/white sand, laterite and brown sandy loam within winter-wet flats, swamps and open woodland (DPaW/WAHERB 2014a). | **Possible –** Preferred soil type/habitat may occur within the proposed offset sites. |

| Species | Conservation status | | Description | Potential to occur |
|---|---|---|---|---|
| | EPBC Act | WC Act | | |
| *Caustis* sp. Boyanup (G.S. McCutcheon 1706) | Not listed | Priority 3 | A rhizomatous, clumped perennial sedge to 1 m tall. Habitat for the species occurs in white or grey sand (DPaW/WAHERB 2014a). | **Possible –** Preferred soil type/habitat may occur within the proposed offset sites. |
| *Thelymitra variegata* | Not listed | Priority 3 | A tuberous, perennial orchid to 35 cm tall. Habitat for the species occurs in sand, sandy clay and laterite (DPaW/WAHERB 2014a). | **Possible –** Preferred soil type/habitat may occur within the proposed offset sites. |
| *Acacia flagelliformis* | Not listed | Priority 4 | A rush-like, erect or sprawling shrub to 1.6 m tall. Flowers are yellow and visible from May to September. Habitat for the species occurs in sandy soils in winter-wet areas (DPaW/WAHERB 2014a). | **Possible –** Preferred soil type/habitat may occur within the proposed offset sites. |
| *Acacia semitrullata* | Not listed | Priority 4 | A slender, erect, pungent shrub to 1.5 m tall. Flowers are cream – white visible from May to October. Habitat for the species occurs in white/grey sand, clay and occasionally laterite in sandplains or swampy areas (DPaW/WAHERB 2014a). | **Possible –** Preferred soil type/habitat may occur within the proposed offset sites. |
| *Aponogeton hexatepalus* | Not listed | Priority 4 | A rhizomatous or cormous, aquatic perennial herb. Habitat for this species occurs in freshwater ponds, rivers and claypans (DPaW/WAHERB 2014a). | **Possible –** Preferred soil type/habitat may occur within the proposed offset sites. |
| *Pultenaea skinneri* | Not listed | Priority 4 | A slender shrub to 2 m tall. Flowers are yellow - orange – red and visible from July to September. Habitat for this species occurs in sandy or clayey soils in winter-wet depressions (DPaW/WAHERB 2014a). | **Possible –** Preferred soil type/habitat may occur within the proposed offset sites. |
| *Ornduffia submersa* | Not listed | Priority 4 | Belongs to the Menyanthaceae family. No other public information available (DPaW/WAHERB 2014a). | **Unlikely –** Not recorded within the City of Bunbury. |
| *Franklandia triaristata* | Not listed | Priority 4 | An erect, lignotuberous shrub to 1 m tall. Flowers are white – cream - yellow/brown – purple and visible from August to October. Habitat for this species occurs in white or grey sand (DPaW/WAHERB 2014a). | **Possible –** Preferred soil type/habitat may occur within the proposed offset sites. |

### 4.1.2 Terrestrial fauna

A desktop survey for Threatened fauna that may potentially occur within 5 km of the site, as presented in Appendix 3. Table 4 lists the conservation significant fauna listed under State and Australian Government legislation which were identified during desktop searches (DPaW 2007-, DotE 2014d).

Table 4: Conservation significant fauna species potentially occurring in the vicinity of the site

| Species | | Conservation status | |
|---|---|---|---|
| Common name | Scientific name | EPBC Act | WC Act |
| Carnaby's Black-Cockatoo | *Calyptorhynchus latirostris* | Endangered | Threatened |
| Baudin's Black-Cockatoo | *Calyptorhynchus baudinii* | Vulnerable | Threatened |
| Forest Red-tailed Black-Cockatoo | *Calyptorhynchus banksii* naso | Vulnerable | Threatened |
| Chuditch, Western Quoll | *Dasyurus geoffroi* | Vulnerable | Threatened |
| Western Ringtail Possum | *Pseudocheirus occidentalis* | Vulnerable | Threatened |
| Quokka | *Setonix brachyurus* | Vulnerable | Threatened |
| Fork-tailed Swift | *Apus pacificus* | Migratory | IA |
| Osprey | *Pandion haliaetus* | Marine | IA |
| Hooded Plover | *Thinornis rubricollis* | Marine | IA |
| Great Egret | *Ardea alba* | Migratory | IA |
| Cattle Egret | *Ardea ibis* | Migratory | IA |
| White Bellied Sea-eagle | *Haliaeetus leucogaster* | Migratory | IA |
| Rainbow Bee-eater | *Merops ornatus* | Migratory | IA |

IA – Protected under International Agreement

## 4.2 Field survey results

### 4.2.1 Native flora

A total of 21 native vascular plant taxa from 18 plant genera and 11 plant families were recorded within the proposed offset sites. Majority of taxa were recorded within the Myrtaceae (7 taxa), Fabaceae (3 taxa) and Orchidaceae (3 taxa) families (Appendix 5).

### 4.2.2 Threatened and Priority flora

No Threatened flora species pursuant to Schedule 1 of the WC Act and as listed by DPaW (2014c) or Priority flora species as listed by DPaW/WAHERB (2014a) were recorded within the proposed offset sites (Appendix 5).

### 4.2.3 Threatened and Priority Ecological Communities

No TECs as listed by DotE (2014c) and by DPaW (2014a) or PECs as listed by DPaW (2014b) were identified within the proposed offset sites. The closest TECs or PECs to the proposed offset sites have a buffer approximately 2 km to the north and 3 km to the southeast (refer to section 4.1.1). None of these TECs or PECs however, are inferred to occur within the proposed offset sites based on floristic composition.

### 4.2.4 Introduced (exotic) flora

A total of five introduced (exotic) taxa were recorded within the proposed offset sites (Appendix 5):

- **Arctotheca calendula*
- **Briza maxima*
- **Hypochaeris glabra*
- *Poaceae sp.
- **Sonchus asper.*

In addition, several exotic species associated with pasture were observed within the proposed offset sites (particularly in proximity to Zone 2). These species were not identified at the time of survey as they do not significantly contribute to the outcomes of the survey and thus were recorded only as '**Pasture species'.*

No exotic taxa recorded within the proposed offset sites are Declared Plant species in Western Australia pursuant to Section 22 of the *Biosecurity and Agriculture Management Act 2007* (BAM Act) according to the Western Australian Department of Agriculture and Food (DAFWA 2013).

## 4.3 Vegetation Types

Five VTs were defined and mapped within the site (Appendix 1; Figure 5) and are summarised in Table 5. Total areas occupied within the survey area by each of the identified vegetation communities are set out in Table 6.

Table 5: Vegetation Types

| Vegetation Type | Description |
|---|---|
| 1 | *Agonis flexuosa, Eucalyptus rudis* and *Melaleuca preissiana* woodland over *Pteridium esculentum*, *Gastrolobium ebracteolatum* and other mixed shrubs over exotic herbs and forbs in drainage lines |
| 2 | Open *Agonis flexuosa* woodland over pasture on flats and slight rises |
| 3 | Open *Banksia attenuata* woodland over *Kunzea glabrescens* over *Xanthorrhoea gracilis* and mixed shrubs over exotic herbs and forbs on sandy flats |
| 4 | Open *Corymbia calophylla* woodland (cleared parkland) over *Banksia attenuata* and *Kunzea glabrescens* over exotic grasses, herbs and forbs on flats and slight rises |
| 5 | *Melaleuca preissiana* wetlands in standing water |
| C* | Cleared areas (Proposed revegetation) |

* Cleared areas have been mapped but are not counted as unique VTs

### 4.3.1 Vegetation Type coverage

The total area mapped was 24.78 ha (Table 6). The dominant VT within the area was VT 5 which can be broadly described as *Melaleuca preissiana* wetlands in standing water.

Table 6: Area (ha) covered by each VT within the site

| VT | Area (ha) | Percentage of the site (vegetated areas) |
|---|---|---|
| 1 | 4.85 | 19.58 |
| 2 | 1.56 | 6.31 |
| 3 | 4.16 | 16.80 |
| 4 | 3.72 | 15.01 |
| 5 | 10.48 | 42.29 |
| **TOTAL** | **24.78** | **100** |

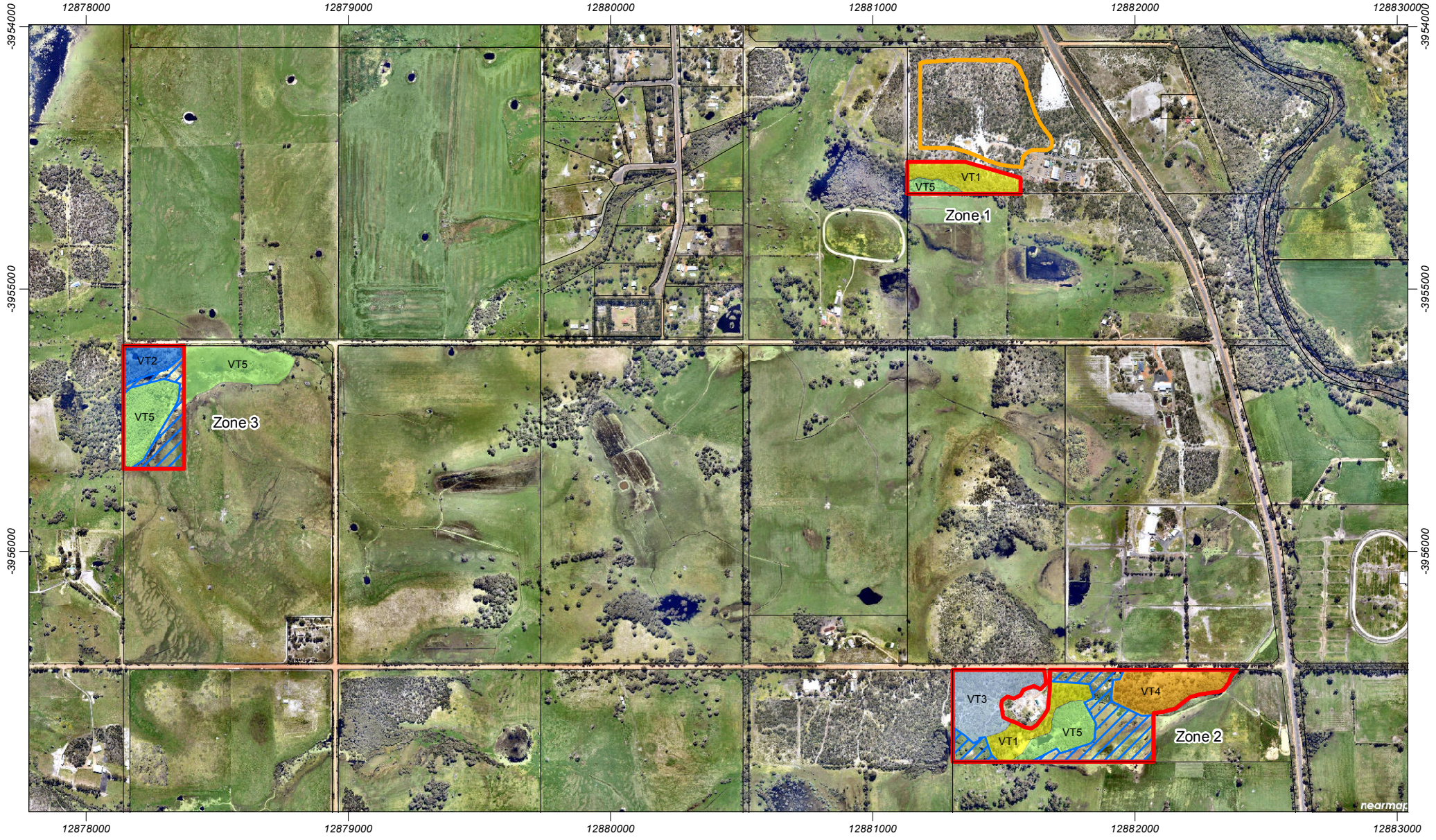



**Figure 5: Vegetation map**

Scale 1:20,000 at A4

0 200 400 m

Coordinate System: WGS 1984 Web Mercator

Note that positional errors may occur in some areas

Date: 16/10/2014

Author: JCrute

Source: Aerial and offset sites: Client 2004

**Legend**

- Existing cadastre
- Proposed offset areas
- Excavation extent
- Proposed revegetation area

**Vegetation type**

- VT1
- VT2
- VT3
- VT4
- VT5

STRATEGEN

info@strategen.com.au www.strategen.com.au

Path: Q:\Consult\2014\SJO\SJO14236\ArcMap_documents\R001\RevA\SJO14236_01_R001_RevA_F005.mxd

## 4.4 Vegetation condition

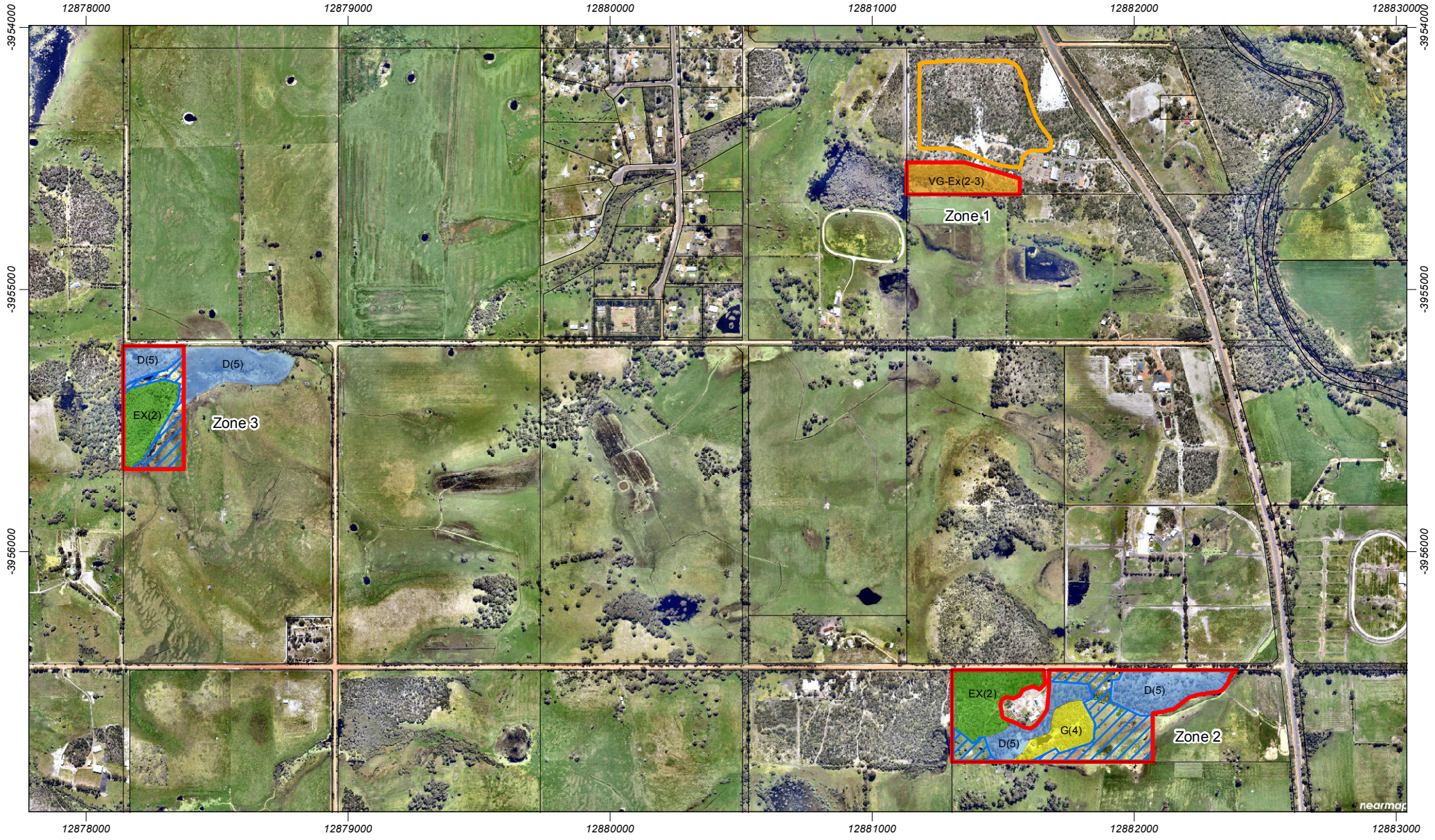
Some areas within the proposed offset sites (particularly Zone 3) show signs of having been degraded for a long period of time. The proximity of agricultural activity, presence of feral animals, nearby clearing and infestations of weeds has had an impact upon the vegetation condition within the area. Vegetation within Zones 1 and 2 however, was generally more undisturbed than that within Zone 3. As such, vegetation condition within the proposed offset sites ranged from Degraded to Excellent (Keighery 1994; Figure 6; Table 7). Table 8 gives a numerical breakdown of vegetation condition within the proposed offset sites.

