



Referral of a Proposal by the Proponent to the Environmental Protection Authority under Section 38(1) of the *Environmental Protection Act 1986*.

PURPOSE OF THIS FORM

Section 38(1) of the *Environmental Protection Act 1986* (EP Act) provides that where a development proposal is likely to have a significant effect on the environment, a proponent may refer the proposal to the Environmental Protection Authority (EPA) for a decision on whether or not it requires assessment under the EP Act. This form sets out the information requirements for the referral of a proposal by a proponent.

Proponents are encouraged to familiarise themselves with the EPA’s *General Guide on Referral of Proposals* [see Environmental Impact Assessment/Referral of Proposals and Schemes] before completing this form.

A referral under section 38(1) of the EP Act by a proponent to the EPA must be made on this form. A request to the EPA for a declaration under section 39B (derived proposal) must be made on this form. This form will be treated as a referral provided all information required by Part A has been included and all information requested by Part B has been provided to the extent that it is pertinent to the proposal being referred. Referral documents are to be submitted in two formats – hard copy and electronic copy. The electronic copy of the referral will be provided for public comment for a period of 7 days, prior to the EPA making its decision on whether or not to assess the proposal.

CHECKLIST

Before you submit this form, please check that you have:

	Yes	No
Completed all the questions in Part A (essential).	✓	
Completed all applicable questions in Part B.	✓	
Included Attachment 1 – location maps.	✓	
Included Attachment 2 – additional document(s) the proponent wishes to provide (if applicable).	✓	
Included Attachment 3 – confidential information (if applicable).		✓
Enclosed an electronic copy of all referral information, including spatial data and contextual mapping but excluding confidential information.	✓	

Following a review of the information presented in this form, please consider the following question (a response is optional).

Do you consider the proposal requires formal environmental impact assessment?		
<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Not sure
If yes, what level of assessment?		
<input type="checkbox"/> Assessment on Proponent Information	<input type="checkbox"/> Public Environmental Review	

PROPONENT DECLARATION (to be completed by the proponent)

I, RICHARD ELLIOT, (full name) declare that I am authorised on behalf of.....Department of Housing..... (being the person responsible for the proposal) to submit this form and further declare that the information contained in this form is true and not misleading.

Signature	<i>Richard Elliot</i>	Name (print)	RICHARD ELLIOT
Position	STRATEGIC PLANNER	Company	DEPARTMENT of HOUSING.
Date	27/11/13		

PART A - PROPONENT AND PROPOSAL INFORMATION

(All fields of Part A must be completed for this document to be treated as a referral)

1 PROPONENT AND PROPOSAL INFORMATION

1.1 Proponent

Name	Department of Housing
Joint Venture parties (if applicable)	
Australian Company Number (if applicable)	56 167 671 885 (ABN)
Postal Address (where the proponent is a corporation or an association of persons, whether incorporated or not, the postal address is that of the principal place of business or of the principal office in the State)	99 Plain Street East Perth WA 6004
Key proponent contact for the proposal: <ul style="list-style-type: none">• name• address• phone• email	C/- Richard Elliot Strategic Planner Department of Housing Level 5, 169 Hay Street, East Perth, 6004 T: (08) 9222 4832 M: 0418 918 299 richard.elliott@housing.wa.gov.au
Consultant for the proposal (if applicable): <ul style="list-style-type: none">• name• address• phone• email	C/- Tamara Smith Director 360 Environmental Pty Ltd 10 Bermondsey Street, West Leederville, 6007 T: (08) 9388 8360 tamarasmith@360environmental.com.au

1.2 Proposal

Title	Department of Housing Kwinana Project
Description	<p>The proposal is to develop three sites within the City of Kwinana into residential housing and mixed use developments. The three sites include the Kwinana Town Centre (KTC), Parmelia and the Train Station Precinct. The objective of the development is to provide for a renewed and modern element to the Kwinana area. The location of the three sites is shown in Figure 1.</p> <p>KTC - Lot E26 Gilmore Avenue, Kwinana (37.7ha), is proposed to consist of urban residential, Public Open Space (POS), mixed use and retail. The residential blocks are proposed to vary between 225 m2 and 1160 m2 creating a mixed density urban development of approximately 470 lots (Figure 2a).</p>

	<p>Parmelia - Lot 9237 Bertram Road, Kwinana (41.1 ha), is proposed to consist of urban residential, POS, and mixed use (Figure 2b).</p> <p>Train Station Precinct, Kwinana – (15.1 ha). The Train Station Precinct consists of seven sub-sites (A, B, C, D, E, F and G). Sub-sites C, E and F adjoin the Kwinana Train Station (Figure 2c). The rail line is expected to positively affect development within the Town with accessibility to the Perth CBD and Kwinana being increased.</p>
Extent (area) of proposed ground disturbance.	<p>The proposed development covers approximately 93.9 hectares (ha), across the three discrete sites. The area (ha) of proposed ground disturbance for each site is as follows:</p> <ul style="list-style-type: none"> • KTC: 37.7 ha, of which 1.9 ha are already cleared. (Figure 3a); • Parmelia: 41.1 ha, of which 0.81 ha are already cleared (Figure 3b); and • Train Station Precinct: 15.1 ha, of which 2.7 ha are already cleared (Figure 3c).
Timeframe in which the activity or development is proposed to occur (including start and finish dates where applicable).	Construction is scheduled to begin in 2014.
Details of any staging of the proposal.	Each of the development areas will be staged as individual subdivision stages within each development zone as referrals are progressed/approved.
Is the proposal a strategic proposal?	No
Is the proponent requesting a declaration that the proposal is a derived proposal? If so, provide the following information on the strategic assessment within which the referred proposal was identified: <ul style="list-style-type: none"> • title of the strategic assessment; and • Ministerial Statement number. 	No
Please indicate whether, and in what way, the proposal is related to other proposals in the region.	The proposal is not related to any other proposals in the region.
Does the proponent own the land on which the proposal is to be established? If not, what other arrangements have been established to access the land?	Yes. The three sites proposed to be developed are owned by the Western Australian Department of Housing and project managed by Satterley Property Group. Two small portions of Unallocated Crown Land within sub-site A of the Train Station Precinct (Lots 9216 and 9217) and associated portions of road reserve are currently owed by the State of Western

	<p>Australia. The intention is for this land to be transferred to the Department of Housing for residential development. Attachment 2A shows authorisation given the Department of Housing by the Department of Regional Development and Lands to make application for environmental approval over Lot 9216 and 9217.</p>
<p>What is the current land use on the property, and the extent (area in hectares) of the property?</p>	<p>Under the City of Kwinana Local Planning Scheme No. 2 (Western Australian Planning Commission [WAPC], 2010a):</p> <ul style="list-style-type: none"> • The KTC site is 37.7 ha and is zoned 'Kwinana Town Centre'. The site consists of predominantly remnant bushland (Figure 2a). A small portion of the site on the eastern boundary has been cleared and fenced for Water Corporation sewage infrastructure. There are several paths and tracks throughout the site and some previously cleared areas (Figure 2a); • The Parmelia site is 41.1 ha and is zoned 'Residential'. The site is predominately remnant bushland with a number of tracks throughout the site and two areas that have been excavated in the past for quarrying (Figure 2b); and • All sub-sites at the Train Station Precinct site are zoned 'Residential'. The total combined area of the train station precinct is 15.1ha. The sites mostly consist of remnant bushland, with portions of previously cleared or disturbed areas (Figure 2c). <p>Under the Metropolitan Region Scheme (MRS) all three sites within the proposed development are zoned 'Urban' (WAPC 2010b).</p>

1.3 Location

Name of the Shire in which the proposal is located.	City of Kwinana
<p>For urban areas:</p> <ul style="list-style-type: none"> • street address; • lot number; • suburb; and • nearest road intersection. 	<ul style="list-style-type: none"> • KTC: Lot E26 Gilmore Avenue, Kwinana, near intersection of Wellard Road and Gilmore Avenue (Figure 3a); • Parmelia: Lot 9237 Bertram Road, Kwinana, near intersection of Challenger Avenue and Gilmore Avenue (Figure 1; 3b); • Train Station Precinct A, C, D, E, F, G: Lots 9004, 9236, 9217, 9216 and 9235 Sulphur Road, Kwinana, near intersection of Sulphur Road and Sicklemore Road (Figure 1; 3c); and • Train Station Precinct B: Lot E6 Sicklemore Road, Kwinana, near intersection of Sulphur Road and Sicklemore Road (Train Station Precinct sub-site B) (Figure 1; 3c).
<p>For remote localities:</p> <ul style="list-style-type: none"> • nearest town; and • distance and direction from that town to the proposal site. 	N/A
<p>Electronic copy of spatial data - GIS or CAD, georeferenced and conforming to the following parameters:</p> <ul style="list-style-type: none"> • GIS: polygons representing all activities and named; • CAD: simple closed polygons representing all activities and named; • datum: GDA94; • projection: Geographic (latitude/longitude) or Map Grid of Australia (MGA); • format: Arcview shapefile, Arcinfo coverages, Microstation or AutoCAD. 	GIS polygon in Arcview shapefile format enclosed.

1.4 Confidential Information

Does the proponent wish to request the EPA to allow any part of the referral information to be treated as confidential?	No
If yes, is confidential information attached as a separate document in hard copy?	No

1.5 Government Approvals

Is rezoning of any land required before the proposal can be implemented? If yes, please provide details.		No	
Is approval required from any Commonwealth or State Government agency or Local Authority for any part of the proposal? If yes, please complete the table below.		Yes	
Agency/ Authority	Approval required	Application lodged Yes / No	Agency/Local Authority contact(s) for proposal
Department of the Environment	Yes – Referral of a Proposed Action under the EPBC Act	Yes	Nikki Ward (02) 6274 2082
City of Kwinana	Yes – Approval of the overall 'Development Concept' (in the form of a Local Structure Plan) and the Local Water Management Strategy	Yes	Ashley Harding Manager Environment Services (08) 9439 0206
Department of Planning (DoP) on behalf of Western Australian Planning Commission (WAPC)	No - Comments and recommendations provided (see Attachment 2B)	No	Anika Chhabra Metropolitan Planning South West (08) 6551 9000
Department of Water	Yes – Approval of Local Water Management Strategy and Urban Water Management Plan	No	Brett Dunn Urban Water Management Peel Region (08) 6364 7600
Department of Education	No – Comments and recommendations provided (see Attachment 2B)	No	Richard Bloor Strategic Asset Planning (08) 9264 4111
Department of Sport and Recreation (DSR)	No – Comments and recommendations provided (see Attachment 2B)	No	Rob Didcoe Facilities and Camps (08) 9492 9700
Department of Aboriginal Affairs (DAA)	No – DAA advised that there are no known heritage sites within the areas of the proposed development (see Attachment 2B)	No	Cesar Rodriguez Heritage Advice and Approvals – Government (08) 6551 8004
State Heritage Office (SHO)	No – SHO Advised that the proposal does not appear to impact upon any place of State cultural heritage significance (see Attachment 2B)	No	Callum Crofton Local Government Services

Department of Fire and Emergency Services	No – Comments and recommendations provided (see Attachment 2B)	No	Graham Hardy Planning Officer (08) 6552 4000
Department of Health (DoH)	No – Comments and Recommendations provided (see Attachment 2B)	No	Jim Dodds (08) 9222 4222

PART B - ENVIRONMENTAL IMPACTS AND PROPOSED MANAGEMENT

2. ENVIRONMENTAL IMPACTS

Describe the impacts of the proposal on the following elements of the environment, by answering the questions contained in Sections 2.1-2.11:

- 2.1 flora and vegetation;
- 2.2 fauna;
- 2.3 rivers, creeks, wetlands and estuaries;
- 2.4 significant areas and/ or land features;
- 2.5 coastal zone areas;
- 2.6 marine areas and biota;
- 2.7 water supply and drainage catchments;
- 2.8 pollution;
- 2.9 greenhouse gas emissions;
- 2.10 contamination; and
- 2.11 social surroundings.

These features should be shown on the site plan, where appropriate.

For all information, please indicate:

- (a) the source of the information; and
- (b) the currency of the information.

2.1 Flora and Vegetation

2.1.1 Do you propose to clear any native flora and vegetation as a part of this proposal?

[A proposal to clear native vegetation may require a clearing permit under Part V of the EP Act (Environmental Protection (Clearing of Native Vegetation) Regulations 2004)]. Please contact the Department of Environment and Conservation (DEC) for more information.

(please tick) Yes **If yes**, complete the rest of this section.

No **If no**, go to the next section

2.1.2 How much vegetation are you proposing to clear (in hectares)?

KTC

Implementation of the proposal will result in the clearing of 35.6 ha with 2.1 hectares of remnant vegetation to be retained in POS areas (Figure 3a).

Parmelia

Implementation of the proposal will result in the clearing of 38.5 ha with 4 hectares of remnant vegetation to be retained in POS (Figure 3b).

Train Station Precinct

Implementation of the proposal will result in the clearing of 15.1 ha (Figure 3c).

2.1.3 Have you submitted an application to clear native vegetation to the DEC (unless you are exempt from such a requirement)?

Yes

No

If yes, on what date and to which office was the application submitted of the DEC?

It is not anticipated that a Clearing Permit is required as clearing in accordance with a subdivision approval given by the responsible authority under the Town Planning and Development Act 1928, is listed as an exemption under *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*.

2.1.4 Are you aware of any recent flora surveys carried out over the area to be disturbed by this proposal?

Yes

No

If yes, please attach a copy of any related survey reports and provide the date and name of persons / companies involved in the survey(s).

If no, please do not arrange to have any biological surveys conducted prior to consulting with the DEC.

A Level 2 flora and vegetation survey was undertaken at KTC by 360 Environmental in October 2006 (360 Environmental 2006, Attachment 2C). To ensure that results obtained from the vegetation and flora survey was current, a subsequent Level 2 flora and vegetation survey was undertaken at KTC in November 2012 (360 Environmental 2012).

A Level 2 flora survey and vegetation survey was undertaken by 360 Environmental at Parmelia in November 2009 (360 Environmental 2010, Attachment 2D).

A Level 2 flora and vegetation survey was undertaken by 360 Environmental at the Train Station Precinct site in October 2008 (360 Environmental 2009, Attachment 2E).

2.1.5 Has a search of DEC records for known occurrences of rare or priority flora or threatened ecological communities been conducted for the site?

Yes

No

If you are proposing to clear native vegetation for any part of your proposal, a search of DEC records of known occurrences of rare or priority flora and threatened ecological communities will be required. Please contact DEC for more information.

Department of Parks and Wildlife (DPaW) records of known occurrences of rare and priority flora and threatened ecological communities were searched prior to undertaking the flora and vegetation surveys for KTC, Parmelia and the Train Station Precinct. Information obtained from the searches was used to determine the likelihood of conservation significant flora being present in the area of the proposed development.

2.1.6 Are there any known occurrences of rare or priority flora or threatened ecological communities on the site?

Yes No **If yes**, please indicate which species or communities are involved and provide copies of any correspondence with DEC regarding these matters.

No Declared Rare Flora (DRF) or Priority flora was recorded during flora and vegetation surveys. The Floristic Community Types (FCTs) identified in KTC, Parmelia and the Train Station Precinct were not considered to be representative of a Threatened Ecological Community listed by DPaW (Attachment 2C, Attachment 2D, Attachment 2E).

2.1.7 If located within the Perth Metropolitan Region, is the proposed development within or adjacent to a listed Bush Forever Site? (You will need to contact the Bush Forever Office, at the Department for Planning and Infrastructure)

Yes No **If yes**, please indicate which Bush Forever Site is affected (site number and name of site where appropriate).

The proposed development is adjacent to the following listed Bush Forever Sites:

- Parmelia is bounded to the West by Bush Forever Site 67;
- Train Station Precinct A is bounded to the North by Bush Forever Site 272 (Figure 5);
- Train Station Precinct B is bounded to the East of Bush Forever Site 272 (Figure 5);
- Train Station Precinct C is bounded to the West of Bush Forever Site 272 (Figure 5);
- Train Station Precinct D is bounded to the West and is slightly within Bush Forever Site 272 (Figure 5); and
- Train Station Precinct G is bounded to the East of Bush Forever Site 272 (Figure 5).

Part of Bush Forever Site No. 272 (Lot 9241) is owned by Department of Housing (freehold), and is zoned under the MRS as Parks and Recreation (with a Bush Forever layer). Lot 9241 of Bush Forever Site 272 is approximately 22 ha (Figure 5). To demonstrate the Department of Housing's commitment to protecting remnant vegetation, it is proposed that Lot 9241 will be transferred from the Department of Housing to the WAPC.

2.1.8 What is the condition of the vegetation at the site?

KTC

The condition of vegetation within KTC is mostly in the range of 'Good' to 'Degraded'. Some areas were assessed as 'Completely Degraded'. The main factor affecting the vegetation condition was weed cover. Perennial veldt grass (*Ehrharta calycina*) formed a grassland and sometimes a closed grassland over most of the survey area and was the most dominant and widespread weed. Some physical disturbance occurred in various places in the survey area. In its current state, the condition of vegetation within KTC is expected to decline further in the absence of fire and weed management (360 Environmental 2006; 2012; Attachment 2C).

Parmelia Site

The condition of the vegetation across the Parmelia site was recorded as being between 'Good' to 'Completely Degraded', with the majority of the site mapped as 'Good to Degraded' (360 Environmental 2010; Attachment 2D).

Train Station Precinct

Four of the sub-sites at the Train Station Precinct (A, B, D, E) were considered to be in predominantly 'Good' condition and three sub-sites (C, F, G) were considered to be mostly in 'Very Good' condition. (360 Environmental 2009; Attachment 2E).

2.2 Fauna

2.2.1 Do you expect that any fauna or fauna habitat will be impacted by the proposal?

(please tick) Yes **If yes, complete the rest of this section.**

No **If no, go to the next section.**

2.2.2 Describe the nature and extent of the expected impact.

Impacts to fauna associated with the proposed development include:

- Loss of potential fauna habitat;
- Loss of potential roosting, breeding and foraging habitat of Black Cockatoos;
- Disruption of movement of fauna across areas of remnant vegetation within and adjacent to the proposed development.

Fauna habitat within the three sites of the proposed development is considered to be of value to fauna given the presence of large mature tree such as Tuart, Marri, Jarrah and Banksia. However there are several factors that lower the value of fauna habitat within the proposed development including;

- High levels of annual weeds in disturbed areas;
- The isolation and fragmentation of the three sites from larger areas of remnant vegetation; and
- The presence of roads and railways. Roads and railways currently surround the proposed development and may impact ground dwelling species such as mammals and reptiles by providing a barrier to the movement of fauna in and out of the area.

Given the isolated and fragmented nature of the three sites within the proposed development, loss of fauna habitats and assemblages are likely to be localised and are unlikely to extend beyond the boundaries of the sites.

2.2.3 Are you aware of any recent fauna surveys carried out over the area to be disturbed by this proposal?

Yes

No

If yes, please attach a copy of any related survey reports and provide the date and name of persons / companies involved in the survey(s).

If no, please do not arrange to have any biological surveys conducted prior to consulting with the DEC.

A Level 1 Vertebrate Survey was undertaken by 360 Environmental at KTC on the mornings of 21 March, 24 April and 21 May 2012 (360 Environmental 2012b; Attachment 2F).

A Level 1 Vertebrate Survey was undertaken by 360 Environmental at Parmelia on 27 July 2012 (360 Environmental 2012a; Attachment 2G).

A Level 1 Vertebrate Survey was undertaken by 360 Environmental at the Train Station Precinct site on the mornings of 20 July and the 7 September 2012 (360 Environmental 2012c; Attachment 2H).

2.2.4 Has a search of DEC records for known occurrences of Specially Protected (threatened) fauna been conducted for the site?

Yes

No

(please tick)

DPaW records of known occurrences of threatened fauna were searched prior to undertaking the Level 1 Vertebrate Surveys at KTC, Parmelia and the Train Station Precinct. Information obtained from the searches was used to determine the likelihood of conservation significant fauna being present on site.

2.2.5 Are there any known occurrences of Specially Protected (threatened) fauna on the site?

Yes

No

If yes, please indicate which species or communities are involved and provide copies of any correspondence with DEC regarding these matters.

A search of the DPaW Threatened Fauna database, the EPBC Act *Protected Matters Search Tool* and NatureMap returned the following fauna as having been recorded to occur within two kilometres of the proposed development (Table 1, Attachment 2F; 2G, 2H).

Note that a referral under the federal Environmental Protection and Biodiversity Conservation (EPBC) Act was lodged with the federal Department of the Environment for potential impacts to matters of National Environmental Significance. An approval under the EPBC Act was received on the 29th August 2014 (Attachment 2O).