Table 7: Vegetation condition scale

| Condition rating | Description |
|---|---|
| Pristine (1) | Pristine or nearly so, no obvious sign of disturbance. |
| Excellent (2) | Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. |
| Very Good (3) | Vegetation structure altered obvious signs of disturbance.<br>For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing. |
| Good (4) | Vegetation structure significantly altered by obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it.<br>For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback, grazing. |
| Degraded (5) | Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management.<br>For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing. |
| 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. |

Table 8: Area (ha) covered by each vegetation condition rating category within the site

| Vegetation Condition | Area (ha) | Percentage of the site |
|---|---|---|
| Excellent | 7.41 | 29.92 |
| Very Good - Excellent | 3.15 | 12.72 |
| Good | 2.46 | 9.92 |
| Degraded | 11.76 | 47.44 |
| **Total** | **24.78** | **100** |




## Figure 6: Vegetation condition map

Scale 1:20,000 at A4

0 200 400 m

Coordinate System: WGS 1984 Web Mercator

Note that positional errors may occur in some areas

Date: 22/10/2014

Author: JCrute

Source: Aerial and offset sites: Client 2004

**Legend**

- Existing cadastre
- Proposed offset areas
- Excavation extent
- Proposed revegetation area

**Vegetation condition**

- Ex(2)
- VG-Ex(2-3)
- G(4)
- D(5)

STRATEGEN

info@strategen.com.au www.strategen.com.au

Path: Q:\Consult\2014\SJO\SJO14236\ArcMap_documents\R001\RevA\SJO14236_01_R001_RevA_F006.mxd

## 4.5 Fauna habitat

Potential habitat for conservation significant fauna species within the proposed offset sites is detailed in Table 9. All other non-migratory conservation significant fauna species identified in Table 4 are unlikely to occur due to a lack of suitable habitat within the proposed offset sites. Migratory birds have the potential to utilise the proposed offset sites for habitat due to the large bodies of water contained within the *Melaleuca preissiana* wetlands (VT 5) and drainage lines. However given their nature (i.e. migratory), these species are unlikely to be present for prolonged periods of time.

Table 9: Conservation significant fauna species habitat

| Species | | Habitat | |
|---|---|---|---|
| Common name | Scientific name | Preferred habitat | Location within proposed offset sites |
| Carnaby's Black-Cockatoo | *Calyptorhynchus latirostris* | This species is known to forage amongst proteaceous shrubs and trees as well as a variety of others within its distribution (DotE 2014b). | VT 1 – Zone 1<br>Zone 2<br>VT 3 – Zone 2<br>VT 4 – Zone 2 |
| Baudin's Black-Cockatoo | *Calyptorhynchus baudinii* | This species is known to forage amongst proteaceous shrubs and trees as well as a variety of others within its distribution (DotE 2014b). | VT 1 – Zone 1<br>Zone 2<br>VT 3 – Zone 2<br>VT 4 – Zone 2 |
| Forest Red-tailed Black Cockatoo | *Calyptorhynchus banksii* naso | This species is known to forage amongst proteaceous shrubs and trees as well as a variety of others within its distribution (DotE 2014b) | VT 1 – Zone 1<br>Zone 2<br>VT 3 – Zone 2<br>VT 4 – Zone 2 |
| Western Ringtail Possum | *Pseudocheirus occidentalis* | Habitat for this species is generally within areas of forest or woodland containing Peppermint trees; *Agonis flexuosa* (DotE 2014b). | VT 1 – Zone 1<br>Zone 2<br>VT 2 – Zone 3 |

### 4.5.1 Black cockatoo habitat

Foraging habitat for all three species of Threatened black cockatoos is present throughout Zones 1 and 2 of the proposed offset sites. A list of all foraging species for Carnaby's Black-Cockatoos is available on the DEC (2011) website. The best quality foraging habitat for black cockatoos was observed within Zone 2, which contained both *Banksia* spp. and *Eucalyptus* spp suitable for foraging by black cockatoos. One potential roosting tree was recorded within Zone 2 as displayed in Table 10 and Plate 1. This tree was recorded as potential habitat as its' diameter at breast height (DBH) exceeded 500 mm (DSEWPaC 2012). No hollows were observed in the tree.

Table 10: Potential roosting/nesting trees

| Species | GPS coordinates (GDA 94) | | DBH (cm) | Value (DEC 2011) |
|---|---|---|---|---|
| | Easting | Northing | | |
| *Eucalyptus marginata* | 380579 | 6296941 | 85 | Roosting |

Plate 1: Potential roosting/breeding tree for black cockatoos

# 5. Discussion

Vegetation within the proposed offset sites comprises five VTs. Impacts such as weed invasion and nearby agriculture have contributed to the condition of vegetation within the proposed offset sites. Transitions between VTs were generally discontinuous, though occasionally abrupt with margins representing admixtures of more than one VT. This discontinuity is primarily due to changes in soil profile and topography, and presence of historically cleared areas. At a broad scale, the proposed offset sites were comprised of *Corymbia calophylla – Eucalyptus marginata Agonis flexuosa – Banksia* spp. woodland on elevated areas and flats and fringing woodland of *Eucalyptus rudis – Melaleuca preissiana* along the streams and wetlands.

The flora and vegetation assessment conducted within the site was undertaken during spring, within the prime flowering time for majority of species within the area. Field reconnaissance involved traversing the majority of the proposed offset sites, which ensured that an accurate representation of all VTs and potential conservation significant flora was obtained.

The number of native and exotic species recorded on the site totalled 26 vascular plant taxa from 23 genera and 13 families. Five[2] of these taxa were introduced (exotic species) which were present in large infestations throughout the proposed offset sites. Of particular note was **Briza maxima* which dominated the understorey of the vegetation assemblage and was observed to be outcompeting native plants within the proposed offset sites. No Declared Plant species pursuant to Section 22 of the BAM Act were recorded within the proposed offset sites (DAFWA 2013).

No conservation significant species or ecological communities were recorded within the site. Effort was made during the field assessment to look for areas of suitable habitat for conservation significant species but none were found, which is likely related the highly degraded nature of the understorey within majority of the proposed offset sites. As the survey was conducted within the prime flowering time for majority of the conservation significant species potentially occurring within the proposed offset sites, there is a low possibility of these species occurring.

All five VTs appear to be well represented within the local area based on surrounding vegetation and are consistent with the vegetation expected to be found within the region. The low levels of species diversity within each VT is a reflection of the degraded nature of the understorey within the proposed offset sites. However, given that the overstorey of the VTs remains largely intact, the proposed offset sites will likely respond well to revegetation measures focussed on weed control and understorey planting.

Vegetation condition within the site ranged from Excellent to Degraded (Keighery 1994). Approximately 29.92% of the vegetated areas within the proposed offset sites were mapped to be in “Excellent” condition, 12.72% in “Very Good - Excellent” condition, 2.46% in “Good” condition and 47.44% in “Degraded” condition.

The proposed offset sites contain potential habitat for all three species of Threatened black cockatoos as well as the Western Ringtail possum. The total area of potential habitat for black cockatoos was 12.74 ha (VTs 1, 3 and 4) and the area of potential habitat for Western Ringtail Possums was 10.58 ha (VTs 1, 2 and 3). It is likely that the area of potential habitat for black cockatoos can be increased by revegetation focussing on planting suitable foraging, roosting and nesting species for the birds.

[2] Several exotic species associated with pasture were observed within the proposed offset sites. These species were not identified at the time of survey as they do not significantly contribute to the outcomes of the survey and thus were recorded only as ‘**Pasture species’.*

No nesting hollows for black cockatoos were observed within the proposed offset areas. Given the large bodies of water contained within the *Melaleuca preissiana* wetlands (VT 5) and drainage lines within the proposed offset areas, the installation of nesting boxes for black cockatoos is worth investigating as part of a revegetation/rehabilitation strategy for the sites. If effective, this will present black cockatoos with prime foraging, nesting and roosting habitat adjacent to water sources, thereby increasing the potential value of the land as on offset.

# 6. References

Beard JS 1981, *Swan, 1:1000000 vegetation series: explanatory notes to sheet 7: the vegetation of the Swan area,* University of Western Australia Press, Nedlands, Western Australia.

Beard JS 1990, *Plant Life of Western Australia.* Kangaroo Press, Kenthurst, New South Wales.

Brown A, Thomson-Dans C & Marchant N 1998, *Western Australia's Threatened Flora*, Department of Conservation and Land Management, Perth.

Bureau of Meteorology (BOM) 2014, *Climatic Statistics for Australian Locations*: *Monthly climate statistics for Bunbury,* [Online], Australian Government, Available from: *http://www.bom.gov.au/climate/averages/tables/cw_009965.shtml* [6 October 2014].

Churchward HM & McArthur WM 1980, 'Landforms and Soils of the Darling System', in *Atlas of Natural Resources, Darling System, Western Australia,* eds Department of Conservation and Environment, Perth, pp. 25-33.

Department of Agriculture and Food (DAFWA) 2013, *Declared Pests (s22) list,* [Online], Government of Western Australia, Available from: *http://www.biosecurity.wa.gov.au/organisms/export/PER-DP*.

Department of the Environment (DotE) 2014a, *Interim Biogeographic Regionalisation for Australia, Version 7,* [Online], Australian Government, Available from: *http://www.environment.gov.au/topics/land/national-reserve-system/science-maps-and-data/australias-bioregions-ibra* [6 October 2014].

Department of the Environment (DotE) 2014b, *EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered) Calyptorhynchus latirostris, Baudin's cockatoo (vulnerable) Calyptorhynchus baudinii, Forest red-tailed black cockatoo (vulnerable) Calyptorhynchus banksii naso*, [Online], Australian Government. Available from: *http://www.environment.gov.au/system/files/resources/895d4094-af63-4dd3-8dff-ad2b9b943312/files/referral-guidelines-wa-black-cockatoo.pdf* [6 October 2014].

Department of the Environment (DotE) 2014c, *EPBC Act List of Threatened Ecological Communities,* [Online], Australian Government, Available from: *http://www.environment.gov.au/cgi-bin/sprat/public/publiclookupcommunities.pl* [6 October 2014].

Department of the Environment (DotE) 2014c, *EPBC Act List of Threatened Flora,* [Online], Australian Government, Available from: *http://www.environment.gov.au/cgi-bin/sprat/public/publicthreatenedlist.pl?wanted=flora* [6 October 2014].

Department of the Environment (DotE) 2014d, *EPBC Act Protected Matters Search Tool*, [Online], Australian Government. Available from: http://www.environment.gov.au/epbc/pmst/index.html [6 October 2014].

Department of the Environment (DotE) 2014e, *Species Profiles and Threats Database*, [Online], Australian Government. Available from: http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl [6 February 2014].

Department of Environment and Conservation (DEC) 2010, *Definitions, Categories and Criteria for Threatened and Priority Ecological Communities* , [Online], Government of Western Australia, Available from: *http://www.dec.wa.gov.au/publications/cat_view/460-threatened-species-and-ecological-communities.html* [6 October 2014].

Department of Environment and Conservation (DEC) 2011, *Plants Used by Carnaby's Black Cockatoo,* [Online], Government of Western Australia, Available from: *http://www.dec.wa.gov.au/plantsforcarnabys* [6 October 2014].

Department of Environment and Conservation (DEC) 2013, *2012 Statewide Vegetation Statistics (Full Report)*, Department of Environment and Conservation, Western Australia.

Department of Parks and Wildlife (DPaW) 2007-, *Naturemap, Mapping Western Australia's Biodiversity,* [Online], Government of Western Australia, Available from: *http://naturemap.dpaw.wa.gov.au/default.aspx* [6 October 2014].

Department of Parks and Wildlife (DPaW) 2014a, *List of Threatened Ecological Communities on the Department of Environment and Conservation's Threatened Ecological Community (TEC) Database endorsed by the Western Australian Minister for the Environment, May 2014,* [Online], Government of Western Australia, Available from: *http://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/tecs/Threatened_ecological_communities_endorsed_by_the_Minister_for_Environment_May 2014.pdf* [6 October 2014].

Department of Parks and Wildlife (DPaW) 2014b, *Priority Ecological Communities for Western Australia Version 21 (4 May 2014),* [Online], Government of Western Australia, Available from: *http://www.dpaw.wa.gov.au/images/documents/plants-animals/threatened-species/tecs/Priority_ecological_community_list_20_May2014.pdf* [6 October 2014].

Department of Parks and Wildlife (DPaW) 2014c, *Wildlife Conservation (Threatened Flora) Notice 2013 (17 September 2013),* [Online], Government of Western Australia, Available from: *http://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/listing* [6 October 2014].

Department of Parks and Wildlife Western Australian Herbarium (DPaW WAHerb) 2014a, *FloraBase – the Western Australian Flora*, [Online], Government of Western Australia, Available from: *http://florabase.dpaw.wa.gov.au/* [6 October 2014].

Department of Parks and Wildlife Western Australian Herbarium (DPaW WAHerb) 2014b, *Western Conservation Codes for Western Australian Flora,* [Online], Government of Western Australia, Available from: *http://florabase.dpaw.wa.gov.au/conservationtaxa* [6 October 2014].

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2012, *EPBC Act referral guidelines for three threatened black cockatoo species*, [Online], Australian Government, Available from: *http://www.environment.gov.au/system/files/resources/895d4094-af63-4dd3-8dff-ad2b9b943312/files/referral-guidelines-wa-black-cockatoo.pdf* [6 October 2014].

Environmental Protection Authority (EPA) 2004, *Guidance Statement No. 51, Guidance for the Assessment of Environmental Factors – Terrestrial Flora and Vegetation surveys for Environmental Impact Assessment in Western Australia,* Environmental Protection Authority, Perth.

Executive Steering Committee for Australian Vegetation Information (ESCAVI) 2003, *Australian Vegetation Attribute Manual: National Vegetation Information System, Version 6.0,* Department of the Environment and Heritage, Australian Capital Territory.

Gibson N, Keighery B, Keighery G, Burbidge A & Lyons M 1994, *A Floristic survey of the southern Swan Coastal Plain*, report prepared for the Australian Heritage Commission, 1994.

Heddle EM, Loneragan OW & Havel JJ 1980, *Darling System, Vegetation Complexes*, Forest Department, Perth.

Keighery B 1994, *Bushland Plant Survey: A Guide to Plant Community Survey for the Community*, Wildflower Society, Floreat.

Mitchell D, Williams K & Desmond A 2002, 'Swan Coastal Plain 2 (SWA2 – Swan Coastal Plain subregion)', in *A biodiversity audit of Western Australia's 53 Biogeographical Subregions in 2002,* eds Department of Conservation and Land Management, Perth, pp. 606-623.

Semeniuk V 1990, 'The geomorphology and soils of Yoongarillup Plain, in the Mandurah-Bunbury coastal zone, southwestern Australia: a critical appraisal', *Journal of the Royal Society of Western Australia*, vol. 73, pp. 1-7.