Table 1. Threatened Fauna Previously Known to Occur or Potentially Occur Within a Two Kilometres of the Proposed Development

		INTERNATIONAL	COMMONWEALTH	STATE	
COMMON NAME	SCIENTIFIC NAME	IUCN	EPBC	DPAW	WCACT
Birds					
Australian Painted Snipe	<i>Rostratula australis</i>	Endangered	Vulnerable	Endangered	Schedule 1
Carnaby's Black Cockatoo	<i>Calyptorhynchus latirostris</i>	Endangered	Endangered	Endangered	Schedule 1
Cattle Egret	<i>Ardea ibis</i>		Migratory Marine, Migratory Wetland		Schedule 3
Forest Red-Tailed Black Cockatoo	<i>Calyptorhynchus banksii naso</i>		Vulnerable	Vulnerable	Schedule 1
Fork-Tailed Swift	<i>Apus pacificus</i>	Least Concern	Migratory Marine		Schedule 3
Great Egret, White Egret	<i>Ardea alba</i>		Migratory Marine, Migratory Wetland		Schedule 3
Malleefowl	<i>Leipoa ocellata</i>	Vulnerable	Vulnerable, Migratory Terrestrial	Vulnerable	Schedule 1
Painted Snipe	<i>Rostratula benghalensis s. lat.</i>	Least Concern	Migratory Wetland		Schedule 3
Rainbow Bee-Eater	<i>Merops ornatus</i>	Least Concern	Migratory Terrestrial		Schedule 3
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Least Concern	Migratory Terrestrial		Schedule 3
Peregrine Falcon	<i>Falco peregrinus</i>	Least Concern			Schedule 4
Hooded Plover	<i>Charadrius rubricollis</i>	Vulnerable	Migratory, Marine	Priority 4	
Australasian Bitten	<i>Botaurus poiciloptilus</i>	Endangered	Endangered	Endangered	Schedule 1
Common Sandpiper	<i>Actitis hypoleucos</i>	Least Concern	Migratory, Marine		Schedule 3
Fairy Tern (Australian)	<i>Sternula nereis nereis</i>	Vulnerable	Vulnerable	Vulnerable	Schedule 1
Glossy Ibis	<i>Plegadis falcinellus</i>	Least concern			Schedule 3
Mammals					
Chuditch	<i>Dasyurus geoffroii</i>	Near Threatened	Vulnerable	Vulnerable	Schedule 1
Quenda	<i>Isodon obesulus</i> subsp. <i>fusciventer</i>	Least Concern		Priority 5	
Quokka	<i>Setonix brachyurus</i>	Vulnerable	Vulnerable	Vulnerable	Schedule 1
Red-Tailed Phascogale	<i>Phascogale calura</i>	Near Threatened	Endangered	Endangered	Schedule 1
Water Rat	<i>Hydromys chrysogaster</i>	Least Concern		Priority 4	
Western Brush Wallaby	<i>Macropus Irma</i>	Least Concern		Priority 4	
Reptiles					
Lined Skink	<i>Lerista lineata</i>			Priority 3	
Rottnest Bobtail	<i>Tiliqua rugosa</i> subsp. <i>konowi</i>			Vulnerable	Schedule 1
Black-striped Snake	<i>Neelaps calonotos</i>	Lower Risk/Near Threatened		Priority 3	
Insects					
Graceful Sun Moth	<i>Synemon gratiosa</i>			Priority 4	

Level 1 Fauna Vertebrate Surveys undertaken by 360 Environmental within the three sites of the proposed development recorded evidence the following species as being present:

KTC

- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) – Endangered;
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – Vulnerable; and
- Quenda (*Isoodon obesulus* subsp. *Fusciventer*) – Priority 5 (360 Environmental 2012b, Attachment F).

Parmelia

- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) – Endangered; and
- Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) – Vulnerable (360 Environmental 2012a, Attachment G).

Train Station Precinct

- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) - Endangered; and
- Quenda (*Isoodon obesulus* subsp. *Fusciventer*) – Priority 5 (360 Environmental 2012c, Attachment H).

A Fauna Relocation Plan will be prepared for the relocation of Quenda that may be inhabiting the KTC and the Train Station Precinct. A Fauna specialist will be engaged as part of the Fauna Relocation Plan for the trapping and relocation of Quenda. The release location and trapping methods used in the Fauna Relocation Plan will be determined in consultation with DPaW and/or the City of Kwinana.

Black Cockatoo surveys were undertaken at all three sites of the proposed development. Each survey assessed foraging habitat, significant trees and potential breeding hollows in consistency with the Department of the Environment's (DotE) *EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species* (2012). Results of each of the surveys are provided below.

Black Cockatoo Survey KTC

- The habitat area includes 26% Jarrah and Marri mix, 4% Banksia and 70% Jarrah and Banksia mix;
- The site is predominantly used by Forest Red-tailed Black Cockatoos however evidence of occasional use by Carnaby's Black Cockatoo was also found;
- Sparse evidence of old feeding debris;
- Evidence of one small roost;
- Three hollows of sufficient size for nesting by Black Cockatoos (however one was infested with bees and another was located too low in a tree to be of use to Black Cockatoos); and
- 574 Significant Trees (exceeding Diameter Breast Height (DBH) 500 mm) (360 Environmental 2012d, Attachment 2I, Figure 4a).

Black Cockatoo Survey Parmelia

- The habitat area includes 17% Jarrah and Marri mix, 1% Banksia and 82% Jarrah and Banksia mix;

- Although not extensively utilised, evidence was found of usage by Carnaby's Black Cockatoos and to a lesser extent Forest Red-tailed Black Cockatoos;
- Sparse evidence of feeding debris;
- One potentially suitable nesting hollow (not used by Black Cockatoos at the time of survey); and
- 449 Significant Trees (exceeding DBH 500 mm) (360 Environmental 2012c, Attachment J, Figure 4b).

Black Cockatoo Survey Train Station Precinct

- The habitat area includes 100% Banksia;
- Feeding evidence by Carnaby's Black Cockatoos; and
- 37 Significant Trees (exceeding DBH 500 mm) (360 Environmental 2012f; 2010a, Attachment 2K; 2L, Figure 4c).

Clearing of the vegetation within the proposed development will remove foraging habitat, roosting habitat and potential breeding habitat for the Carnaby's Black Cockatoo and Forest Red-tailed Cockatoo. Several measures have been incorporated into the design of the proposed development to avoid, reduce and offset the loss of Black Cockatoo habitat including:

Public Open Space

The proponent has undertaken planning and design processes to minimise impacts on Black Cockatoo habitat. This includes retaining significant trees where possible in POS areas and streetscape design. Approximately 6.1 hectares of remnant vegetation will be retained in POS areas of the proposed development.

Revegetation

The proponent has committed to revegetating areas cleared for the proposed development with a minimum of 1080 seedlings that will include a mix of Black Cockatoo foraging habitat species. Revegetation will likely occur in public open spaces (POS) and streetscape areas.

Topsoil from the three sites of the proposed development will also be collected prior to construction and reused where possible for rehabilitation of cleared areas.

Construction Management

Several strategies are currently in place to minimise impacts to Black Cockatoos during the construction phase of the proposed development, such as:

- If Black Cockatoos are present at the site during construction the construction will cease until the Black Cockatoos leave the area;
- All hollows will be visually checked prior to clearing. Should Black Cockatoos be present at the hollow the tree will be retained until the nest is abandoned or relocation will be undertaken in consultation with DPaW;
- Tree hollows and logs that may be potentially suitable for fauna habitat will be salvaged and relocated to the areas of POS if possible; and
- Construction personnel will be inducted prior to commencing work on site of the procedures for encountering fauna on site during clearing.

Acquisition of Conservation Estate

Kwinana Offset

The Department of Housing intends to transfer Lot 9241 (Bush Forever 272) to the WAPC for protection in perpetuity. The availability of foraging habitat and breeding habitat distinguished the site as being of value to Black Cockatoo species.

A Black Cockatoo habitat and significant tree survey was undertaken on Lot 9241 by 360 Environmental on the 18 and 19 of October 2012 (360 Environmental 2012, Attachment 2M) in consistency with the *EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species* (SEWPaC 2012). The survey did not find any evidence of Black Cockatoo breeding on the site however the site did contain suitable feeding species (Banksia and Jarrah) and sparse evidence of feeding debris were recorded. Fourteen locations showed evidence of Carnaby's Black Cockatoo feeding.

The significant tree survey identified 89 Jarrah trees on site with a DBH of 500mm or more. Although none of the trees had hollows of a suitable size for Black Cockatoo species, the presence of significant trees on site suggested the site had the potential to be of breeding significance to Black Cockatoo species in the future.

The habitat of Lot 9241 is similar to that found on the three sites of the proposed development and has been described as consisting of Banksia Woodland (*Banksia attenuata*, *B. menziesii* and to a lesser extent, *B. ilicifolia*) with an over storey of Jarrah (*Eucalyptus marginata*), a mid-storey of Sheoak (*Allocasuarina fraseriana*), Woolly Bush (*Adenanthos* sp.) and an understorey of Grass trees (*Xanthorea* spp), Zamia Palms (*Macrozamia* sp.) and annual weed species (360 Environmental 2012, Attachment 2M). Banksia woodland is a predominant vegetation type of the proposed development.

The last vegetation and flora survey of Bush Forever site 272 was conducted by the Department of Environment Protection in 1999. Vegetation condition of the site was recorded as <40% excellent; >30% Very Good; >30% Good to Degraded with areas of severe localised disturbance (DEP 2000). Bush Forever site 272 has also been distinguished as being part of a significant contiguous bushland/wetland linkage (DEP 2000).

It is envisaged DPaW will be responsible for the management of Lot 9241 for conservation and habitat protection purposes on behalf of the WAPC.

Provision of Funding for Black Cockatoo Research

In addition to the transfer of Bush Forever Site 272 into conservation estate, the proponent has committed to facilitating Black Cockatoo research projects through the provision of significant funding to the Western Australian Museum and Murdoch University as detailed in Attachment 2N.

2.3 Rivers, Creeks, Wetlands and Estuaries

2.3.1 Will the development occur within 200 metres of a river, creek, wetland or estuary?

(please tick)

Yes

If yes, complete the rest of this section.

No

If no, go to the next section.

There are no waterways, wetlands or hydrological features within proximity to KTC Parmelia or the Train Station Precinct. The nearest water features are Small Eye Spectacle Swamp which is located approximately 0.2 km from the Train Station Precinct and Bollard Bullrush Swamp which is a Multiple Use, Resource Enhancement and Conservation Category wetland located approximately 0.2km from Parmelia.

2.3.2 Will the development result in the clearing of vegetation within the 200 metre zone?

Yes No **If yes**, please describe the extent of the expected impact.

2.3.3 Will the development result in the filling or excavation of a river, creek, wetland or estuary?

Yes No **If yes**, please describe the extent of the expected impact.

2.3.4 Will the development result in the impoundment of a river, creek, wetland or estuary?

Yes No **If yes**, please describe the extent of the expected impact.

2.3.5 Will the development result in draining to a river, creek, wetland or estuary?

Yes No **If yes**, please describe the extent of the expected impact.

2.3.6 Are you aware if the proposal will impact on a river, creek, wetland or estuary (or its buffer) within one of the following categories? (please tick)

Conservation Category Wetland	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Unsure
Environmental Protection (South West Agricultural Zone Wetlands) Policy 1998	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Unsure
Perth's Bush Forever site	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	<input type="checkbox"/> Unsure
Environmental Protection (Swan & Canning Rivers) Policy 1998	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Unsure
The management area as defined in s4(1) of the <i>Swan River Trust Act 1988</i>	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Unsure
Which is subject to an international agreement, because of the importance of the wetland for waterbirds and waterbird habitats (e.g. Ramsar, JAMBA, CAMBA)	<input type="checkbox"/> Yes	<input checked="" type="checkbox"/> No	<input type="checkbox"/> Unsure

2.4 Significant Areas and/ or Land Features

2.4.1 Is the proposed development located within or adjacent to an existing or proposed National Park or Nature Reserve?

Yes No **If yes**, please provide details.

2.4.2 Are you aware of any Environmentally Sensitive Areas (as declared by the Minister under section 51B of the EP Act) that will be impacted by the proposed development?

Yes No **If yes**, please provide details.

Bush Forever Site 67 which bounds the West of Parmelia is declared as an Environmentally Sensitive Area (DEC, 2012).

Bush Forever Site 272 which bounds the Train Station Precinct sub-sites is declared as an Environmentally Sensitive Area.

The small amount of clearing that will be undertaken in Bush Forever Site 272 will be offset by the transfer of Lot 9241 Parmelia from the Western Australian Department of Housing to the WAPC into conservation estate for protection in perpetuity in addition to the provision of funding to facilitate Black Cockatoo research as outlined in Attachment 2N.

2.4.3 Are you aware of any significant natural land features (e.g. caves, ranges etc) that will be impacted by the proposed development?

Yes No **If yes**, please provide details.

No significant land features occur in the area of the proposed development.

2.5 Coastal Zone Areas (Coastal Dunes and Beaches)

2.5.1 Will the development occur within 300metres of a coastal area?

- (please tick) Yes **If yes**, complete the rest of this section.
 No **If no**, go to the next section.

2.5.2 What is the expected setback of the development from the high tide level and from the primary dune?

2.5.3 Will the development impact on coastal areas with significant landforms including beach ridge plain, cusped headland, coastal dunes or karst?

- Yes No **If yes**, please describe the extent of the expected impact.

2.5.4 Is the development likely to impact on mangroves?

- Yes No **If yes**, please describe the extent of the expected impact.

2.6 Marine Areas and Biota

2.6.1 Is the development likely to impact on an area of sensitive benthic communities, such as seagrasses, coral reefs or mangroves?

- Yes No **If yes**, please describe the extent of the expected impact.

2.6.2 Is the development likely to impact on marine conservation reserves or areas recommended for reservation (as described in *A Representative Marine Reserve System for Western Australia*, CALM, 1994)?

- Yes No **If yes**, please describe the extent of the expected impact.

2.6.3 Is the development likely to impact on marine areas used extensively for recreation or for commercial fishing activities?

- Yes No **If yes**, please describe the extent of the expected impact, and provide any written advice from relevant agencies (e.g. Fisheries WA).

2.7 Water Supply and Drainage Catchments

2.7.1 Are you in a proclaimed or proposed groundwater or surface water protection area?

(You may need to contact the Department of Water (DoW) for more information on the requirements for your location, including the requirement for licences for water abstraction. Also, refer to the DoW website)

- Yes No **If yes**, please describe what category of area.

KTC, Parmelia and the Train Station Precinct are all within the Rockingham proclaimed groundwater protection area.

Neither KTC, Parmelia or the Train Station Precinct sites are within a proclaimed surface water protection area.

2.7.2 Are you in an existing or proposed Underground Water Supply and Pollution Control area?

(You may need to contact the DoW for more information on the requirements for your location, including the requirement for licences for water abstraction. Also, refer to the DoW website)

Yes No **If yes**, please describe what category of area.

2.7.3 Are you in a Public Drinking Water Supply Area (PDWSA)?

(You may need to contact the DoW for more information or refer to the DoW website. A proposal to clear vegetation within a PDWSA requires approval from DoW.)

Yes No **If yes**, please describe what category of area.

2.7.4 Is there sufficient water available for the proposal?

(Please consult with the DoW as to whether approvals are required to source water as you propose. Where necessary, please provide a letter of intent from the DoW)

Yes No (please tick)

The proposed development will be serviced with scheme water to assist in construction and for use following development. There may be the requirement to utilise minimal amounts of groundwater to irrigate POS. This will be discussed with the Department of Water once initial approvals are issued.

2.7.5 Will the proposal require drainage of the land?

Yes No **If yes**, how is the site to be drained and will the drainage be connected to an existing Local Authority or Water Corporation drainage system? Please provide details.

Drainage will be designed in consistency with the *Better Urban Water Management Guidelines* (WAPC, 2010). Management plans and strategies for drainage design will be prepared for each site and approved by the Department of Water prior to development.

2.7.6 Is there a water requirement for the construction and/ or operation of this proposal?

(please tick) Yes **If yes**, complete the rest of this section.
 No **If no**, go to the next section.

The proponent will utilise scheme water during construction, If scheme water is not available, water will be transported to site for use.

2.7.7 What is the water requirement for the construction and operation of this proposal, in kilolitres per year?

This information is not yet available.

2.7.8 What is the proposed source of water for the proposal? (e.g. dam, bore, surface water etc.)

The proposed development will use scheme water.

2.8 Pollution

2.8.1 Is there likely to be any discharge of pollutants from this development, such as noise, vibration, gaseous emissions, dust, liquid effluent, solid waste or other pollutants?

(please tick) Yes **If yes**, complete the rest of this section.

No **If no**, go to the next section.

Construction will likely emit minimal levels of noise, dust and vibration. Noise, dust and vibration levels will be managed through best practice construction management.

Following completion of development, private dwellings will be connected to serviced sewerage.

2.8.2 Is the proposal a prescribed premise, under the Environmental Protection Regulations 1987?

(Refer to the EPA's *General Guide for Referral of Proposals to the EPA under section 38(1) of the EP Act 1986* for more information)

Yes No **If yes**, please describe what category of prescribed premise.

2.8.3 Will the proposal result in gaseous emissions to air?

Yes No **If yes**, please briefly describe.

2.8.4 Have you done any modelling or analysis to demonstrate that air quality standards will be met, including consideration of cumulative impacts from other emission sources?

Yes No **If yes**, please briefly describe.

2.8.5 Will the proposal result in liquid effluent discharge?

Yes No **If yes**, please briefly describe the nature, concentrations and receiving environment.

2.8.6 If there is likely to be discharges to a watercourse or marine environment, has any analysis been done to demonstrate that the State Water Quality Management Strategy or other appropriate standards will be able to be met?

Yes No **If yes**, please describe.

2.8.7 Will the proposal produce or result in solid wastes?

Yes No **If yes**, please briefly describe the nature, concentrations and disposal location/ method.

2.8.8 Will the proposal result in significant off-site noise emissions?

Yes No **If yes**, please briefly describe.

2.8.9 Will the development be subject to the Environmental Protection (Noise) Regulations 1997?

Yes No **If yes**, has any analysis been carried out to demonstrate that the proposal will comply with the Regulations?

Please attach the analysis.

Construction activities will be subject to the requirements of the *Environmental Protection (Noise) Regulations 1997*, including observing start and finish times, and controlling noise levels to prevent impacts to surrounding residential areas.

2.8.10 Does the proposal have the potential to generate off-site, air quality impacts, dust, odour or another pollutant that may affect the amenity of residents and other “sensitive premises” such as schools and hospitals (proposals in this category may include intensive agriculture, aquaculture, marinas, mines and quarries etc.)?

Yes No **If yes**, please describe and provide the distance to residences and other “sensitive premises”.

2.8.11 If the proposal has a residential component or involves “sensitive premises”, is it located near a land use that may discharge a pollutant?

Yes No Not Applicable

If yes, please describe and provide the distance to the potential pollution source

2.9 Greenhouse Gas Emissions

2.9.1 Is this proposal likely to result in substantial greenhouse gas emissions (greater than 100 000 tonnes per annum of carbon dioxide equivalent emissions)?

Yes No **If yes**, please provide an estimate of the annual gross emissions in absolute and in carbon dioxide equivalent figures.

2.9.2 Further, if yes, please describe proposed measures to minimise emissions, and any sink enhancement actions proposed to offset emissions.

2.10 Contamination

2.10.1 Has the property on which the proposal is to be located been used in the past for activities which may have caused soil or groundwater contamination?

Yes No Unsure **If yes, please describe.**

2.10.2 Has any assessment been done for soil or groundwater contamination on the site?

Yes No **If yes, please describe.**

A desktop review of previous land uses, and a search of the DER's Contaminated Sites GIS database was undertaken to identify contaminated sites that may occur within the proposal area (DER, 2013).

2.10.3 Has the site been registered as a contaminated site under the *Contaminated Sites Act 2003*? (on finalisation of the CS Regulations and proclamation of the CS Act)

Yes No **If yes, please describe.**

2.11 Social Surroundings

2.11.1 Is the proposal on a property which contains or is near a site of Aboriginal ethnographic or archaeological significance that may be disturbed?

Yes No Unsure **If yes, please describe.**

Parmelia is approximately 80m from Aboriginal Heritage Site 4350 Wellard/Bertram Roads which is described as an Artefacts/Scatter site. It is not expected this site will not be disturbed by the proposal since clearing will not occur within the Site.

No Aboriginal Heritage sites occur within one kilometre of KTC, or the Train Station Precinct.

Other Heritage site 4350 described as Scatter/Artefacts occurs approximately 150m from Parmelia. Given the distance between the site and the proposed development, it is not expected that Other Heritage site 4350 will be impacted by the development.

No Other Heritage sites occur within one kilometre of KTC or the Train Station Precinct.

2.11.2 Is the proposal on a property which contains or is near a site of high public interest (e.g. a major recreation area or natural scenic feature)?

Yes No **If yes, please describe.**

2.11.3 Will the proposal result in or require substantial transport of goods, which may affect the amenity of the local area?

Yes

No

If yes, please describe.

3. PROPOSED MANAGEMENT

3.1 Principles of Environmental Protection

3.1.1 Have you considered how your project gives attention to the following Principles, as set out in section 4A of the EP Act? (For information on the Principles of Environmental Protection, please see EPA Position Statement No. 7, available on the EPA website)

- | | | |
|--|---|-----------------------------|
| 1. The precautionary principle. | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |
| 2. The principle of intergenerational equity. | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |
| 3. The principle of the conservation of biological diversity and ecological integrity. | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |
| 4. Principles relating to improved valuation, pricing and incentive mechanisms. | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |
| 5. The principle of waste minimisation. | <input checked="" type="checkbox"/> Yes | <input type="checkbox"/> No |

3.1.2 Is the proposal consistent with the EPA's Environmental Protection Bulletins/Position Statements and Environmental Assessment Guidelines/Guidance Statements (available on the EPA website)?