# Appendix 1
# Vascular plant taxa recorded by site and vegetation community

| Species | Site | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | SITE 01 | SITE 02 | SITE 03 | SITE 04 | SITE 05 | WETLAND 01 | WETLAND 02 | WETLAND 03 |
| *Acacia pulchella* | | | x | | | | | |
| *Acacia willdenowiana* | | | x | | | | | |
| *Agonis flexuosa* | x | x | | x | | | | |
| **Arctotheca calendula* | | x | | | | | | |
| *Banksia attenuata* | | | x | | x | | | |
| **Briza maxima* | x | x | | | x | | | |
| *Burchardia congesta* | | | x | | | | | |
| *Caladenia flava* | | | x | | | | | |
| *Caladenia latifolia* | x | | | | | | | |
| *Corymbia calophylla* | x | | | x | x | | | |
| *Cyanicula gemmata* | | | x | | | | | |
| *Dasypogon bromeliifolius* | | | x | | | | | |
| *Eucalyptus marginata* | | | x | | | | | |
| *Eucalyptus rudis* | x | | | x | | | | |
| *Gastrolobium ebracteolatum* | x | | | | | | | |
| *Hibbertia subvaginata* | | x | | | | | | |
| **Hypochaeris glabra* | x | x | x | | | | | |
| *Kunzea glabrescens* | | | x | | x | | | |
| *Melaleuca preissiana* | x | | | | | x | x | x |
| *Pasture species[1] | | | | x | | | | |
| *Plathytheca galioides* | | | x | | | | | |
| **Poaceae* sp. | x | x | | | x | | | |
| *Pteridium esculentum* | x | | | | | | | |
| **Sonchus asper* | x | | | | | | | |
| *Taxandria linearifolia* | | | | x | | | | |
| *Trachymene pilosa* | | x | | | | | | |
| *Xanthorrhoea gracilis* | | | x | | | | | |

| Legend |
|---|
| VT 1 |
| VT 2 |
| VT 3 |
| VT 4 |
| VT 5 |

* denotes introduced (exotic) species (DPaW WAHERB 2013a)

[1] Represents a mxiture of pasture grasses, herbs and forbs

# Appendix 2
# Photographic record of site and Vegetation Types

| Site | Photo | Vegetation Type |
| --- | --- | --- |
| Site 1 |  | VT 1 |
| Site 2 |  | VT 2 |

| Site | Photo | Vegetation Type |
| --- | --- | --- |
| Site 3 |  | VT 3 |
| Site 4 |  | VT 1 |

| Site | Photo | Vegetation Type |
|---|---|---|
| Site 5 |  | VT 4 |
| Wetland 1 |  | VT 5 |

| Site | Photo | Vegetation Type |
|---|---|---|
| Wetland 2 |  | VT 5 |
| Wetland 3 | Technical error importing photo from camera | VT 5 |

# Appendix 3
# Desktop assessment results
# (DPaW 2007-, DotE 2014d)

Australian Government

Department of the Environment

# EPBC Act Protected Matters Report

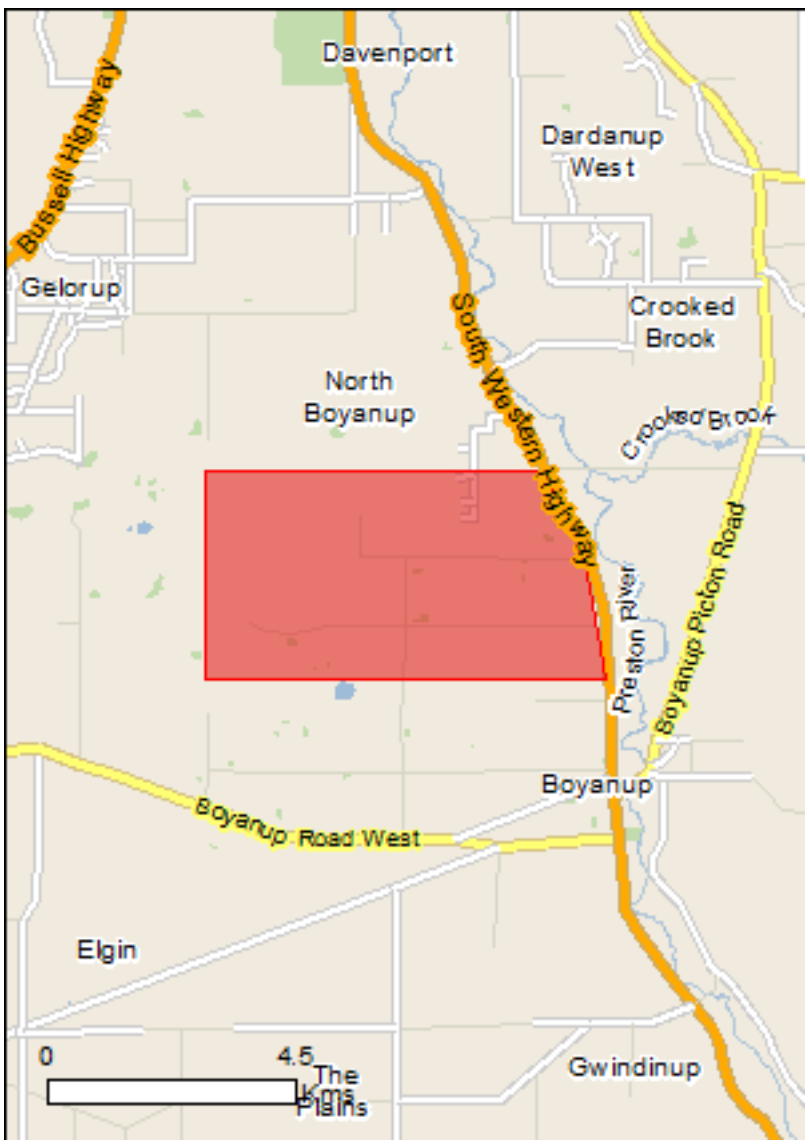
This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 06/10/14 14:20:10

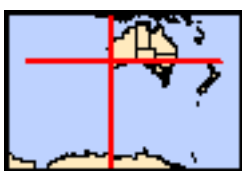





This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates

Buffer: 2.0Km



# Summary

## Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

| | |
|---|---|
| World Heritage Properties: | None |
| National Heritage Places: | None |
| Wetlands of International Importance: | None |
| Great Barrier Reef Marine Park: | None |
| Commonwealth Marine Areas: | None |
| Listed Threatened Ecological Communities: | None |
| Listed Threatened Species: | 24 |
| Listed Migratory Species: | 5 |

## Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place and the heritage values of a place on the Register of the National Estate.

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

| | |
|---|---|
| Commonwealth Land: | 1 |
| Commonwealth Heritage Places: | None |
| Listed Marine Species: | 7 |
| Whales and Other Cetaceans: | None |
| Critical Habitats: | None |
| Commonwealth Reserves Terrestrial: | None |
| Commonwealth Reserves Marine | None |

## Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

| | |
|---|---|
| Place on the RNE: | None |
| State and Territory Reserves: | None |
| Regional Forest Agreements: | None |
| Invasive Species: | 25 |
| Nationally Important Wetlands: | None |
| Key Ecological Features (Marine) | None |

# Details

## Matters of National Environmental Significance

| Listed Threatened Species | | [ Resource Information ] |
|---|---|---|
| Name | Status | Type of Presence |
| Birds | | |
| Calyptorhynchus banksii naso | | |
| Forest Red-tailed Black-Cockatoo, Karrak [67034] | Vulnerable | Species or species habitat may occur within area |
| Calyptorhynchus baudinii | | |
| Baudin's Black-Cockatoo, Long-billed Black-Cockatoo [769] | Vulnerable | Breeding known to occur within area |
| Calyptorhynchus latirostris | | |
| Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523] | Endangered | Breeding likely to occur within area |
| Mammals | | |
| Dasyurus geoffroii | | |
| Chuditch, Western Quoll [330] | Vulnerable | Species or species habitat likely to occur within area |
| Pseudocheirus occidentalis | | |
| Western Ringtail Possum, Ngwayir [25911] | Vulnerable | Species or species habitat known to occur within area |
| Setonix brachyurus | | |
| Quokka [229] | Vulnerable | Species or species habitat may occur within area |
| Plants | | |
| Andersonia gracilis | | |
| Slender Andersonia [14470] | Endangered | Species or species habitat may occur within area |
| Banksia nivea subsp. uliginosa | | |
| Swamp Honeypot [82766] | Endangered | Species or species habitat may occur within area |
| Banksia squarrosa subsp. argillacea | | |
| Whicher Range Dryandra [82769] | Vulnerable | Species or species habitat may occur within area |

| Name | Status | Type of Presence |
|---|---|---|
| Brachyscias verecundus | | |
| Ironstone Brachyscias [81321] | Critically Endangered | Species or species habitat may occur within area |
| Caladenia huegelii | | |
| King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309] | Endangered | Species or species habitat likely to occur within area |
| Centrolepis caespitosa | | |
| [6393] | Endangered | Species or species habitat likely to occur within area |
| Chamelaucium sp. C Coastal Plain (R.D.Royce 4872) | | |
| Royce's Waxflower [86887] | Vulnerable | Species or species habitat may occur within area |
| Darwinia foetida | | |
| Muchea Bell [83190] | Critically Endangered | Species or species habitat likely to occur within area |
| Darwinia whicherensis | | |
| Abba Bell [83193] | Endangered | Species or species habitat may occur within area |
| Diuris micrantha | | |
| Dwarf Bee-orchid [55082] | Vulnerable | Species or species habitat likely to occur within area |
| Diuris purdiei | | |
| Purdie's Donkey-orchid [12950] | Endangered | Species or species habitat may occur within area |
| Drakaea elastica | | |
| Glossy-leafed Hammer-orchid, Praying Virgin [16753] | Endangered | Species or species habitat known to occur within area |
| Drakaea micrantha | | |
| Dwarf Hammer-orchid [56755] | Vulnerable | Species or species habitat known to occur within area |
| Eleocharis keigheryi | | |
| Keighery's Eleocharis [64893] | Vulnerable | Species or species habitat likely to occur within area |
| Gastrolobium papilio | | |
| Butterfly-leaved Gastrolobium [78415] | Endangered | Species or species habitat may occur within area |
| Lambertia echinata subsp. occidentalis | | |
| Western Prickly Honeysuckle [64528] | Endangered | Species or species habitat may occur within area |
| Petrophile latericola | | |
| Laterite Petrophile [64532] | Endangered | Species or species habitat may occur within area |
| Synaphea stenoloba | | |
| Dwellingup Synaphea [66311] | Endangered | Species or species habitat may occur within area |

## Listed Migratory Species [ Resource Information ]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

| Name | Threatened | Type of Presence |
|---|---|---|
| Migratory Marine Birds | | |
| Apus pacificus | | |
| Fork-tailed Swift [678] | | Species or species habitat likely to occur within area |
| Migratory Terrestrial Species | | |
| Haliaeetus leucogaster | | |
| White-bellied Sea-Eagle [943] | | Species or species habitat known to occur |

| Name | Threatened | Type of Presence |
|---|---|---|
| | | within area |
| Merops ornatus | | |
| Rainbow Bee-eater [670] | | Species or species habitat may occur within area |
| Migratory Wetlands Species | | |
| Ardea alba | | |
| Great Egret, White Egret [59541] | | Species or species habitat likely to occur within area |
| Ardea ibis | | |
| Cattle Egret [59542] | | Species or species habitat likely to occur within area |

## Other Matters Protected by the EPBC Act

### Commonwealth Land [ Resource Information ]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

| Name |
|---|
| Commonwealth Land - |

### Listed Marine Species [ Resource Information ]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

| Name | Threatened | Type of Presence |
|---|---|---|
| Birds | | |
| Apus pacificus | | |
| Fork-tailed Swift [678] | | Species or species habitat likely to occur within area |
| Ardea alba | | |
| Great Egret, White Egret [59541] | | Species or species habitat likely to occur within area |
| Ardea ibis | | |
| Cattle Egret [59542] | | Species or species habitat likely to occur within area |
| Haliaeetus leucogaster | | |
| White-bellied Sea-Eagle [943] | | Species or species habitat known to occur within area |
| Merops ornatus | | |
| Rainbow Bee-eater [670] | | Species or species habitat may occur within area |
| Pandion haliaetus | | |
| Osprey [952] | | Species or species habitat likely to occur within area |
| Thinornis rubricollis | | |
| Hooded Plover [59510] | | Species or species habitat may occur within area |

## Extra Information

### Invasive Species [ Resource Information ]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

| Name | Status | Type of Presence |
|---|---|---|
| Birds | | |
| Anas platyrhynchos<br>Mallard [974] | | Species or species habitat likely to occur within area |
| Columba livia<br>Rock Pigeon, Rock Dove, Domestic Pigeon [803] | | Species or species habitat likely to occur within area |
| Passer domesticus<br>House Sparrow [405] | | Species or species habitat likely to occur within area |
| Passer montanus<br>Eurasian Tree Sparrow [406] | | Species or species habitat likely to occur within area |
| Streptopelia chinensis<br>Spotted Turtle-Dove [780] | | Species or species habitat likely to occur within area |
| Streptopelia senegalensis<br>Laughing Turtle-dove, Laughing Dove [781] | | Species or species habitat likely to occur within area |
| Mammals | | |
| Canis lupus familiaris<br>Domestic Dog [82654] | | Species or species habitat likely to occur within area |
| Felis catus<br>Cat, House Cat, Domestic Cat [19] | | Species or species habitat likely to occur within area |
| Feral deer<br>Feral deer species in Australia [85733] | | Species or species habitat likely to occur within area |
| Mus musculus<br>House Mouse [120] | | Species or species |

| Name | Status | Type of Presence |
|---|---|---|
| | | habitat likely to occur within area |
| Oryctolagus cuniculus<br>Rabbit, European Rabbit [128] | | Species or species habitat likely to occur within area |
| Rattus rattus<br>Black Rat, Ship Rat [84] | | Species or species habitat likely to occur within area |
| Sus scrofa<br>Pig [6] | | Species or species habitat likely to occur within area |
| Vulpes vulpes<br>Red Fox, Fox [18] | | Species or species habitat likely to occur within area |
| Plants | | |
| Asparagus asparagoides<br>Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473] | | Species or species habitat likely to occur within area |
| Brachiaria mutica<br>Para Grass [5879] | | Species or species habitat may occur within area |
| Cenchrus ciliaris<br>Buffel-grass, Black Buffel-grass [20213] | | Species or species habitat may occur within area |
| Chrysanthemoides monilifera<br>Bitou Bush, Boneseed [18983] | | Species or species habitat may occur within area |
| Genista linifolia<br>Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800] | | Species or species habitat likely to occur within area |
| Genista sp. X Genista monspessulana<br>Broom [67538] | | Species or species habitat may occur within area |
| Lycium ferocissimum<br>African Boxthorn, Boxthorn [19235] | | Species or species habitat likely to occur within area |
| Olea europaea<br>Olive, Common Olive [9160] | | Species or species habitat may occur within area |
| Pinus radiata<br>Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780] | | Species or species habitat may occur within area |
| Rubus fruticosus aggregate<br>Blackberry, European Blackberry [68406] | | Species or species habitat likely to occur within area |
| Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii<br>Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497] | | Species or species habitat likely to occur within area |

# Coordinates

-33.438663 115.716563,-33.448618 115.722829,-33.448618 115.722829,-33.467093 115.726949,-33.466878 115.66146,-33.438519 115.66146,-33.438663 115.716563

# Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World Heritage and Register of National Estate properties, Wetlands of International Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

# Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Department of Environment, Climate Change and Water, New South Wales
-Department of Sustainability and Environment, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment and Natural Resources, South Australia
-Parks and Wildlife Service NT, NT Dept of Natural Resources, Environment and the Arts
-Environmental and Resource Management, Queensland
-Department of Environment and Conservation, Western Australia
-Department of the Environment, Climate Change, Energy and Water
-Birds Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-SA Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
-State Forests of NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.