- Yes No

3.2 Consultation

3.2.1 Has public consultation taken place (such as with other government agencies, community groups or neighbours), or is it intended that consultation shall take place?

- Yes No **If yes**, please list those consulted and attach comments or summarise response on a separate sheet.

Public consultation has been undertaken with government agencies, local government and residents of Kwinana. A list of those consulted is provided in Attachment 2C.

3.3 References

360 Environmental 2012, Level 2 Flora and Vegetation Survey – Kwinana Town Centre (Document Reference Number EBS197-1 AB)

360 Environmental 2012a, Level 1 Vertebrate Fauna Survey – Lot 9001 Bertram Road, Parmelia (Document Reference Number 197-2AC)

360 Environmental 2012b, Level 1 Vertebrate Fauna Survey – Kwinana Town Centre (Document Reference Number EBS165-3 AB)

360 Environmental 2012c, Level 1 Vertebrate Fauna Survey – Kwinana Train Station Precinct (Document Reference Number EBS197-3 AD)

360 Environmental 2012d, Black Cockatoo Survey – Kwinana Town Centre (Document Reference Number EBS165-1 AB)

360 Environmental 2012e, Black Cockatoo Survey – Lot 9001 Bertram Road, Parmelia (Document Reference Number EBS197-2 AC)

360 Environmental 2012f, Black Cockatoo Survey – Kwinana Train Station Precinct (Document Reference Number EBS197-3 AD)

360 Environmental 2010, Parmelia Avenue, Parmelia Spring 2009 Flora and Vegetation Survey (Document Reference Number 819 AC)

360 Environmental 2010a Bertram Train Station West Black Cockatoo Survey (sub-site B) (Document Reference Number LD024-2AC)

360 Environmental 2009, Bertram Station Precinct Level 2 Flora and Vegetation Survey (Document Reference Number 583 AC)

360 Environmental 2006, Level 2 Flora and Vegetation Survey – Kwinana Town Centre (Document Reference Number 70/1 AD)

Beard, J.S. 1980. *A New Phytogeographic map of Western Australia*, Western Australian Herbarium Research Notes 3, 37-58.

Department of Agriculture and Food (DAFWA) 2012, *Pre-European Vegetation Extents*, GIS Dataset, Government of Western Australia.

Department of Agriculture and Food (DAFWA) 2012a, *Native Vegetation Extents*, GIS Dataset, Government of Western Australia.

Department of Environment and Conservation (DEC) 2012. Environmentally Sensitive Areas. GIS Dataset, Government of Western Australia.

Department of Environment and Conservation (DEC) 2007, *Forest Black Cockatoo and Forest Red-tailed Black Cockatoo Recovery Plan 2007-2016*. Department of Environment and Conservation), Government of Western Australia. Available at: http://www.dec.wa.gov.au/pdf/plants_animals/threatened_species/frps/FBC_Recovery_Plan_2007_2016_FEB2007.pdf

Department of Environment and Regulation (DER) 2013. Contaminated Sites GIS dataset, Government of Western Australia.

Department of Environment Protection (DEP) 2000. *Bush Forever Volume 2 Directory of Bush Forever Sites*. Government of Western Australia

Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) 2012. *EPBC Act Referral Guidelines for Three Threatened Black Cockatoo Species*, Commonwealth of Australia.

Department of Parks and Wildlife (DPaW) 2013, *2012 Statewide Vegetation Statistics* (formerly the CAR Reserve Analysis) – Full Report. Government of Western Australia.

Hedde, 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, Western Australia.

Western Australian Planning Commission (WAPC) 2010a. *Local Planning Schemes*. Accessed 22 October 2010. <http://www.planning.wa.gov.au/The+planning+system/Region+schemes/Local+planning+schemes/Default.aspx>

Western Australian Planning Commission (WAPC) 2010b. *Metropolitan Region Schemes*. Accessed 22 October 2010.

List of Figures

- Figure 1: Site Location;
- Figure 2a: Kwinana Town Centre;
- Figure 2b: Parmelia;
- Figure 2c: Train Station Precinct;
- Figure 3a: Kwinana Town Centre LSP;
- Figure 3b: Parmelia LSP;
- Figure 3c: Train Station Precinct LSP;
- Figure 4a: Kwinana Town Centre Black Cockatoo Habitat;
- Figure 4b: Parmelia Black Cockatoo Habitat;
- Figure 4c: Train Station Precinct Black Cockatoo Habitat; and
- Figure 5: Kwinana Offset Site.

List of Attachments

- Attachment 1: Location Maps
- Attachment 2A: Letter of Authorisation from Department of Regional Development and Lands
- Attachment 2B: List of Public and Stakeholder Consultation
- Attachment 2C: KTC Flora and Vegetation (360 Environmental, 2006) (Document Reference Number EBS197-1 AB);
- Attachment 2D: Parmelia Flora and Vegetation (360 Environmental, 2010a) (Document Reference Number 819 AC);
- Attachment 2E: Train Station Precinct – all sub-sites (360 Environmental, 2009) (Document Reference Number 583 AC);
- Attachment 2F: KTC Fauna Survey (360 Environmental, 2012c) (Document Reference Number EBS165-3 AB);
- Attachment 2G: Parmelia Fauna Survey (360 Environmental, 2012b) (Document Reference Number EBS197-2 AC);
- Attachment 2H: Train Station Precinct Fauna Survey (sub-sites A, C, D, E, F, G) (360 Environmental, 2012d) (Document Reference Number EBS197-3 AD);
- Attachment 2I: KTC Black Cockatoo Survey (360 Environmental, 2012e) (Document Reference Number EBS165-1 AB);
- Attachment 2J: Parmelia Black Cockatoo Survey (360 Environmental, 2012f) (Document Reference Number EBS197-2 AB);
- Attachment 2K: Train Station Precinct Black Cockatoo (sub-sites A, C, D, E, F, G) (360 Environmental, 2012g) (Document Reference Number EBS197-3 AC);

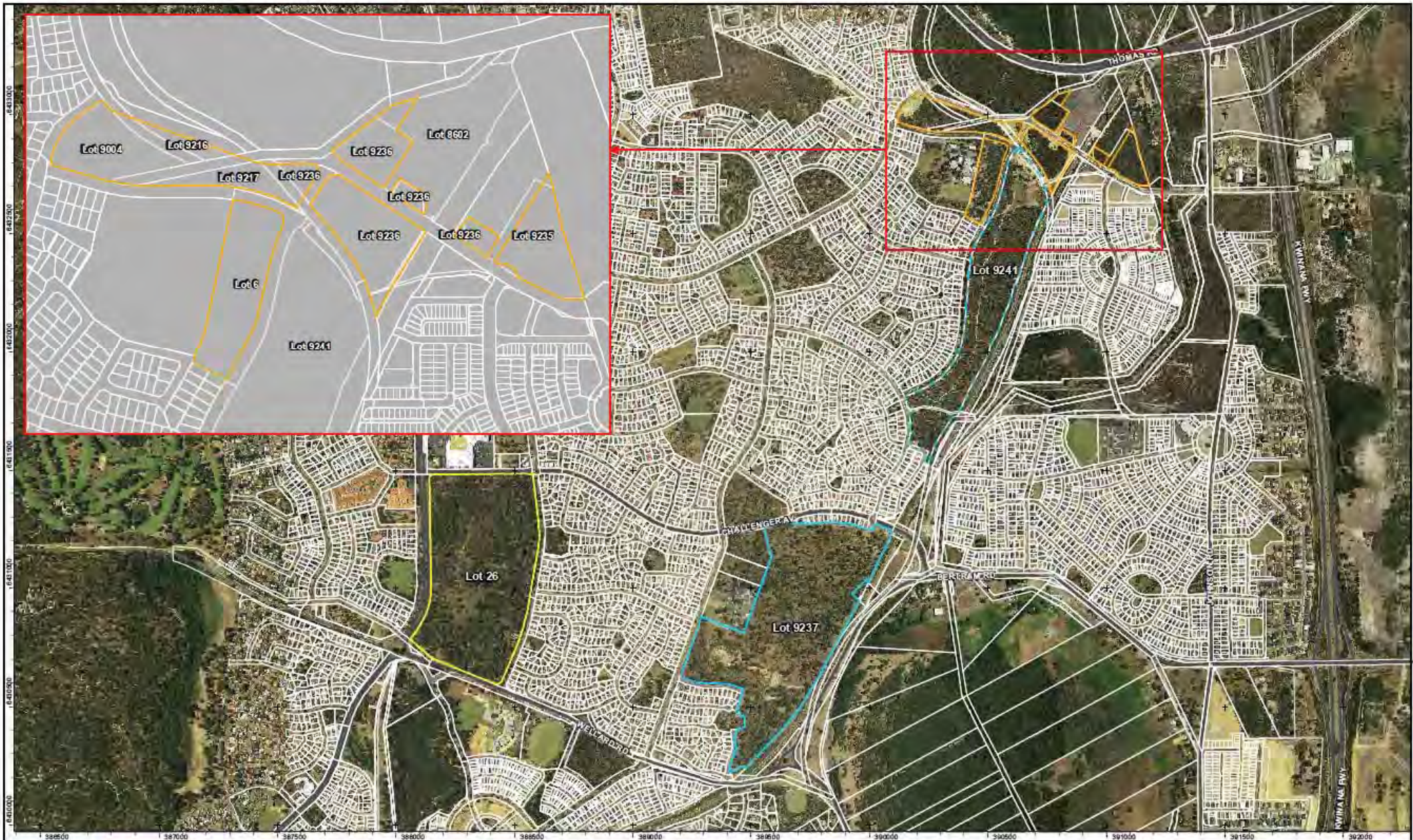
Attachment 2L: Train Station Precinct Black Cockatoo (sub-site B) (360 Environmental, 2010b) (Document Reference Number LD024-2AC); and

Attachment 2M: Black Cockatoo Survey- Bush Forever Site 272, Kwinana (360 Environmental, 2012) (Document Reference Number EBS223-AB).

Attachment 2N: Proposed Offset Strategy for the Clearing of Native Vegetation.

Attachment 2O: EPBC Decision Notice

ATTACHMENT 1



LEGEND

- Train Station Precinct (15.1 ha)
- Kwinana Town Centre (38.3 ha)
- Parmelia (41.1 ha)
- Lot 9241 - Parmelia Offset Area (21.9 ha)
- Major Roads
- Cadastre

DATA SOURCES
 LOCALITY MAP: TRAVELLERS ATLAS 2006
 CADASTRE: LANDGATE JUNE 2013
 © State of Western Australia 2006
 AERIAL IMAGERY: LANDGATE 2013
 © Western Australian Land Information Authority 2013

SLIP ENABLER

360 environmental
 a 10 Birchwood St, West Leederville, 6007 WA
 (08) 9388 8380
 (08) 9381 2380
 www.360environmental.com.au

people planet professional

Government of Western Australia
 Department of Housing

Satterley

0 100 200 400 600 800
 Meters

PROJECT NUMBER: **LD024**
 DRAWINGS NO.: **FIGURE 1**

NORTH


NOTE THAT POSITIONAL ERRORS MAY BE ±5M IN SOME AREAS

SCALE 1:15,000	SIZE A3
HORIZONTAL DATUM GDA MGA ZONE 50	VERTICAL DATUM -
STATUS FINAL	REVISION C
DRAWN JJ	DATE 08/08/2013
CHECKED FD	APPROVED TS

James Satterley

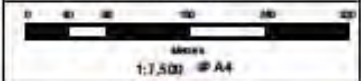
PROJECT	DEPARTMENT OF HOUSING KWINANA PROJECT
STUDY	CONSOLIDATED REFERRALS
DRAWING TITLE	SITE LOCATIONS
CLIENT	DEPARTMENT OF HOUSING SATTERLEY PROPERTY GROUP KWINANA LANDHOLDINGS



Legend
 Kwinana Town Centre

Id	Longitude	Latitude
1	115.812571	-32.247839
2	115.817183	-32.247792
3	115.815566	-32.255796
4	115.812618	-32.254778
5	115.811656	-32.254089

NOTE THAT POSITION ERRORS CAN BE > 5M IN SOME AREAS
 -AERIAL PHOTOGRAPHY SOURCED FROM LANDSAT 7/22
 -LOCALITY MAP SUSHYDSD FROM LANDSAT 7/20B



DRAWING ID LD024.02a		DATE 06/06/2012	
HORIZONTAL DATUM AND PROJECTION GDA 1994 MGA Zone 50			
CREATED JJ	CHECKED FD	APPROVED TS	REVISION 0

Department of Housing
 Satterley Property Group
 Kwinana Landholdings

360
 www.360.com.au

Consolidated Referrals

Kwinana Town Centre
 Figure 2a

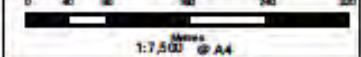


Legend

Parmelia

ID	Longitude	Latitude
1	115.833312	-32.250121
2	115.832241	-32.252084
3	115.832103	-32.251982
4	115.831511	-32.252501
5	115.831818	-32.252754
6	115.826636	-32.25908
7	115.826549	-32.258993
8	115.825911	-32.259254
9	115.826263	-32.257635
10	115.826592	-32.257534
11	115.826653	-32.25714
12	115.826216	-32.2569
13	115.82658	-32.256084
14	115.823741	-32.255607
15	115.824722	-32.253277
16	115.826594	-32.253943
17	115.827887	-32.251071
18	115.827589	-32.249949
19	115.828845	-32.249716
20	115.828891	-32.249855
21	115.829394	-32.249741
22	115.829431	-32.249854
23	115.832414	-32.250101
24	115.832603	-32.249851

NOTE THAT POSITION ERRORS CAN BE > 5M IN SOME AREAS
 - AERIAL PHOTOGRAPHY SOURCED FROM LANDSAT 200
 - LOCALITY MAP SOURCED FROM LANDSAT 200



LOCALITY MAP



DRAWING ID LD024.02b	DATE 25/09/2012
HORIZONTAL DATUM AND PROJECTION GDA 1994 MGA Zone 50	

CREATED JJ	CHECKED FD	APPROVED TS	REVISION 0
---------------	---------------	----------------	---------------

Department of Housing
 Satterley Property Group
 Kwinana Landholdings

Consolidated Referrals

Parmelia
 Figure 2b





Legend

Train Station Precinct

Label	Latitude	Longitude
1	-32.233423	115.834889
2	-32.234602	115.839351
3	-32.235372	115.838913
4	-32.23455	115.833775
5	-32.234361	115.839685
6	-32.233552	115.840953
7	-32.233415	115.841523
8	-32.233991	115.841055
9	-32.234201	115.841405
10	-32.235025	115.84076
11	-32.234855	115.841123
12	-32.235174	115.841688
13	-32.235514	115.841608
14	-32.23512	115.840903
15	-32.235555	115.842561
16	-32.235916	115.843207
17	-32.236282	115.842942
18	-32.235893	115.84227
19	-32.234787	115.844267
20	-32.237051	115.844987
21	-32.236371	115.843098
22	-32.23582	115.841651
23	-32.234775	115.839834
24	-32.235307	115.839217
25	-32.23732	115.840586
26	-32.235494	115.838641
27	-32.235203	115.837593
28	-32.238463	115.837383
29	-32.238129	115.83671

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
 - AERIAL PHOTOGRAPHY SOURCED FROM LANDSAT-8 2013
 - LOCALITY MAP SOURCED FROM LANDSAT-8 2008



Scale 1:6,000 @ A4
LOCALITY MAP



DRAWING ID LDD24.02c	DATE 25/09/2012		
HORIZONTAL DATUM AND PROJECTION GDA 1994 MGA Zone 50			
CREATED JJ	CHECKED FD	APPROVED TB	REVISION 0

Department of Housing
 Satterley Property Group
 Kwinana Landholdings

Consolidated Referrals

Train Station Precinct
 Figure 2c



- Legend**
- Site Plan
 - Public Open Spaces
 - Special Use
 - Existing Lots
 - 1-14c Laneway
 - Grouped Housing
 - Mixed Use

NOTE THAT POSITION ERRORS CAN BE > 5M IN SOME AREAS
 AERIAL PHOTOGRAPHY SOURCED FROM LANDSAT 2012
 LOCALITY MAP SOURCED FROM LANDSAT 2008



Scale: 1:5,000 @ A4

LOCALITY MAP



DRAWING ID LD024.03a	DATE 12/11/2012
-------------------------	--------------------

HORIZONTAL DATUM AND PROJECTION
 GDA 1984 MGA Zone 50

CREATED JJ	CHECKED FD	APPROVED TS	REVISION 0
---------------	---------------	----------------	---------------

Department of Housing/
 Satterley Property Group,
 Kwinana Landholdings

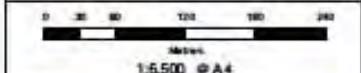


Consolidated Referrals
 LSP Kwinana Town Centre
 Figure 3a



- Legend**
- Parmelia Development Area (41.1 ha)
 - Public Open Spaces (4.0 ha)

NOTE THAT POSITION ERRORS CAN BE ±5M IN SOME AREAS
 -AERIAL PHOTOGRAPHY SOURCED FROM LANDSAT 8 2012
 -LOCALITY MAP SOURCED FROM LANDSAT 8 2009



DRAWING ID LD024.03b		DATE 25/09/2012	
HORIZONTAL DATUM AND PROJECTION GDA 1994 MGA Zone 50			
CREATED JJ	CHECKED FD	APPROVED TS	REVISION 0

Department of Housing/
 Satterley Property Group,
 Kwinana Landholdings

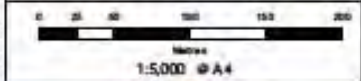
Consolidated Referrals

LSP Parmelia
 Figure 3b



- Legend**
- Train Station Precinct Development Area (11.4 ha)
 - Public Open Space (1.82 ha)

- NOTE THAT POSITION ERRORS CAN BE +/- 5M IN SOME AREAS
 - AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2012
 - LOCALITY MAP SOURCED FROM LANDGATE 2009

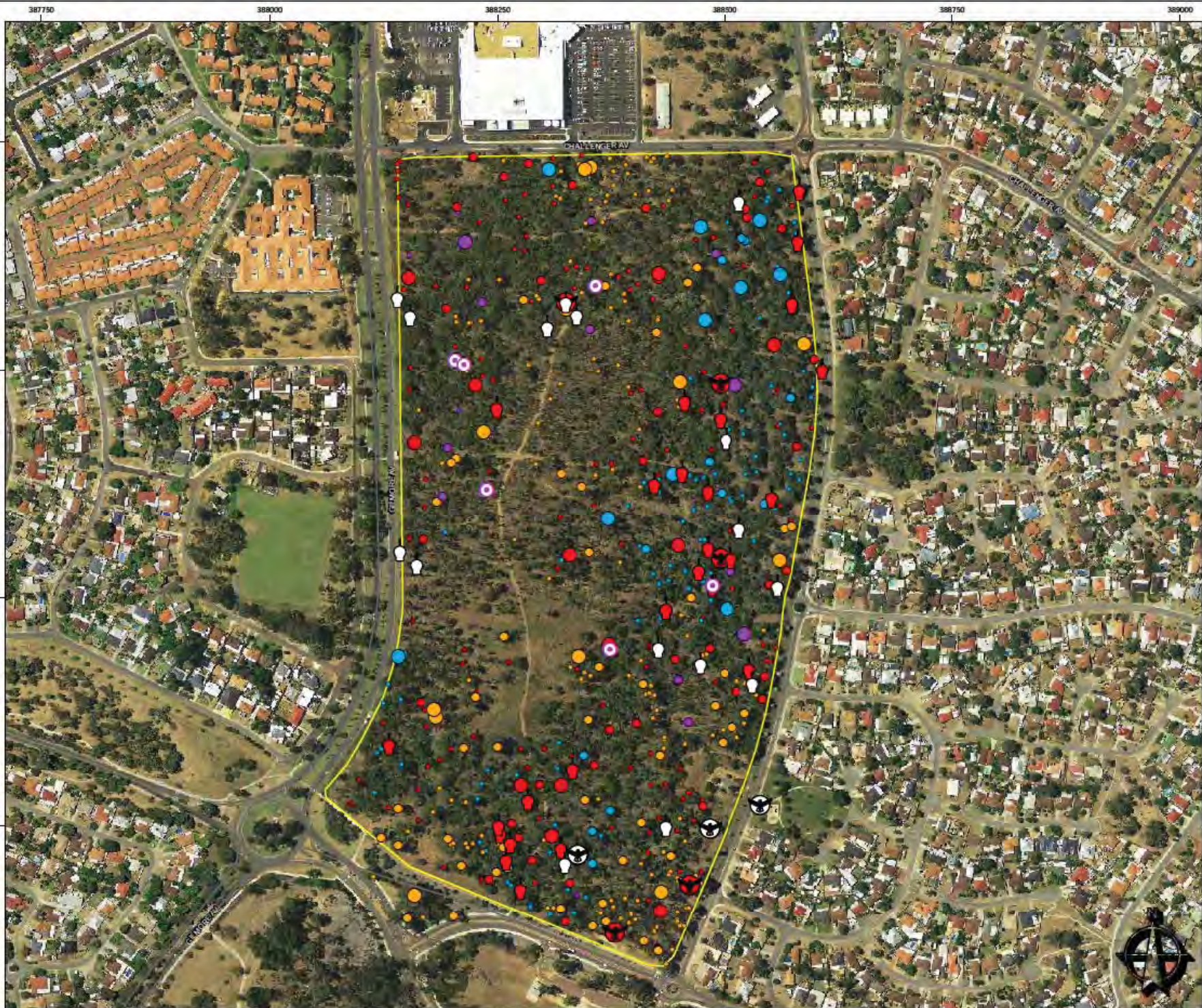


DRAWING ID LD024.03c		DATE 12/11/2012	
HORIZONTAL DATUM AND PROJECTION GDA 1994 MGA Zone 50			
CREATED JJ	CHECKED FD	APPROVED TS	REVISION 0