Department of the Environment
GPO Box 787
Canberra ACT 2601 Australia
+61 2 6274 1111

NatureMap
Mapping Western Australia's biodiversity

# SJO14236.01 Flora

*Created By Daniel Panickar on 06/10/2014*

| | |
|---|---|
| **Kingdom** | Plantae |
| **Current Names Only** | Yes |
| **Core Datasets Only** | Yes |
| **Method** | 'By Circle' |
| **Centre** | 115°43' 05" E,33°26' 35" S |
| **Buffer** | 5km |
| **Group By** | Family |

| Family | Species | Records |
|---|---|---|
| Amaranthaceae | 1 | 3 |
| Amaryllidaceae | 2 | 2 |
| Anarthriaceae | 2 | 2 |
| Apiaceae | 1 | 1 |
| Aponogetonaceae | 1 | 5 |
| Araliaceae | 1 | 1 |
| Asparagaceae | 10 | 12 |
| Asteraceae | 16 | 17 |
| Brassicaceae | 1 | 1 |
| Campanulaceae | 1 | 1 |
| Caprifoliaceae | 1 | 2 |
| Caryophyllaceae | 3 | 4 |
| Casuarinaceae | 1 | 1 |
| Chenopodiaceae | 2 | 3 |
| Colchicaceae | 3 | 3 |
| Commelinaceae | 1 | 1 |
| Cyperaceae | 19 | 23 |
| Dasypogonaceae | 2 | 3 |
| Dennstaedtiaceae | 1 | 1 |
| Dicranaceae | 1 | 1 |
| Dilleniaceae | 4 | 8 |
| Droseraceae | 6 | 12 |
| Elaeocarpaceae | 1 | 2 |
| Elatinaceae | 1 | 1 |
| Ericaceae | 8 | 10 |
| Euphorbiaceae | 1 | 1 |
| Fabaceae | 38 | 78 |
| Gentianaceae | 1 | 1 |
| Geraniaceae | 2 | 3 |
| Goodeniaceae | 3 | 3 |
| Haemodoraceae | 7 | 10 |
| Haloragaceae | 1 | 1 |
| Hemerocallidaceae | 3 | 3 |
| Hydatellaceae | 1 | 1 |
| Hydrocharitaceae | 1 | 1 |
| Iridaceae | 8 | 11 |
| Juncaceae | 2 | 2 |
| Lamiaceae | 2 | 2 |
| Linaceae | 1 | 1 |
| Loganiaceae | 2 | 3 |
| Loranthaceae | 1 | 1 |
| Malvaceae | 1 | 1 |
| Marsileaceae | 2 | 2 |
| Menyanthaceae | 1 | 3 |
| Myrtaceae | 20 | 25 |
| Orchidaceae | 33 | 42 |
| Poaceae | 22 | 25 |
| Polygalaceae | 1 | 1 |
| Polygonaceae | 2 | 2 |
| Proteaceae | 16 | 21 |
| Racopilaceae | 1 | 1 |
| Restionaceae | 4 | 6 |
| Rutaceae | 4 | 9 |
| Santalaceae | 3 | 4 |
| Selaginellaceae | 1 | 1 |
| Stylidiaceae | 9 | 13 |
| Thymelaeaceae | 4 | 4 |
| Xanthorrhoeaceae | 1 | 3 |
| **TOTAL** | **289** | **405** |

| | Name ID | Species Name | Naturalised | Conservation Code | [1]Endemic To Query Area |
|---|---|---|---|---|---|
| **Amaranthaceae** | | | | | |
| 1. | 2655 | *Amaranthus albus (Tumbleweed)* | Y | | |
| **Amaryllidaceae** | | | | | |
| 2. | 1493 | *Leucojum aestivum (Snowflake)* | Y | | |

| | Name ID | Species Name | Naturalised | Conservation Code | [1]Endemic To Query Area |
|---|---|---|---|---|---|
| 3. | 1495 | *Narcissus tazetta (Jonquil)* | Y | | |
| **Anarthriaceae** | | | | | |
| 4. | 1062 | *Anarthria prolifera* | | | |
| 5. | 18049 | *Lyginia imberbis* | | | |
| **Apiaceae** | | | | | |
| 6. | 6249 | *Platysace compressa (Tapeworm Plant)* | | | |
| **Aponogetonaceae** | | | | | |
| 7. | 141 | *Aponogeton hexatepalus (Stalked Water Ribbons)* | | P4 | |
| **Araliaceae** | | | | | |
| 8. | 6280 | *Trachymene pilosa (Native Parsnip)* | | | |
| **Asparagaceae** | | | | | |
| 9. | 8779 | *Asparagus asparagoides (Bridal Creeper)* | Y | | |
| 10. | 1280 | *Chamaescilla corymbosa (Blue Squill)* | | | |
| 11. | 1308 | *Laxmannia sessiliflora (Nodding Lily)* | | | |
| 12. | 1228 | *Lomandra hermaphrodita* | | | |
| 13. | 1234 | *Lomandra nigricans* | | | |
| 14. | 1239 | *Lomandra preissii* | | | |
| 15. | 1243 | *Lomandra sericea (Silky Mat Rush)* | | | |
| 16. | 1372 | *Ornithogalum arabicum (Lesser Cape Lily)* | Y | | |
| 17. | 1339 | *Thysanotus multiflorus (Many-flowered Fringe Lily)* | | | |
| 18. | 1343 | *Thysanotus patersonii* | | | |
| **Asteraceae** | | | | | |
| 19. | 7838 | *Arctotheca calendula (Cape Weed)* | Y | | |
| 20. | 7851 | *Asteridea pulverulenta (Common Bristle Daisy)* | | | |
| 21. | 7947 | *Cotula turbinata (Funnel Weed)* | Y | | |
| 22. | 13354 | *Craspedia variabilis* | | | |
| 23. | 16759 | *Hyalosperma simplex subsp. simplex* | | | |
| 24. | 8105 | *Millotia myosotidifolia* | | | |
| 25. | 8117 | *Myriocephalus helichrysoides* | | | |
| 26. | 8133 | *Olearia elaeophila* | | | |
| 27. | 8175 | *Podolepis gracilis (Slender Podolepis)* | | | |
| 28. | 13300 | *Rhodanthe citrina* | | | |
| 29. | 13312 | *Rhodanthe pyrethrum* | | | |
| 30. | 8203 | *Senecio diaschides* | Y | | |
| 31. | 20663 | *Senecio multicaulis subsp. multicaulis* | | | |
| 32. | 9367 | *Sonchus hydrophilus (Native Sowthistle)* | | | |
| 33. | 8248 | *Tolpis barbata (Yellow Hawkweed)* | Y | | |
| 34. | 38388 | *Ursinia anthemoides subsp. anthemoides* | Y | | |
| **Brassicaceae** | | | | | |
| 35. | 3071 | *Sisymbrium officinale (Hedge Mustard)* | Y | | |
| **Campanulaceae** | | | | | |
| 36. | 7408 | *Lobelia tenuior (Slender Lobelia)* | | | |
| **Caprifoliaceae** | | | | | |
| 37. | 7366 | *Centranthus macrosiphon* | Y | | |
| **Caryophyllaceae** | | | | | |
| 38. | 2894 | *Moenchia erecta (Erect Chickweed)* | Y | | |
| 39. | 19825 | *Petrorhagia dubia* | Y | | |
| 40. | 2912 | *Spergula arvensis (Corn Spurry)* | Y | | |
| **Casuarinaceae** | | | | | |
| 41. | 1732 | *Allocasuarina humilis (Dwarf Sheoak)* | | | |
| **Chenopodiaceae** | | | | | |
| 42. | 2491 | *Chenopodium macrospermum* | Y | | |
| 43. | 33480 | *Dysphania pumilio (Clammy Goosefoot)* | | | |
| **Colchicaceae** | | | | | |
| 44. | 1382 | *Baeometra uniflora* | Y | | |
| 45. | 12770 | *Burchardia congesta* | | | |
| 46. | 1385 | *Burchardia multiflora (Dwarf Burchardia)* | | | |
| **Commelinaceae** | | | | | |
| 47. | 1162 | *Cartonema philydroides* | | | |
| **Cyperaceae** | | | | | |
| 48. | 748 | *Baumea vaginalis (Sheath Twigrush)* | | | |
| 49. | 13766 | *Caustis sp. Boyanup (G.S. McCutcheon 1706)* | | P3 | |
| 50. | 822 | *Eleocharis acuta (Common Spikerush)* | | | |

| | Name ID | Species Name | Naturalised | Conservation Code | [1]Endemic To Query Area |
|---|---|---|---|---|---|
| 51. | 17605 | *Eleocharis keigheryi* | | T | |
| 52. | 835 | *Evandra pauciflora* | | | |
| 53. | 917 | *Isolepis marginata (Coarse Club-rush)* | Y | | |
| 54. | 919 | *Isolepis oldfieldiana* | | | |
| 55. | 930 | *Lepidosperma costale* | | | |
| 56. | 937 | *Lepidosperma longitudinale (Pithy Sword-sedge)* | | | |
| 57. | 940 | *Lepidosperma pubisquameum* | | | |
| 58. | 945 | *Lepidosperma squamatum* | | | |
| 59. | 946 | *Lepidosperma striatum* | | | |
| 60. | 11473 | *Mesomelaena stygia subsp. stygia* | | | |
| 61. | 975 | *Schoenus bifidus* | | | |
| 62. | 978 | *Schoenus brevisetis* | | | |
| 63. | 984 | *Schoenus curvifolius* | | | |
| 64. | 986 | *Schoenus efoliatus* | | | |
| 65. | 1020 | *Schoenus sublateralis* | | | |
| 66. | 1036 | *Tetraria octandra* | | | |
| **Dasypogonaceae** | | | | | |
| 67. | 19309 | *Calectasia narragara* | | | |
| 68. | 1218 | *Dasypogon bromeliifolius (Pineapple Bush)* | | | |
| **Dennstaedtiaceae** | | | | | |
| 69. | 41651 | *Pteridium esculentum subsp. esculentum* | | | |
| **Dicranaceae** | | | | | |
| 70. | 32338 | *Campylopus introflexus* | Y | | |
| **Dilleniaceae** | | | | | |
| 71. | 20051 | *Hibbertia diamesogenos* | | | |
| 72. | 5135 | *Hibbertia hypericoides (Yellow Buttercups)* | | | |
| 73. | 5162 | *Hibbertia racemosa (Stalked Guinea Flower)* | | | |
| 74. | 5172 | *Hibbertia stellaris (Orange Stars)* | | | |
| **Droseraceae** | | | | | |
| 75. | 13217 | *Drosera erythrorhiza subsp. erythrorhiza* | | | |
| 76. | 3102 | *Drosera huegelii (Bold Sundew)* | | | |
| 77. | 13209 | *Drosera marchantii subsp. marchantii* | | | |
| 78. | 13216 | *Drosera menziesii subsp. penicillaris* | | | |
| 79. | 3117 | *Drosera paleacea (Dwarf Sundew)* | | | |
| 80. | 3118 | *Drosera pallida (Pale Rainbow)* | | | |
| **Elaeocarpaceae** | | | | | |
| 81. | 4524 | *Platytheca galioides* | | | |
| **Elatinaceae** | | | | | |
| 82. | 5187 | *Elatine gratioloides (Waterwort)* | | | |
| **Ericaceae** | | | | | |
| 83. | 6306 | *Andersonia caerulea (Foxtails)* | | | |
| 84. | 6348 | *Conostephium pendulum (Pearl Flower)* | | | |
| 85. | 6360 | *Leucopogon australis (Spiked Beard-heath)* | | | |
| 86. | 6367 | *Leucopogon capitellatus* | | | |
| 87. | 6374 | *Leucopogon conostephioides* | | | |
| 88. | 6436 | *Leucopogon propinquus* | | | |
| 89. | 29492 | *Leucopogon sp. Busselton (D. Cooper 243)* | | P2 | |
| 90. | 34736 | *Lysinema pentapetalum* | | | |
| **Euphorbiaceae** | | | | | |
| 91. | 4705 | *Ricinus communis (Castor Oil Plant)* | Y | | |
| **Fabaceae** | | | | | |
| 92. | 15466 | *Acacia applanata* | | | |
| 93. | 3331 | *Acacia extensa (Wiry Wattle)* | | | |
| 94. | 3339 | *Acacia flagelliformis* | | P4 | |
| 95. | 3374 | *Acacia huegelii* | | | |
| 96. | 3410 | *Acacia lateriticola* | | | |
| 97. | 15481 | *Acacia pulchella var. glaberrima* | | | |
| 98. | 3537 | *Acacia semitrullata* | | P4 | |
| 99. | 3557 | *Acacia stenoptera (Narrow Winged Wattle)* | | | |
| 100. | 15487 | *Acacia varia var. varia* | | | |
| 101. | 3688 | *Aotus gracillima* | | | |
| 102. | 3710 | *Bossiaea eriocarpa (Common Brown Pea)* | | | |
| 103. | 8971 | *Chorizema cordatum* | | | |
| 104. | 3757 | *Chorizema glycinifolium* | | | |
| 105. | 11879 | *Daviesia hakeoides subsp. hakeoides* | | | |

| | Name ID | Species Name | Naturalised | Conservation Code | [1]Endemic To Query Area |
|---|---|---|---|---|---|
| 106. | 3832 | *Daviesia physodes* | | | |
| 107. | 3839 | *Daviesia rhombifolia* | | | |
| 108. | 3872 | *Euchilopsis linearis (Swamp Pea)* | | | |
| 109. | 3880 | *Eutaxia virgata* | | | |
| 110. | 20474 | *Gastrolobium whicherense* | | P2 | |
| 111. | 3948 | *Gompholobium capitatum* | | | |
| 112. | 3954 | *Gompholobium polymorphum* | | | |
| 113. | 3956 | *Gompholobium shuttleworthii* | | | |
| 114. | 3957 | *Gompholobium tomentosum (Hairy Yellow Pea)* | | | |
| 115. | 3961 | *Hardenbergia comptoniana (Native Wisteria)* | | | |
| 116. | 3968 | *Hovea trisperma (Common Hovea)* | | | |
| 117. | 4012 | *Jacksonia furcellata (Grey Stinkwood)* | | | |
| 118. | 4017 | *Jacksonia horrida* | | | |
| 119. | 4036 | *Kennedia carinata* | | | |
| 120. | 4037 | *Kennedia coccinea (Coral Vine)* | | | |
| 121. | 4044 | *Kennedia prostrata (Scarlet Runner)* | | | |
| 122. | 4052 | *Latrobea tenella* | | | |
| 123. | 4113 | *Ornithopus compressus (Yellow Serradella)* | Y | | |
| 124. | 4183 | *Pultenaea skinneri (Skinner's Pea)* | | P4 | |
| 125. | 4207 | *Sphaerolobium medium* | | | |
| 126. | 4210 | *Sphaerolobium scabriusculum* | | | |
| 127. | 4302 | *Trifolium ligusticum (Ligurian Clover)* | Y | | |
| 128. | 4313 | *Trifolium subterraneum (Subterranean Clover)* | Y | | |
| 129. | 11474 | *Vicia sativa subsp. nigra* | Y | | |
| **Gentianaceae** | | | | | |
| 130. | 6543 | *Cicendia filiformis (Slender Cicendia)* | Y | | |
| **Geraniaceae** | | | | | |
| 131. | 4332 | *Erodium botrys (Long Storksbill)* | Y | | |
| 132. | 4337 | *Geranium dissectum (Cutleaf Cranesbill)* | Y | | |
| **Goodeniaceae** | | | | | |
| 133. | 7462 | *Dampiera pedunculata* | | | |
| 134. | 7517 | *Goodenia incana (Hoary Goodenia)* | | | |
| 135. | 19284 | *Goodenia pulchella subsp. Coastal Plain B (L.W. Sage 2336)* | | | |
| **Haemodoraceae** | | | | | |
| 136. | 1411 | *Anigozanthos manglesii (Mangles Kangaroo Paw, Kurulbrang)* | | | |
| 137. | 1418 | *Conostylis aculeata (Prickly Conostylis)* | | | |
| 138. | 1453 | *Conostylis serrulata* | | | |
| 139. | 1468 | *Haemodorum laxum* | | | |
| 140. | 1474 | *Haemodorum sparsiflorum* | | | |
| 141. | 1475 | *Haemodorum spicatum (Mardja)* | | | |
| 142. | 1482 | *Tribonanthes brachypetala* | | | |
| **Haloragaceae** | | | | | |
| 143. | 33620 | *Glischrocaryon angustifolium* | | | |
| **Hemerocallidaceae** | | | | | |
| 144. | 23474 | *Agrostocrinum hirsutum* | | | |
| 145. | 1295 | *Johnsonia acaulis* | | | |
| 146. | 1361 | *Tricoryne elatior (Yellow Autumn Lily)* | | | |
| **Hydatellaceae** | | | | | |
| 147. | 1139 | *Trithuria bibracteata* | | | |
| **Hydrocharitaceae** | | | | | |
| 148. | 168 | *Ottelia ovalifolia (Swamp Lily)* | | | |
| **Iridaceae** | | | | | |
| 149. | 18392 | *Freesia alba x leichtlinii* | Y | | |
| 150. | 1532 | *Ixia maculata (Yellow Ixia)* | Y | | |
| 151. | 1533 | *Ixia paniculata* | Y | | |
| 152. | 19179 | *Moraea flaccida (One-leaf Cape Tulip)* | Y | | |
| 153. | 1550 | *Patersonia occidentalis (Purple Flag, Koma)* | | | |
| 154. | 11550 | *Patersonia umbrosa var. xanthina (Yellow Flags)* | | | |
| 155. | 1557 | *Sisyrinchium exile* | Y | | |
| 156. | 1561 | *Tritonia crocata* | Y | | |
| **Juncaceae** | | | | | |
| 157. | 1179 | *Juncus caespiticius (Grassy Rush)* | | | |
| 158. | 1186 | *Juncus microcephalus* | Y | | |
| **Lamiaceae** | | | | | |
| 159. | 6839 | *Hemiandra pungens (Snakebush)* | | | |