Department of Housing/
 Satterley Property Group,
 Kwinana Landholdings

Consolidated Referrals

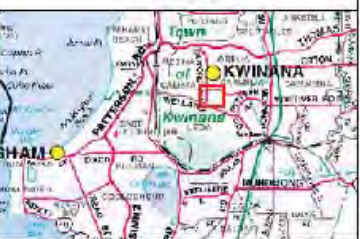
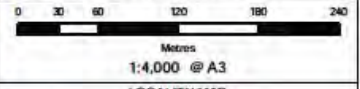
LSP Train Station Precinct
 Figure 3c



Legend

- Kwinana Town Centre
- Tree Species**
- Jarrah
- Marri
- Stag
- Tuart
- Trunk Diameter (mm)**
- 500 - 800
- 800 - 1200
- >1200
- Possible Cockatoo Nesting Hollow**
- Possible Cockatoo Nesting Hollow
- Carnaby's Black Cockatoo**
- Sighting Location
- Foraging Location
- Red-tailed Black Cockatoo**
- Sighting Location
- Foraging Location

- NOTE THAT POSITION ERRORS CAN BE ± 5M IN SOME AREAS
 - HABITAT TREES AND SIGHTINGS SOURCED FROM 360 ENVIRONMENTAL 2010
 - AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2012
 - LOCALITY MAP SOURCED FROM LANDGATE 2006



DRAWING ID LD024.04a		DATE 17/10/2012	
HORIZONTAL DATUM AND PROJECTION GDA 1994 MGA Zone 50			

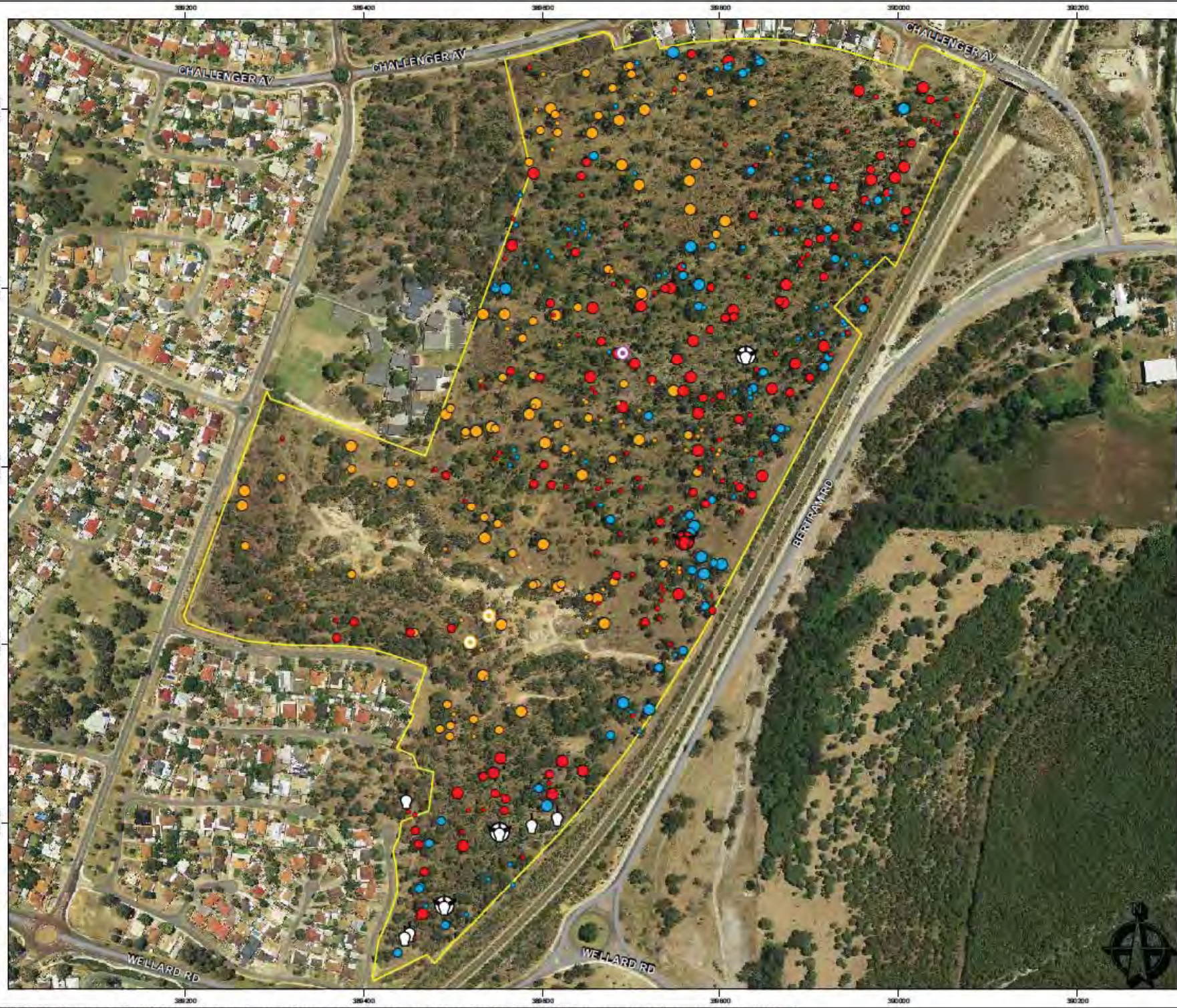
CREATED	CHECKED	APPROVED	REVISION
JJ	FD	TS	0

Department of Housing
 Satterley Property Group
 Kwinana Landholdings



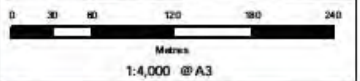
Consolidated Referrals
 Kwinana Town Centre
 Black Cockatoo Habitat

Figure 4a



- Legend**
- Parmelia
 - Major Roads
 - Tree Species**
 - Jarrah
 - Marri
 - Tuart
 - Trunk Diameter**
 - 500 - 800mm
 - 800 - 1200mm
 - >1200mm
 - Nesting Hollows**
 - Possible Cockatoo Nesting Hollow
 - Hollow Unsuitable for Cockatoos
 - Carnaby's Black Cockatoo**
 - Calling Location
 - Foraging Location
 - Red-tailed Black Cockatoo**
 - Sighting Location
 - Foraging Location

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
 - COCKATOO HABITAT TREES SOURCED FROM 360 ENVIRONMENTAL 2010
 - COCKATOO SIGHTINGS SOURCED FROM 360 ENVIRONMENTAL 2010
 - AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2012
 - LOCALITY MAP SOURCED FROM LANDGATE 2010



LOCALITY MAP



DRAWING ID LD024.4b		DATE 18/10/2012	
HORIZONTAL DATUM AND PROJECTION GDA 1994 MGA Zone 50			
CREATED JJ	CHECKED FD	APPROVED TS	REVISION 0

Department of Housing
 Satterley Property Group
 Kwinana Landholdings



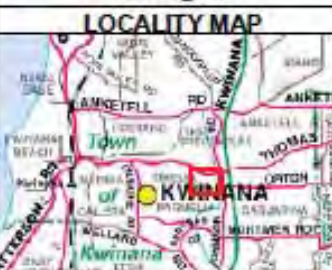
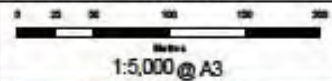
Consolidated Referrals
 Parmelia
 Black Cockatoo Habitat

Figure 4b



- Legend**
- Train Station Precinct Sites
 - Major Roads
 - Tree Species**
 - Jarrah
 - Trunk Diameter (mm)**
 - 500 - 800
 - 800 - 1200
 - >1200
 - Nesting Hollows**
 - Possible Cockatoo Nesting Hollow
 - Hollow Unsuitable for Cockatoos
 - Carnaby's Black Cockatoo**
 - 👁️ Calling Location
 - 👤 Foraging Location

NOTE THAT PORTION BRANCHES CAN BE 15M IN SOME AREAS
 HABITAT TREES SOURCED FROM 360 ENVIRONMENTAL 2010 & 2012
 COCKATOOS LOCALITIES SOURCED FROM 360 ENVIRONMENTAL 2010
 ANNUAL PHOTO SURVEY SOURCED FROM JANUARY 2008
 LOCALITY MAP SOURCED FROM LANDSAT 2008



DRAWING ID L0024 4c		DATE 12/06/2012	
HORIZONTAL DATUM AND PROJECTION GDA 1984 MO A Zone 50			
CREATED JJ	CHECKED FD	APPROVED TS	REVISION 0

Satterley Property Group/ Department of Housing, Kwinana

Consolidated Referrals
 Train Station Precinct
 Black Cockatoo Habitat

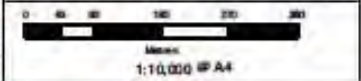


Figure 4c



- Legend**
- Train Station Precinct
 - Kwinana Offset Area (Lot 9241)
 - Parmelia (Lot 9237)
 - Bush Forever Site 272

-NOTE THAT POSITION ERRORS CAN BE ± 5M IN SOME AREAS
 -AERIAL PHOTOGRAPHY SOURCED FROM LANDSAT 200
 -LOCALITY MAP SOURCED FROM LANDSAT 2008



DRAWING ID LD024.05		DATE 06/06/2012	
HORIZONTAL DATUM AND PROJECTION GDA 1994 MGA Zone 50			
CREATED JJ	CHECKED FD	APPROVED TS	REVISION 0

Department of Housing/
 Satterley Property Group,
 Kwinana Landholdings

360
 environmental

Consolidated Referrals
 Kwinana Offset Area - Bush Forever
 Site 272
 Figure 5

ATTACHMENT 2A



Government of **Western Australia**
Department of **Regional Development and Lands**

State Land Services

Your ref: -
Our ref: File 01831-1982/4
Enquiries: Kylie Binks Telephone: (08) 6552 4730
Facsimile: (08) 6552 4415
E-mail: kylie.binks@rdl.wa.gov.au

20 May 2013

Mr Richard Elliot
Manager Planning, Acquisitions & Assets
Department of Housing
Private Bag 22
EAST PERTH WA 6892



Dear Mr Elliot

UNALLOCATED CROWN LAND - LOTS 9216, 9217 SULPHUR ROAD and ASSOCIATED ROAD RESERVES, PARMELIA

The Department of Regional Development and Lands has no objection to an application for environmental approval under the *Environment Protection and Biodiversity Conservation Act 1999* being made in respect of the following Crown land or roads, permitting this application to be assessed under the appropriate legislation:

- Lot 9216 on Deposited Plan 55472
- Lot 9217 on Deposited Plan 55472
- Road Reserve adjacent Lot 8602 on Deposited Plan 69102
- Unmade Road Reserves adjacent Lot 9217 on Deposited Plan 55472
- Unmade Road Reserve adjacent Lot 9216 on Deposited Plan 55472
- Unmade Road Reserve adjacent Lot 9236 on Deposited Plan 69102

This letter does not represent approval or consent under the relevant legislation and if the application is granted; this letter should not be taken as an acknowledgement of or consent to the commencement or carrying out of the proposed works or to any modification of the tenure or reservation classification of the Crown land component.