| | Name ID | Species Name | Naturalised | Conservation Code | [1]Endemic To Query Area |
|---|---|---|---|---|---|
| 160. | 6883 | *Mentha pulegium (Pennyroyal)* | Y | | |
| **Linaceae** | | | | | |
| 161. | 4363 | *Linum trigynum (French Flax)* | Y | | |
| **Loganiaceae** | | | | | |
| 162. | 43201 | *Adelphacme minima* | | P3 | |
| 163. | 13128 | *Logania serpyllifolia subsp. angustifolia* | | | |
| **Loranthaceae** | | | | | |
| 164. | 2401 | *Nuytsia floribunda (Christmas Tree, Mudja)* | | | |
| **Malvaceae** | | | | | |
| 165. | 10915 | *Brachychiton populneus (Kurrajong)* | Y | | |
| **Marsileaceae** | | | | | |
| 166. | 74 | *Marsilea drummondii (Common Nardoo)* | | | |
| 167. | 78 | *Pilularia novae-hollandiae (Austral Pillwort)* | | | |
| **Menyanthaceae** | | | | | |
| 168. | 36200 | *Ornduffia submersa* | | P4 | |
| **Myrtaceae** | | | | | |
| 169. | 5315 | *Actinodium cunninghamii (Albany Daisy)* | | | |
| 170. | 5316 | *Agonis flexuosa (Peppermint, Wonil)* | | | |
| 171. | 17202 | *Agonis flexuosa var. flexuosa* | | | |
| 172. | 20283 | *Astartea scoparia* | | | |
| 173. | 5415 | *Calothamnus lateralis* | | | |
| 174. | 5458 | *Calytrix flavescens (Summer Starflower)* | | | |
| 175. | 5708 | *Eucalyptus marginata (Jarrah, Djara)* | | | |
| 176. | 5763 | *Eucalyptus rudis (Flooded Gum, Kulurda)* | | | |
| 177. | 12906 | *Eucalyptus wandoo subsp. wandoo* | | | |
| 178. | 5816 | *Homalospermum firmum* | | | |
| 179. | 5817 | *Hypocalymma angustifolium (White Myrtle, Kudjid)* | | | |
| 180. | 35070 | *Hypocalymma angustifolium subsp. Swan Coastal Plain (G.J. Keighery 16777)* | | | |
| 181. | 5819 | *Hypocalymma ericifolium* | | | |
| 182. | 5841 | *Kunzea recurva* | | | |
| 183. | 18394 | *Melaleuca parviceps* | | | |
| 184. | 6006 | *Pericalymma ellipticum (Swamp Teatree)* | | | |
| 185. | 16478 | *Pericalymma ellipticum var. floridum* | | | |
| 186. | 20133 | *Taxandria parviceps* | | | |
| 187. | 12388 | *Verticordia acerosa var. preissii* | | | |
| 188. | 15618 | *Verticordia plumosa var. plumosa* | | | |
| **Orchidaceae** | | | | | |
| 189. | 15332 | *Caladenia attingens subsp. attingens* | | | |
| 190. | 15579 | *Caladenia chapmanii* | | | |
| 191. | 1586 | *Caladenia discoidea (Dancing Orchid)* | | | |
| 192. | 15348 | *Caladenia flava subsp. flava* | | | |
| 193. | 1599 | *Caladenia latifolia (Pink Fairy Orchid)* | | | |
| 194. | 13859 | *Caladenia longicauda subsp. clivicola* | | | |
| 195. | 15372 | *Caladenia nana subsp. unita* | | | |
| 196. | 17760 | *Caladenia nobilis* | | | |
| 197. | 18026 | *Caladenia pendens subsp. pendens* | | | |
| 198. | 15377 | *Caladenia reptans subsp. reptans* | | | |
| 199. | 18019 | *Caladenia vulgata* | | | |
| 200. | 15114 | *Cyanicula gemmata* | | | |
| 201. | 15404 | *Cyanicula sericea* | | | |
| 202. | 19649 | *Disa bracteata* | Y | | |
| 203. | 11049 | *Diuris corymbosa* | | | |
| 204. | 1639 | *Drakaea elastica (Glossy-leaved Hammer Orchid)* | | T | |
| 205. | 11156 | *Drakaea livida* | | | |
| 206. | 13635 | *Drakaea micrantha* | | T | |
| 207. | 1643 | *Elythranthera brunonis (Purple Enamel Orchid)* | | | |
| 208. | 15410 | *Eriochilus dilatatus subsp. dilatatus* | | | |
| 209. | 15412 | *Eriochilus dilatatus subsp. multiflorus* | | | |
| 210. | 1653 | *Leporella fimbriata (Hare Orchid)* | | | |
| 211. | 31713 | *Microtis cupularis* | | | |
| 212. | 15419 | *Microtis media subsp. media* | | | |
| 213. | 1667 | *Paracaleana nigrita (Flying Duck Orchid)* | | | |
| 214. | 10853 | *Prasophyllum plumiforme* | | | |
| 215. | 1693 | *Pterostylis recurva (Jug Orchid)* | | | |
| 216. | 18655 | *Pterostylis sp. crinkled leaf (G.J. Keighery 13426)* | | | |
| 217. | 1698 | *Pterostylis vittata (Banded Greenhood)* | | | |

| | Name ID | Species Name | Naturalised | Conservation Code | [1]Endemic To Query Area |
|---|---|---|---|---|---|
| 218. | 1705 | *Thelymitra crinita (Blue Lady Orchid)* | | | |
| 219. | 1707 | *Thelymitra flexuosa (Twisted Sun Orchid)* | | | |
| 220. | 20730 | *Thelymitra paludosa* | | | |
| 221. | 1717 | *Thelymitra variegata (Queen of Sheba)* | | P3 | |
| **Poaceae** | | | | | |
| 222. | 184 | *Aira caryophyllea (Silvery Hairgrass)* | Y | | |
| 223. | 186 | *Aira elegantissima* | Y | | |
| 224. | 13380 | *Amphibromus nervosus* | | | |
| 225. | 200 | *Amphipogon turbinatus* | | | |
| 226. | 202 | *Anthoxanthum odoratum (Sweet Vernal Grass)* | Y | | |
| 227. | 17233 | *Austrostipa campylachne* | | | |
| 228. | 17234 | *Austrostipa compressa* | | | |
| 229. | 17253 | *Austrostipa semibarbata* | | | |
| 230. | 234 | *Avena fatua (Wild Oat)* | Y | | |
| 231. | 244 | *Briza maxima (Blowfly Grass)* | Y | | |
| 232. | 41564 | *Cenchrus clandestinus (Kikuyu Grass)* | Y | | |
| 233. | 41567 | *Cenchrus macrourus (African Feather Grass)* | Y | | |
| 234. | 347 | *Ehrharta calycina (Perennial Veldt Grass)* | Y | | |
| 235. | 376 | *Eragrostis curvula (African Lovegrass)* | Y | | |
| 236. | 17043 | *Glyceria declinata* | Y | | |
| 237. | 20019 | *Lachnagrostis filiformis* | | | |
| 238. | 528 | *Paspalum distichum (Water Couch)* | Y | | |
| 239. | 548 | *Phalaris aquatica (Phalaris)* | Y | | |
| 240. | 571 | *Poa annua (Winter Grass)* | Y | | |
| 241. | 40431 | *Rytidosperma acerosum* | | | |
| 242. | 40426 | *Rytidosperma occidentale* | | | |
| 243. | 617 | *Sorghum halepense (Johnson Grass)* | Y | | |
| **Polygalaceae** | | | | | |
| 244. | 4550 | *Comesperma calymega (Blue-spike Milkwort)* | | | |
| **Polygonaceae** | | | | | |
| 245. | 17774 | *Acetosella vulgaris* | Y | | |
| 246. | 11052 | *Persicaria prostrata* | | | |
| **Proteaceae** | | | | | |
| 247. | 1791 | *Adenanthos obovatus (Basket Flower)* | | | |
| 248. | 1800 | *Banksia attenuata (Slender Banksia, Piara)* | | | |
| 249. | 1822 | *Banksia ilicifolia (Holly-leaved Banksia)* | | | |
| 250. | 1863 | *Conospermum capitatum* | | | |
| 251. | 1945 | *Franklandia triaristata (Lanoline Bush)* | | P4 | |
| 252. | 13427 | *Grevillea manglesioides subsp. manglesioides* | | | |
| 253. | 2128 | *Hakea amplexicaulis (Prickly Hakea)* | | | |
| 254. | 2152 | *Hakea cyclocarpa (Ramshorn)* | | | |
| 255. | 2216 | *Hakea varia (Variable-leaved Hakea)* | | | |
| 256. | 2273 | *Persoonia saccata (Snottygobble)* | | | |
| 257. | 2299 | *Petrophile linearis (Pixie Mops)* | | | |
| 258. | 2316 | *Stirlingia latifolia (Blueboy)* | | | |
| 259. | 15529 | *Synaphea floribunda* | | | |
| 260. | 2323 | *Synaphea gracillima* | | | |
| 261. | 16865 | *Synaphea odocoileops* | | P1 | |
| 262. | 2324 | *Synaphea petiolaris (Synaphea)* | | | |
| **Racopilaceae** | | | | | |
| 263. | 32480 | *Racopilum cuspidigerum var. convolutaceum* | | | |
| **Restionaceae** | | | | | |
| 264. | 17691 | *Desmocladus fasciculatus* | | | |
| 265. | 1070 | *Hypolaena exsulca* | | | |
| 266. | 19833 | *Leptocarpus laxus* | | | |
| 267. | 1082 | *Leptocarpus tenax (Slender Twine Rush)* | | | |
| **Rutaceae** | | | | | |
| 268. | 4417 | *Boronia dichotoma* | | | |
| 269. | 16618 | *Boronia humifusa* | | P1 | |
| 270. | 17804 | *Boronia tetragona* | | P3 | |
| 271. | 18529 | *Philotheca spicata (Pepper and Salt)* | | | |
| **Santalaceae** | | | | | |
| 272. | 2342 | *Leptomeria cunninghamii* | | | |
| 273. | 17702 | *Leptomeria furtiva* | | P2 | |
| 274. | 2353 | *Leptomeria scrobiculata* | | | |

| | Name ID | Species Name | Naturalised | Conservation Code | [1]Endemic To Query Area |
|---|---|---|---|---|---|
| **Selaginellaceae** | | | | | |
| 275. | 6 | *Selaginella gracillima (Tiny Clubmoss)* | | | |
| **Stylidiaceae** | | | | | |
| 276. | 25831 | *Stylidium araeophyllum* | | | |
| 277. | 25801 | *Stylidium hesperium* | | | |
| 278. | 7773 | *Stylidium petiolare (Horn Triggerplant)* | | | |
| 279. | 7774 | *Stylidium piliferum (Common Butterfly Triggerplant)* | | | |
| 280. | 7782 | *Stylidium pulchellum (Thumbelina Triggerplant)* | | | |
| 281. | 7785 | *Stylidium repens (Matted Triggerplant)* | | | |
| 282. | 7798 | *Stylidium schoenoides (Cow Kicks)* | | | |
| 283. | 7806 | *Stylidium utricularioides (Pink Fan Triggerplant)* | | | |
| 284. | 7808 | *Stylidium violaceum (Violet Triggerplant)* | | | |
| **Thymelaeaceae** | | | | | |
| 285. | 5252 | *Pimelea lanata* | | | |
| 286. | 11639 | *Pimelea longiflora subsp. longiflora* | | | |
| 287. | 5259 | *Pimelea preissii* | | | |
| 288. | 18117 | *Pimelea rosea subsp. rosea* | | | |
| **Xanthorrhoeaceae** | | | | | |
| 289. | 14545 | *Xanthorrhoea brunonis subsp. semibarbata* | | | |

**Conservation Codes**
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

NatureMap
Mapping Western Australia's biodiversity

# SJO14236.01 Fauna

*Created By Daniel Panickar on 06/10/2014*

**Kingdom** Animalia
**Current Names Only** Yes
**Core Datasets Only** Yes
**Method** 'By Circle'
**Centre** 115°43' 05" E,33°26' 35" S
**Buffer** 5km
**Group By** Family

| Family | Species | Records |
|---|---|---|
| Acanthizidae | 4 | 27 |
| Accipitridae | 5 | 8 |
| Aegothelidae | 1 | 1 |
| Anatidae | 7 | 19 |
| Araneidae | 3 | 3 |
| Ardeidae | 3 | 3 |
| Artamidae | 2 | 6 |
| Campephagidae | 1 | 5 |
| Columbidae | 3 | 11 |
| Corvidae | 1 | 16 |
| Cracticidae | 4 | 18 |
| Cuculidae | 1 | 1 |
| Dasyuridae | 1 | 1 |
| Dicruridae | 2 | 24 |
| Elapidae | 1 | 2 |
| Falconidae | 2 | 3 |
| Halcyonidae | 2 | 11 |
| Hirundinidae | 1 | 8 |
| Hyriidae | 1 | 1 |
| Idiopidae | 1 | 2 |
| Julidae | 1 | 1 |
| Limnodynastidae | 1 | 1 |
| Macropodidae | 1 | 1 |
| Maluridae | 1 | 6 |
| Meliphagidae | 5 | 22 |
| Meropidae | 1 | 1 |
| Myobatrachidae | 3 | 7 |
| Pachycephalidae | 4 | 12 |
| Paradoxosomatidae | 2 | 2 |
| Pardalotidae | 1 | 10 |
| Pelecanidae | 1 | 1 |
| Phalacrocoracidae | 1 | 1 |
| Phasianidae | 1 | 1 |
| Podargidae | 1 | 1 |
| Podicipedidae | 2 | 3 |
| Pseudocheiridae | 1 | 24 |
| Psittacidae | 4 | 8 |
| Pygopodidae | 1 | 1 |
| Rallidae | 3 | 5 |
| Recurvirostridae | 2 | 2 |
| Scolopendridae | 1 | 4 |
| Scutigeridae | 1 | 1 |
| Sylviidae | 2 | 2 |
| Threskiornithidae | 3 | 13 |
| Zosteropidae | 1 | 4 |
| **TOTAL** | **91** | **304** |

| | Name ID | Species Name | Naturalised | Conservation Code | [1]Endemic To Query Area |
|---|---|---|---|---|---|
| **Acanthizidae** | | | | | |
| 1. | 24260 | *Acanthiza apicalis (Broad-tailed Thornbill, Inland Thornbill)* | | | |
| 2. | 24261 | *Acanthiza chrysorrhoa (Yellow-rumped Thornbill)* | | | |
| 3. | 25530 | *Gerygone fusca (Western Gerygone)* | | | |
| 4. | 25534 | *Sericornis frontalis (White-browed Scrubwren)* | | | |
| **Accipitridae** | | | | | |
| 5. | 25536 | *Accipiter fasciatus (Brown Goshawk)* | | | |
| 6. | 24285 | *Aquila audax (Wedge-tailed Eagle)* | | | |
| 7. | 24288 | *Circus approximans (Swamp Harrier)* | | | |
| 8. | 24293 | *Haliaeetus leucogaster (White-bellied Sea-Eagle)* | | IA | |
| 9. | 24295 | *Haliastur sphenurus (Whistling Kite)* | | | |
| **Aegothelidae** | | | | | |
| 10. | 24301 | *Aegotheles cristatus subsp. cristatus (Australian Owlet-nightjar)* | | | |

| | Name ID | Species Name | Naturalised | Conservation Code | [1]Endemic To Query Area |
|---|---|---|---|---|---|
| **Anatidae** | | | | | |
| 11. | 24312 | *Anas gracilis (Grey Teal)* | | | |
| 12. | 24316 | *Anas superciliosa (Pacific Black Duck)* | | | |
| 13. | 24318 | *Aythya australis (Hardhead)* | | | |
| 14. | 24319 | *Biziura lobata (Musk Duck)* | | | |
| 15. | 24321 | *Chenonetta jubata (Australian Wood Duck, Wood Duck)* | | | |
| 16. | 24322 | *Cygnus atratus (Black Swan)* | | | |
| 17. | 24331 | *Tadorna tadornoides (Australian Shelduck, Mountain Duck)* | | | |
| **Araneidae** | | | | | |
| 18. | -12651 | *Araneus senicaudatus* | | | |
| 19. | -12293 | *Austracantha minax* | | | |
| 20. | -13714 | *Cyclosa trilobata* | | | |
| **Ardeidae** | | | | | |
| 21. | 41324 | *Ardea modesta (Eastern Great Egret)* | | IA | |
| 22. | 24341 | *Ardea pacifica (White-necked Heron)* | | | |
| 23. | 25564 | *Nycticorax caledonicus (Rufous Night Heron)* | | | |
| **Artamidae** | | | | | |
| 24. | 25566 | *Artamus cinereus (Black-faced Woodswallow)* | | | |
| 25. | 24353 | *Artamus cyanopterus (Dusky Woodswallow)* | | | |
| **Campephagidae** | | | | | |
| 26. | 25568 | *Coracina novaehollandiae (Black-faced Cuckoo-shrike)* | | | |
| **Columbidae** | | | | | |
| 27. | 24407 | *Ocyphaps lophotes (Crested Pigeon)* | | | |
| 28. | 24409 | *Phaps chalcoptera (Common Bronzewing)* | | | |
| 29. | 25590 | *Streptopelia senegalensis (Laughing Turtle-Dove)* | Y | | |
| **Corvidae** | | | | | |
| 30. | 25592 | *Corvus coronoides (Australian Raven)* | | | |
| **Cracticidae** | | | | | |
| 31. | 25595 | *Cracticus tibicen (Australian Magpie)* | | | |
| 32. | -13803 | *Cracticus torquartus* | | | |
| 33. | 25596 | *Cracticus torquatus (Grey Butcherbird)* | | | |
| 34. | 25597 | *Strepera versicolor (Grey Currawong)* | | | |
| **Cuculidae** | | | | | |
| 35. | 25598 | *Cacomantis flabelliformis (Fan-tailed Cuckoo)* | | | |
| **Dasyuridae** | | | | | |
| 36. | 24099 | *Phascogale tapoatafa subsp. tapoatafa (Southern Brush-tailed Phascogale, Wambenger)* | | T | |
| **Dicruridae** | | | | | |
| 37. | 24443 | *Grallina cyanoleuca (Magpie-lark)* | | | |
| 38. | 25614 | *Rhipidura leucophrys (Willie Wagtail)* | | | |
| **Elapidae** | | | | | |
| 39. | 25255 | *Parasuta nigriceps* | | | |
| **Falconidae** | | | | | |
| 40. | 25622 | *Falco cenchroides (Australian Kestrel)* | | | |
| 41. | 25623 | *Falco longipennis (Australian Hobby)* | | | |
| **Halcyonidae** | | | | | |
| 42. | 30901 | *Dacelo novaeguineae (Laughing Kookaburra)* | Y | | |
| 43. | 25549 | *Todiramphus sanctus (Sacred Kingfisher)* | | | |
| **Hirundinidae** | | | | | |
| 44. | 24491 | *Hirundo neoxena (Welcome Swallow)* | | | |
| **Hyriidae** | | | | | |
| 45. | 34113 | *Westralunio carteri (Carter's Freshwater Mussel)* | | P4 | |
| **Idiopidae** | | | | | |
| 46. | -13168 | *Idiosoma sigillatum* | | | |
| **Julidae** | | | | | |
| 47. | -13056 | *Ommatoiulus moreletii* | | | |
| **Limnodynastidae** | | | | | |
| 48. | 25410 | *Heleioporus eyrei (Moaning Frog)* | | | |
| **Macropodidae** | | | | | |
| 49. | 24132 | *Macropus fuliginosus (Western Grey Kangaroo)* | | | |

| | Name ID | Species Name | Naturalised | Conservation Code | [1]Endemic To Query Area |
|---|---|---|---|---|---|
| **Maluridae** | | | | | |
| 50. | 25654 | *Malurus splendens (Splendid Fairy-wren)* | | | |
| **Meliphagidae** | | | | | |
| 51. | 24560 | *Acanthorhynchus superciliosus (Western Spinebill)* | | | |
| 52. | 24561 | *Anthochaera carunculata (Red Wattlebird)* | | | |
| 53. | 24567 | *Epthianura albifrons (White-fronted Chat)* | | | |
| 54. | 25661 | *Lichmera indistincta (Brown Honeyeater)* | | | |
| 55. | 24596 | *Phylidonyris novaehollandiae (New Holland Honeyeater)* | | | |
| **Meropidae** | | | | | |
| 56. | 24598 | *Merops ornatus (Rainbow Bee-eater)* | | IA | |
| **Myobatrachidae** | | | | | |
| 57. | 25398 | *Crinia georgiana (Quacking Frog)* | | | |
| 58. | 25400 | *Crinia insignifera (Squelching Froglet)* | | | |
| 59. | 25401 | *Crinia pseudinsignifera (Bleating Froglet)* | | | |
| **Pachycephalidae** | | | | | |
| 60. | 25675 | *Colluricincla harmonica (Grey Shrike-thrush)* | | | |
| 61. | 24616 | *Falcunculus frontatus subsp. leucogaster (Western Shrike-tit, Crested Shrike-tit)* | | P4 | |
| 62. | 25679 | *Pachycephala pectoralis (Golden Whistler)* | | | |
| 63. | 25680 | *Pachycephala rufiventris (Rufous Whistler)* | | | |
| **Paradoxosomatidae** | | | | | |
| 64. | -13664 | *Akamptogonus novarae* | | | |
| 65. | -12215 | *Antichiropus nanus* | | | |
| **Pardalotidae** | | | | | |
| 66. | 25682 | *Pardalotus striatus (Striated Pardalote)* | | | |
| **Pelecanidae** | | | | | |
| 67. | 24648 | *Pelecanus conspicillatus (Australian Pelican)* | | | |
| **Phalacrocoracidae** | | | | | |
| 68. | 24667 | *Phalacrocorax sulcirostris (Little Black Cormorant)* | | | |
| **Phasianidae** | | | | | |
| 69. | 24671 | *Coturnix pectoralis (Stubble Quail)* | | | |
| **Podargidae** | | | | | |
| 70. | 25703 | *Podargus strigoides (Tawny Frogmouth)* | | | |
| **Podicipedidae** | | | | | |
| 71. | 24681 | *Poliocephalus poliocephalus (Hoary-headed Grebe)* | | | |
| 72. | 25705 | *Tachybaptus novaehollandiae (Australasian Grebe, Black-throated Grebe)* | | | |
| **Pseudocheiridae** | | | | | |
| 73. | 24166 | *Pseudocheirus occidentalis (Western Ringtail Possum)* | | T | |
| **Psittacidae** | | | | | |
| 74. | 25717 | *Calyptorhynchus banksii (Red-tailed Black-Cockatoo)* | | | |
| 75. | 24738 | *Neophema elegans (Elegant Parrot)* | | | |
| 76. | 25720 | *Platycercus icterotis (Western Rosella)* | | | |
| 77. | 25722 | *Polytelis anthopeplus (Regent Parrot)* | | | |
| **Pygopodidae** | | | | | |
| 78. | 25005 | *Lialis burtonis* | | | |
| **Rallidae** | | | | | |
| 79. | 25727 | *Fulica atra (Eurasian Coot)* | | | |
| 80. | 25729 | *Gallinula tenebrosa (Dusky Moorhen)* | | | |
| 81. | 25731 | *Porphyrio porphyrio (Purple Swamphen)* | | | |
| **Recurvirostridae** | | | | | |
| 82. | 24774 | *Cladorhynchus leucocephalus (Banded Stilt)* | | | |
| 83. | 25734 | *Himantopus himantopus (Black-winged Stilt)* | | | |
| **Scolopendridae** | | | | | |
| 84. | -12294 | *Cormocephalus hartmeyeri* | | | |
| **Scutigeridae** | | | | | |
| 85. | -12319 | *Allothereua maculata* | | | |
| **Sylviidae** | | | | | |
| 86. | 25755 | *Acrocephalus australis (Australian Reed Warbler)* | | | |
| 87. | 24833 | *Cincloramphus cruralis (Brown Songlark)* | | | |
| **Threskiornithidae** | | | | | |
| 88. | 24841 | *Platalea flavipes (Yellow-billed Spoonbill)* | | | |

| | Name ID | Species Name | Naturalised | Conservation Code | [1]Endemic To Query Area |
|---|---|---|---|---|---|
| 89. | 24844 | *Threskiornis molucca (Australian White Ibis)* | | | |
| 90. | 24845 | *Threskiornis spinicollis (Straw-necked Ibis)* | | | |

## Zosteropidae

| | | | | | |
|---|---|---|---|---|---|
| 91. | 25765 | *Zosterops lateralis (Grey-breasted White-eye, Silvereye)* | | | |

**Conservation Codes**
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

# Appendix 4
# Conservation significant flora and ecological community definitions

## *Conservation Codes for Western Australia (DPaW/WAHERB 2014b)*

Under the *Wildlife Conservation Act* (1950), the Minister for the Environment may declare species of flora to be protected if they are considered to be in danger of extinction, rare or otherwise in need of special protection. Schedules 1 and 2 deal with those that are threatened and those that are presumed extinct, respectively.

**T: Threatened Flora (Declared Rare Flora – Extant)**

Species 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
- X: Presumed Extinct Flora (Declared Rare Flora – Extinct).

Species that 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).

## *Priority Flora*

Species that have not yet been adequately surveyed to be listed under Schedule 1 or 2 are added to the Priority Flora List under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna. Species that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Conservation Dependent species are placed in Priority 5.

**Priority One: Poorly-known Species**

Species that are known from one or a few collections or sight records (generally less than 5), 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. Species 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.

**Priority Two: Poorly-known Species**

Species that 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. Species 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.

**Priority Three: Poorly-known Species**

Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species 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.

**Priority Four: Rare, Near Threatened and other species in need of monitoring**

1. Rare: Species that are considered to be 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 species are usually represented on conservation lands.
2. Near Threatened: Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
3. Species that have been removed from the list of threatened species during the past 5 years for reasons other than taxonomy.

**Priority 5: Conservation Dependent Species**

Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within 5 years.

## *Definition of Threatened Ecological Communities (DEC 2010)*

**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:

- records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or
- 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:

1. 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:
   (a) 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 10 years)
   (b) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated.
2. Current distribution is limited, and one or more of the following apply:
   (a) 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 10 years)
   (b) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes
   (c) 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.
3. The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 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:

1. The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply:
   (a) the estimated 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 future (within approximately 20 years)
   (b) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.

2. Current distribution is limited, and one or more of the following apply”
    (a) 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 20 years)
    (b) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes
    (c) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.
3. The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 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 or significant modification 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:

1. The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.
2. The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.
3. The ecological community may be still 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.

## *Definition of Priority Ecological Communities (DEC 2010)*

**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**

- 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
- 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
- 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. These include:

1. 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.
2. 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.
3. 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.

# Appendix 5
# Vascular plant taxa recorded within the site

| Family | Species |
|---|---|
| Araliaceae | *Trachymene pilosa* |
| Asteraceae | **Arctotheca calendula* |
| | **Hypochaeris glabra* |
| | **Sonchus asper* |
| Colchicaceae | *Burchardia congesta* |
| Dasypogonaceae | *Dasypogon bromeliifolius* |
| Dennstaedtiaceae | *Pteridium esculentum* |
| Dilleniaceae | *Hibbertia subvaginata* |
| Elaeocarpaceae | *Platytheca galioides* |
| Fabaceae | *Acacia pulchella* |
| | *Acacia willdenowiana* |
| | *Gastrolobium ebracteolatum* |
| Myrtaceae | *Agonis flexuosa* |
| | *Corymbia calophylla* |
| | *Eucalyptus marginata* |
| | *Eucalyptus rudis* |
| | *Kunzea glabrescens* |
| | *Melaleuca preissiana* |
| | *Taxandria linearifolia* |
| Orchidaceae | *Caladenia flava* |
| | *Caladenia latifolia* |
| | *Cyanicula gemmata* |
| Poaceae | **Briza maxima* |
| | *Poaceae sp. |
| Proteaceae | *Banksia attenuata* |
| Xanthorrhoeaceae | *Xanthorrhoea gracilis* |

* Pasture species not included in this list

# Appendix 2
# Offset calculations – Land acquisition

# Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

| Matter of National Environmental Significance | |
|---|---|
| **Name** | Carnaby's Black-Cockatoo |
| **EPBC Act status** | Endangered |
| **Annual probability of extinction**<br>Based on IUCN category definitions | **1.2%** |

| Key to Cell Colours |
|---|
| User input required |
| Drop-down list |
| Calculated output |
| Not applicable to attribute |

## Impact calculator

| Protected matter attributes | Attribute relevant to case? | Description | Quantum of impact | | Units | Information source |
|---|---|---|---|---|---|---|
| ***Ecological communities*** | | | | | | |
| **Area of community** | No | | **Area** | | | |
| | | | **Quality** | | | |
| | | | **Total quantum of impact** | 0.00 | | |
| ***Threatened species habitat*** | | | | | | |
| **Area of habitat** | Yes | | **Area** | 7.5 | Hectares | |
| | | | **Quality** | **4** | Scale 0-10 | |
| | | | **Total quantum of impact** | 3.00 | Adjusted hectares | |
| **Protected matter attributes** | **Attribute relevant to case?** | **Description** | **Quantum of impact** | | **Units** | **Information source** |
| **Number of features**<br>e.g. Nest hollows, habitat trees | No | | | | | |
| **Condition of habitat**<br>Change in habitat condition, but no change in extent | No | | | | | |
| ***Threatened species*** | | | | | | |
| **Birth rate**<br>e.g. Change in nest success | No | | | | | |
| **Mortality rate**<br>e.g Change in number of road kills per year | No | | | | | |
| **Number of individuals**<br>e.g. Individual plants/animals | No | | | | | |

## Offset calculator

| Protected matter attributes | Attribute relevant to case? | Total quantum of impact | Units | Proposed offset | Time horizon (years) | | Start area and quality | | Future area and quality without offset | | Future area and quality with offset | | Raw gain | Confidence in result (%) | Adjusted gain | Net present value (adjusted hectares) | % of impact offset | Minimum (90%) direct offset requirement met? | Cost ($ total) | Information source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Ecological Communities*** | | | | | | | | | | | | | | | | | | | | |
| **Area of community** | No | | | | **Risk-related time horizon (max. 20 years)** | | **Start area (hectares)** | | **Risk of loss (%) without offset** | | **Risk of loss (%) with offset** | | | | | | | | | |
| | | | | | | | | | **Future area without offset (adjusted hectares)** | 0.0 | **Future area with offset (adjusted hectares)** | 0.0 | | | | | | | | |
| | | | | | **Time until ecological benefit** | | **Start quality (scale of 0-10)** | | **Future quality without offset (scale of 0-10)** | | **Future quality with offset (scale of 0-10)** | | | | | | | | | |
| ***Threatened species habitat*** | | | | | | | | | | | | | | | | | | | | |
| **Area of habitat** | Yes | 3.00 | Adjusted hectares | | **Time over which loss is averted (max. 20 years)** | 20 | **Start area (hectares)** | 12.73 | **Risk of loss (%) without offset** | 30% | **Risk of loss (%) with offset** | 10% | | | | | | | | |
| | | | | | | | | | **Future area without offset (adjusted hectares)** | 8.9 | **Future area with offset (adjusted hectares)** | 11.5 | 2.55 | 90% | 2.29 | 1.81 | 2.06 | 68.53% | No | |
| | | | | | **Time until ecological benefit** | 1 | **Start quality (scale of 0-10)** | **7** | **Future quality without offset (scale of 0-10)** | **6** | **Future quality with offset (scale of 0-10)** | **7** | 1.00 | 90% | 0.90 | 0.89 | | | | |
| **Protected matter attributes** | **Attribute relevant to case?** | **Total quantum of impact** | **Units** | **Proposed offset** | **Time horizon (years)** | | **Start value** | | **Future value without offset** | | **Future value with offset** | | **Raw gain** | **Confidence in result (%)** | **Adjusted gain** | **Net present value** | **% of impact offset** | **Minimum (90%) direct offset requirement met?** | **Cost ($ total)** | **Information source** |
| **Number of features**<br>e.g. Nest hollows, habitat trees | No | | | | | | | | | | | | | | | | | | | |
| **Condition of habitat**<br>Change in habitat condition, but no change in extent | No | | | | | | | | | | | | | | | | | | | |
| ***Threatened species*** | | | | | | | | | | | | | | | | | | | | |
| **Birth rate**<br>e.g. Change in nest success | No | | | | | | | | | | | | | | | | | | | |
| **Mortality rate**<br>e.g Change in number of road kills per year | No | | | | | | | | | | | | | | | | | | | |
| **Number of individuals**<br>e.g. Individual plants/animals | No | | | | | | | | | | | | | | | | | | | |

## Summary

| Protected matter attributes | Quantum of impact | Net present value of offset | % of impact offset | Direct offset adequate? | Cost ($) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Direct offset ($) | Other compensatory measures ($) | Total ($) |
| **Birth rate** | 0 | | | | $0.00 | | $0.00 |
| **Mortality rate** | 0 | | | | $0.00 | | $0.00 |
| **Number of individuals** | 0 | | | | $0.00 | | $0.00 |
| **Number of features** | 0 | | | | $0.00 | | $0.00 |
| **Condition of habitat** | 0 | | | | $0.00 | | $0.00 |
| **Area of habitat** | 3 | 2.06 | 68.53% | **No** | $0.00 | #DIV/0! | #DIV/0! |
| **Area of community** | 0 | | | | $0.00 | | $0.00 |
| | | | | | **$0.00** | **#DIV/0!** | **#DIV/0!** |

# Appendix 3
# Offset calculations - Revegetation

# Offsets Assessment Guide

For use in determining offsets under the *Environment Protection and Biodiversity Conservation Act 1999*
2 October 2012

This guide relies on Macros being enabled in your browser.

| Matter of National Environmental Significance | |
|---|---|
| **Name** | Carnaby's Black-Cockatoo |
| **EPBC Act status** | Endangered |
| **Annual probability of extinction**<br>Based on IUCN category definitions | **1.2%** |

| Key to Cell Colours |
|---|
| User input required |
| Drop-down list |
| Calculated output |
| Not applicable to attribute |

## Impact calculator

| Protected matter attributes | Attribute relevant to case? | Description | Quantum of impact | | Units | Information source |
|---|---|---|---|---|---|---|
| ***Ecological communities*** | | | | | | |
| **Area of community** | No | | **Area** | | | |
| | | | **Quality** | | | |
| | | | **Total quantum of impact** | 0.00 | | |
| ***Threatened species habitat*** | | | | | | |
| **Area of habitat** | Yes | | **Area** | 7.5 | Hectares | |
| | | | **Quality** | **4** | Scale 0-10 | |
| | | | **Total quantum of impact** | 3.00 | Adjusted hectares | |
| **Protected matter attributes** | **Attribute relevant to case?** | **Description** | **Quantum of impact** | | **Units** | **Information source** |
| **Number of features**<br>e.g. Nest hollows, habitat trees | No | | | | | |
| **Condition of habitat**<br>Change in habitat condition, but no change in extent | No | | | | | |
| ***Threatened species*** | | | | | | |
| **Birth rate**<br>e.g. Change in nest success | No | | | | | |
| **Mortality rate**<br>e.g Change in number of road kills per year | No | | | | | |
| **Number of individuals**<br>e.g. Individual plants/animals | No | | | | | |

## Offset calculator

| Protected matter attributes | Attribute relevant to case? | Total quantum of impact | Units | Proposed offset | Time horizon (years) | | Start area and quality | | Future area and quality without offset | | Future area and quality with offset | | Raw gain | Confidence in result (%) | Adjusted gain | Net present value (adjusted hectares) | % of impact offset | Minimum (90%) direct offset requirement met? | Cost ($ total) | Information source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ***Ecological Communities*** | | | | | | | | | | | | | | | | | | | | |
| **Area of community** | No | | | | **Risk-related time horizon (max. 20 years)** | | **Start area (hectares)** | | **Risk of loss (%) without offset** | | **Risk of loss (%) with offset** | | | | | | | | | |
| | | | | | | | | | **Future area without offset (adjusted hectares)** | 0.0 | **Future area with offset (adjusted hectares)** | 0.0 | | | | | | | | |
| | | | | | **Time until ecological benefit** | | **Start quality (scale of 0-10)** | | **Future quality without offset (scale of 0-10)** | | **Future quality with offset (scale of 0-10)** | | | | | | | | | |
| ***Threatened species habitat*** | | | | | | | | | | | | | | | | | | | | |
| **Area of habitat** | Yes | 3.00 | Adjusted hectares | | **Time over which loss is averted (max. 20 years)** | 20 | **Start area (hectares)** | 4 | **Risk of loss (%) without offset** | 40% | **Risk of loss (%) with offset** | 10% | | | | | | | | |
| | | | | | | | | | **Future area without offset (adjusted hectares)** | 2.4 | **Future area with offset (adjusted hectares)** | 3.6 | 1.20 | 80% | 0.96 | 0.76 | 0.74 | 24.66% | No | |
| | | | | | **Time until ecological benefit** | 5 | **Start quality (scale of 0-10)** | **3** | **Future quality without offset (scale of 0-10)** | **3** | **Future quality with offset (scale of 0-10)** | **5** | 2.00 | 80% | 1.60 | 1.51 | | | | |
| **Protected matter attributes** | **Attribute relevant to case?** | **Total quantum of impact** | **Units** | **Proposed offset** | **Time horizon (years)** | | **Start value** | | **Future value without offset** | | **Future value with offset** | | **Raw gain** | **Confidence in result (%)** | **Adjusted gain** | **Net present value** | **% of impact offset** | **Minimum (90%) direct offset requirement met?** | **Cost ($ total)** | **Information source** |
| **Number of features**<br>e.g. Nest hollows, habitat trees | No | | | | | | | | | | | | | | | | | | | |
| **Condition of habitat**<br>Change in habitat condition, but no change in extent | No | | | | | | | | | | | | | | | | | | | |
| ***Threatened species*** | | | | | | | | | | | | | | | | | | | | |
| **Birth rate**<br>e.g. Change in nest success | No | | | | | | | | | | | | | | | | | | | |
| **Mortality rate**<br>e.g Change in number of road kills per year | No | | | | | | | | | | | | | | | | | | | |
| **Number of individuals**<br>e.g. Individual plants/animals | No | | | | | | | | | | | | | | | | | | | |

## Summary

| Protected matter attributes | Quantum of impact | Net present value of offset | % of impact offset | Direct offset adequate? | Cost ($) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Direct offset ($) | Other compensatory measures ($) | Total ($) |
| **Birth rate** | 0 | | | | $0.00 | | $0.00 |
| **Mortality rate** | 0 | | | | $0.00 | | $0.00 |
| **Number of individuals** | 0 | | | | $0.00 | | $0.00 |
| **Number of features** | 0 | | | | $0.00 | | $0.00 |
| **Condition of habitat** | 0 | | | | $0.00 | | $0.00 |
| **Area of habitat** | 3 | 0.74 | 24.66% | **No** | $0.00 | #DIV/0! | #DIV/0! |
| **Area of community** | 0 | | | | $0.00 | | $0.00 |
| | | | | | **$0.00** | **#DIV/0!** | **#DIV/0!** |

# Lot 1 South West Highway

# Proposal for Sand Extraction Licence

# Rehabilitation and Decommissioning Programme as per Shire of Capel Criteria

# Compiled By

**Albert Gorman BSc Environmental Restoration and Management**

Refer to Drawings 11443E – CK07 & 08

**Introduction**

The proposed sand extraction site is at this time highly degraded, due mainly to the past uses of the site. It was previously used as a sand extraction pit, coupled with overgrazing by both native as well as exotic herbivore species and the presence of the fungal disease *Phytophthora cinnamomi* or Dieback disease, has led this to the highly degraded state that it is currently in. It is proposed that the sand extraction process be a staged process, with each of the six stages being less than two hectares in size. As the sand extraction processes are completed within each section, rehabilitation processes can commence while extraction of sand can begin on the next stage. It is hoped that with the right programmes in place, visible rehabilitation will follow the extraction process throughout the life of the sand mine. The restoration/rehabilitation programme upon completion/end-use of sand extraction pit are to restore the site to traditional existing neighbouring farming pastures (Restoration sites 1, 2, 4, 5 and sites 3 & 6). Where there is a batter of 1:10 in final land formation suitable/appropriate dieback resistant native flora species will be planted. (Appendices A & B) Tall trees and an understory of shrubs and native grasses will be established on all sloping terrain/1:10 Batters (sections of sites 3, 6, 5, 4 & 1). The proposed extraction sand pit site and surrounding locations are at present zoned rural. All adjacent properties are currently cropped as grazing pasture and/ hay production.

**Objectives**

On completion of sand extraction activities from Lot 1 South West Highway, Boyanup and final land forms established, all 1:10 battered sections will have been replanted with 3500 dieback tolerant native flora species. The taller canopy trees will be replanted to approximately 1000 stems per hectare which equates to 3.16m x 3.16m between stems and the understory species of 2500 stems per hectare or a stem 2m x 2m, or every four square meters. The level finished surfaces will be re-established to traditional agricultural pastures. Because the proximity of the groundwater table and the use of irrigational flows it is anticipated hat he rehabilitated sections will become self sufficient within three years. The use of canopy trees will aid existing ecological links as well as provide habitat for locally present native fauna.

The function and end use of all sites in the rehabilitation processes will be,

- To have a self sustain ecosystem made up of both flora and fauna
- To have restored sections that meet land use expectations
- To have sections integrated into the surrounding landscape
- To have native vegetation that can be integrated with forest management
- To have pasture that will thrive with perennials and nitrogen fixing legumes being dominate species
- To have minimal effect on the existing perched aquifer water quality

**Site Assessment**

The proposed sand extraction site is 10.7 hectares in size. Various test excavations were made to access the soil composition and structure of the proposed site.

**Photo 1: Excavation detailing sand profile**

The site substrata consists of highly porous Bassendean Sands (for site assessment, refer to Agronomist Report – Attachment 9). This is a highly disturbed site as it has been used as a sand extraction pit in the past.

**Photo 2: Previous Extraction**

There is ample evidence of this occurrence in the form of previous top soil storage dumps and excavations. Ground cover vegetation is all but nonexistent due to the constant over grazing by kangaroos. It is because of these previous activities and the reintroduction of certain volunteer flora species, both native and exotic, that there is a variation in the number and condition of the identifiable soil horizons.

**Photo 3: Non-existent groundcover due to overgrazing by kangaroos.**

Due to the previous sand pit activities and level of disturbance, the topsoil (A horizon) varied in depth from 150 millimetres to 300 millimetres in depth over the entire site. Plant root penetration of less than 500 millimetres suggesting recent establishment. Certain sections of some proposed restoration sites had no identifiable soil profile and no vegetation cover at all. No organic litter or evidence of soil seed banks. What could normally be described as the B horizon extended right to the surface.

**Photo 3: Shallow root penetration and minimal to zero A Horizon**

In proposed Stages 5 and 6 evidence suggests that because of previous limited disturbance the A horizon/top soil is deeper and plant root activity in some instances was evident to a depth of 1.2 metres. With only slight variances in soil structure and composition, the proposed excavation site is uniform in its makeup, that is, highly porous Bassendean Sands with little or no water storage capacity.

There is strong evidence of the plant disease *Phytophthora cinnamomi* with 78.5% of the site being mapped as infested. For complete details refer to Attachment 5 –labelled ‘’A Vegetation and Dieback Survey of part Lot 1 South West Highway North Boyanup.’’

**Soil management**

- The proposed soil extraction pit processes will be completed in approximate two hectare Stages.
- Top soil removal and the removal of any remnant vegetation will proceed as a staged process according to development of proposed extraction pit.
- Remnant vegetation will be removed by rubber tyred front end loaders with minimal disturbance to top soil and stock piled adjacent to relevant excavation pit stage.
- The topsoil (A Horizon) will then be removed using appropriate machinery to suit the contours of existing soil formations.
- Removed top soil is to be stored at a convenient location adjacent to the stage of sand pit extraction, to a maximum height of two metres.
- Because of the variation in the depth of top soil throughout the proposed extraction pit absolute quantities of top soil are not known, their storage will however, conform to Shire of Capel Regulations.
- Water in the form of a sprayed application as well as wetting agent will be used to control dust and wind erosion of stockpiled top soil as well as the pit floor should it become necessary.
- As each stage of sand extraction is completed and permanent soil contours are established, the topsoil will be relocated to site using appropriate machinery to a depth similar to that prior to disturbance.
- The stockpiled remnant vegetation is to be mulched as needed on site by mechanical means and distributed evenly over the now relocated top soil to a nominal depth of 50 millimetres. A wetting agent will be applied to soil surface prior to the redistribution of mulched vegetation.
- The final contours shall be achieved and confirmed using the surveying data controls identified in order to achieve land form approved for pit development.

**Weed and Pest Management**

- This site is to be restored to conventional farming pasture to be used to supply fodder to grazing animals. (Appendix B)
- The surrounding 1:10 batter will be rehabilitated with dieback resistant native vegetation. (Appendix A)
- During the restoration process the sites will be fenced off to prevent grazing animals including exotic species such as rabbits, foxes and native species such as kangaroos from entering the site.
- After the decommissioning of the proposed sand pit a permanent fence will be erected to protect all native vegetation in the 1:10 battered sections.
- Prior to the pasture seeding the area will be sprayed with a suitable herbicide to remove all exotic plant species.

- Follow up weed monitoring will take place with all exotic infestations treated with a herbicide.

**Seedbed Preparation**

The sand extraction pit is to proceed in two hectare increments. On completion of each stage's extraction, that is when final land forms are established, topsoil will be relocated. A suitable wetting agent will be applied and a layer of mulch applied to the surface. The area will be fenced off to prevent traffic, both mechanical and animal. Stages will be allowed to settle allowing microorganisms, invertebrates and detravors to re-establish. With the coming of Autumn rains or when the ground conditions allow a suitable application of an appropriate herbicide will be applied. Shortly after pasture seeds will be direct drilled into topsoil. An application of a suitable fertilizer (500 kilograms Neutrog Bounce Back, 3-1-1 to hectare) will be applied prior to germination. Similar seed bed preparation will occur with the planting of native species seedlings, the exception being that different rates and types of fertilizer will be applied. In the case of native vegetation 100 kilograms of phosphate per hectare. Commercial wetting agents such as Lure H20 will be added to the sites t the time of rehabilitation to counter any hydrophobia and so control rain runoff in the 1:10 batter sections. It is not anticipated that mechanical deep-ripping will be necessary prior to the panting of native seedlings. This option will be left open should circumstances arise that require deep ripping.

**Erosion and Sediment Control**

During the sand removal process and subsequent restoration processes wetting agents will be applied on the 1:10 batters to control water runoff. Erosion that is due to wind forces in dry conditions will be controlled with the further application of wetting agents as well as water from an on-site water truck.

**Environmental Controls**

Dieback Procedures: (Refer to Attachment 11)

Noise Management Controls: (Refer to Attachment 11)

Dust Management Controls: (Refer to Attachment 11)

**Revegetation Pasture**

- *Identification of appropriate species:* from neighbouring properties with simular soil types, properties and structures. Advice from senior agronomist from Elders Limited. Pasture types include annual species for initial soil stabilization as well as fodder and perennials for long term soil stabilization.
- *Soil conditions:* For details of soil types and growing characteristics please refer to agronomists report. (Attachment 9)

- *Fodder species includes:* rye grasses, clovers and broad leaf varieties see (Appendix B)
- *Suitable supplier:* Elders Limited Bunbury & Bell Pasture Seeds Boyanup.
- *Fertilizer:* 500 kilograms per hectare of Neutrog Bounce Back + Trace Elements will be applied prior to seeding using traditional three point linkage tractor mounted super spreader.
- *At the appropriate time:* seeds will be direct drilled into soil.
- *Direct drilling of seeds:* will take place in autumn after season breaking rains. All invasive grass species to be treated with a suitable herbicide/roundup.
- *Protection measures:* Vermin proof fencing to be erected and maintained surrounding restoration area. Visual inspections and a monitoring log to be kept.
- *Rehabilitation to pasture:* Total area 6.28 Hectares

**Revegetation Native species**

- *Dieback Resistant Native Vegetation:* species (see Appendix A)
- *Suitable supplier:* Boyanup Native Nursery, Southwest Highway Boyanup.
- *Timing*: Seedling stocks are to be ordered in advance, delivery date 1 June and stored under appropriate conditions until seeding programme is to commence. Because of the two hectare increment nature of the restoration programme and the varying size of native revegetation in each section, seedling quantities will be ordered on an as you go basis.
- Seedlings will be planted by hand and spaced accordingly across the 1:10 batters. Canopy species with a density of 1000 (3.16m x 3.16m) stems per hectare and understory species 2500 (2m x 2m) stems per hectare (Smith. R. PC).
- *Fertilizer:* 100 kilograms per hectare of superphosphate will be applied prior to planting of seedlings using traditional three point linkage tractor mounted super spreader.
- *Protection measures:* to include appropriate fencing of restoration site.
- Monitoring for exotic weed infestations as well as fatalities within the native vegetation community and necessary amelioration processes put in place.
- Replanting of species if deemed appropriate. Log book to be kept detailing the progress of restoration processes.
- *Rehabilitation of Native species*: Total area 4.42 hectares.

**Monitoring and Maintenance**

- Upon completion of pasture seed drilling processes and the replanting of native species where appropriate, the site will be monitored during and after seed germination for the presence of any exotic plant species and these will be removed manually or with follow up application of herbicide depending on the severity of the infestation.

- An appropriate back up supplies of seedlings will be kept on site should they be needed to replace fatalities.
- Dead seedlings are to be replace with the same species or if circumstances demand it a similar species.
- Fences will be maintained and evidence of intrusion by both exotic as well as domestic stock monitored and ameliorated.
- Visual checks will be made on a regular basis through the entire restoration processes.
- A photographic as well as a written diary will be kept of all restoration processes and their progress.
- All monitoring data will be available for inspection by local government personnel.

Measures to ensure the success of restoration/reintroduction of pasture fodder species will include visual checks of plant vigour/resilience.

- Visual checks of plant vigour/resilience
- Monitoring of exotic weed infestation
- To be treated as soon as practicability allows
- The re-seeding of pasture is deemed necessary because of external forces such as frost or wind burn
- The planting of a pioneer crop such as swan oats to help in organic matter build up in soil profile

Other measures/procedures for procuring data that leads to successful outcomes

- The identification and amelioration of areas that appear to be suffering or lacking growth vigour
- The exploration of simular macrophyte/pasture species capable of thriving under same conditions if required
- Comparing soil horizons from different locations throughout the site and compare health of fodder adjacent to horizon monitoring site
- Regular inspections of the exclusion fence will be made looking for damage as well as any burrowing activity
- Identification of fauna activity will be recorded along with all issues pertaining to the success of restoration project
- A photographic inventory of the processes involved in this restoration project will be maintained for review purposes
- This property is zoned rural and at present complies with all statutory fire prevention measures, that is regulation boundary fire brakes and additional both fast attack fire response vehicles as well as tankers with up wards of 10,000 litres at their disposal. It is not anticipated any additional fire prevention measures will be required.

The proposed sand extraction pit is on the western side of Lot 1 South West Highway, Boyanup.

- It is not visible to either neighbours or passing traffic from the South West Highway that runs past the Eastern side of the lot.
- All records and data pertaining to the sand extraction volumes and methods of extraction will be maintained and available for scrutiny by appropriate statutory bodies.
- The possible presence of *Phytothora cinnimoni* in the extracted soil shall be advertised in advance of soil sales and deliveries

**Hydrocarbon/construction debris**

- Refuelling of all plant will be at existing established refuelling points away from sand extraction pit locations
- It is envisaged that there will be little if any debris on the site at the completion of project due mainly to the staged restoration methods to be employed on this site
- The installation of permanent and temporary barriers and signage around the pit site will aid environmental integrity

**Rehabilitation Estimates and Costing**

*Native Vegetation Supplier: Boyanup Botanical*

Cell trays of 64 plants for all species are $43.00 per tray. All seedlings are available on the 1st of June. A recommendation of 1000 canopy species (Marri 40%, Peppermint 60%) stems per hectare and 2500 ground cover/understory (Approximately 6% of each species listed) stems (Willyams. D. PC.) will be the target planting rate for this restoration programme.

**Tall canopy type vegetation**

| | |
|---|---|
| *Corymbia calophylla* (Marri). 28 trays at $43.00 per tray | =$1204.00 |
| *Agonis flexuosa* (Peppermint tree) 42 trays at $43.00 per tray | =$1806.00 |
| Total canopy tree costing | **$3010.00** |

**Understory vegetation and ground covers.**

| | |
|---|---|
| *Acacia extensa* (Wiry Wattle) 11 Trays at $43.00 per tray | = $ 473.00 |
| *Acacia huegelii.* 11Trays at $43.00 per tray | = $473.00 |
| *Acacia pulchella* (Prickly Moses) 5 at Trays at $43.00 per tray | = $215.00 |
| *Allocasuarina humilis* (Dwarf Sheoak) 11 Trays at $43.00 per tray | = $473.00 |
| *Bossiaea eriocarpa* (Common brown Pea) 11 trays at $43.00 per tray | = $473.00 |
| *Calytrix fraseri* (Pink Summer Calytrix) 11 Trays at $43.00 per tray | = $473.00 |
| *Gompholobium tomentosum* (Hairy yellow Pea) 11 Trays at $43.00 per tray | = $473.00 |
| *Hakea varia* (Variable-leaved Hakea) 11 Trays at $43.00 per tray | = $ 473.00 |
| *Hardenbergia comptoniana* (Native Wisteria) 11Trays at $43.00 per tray | = $473.00 |
| *Hermiandra pungens* (Snake Bush) 11 Trays at $43.00 per tray | =$473.00 |
| *Hibbertia racemosa* (Stalked Guinea Flower) 11Trays at $43.00 per tray | = $473.00 |
| *Hibbertia vaginata* 11 Trays at $43.00 per tray | = $473.00 |
| *Hypocalymma robustum* (Swan River Myrtle) 11 Trays at $43.00 per tray | = $473.00 |
| *Jacksonia furcellata* (Gray Stinkwood) 11Trays at $43.00 per tray | = $473.00 |
| *Kunzea glabrescens* (Spearwood )11 Trays at $43.00 per tray | = $473.00 |
| *Lepidosperma longitudinal* (Pithy Sward-edge) 11trays at $43.00 per tray | = $473.00 |
| *Melaleuca thymoides* 11 Trays at $43.00 per tray | = $473.00 |

*Stirlingia latifolia* (Blue Boy)11 trays at $43.00 per tray = $473.00

Total seedling cost**.** **$8256.00**

Total fertilizer cost. 400 kilograms. Super phosphate. 100 kilo per hectare **$480.00**

Wetting agent 4.42 hectares at 20ltr per hectare = 88.5 lts **$700.00**

Total material costing for return to native vegetation **$9436.00**

***Pasture Revegetation*** *Bells Pasture Seeds*

The composition of the pasture seeds used in the back to pasture processes will consist of a blending of both annual and perennial ryegrasses as well as legumes/clovers. The seed application rate will be 25 kilogram of seed to the hectare. Prior to the seed drilling an application of Neutrog Bounce Back (3-1-1) at a rate 500 kilograms to the hectare will be applied using a three point linkage super spreader on a conventional farming tractor.

BPS Pasture Blend:

- Atomic ryegrass, Tetila Gold ryegrass, Wicher ryegrass,
- Balansa clover, Turbo clover, Trikkala sub clover.

Total seed costing, 6.28 hectares at 25 kilograms per hectare

= 157 kilograms of BPS pasture blend at $4.18 per kilo **$656.26**

Total fertilizer costing, 6.28 hectares at 500 kilograms per hectare

= 3 140 kilograms 3 140 kilograms at $695.00 per ton **$2,182.30**

Wetting agent: 6.28 hectares at 20lts per hectare = 125.6lts **$1000.00**

Total material costing for return to pasture **$3838.56**

**Costing of Individual Stages 1 – 6 (***Note, all costing and estimates may be rounded up to next decimal)*

*Stage 1:* Pasture: 1.08 hectares. Fertilizer, seeds, wetting agent

and herbicide $1120.00

Natives vegetation: 0.710 Fertilizer, seedlings, wetting agent and herbicide $1785.00

Total costs including labour ($5 635.00) **$8 540.00**

| | |
|---|---|
| *Stage 2:* Pasture: 1.46 hectares Fertilizer, seed, wetting agent and herbicide | $1515.00 |
| Native vegetation 0.43 hectares Fertilizer, seedlings, wetting agent and herbicide | $1122.00 |
| Total cost including labour ($3 461.00) | **$6098.00** |

| | |
|---|---|
| *Stage 3:* Pasture: 0.60 hectares Fertilizer, seed, wetting agent and herbicide | $625.00 |
| Native vegetation 1.13 hectares Fertilizer, seedling, wetting agent and herbicide | $3430.00 |
| Total cost including labour ($10 545.00) | **$14 600.00** |

| | |
|---|---|
| *Stage 4* Pasture: 1.46 hectares Fertilizer, seed, wetting agent and herbicide | $1507.00 |
| Native vegetation 0.50 hectares Fertilizer, seedling, wetting agent and herbicide | $1339.00 |
| Total cost including labour ($4025.00) | **$6871.00** |

| | |
|---|---|
| *Stage 5* Pasture: 1014 hectares Fertilizer, seed, wetting agent and herbicide | $1460.00 |
| Native vegetation 0.29 hectares Fertilizer, seedling, wetting agent and herbicide | $780.00 |
| Total cost including labour ($2334.00) | **$4574.00** |

| | |
|---|---|
| *Stage 6* Pasture: 0.27 hectares Fertilizer, seed, wetting agent and herbicide | $298.00 |
| Native vegetation 1.19 hectares Fertilizer, seedling, wetting agent and herbicide | $3098.00 |
| Total cost including labour ($9 579.00) | **$12 975.00** |

**Land form Preparation**

Prior to seeding and planting of native flora

| | |
|---|---|
| Stage 1: 1.78 hectares. Relocating mulched vegetation to site | $1246.00 |

| | |
|---|---|
| Stage 2: 1.89 hectares. Relocating mulched vegetation to site | $1323.00 |
| Stage 3: 1.91 hectares. Relocating mulched vegetation to site | $1337.00 |
| Stage 4: 1.96 hectares. Relocating mulched vegetation to site | $1372.00 |
| Stage 5: 1.70 hectares. Relocating mulched vegetation to site | $1190.00 |
| Stage 6: 1.46 hectares. Relocating mulched vegetation to site | $1022.00 |
| Total cost of mulching and relocation | **$7490.00** |

**Total Rehabilitation Cost Estimates for Each Individual Excavations Site**

| | |
|---|---|
| Stage 1: 1.78 hectares. Vegetation and Associated Cost + Land Form Preparation | $ 9786.00 |
| Stage 2: 1.89 hectares. Vegetation and Associated Cost + Land Form Preparation | $ 7421.00 |
| Stage 3: 1.91 hectares. Vegetation and Associated Cost + Land Form Preparation | $15 937.00 |
| Stage 4: 1.96 hectares. Vegetation and Associated Cost + Land Form Preparation | $ 8846.00 |
| Stage 5: 1.70 hectares. Vegetation and Associated Cost + Land Form Preparation | $ 5764.00 |
| Stage 6: 1.46 hectares. Vegetation and Associated Cost + Land Form Preparation | $13 991.00 |
| **Total** | **$61 745.00** |

**Fencing**

Based on present prices of $6.00 per metre and the removal and relocation of intermediate fencing between site locations, it is anticipated that all staged internal fencing will cost in the vicinity of $5,000 and the permanent exclusion fence approximately $7200.00. Combined total fence costing for the duration and eventual closure of sand extraction pit.

**$10 200.00**

**Costing totals for the restoration and closure of proposed sand extraction pit located at location 1 South West Highway North Boyanup. $71,945.00**

**Stem Densities per Site**

| | |
|---|---|
| Stage 1: Canopy Species. 700 in total. 40% Marri. Minimum numbers needed. | 280 |
| Peppermint trees 60% Minimum numbers required. | 420 |
| Understory species total seedlings | 1750 |
| Stage 2: Canopy Species. 430 in total. 40% Marri. Minimum numbers needed. | 172 |
| Peppermint trees 60% Minimum numbers required. | 678 |
| Understory species total seedlings | 1075 |
| Stage 3: Canopy Species. 1130 in total. 40% Marri. Minimum numbers needed. | 452 |
| Peppermint trees 60% Minimum numbers required. | 678 |
| Understory species total seedlings | 2825 |
| Stage 4: Canopy Species. 500 in total. 40% Marri. Minimum numbers needed. | 200 |
| Peppermint trees 60% Minimum numbers required. | 300 |
| Understory species total seedlings | 1250 |
| Stage 5: Canopy Species. 290 in total. 40% Marri. Minimum numbers needed. | 116 |
| Peppermint trees 60% Minimum numbers required. | 176 |
| Understory species total seedlings | 725 |
| Stage 6: Canopy Species. 1190 in total. 40% Marri. Minimum numbers needed. | 476 |
| Peppermint trees 60% Minimum numbers required. | 714 |
| Understory species total seedlings | 2975 |

**Understory Species Selection**

There are 15 species of Dieback resistant local flora available. Acting on advice from Mr Russel Smith and with the aim of flora biodiversity, a major consideration, we will be using a mosaic approach in species selection for rehabilitation of 1:10 batters. That is rather than jam as many species in any one given area. We intend to initiate quadrants of particular species blending into alternate species throughout the various sites. For Dieback resistant species selections please refer to appendix A.

# References

Willyams. David. *Personal Communication.* 8.30am Monday 16th April 2012. Propagation and Revegetation Research Officer. Marrinup Nursery Alcoa Pinjarra Australia.

Smith. Russell. Personal Communication/email. Monday 16th April 2012. Ekologica Pty ltd Bunbury Western Australia.

**Appendix A**

Dieback resistant species Lot 16580 South West Highway, North Boyanup Western Australia.

As compiled by Russell Smith BSc (Hons) MPhil

| **Latin Name** | **Common Name** |
|---|---|
| *Acacia extensa* | Wiry Wattle |
| *Acacia huegelii* | |
| *Acacia pulchella* | Prickly Moses |
| *Agonis flexuosa* | Peppermint |
| *Allocasuarina humilis* | Dwarf Sheoak |
| *Bossiaea eriocarpa* | Common Brown Pea |
| *Calytrix fraseri* | Pink Summer Calytrix |
| *Corymbia calophylla* | Marri |
| *Gompholobium tomentosum* | Hairy Yellow Pea |
| *Hakea varia* | Variable-leaved Hakea |
| *Hardenbergia comptoniana* | Native Wisteria |
| *Hemiandra pungens* | Snakebush |
| *Hibbertia racemosa* | Stalked Guinea Flower |
| *Hibbertia vaginata* | |
| *Hypocalymma robustum* | Swan River Myrtle |
| *Jacksonia furcellata* | Grey Stinkwood |
| *Kunzea glabrescens* | Spearwood |
| *Lepidosperma longitudinale* | Pithy Sword-sedge |
| *Melaleuca thymoides* | |
| *Stirlingia latifolia* | Blueboy |

# BELL PASTURE SEEDS 2012 PRICELIST

Terry 0427389567 Rob 0427271638 Phone/Fax 08 97272243
bellpastureseeds@gmail.com

| | | gst exclusive | gst inclusive |
|---|---|---|---|
| **ANNUAL RYEGRASS** | | | |
| Atomic | *mid late tetraploid - new variety* | $3.70 | $4.07 |
| **BPS Wicher** | *mid late tetraploid W.A grown* | $2.70 | $2.97 |
| Abundant | *mid late tetraploid* | $3.60 | $3.96 |
| Winter Star | *mid late tetraploid* | $3.95 | $4.35 |
| Tetila Gold | *mid tetraploid - best of the tetila ryegrasses* | $2.60 | $2.86 |
| Sungrazer | *mid tetraploid* | $3.30 | $3.63 |
| Betta Tetila | *early mid tetraploid* | $2.20 | $2.42 |
| Fantastic | *Diploid - new variety* | $3.60 | $3.96 |
| Wimmera | *very early* | $2.30 | $2.53 |
| **PERENNIAL RYEGRASS** | | | |
| Everlast | | $5.50 | $6.05 |
| Banquet 11 | *endo 5* | $9.00 | $9.90 |
| **LEGUMES/ CLOVERS** | | | |
| Balansa Paradana | | $2.90 | $3.19 |
| Turbo Persian Clover | | $4.30 | $4.73 |
| Crimson Clover | | $4.50 | $4.95 |
| Dalkeith Sub Clover | | $5.10 | $5.61 |
| Trikkala Sub Clover | | $5.80 | $6.38 |
| Seaton Park Sub Clover | | $5.20 | $5.72 |
| **OATS** | | | |
| Massif | *tall late hay and grazing oat* | $1.00 | $1.10 |
| Saia | *tall hay and grazing oat* | $0.85 | $0.94 |
| **Elgin** | *tall very late and dense hay and grazing oat* | $0.70 | $0.77 |
| Graza 50 | *semi-tall medium grazing and hay oat* | $0.75 | $0.83 |
| Vasse | *medium hay oat* | $0.65 | $0.72 |
| Winjardie | *semi tall hay oat* | $0.60 | $0.66 |
| Swan | *tall hay oat - early maturity* | $0.65 | $0.72 |
| Carrolup | *medium hay oat - thin straw* | $0.50 | $0.55 |
| **GRAZING CEREALS** | | | |
| Yukuri Triticale (awnless) | | $0.75 | $0.83 |
| Forerunner Triticale | | $0.85 | $0.94 |
| Revenue Wheat | | $0.80 | $0.88 |
| White Stallion Barley | | $2.20 | $2.42 |
| **BPS RYEGRASS MIX** | | | |
| Atomic, Wicher, Tetila Gold | 25kg bags | $3.20 | $3.52 |
| **BPS WICHER PASTURE** | | | |
| Wicher, Balansa Paradana, Turbo Persian, Trikkala | 25kg bags | $3.60 | $3.96 |
| **BPS PASTURE BLEND** | | | |
| Atomic, Tetila Gold, Wicher, Balansa, Turbo, Trikkala | 25kg bags | $3.80 | $4.18 |
| **BPS QUICKFEED OAT & RYEGRASS** | | | |
| Carrolup oats (15kg) and BPS Ryegrass Blend (10kg) | 25kg bags | $1.60 | $1.76 |
| **BPS OAT & PASTURE BLEND** | | | |
| Elgin Oats (15kg) and BPS Pasture Blend (10kg) | 25kg bags | $1.90 | $2.09 |

**CUSTOM MIXING AND BLENDING WELCOME**

**All prices ex BPS cleaning sheds Cain Road Boyanup - Prices subject to change without notice**

**Trailer mounted mister for insect control available - dry hire**