Yours sincerely,

Kylie Binks
A/TEAM LEADER
STATE LANDS – METROPOLITAN SOUTH

ATTACHMENT 2C

**Kwinana Town Centre
Spring Flora Survey**

**Department of Housing and Works
and
Satterley Property Group**



environmental management consultants

December 2006

Report Reference: 70/1-AD



Kwinana Town Centre

Department of Housing and Works and Satterley Property Group

Spring Flora Survey

Revision	Revision Date	Details	Authorised	
			Report Prepared	Report Reviewed
70-1-AD	11/12/06	FINAL	BM, SH,	MR

Disclaimer

This report has been prepared for the sole use and benefit of **Department of Housing and Works and Satterley Property Group** (the "Client"). This report is issued in accordance with, and is subject to, the terms of the contract between the Client and 360 Environmental Pty Ltd, including, without limitation, the agreed scope of the report. To the extent permitted by law, 360 Environmental Pty Ltd shall not be liable in contract, tort (including, without limitation, negligence) or otherwise for any use of, or reliance on, this report by any person or organisation other than the Client.

360 Environmental Pty Ltd considers the contents of this report to be current as at the date it was produced. This report, including each opinion, conclusion and recommendation it contains, should be considered in the context of the report as a whole. The opinions, conclusions and recommendations in this report are limited by its agreed scope. More extensive, or different, investigation, sampling and testing may have produced different results and therefore different opinions, conclusions and recommendations.

Subject to the terms of the contract between the Client and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating this report, or any part of it, is prohibited (except to the extent required by law) without the prior written consent of 360 Environmental Pty Ltd.

© Copyright 2006 360 Environmental Pty Ltd ACN 109 499 041



EXECUTIVE SUMMARY

A residential and commercial development is proposed for Lot E26 Mears Avenue, Kwinana. A flora and vegetation survey was undertaken to assess the flora and vegetation to be impacted by the development. The survey area is bounded by Meares Avenue, Challenger Avenue, Gilmore Avenue and Wellard Road.

One hundred and ten (110) species of native flowering plants and two (2) native Gymnosperms (one native cycad (the Zamia Palm, *Macrozamia riedlei*) and one native pine (*Callitris canescens*) were recorded from the survey area. In addition, a high number of weed species (37) were recorded from the survey area. A relatively low number of annual or ephemeral native plants (particularly herbs) were recorded during the survey. The significant weed cover in most parts of the survey area would have impacted on the presence or abundance of these plants.

No Declared Rare Flora (DRF) species were recorded in the survey area during the survey work carried out for this report. No Priority species were recorded during the survey. None of the species recorded in the survey area were considered to be "Significant Flora of the Perth Metropolitan Region" (DEP, 2000). No other species recorded in the survey area were considered of special conservation significance.

Nine vegetation units were defined and mapped for the survey area. These could be classified into four broader vegetation groups: Jarrah-Banksia woodlands; Tuart woodlands; Marri woodlands; and finally shallow limestone shrublands. The tuart woodlands included Jarrah and Banksia elements and are therefore closely related to the Jarrah-Banksia woodlands group. The Jarrah-Banksia vegetation units covered the largest part of the survey area (see Figure 2).

The condition of vegetation in the survey area was mostly in the range of 'Good' to 'Very Poor'. Some 'Completely Degraded' areas were also recorded. Small patches of vegetation in 'Very Good' condition also occurred. The main factor affecting the vegetation condition was weed cover. Perennial veldt grass (**Ehrharta calycina*) formed a grassland and sometimes a closed grassland over most of the survey area and was the most dominant and widespread weed. Some physical disturbance occurred in various places in the survey area.



It was noted that the crowns of many of the jarrah trees in the survey area were very brown and the trees appeared to be in poor health. This was due to what appeared to be intensive Jarrah leafminer damage (caused by the larvae of the moth, *Perthida glyphopa*).

Dead Banksia trees were recorded at four sites in the survey area. Between 1 and 6 dead trees were recorded at each location. One group of deaths was around a sump and the deaths may be related to the sump. No other obvious signs of jarrah dieback were noted. An accredited dieback interpreter would need to survey the dead Banksia sites to determine if dieback was in the survey area.

Review of the Department of Environment and Conservation (DEC) Floristic Community Types (FCT) data shows that Spearwood FCT's 21a, 24, 25 and 28 occur in the locality of the Lot E26 Meares Avenue survey area. The Jarrah-Banksia woodland unit quadrats and tuart woodland units had similarities with all of the FCT's 21a, 24, 25 and 28, but appeared to be closest to FCT 28. The limestone shrubland units were most similar to FCT's 24 and 28. None of the Spearwood FCT's 21a, 24, 25 and 28 have Threatened Ecological Community status.

A search of the DEC's Threatened Ecological Community (TEC) database showed that two TEC's had been recorded within five kilometres of the Lot E26 Meares Avenue survey area (see Table 5). The vegetation in the Lot E26 Meares Avenue survey area did not belong to either of these TEC's.

Flora and vegetation conservation values at the Lot E26 Meares Ave survey area

One hundred and twelve (112) native species were recorded from the survey area and this is a modest number for the size of the survey area (about 38 hectares) on Spearwood sands. The number of species recorded in the Lot E26 Meares Ave survey area suggests a 'moderate general' value for flora.

As no DRF or Priority taxa were recorded in the survey area and no species were recorded that would be considered to be 'Significant Flora of the Perth Metropolitan Region' (DEP, 2000), the conservation value for species of conservation significance in the survey area could be considered low.

The vegetation units in the Lot E26 Meares Avenue survey area were inferred to be FCT's 28 or 24, which are not TEC units. Nor were either of the TEC's that occur in the locality



of the survey area (TEC26a and 19b) found to occur in the Lot E26 Meares Avenue survey area. The fact that no TEC's appear to occur in the survey area suggests moderate vegetation conservation values for the survey area.

However, tuart occurred in the survey area as tuart open woodland and in other units as a scattered trees in the tree strata. Tuart vegetation has high conservation status because of the variation within tuart vegetation relative to the area protected and because of the extensive significant impact by grazing, frequent fire, weed invasion and other threatening processes on tuart communities. However, the tuart units in the survey area were, for the most part, in poor condition (mostly 'Good' to 'Very Poor', with small patches in 'Good' to 'Very Good' condition). Taking these points into consideration, the tuart vegetation units in the survey area would have moderate to high conservation value.

With regard to the regional significance of the survey area vegetation, it belonged to the Cottesloe Complex – Central and South. The remaining area of the Cottesloe Complex – Central and South is 41.1percent, while its remaining area in secure tenure is 8.8 percent (EPA, 2003). This shows that while the Cottesloe Complex – Central and South has more than 40 percent of pre-1750 extent remaining (as at the time of the data compilation in 2002), the situation is not secure.

Lot E26 Meares Avenue survey area contains the one landform unit, with a modest diversity of vegetation units and could therefore be considered as having moderate values for diversity. Therefore, the overall vegetation conservation value for the Lot E26 Meares Avenue survey area might be considered to be moderate to high. While there are no TEC's in the survey area, the vegetation has additional value because of the presence of tuart vegetation units (albeit in generally poor condition) and the fact that less than 15 percent of the Cottesloe Complex – Central and South is in secure tenure.



Table of Contents

1.	INTRODUCTION	1
1.1	Background	1
1.2	Scope Of Work.....	1
1.3	Report Format	2
2.	SITE DESCRIPTION	3
2.1	Study Area	3
2.2	The Geomorphology Of The Survey Area.....	3
2.3	Regional Botanical Context	3
2.4	Threatened Ecological Communities (TEC's)	4
3.	BOTANICAL SURVEY	5
3.1	Field Investigations.....	5
3.2	Methods of the Flora survey	6
3.3	Vegetation Mapping	7
3.4	Determining Vegetation Unit Floristic Community Types	7
3.5	Flora Of The Survey Area.....	8
4	ACKNOWLEDGEMENTS.....	32
5	LIMITATIONS	33
6	REFERENCES	34



List of Tables

Table 1	Declared Rare Flora (DRF) and Priority Flora
Table 2	Abbreviation for species names used in vegetation unit codes
Table 3	Location of discrete occurrences of other aggressive weed species
Table 4	Location of recorded banksia deaths
Table 5	TEC's recorded within five kilometres of the site
Table 6	Remnant vegetation of the Swan Coastal Plain Bioregion within the system

List of Figures

Figure 1	Locality Map
Figure 2	Flora Survey Area
Figure 3	Vegetation Condition

Appendices

Appendix 1	The Department of Environment and Conservation Priority Flora categories (from Atkins 2006)
Appendix 2	Vegetation structural table of Trudgen based on Aplins (1979) modification of Specht's classification
Appendix 3	Vegetation condition scale (Department of Environmental Protection 2000)
Appendix 4	Flora list
Appendix 5	Quadrat descriptions and species lists
Appendix 6	Releve description and species lists



1. Introduction

1.1 Background

360 Environmental was commissioned to undertake a spring flora survey to provide information during the planning phase of the proposed development at Kwinana Town Centre at Lot E26 Meares Avenue, Kwinana (Figure 1). The purpose of this survey was to list the flora, describe and map the vegetation and its condition at the survey area and to assess the flora and vegetation values for that area.

1.2 Scope of Work

The investigation has been undertaken in accordance with 360 Environmental's proposal (provided on the 28 August 2006), and includes an assessment of the project area, including:

- Conducting a vegetation survey in accordance with the EPA Guidance Statement 51 requirements;
- Mapping the vegetation and assessing its conservation values;
- A search for flora of special conservation significance;
- Assessing the flora and vegetation values of the survey area, including the locations of any significant plant species and vegetation units;
- Determine the presence of Declared Rare Flora (DRF), endangered and priority species and map areas to be avoided (as required).
- Formulation of a report detailing the outcomes of the investigations.



1.3 Report Format

The remainder of this report comprises the following components:

- Section 2 – Site Description
- Section 3 – Botanical Survey
- Section 4 – Acknowledgments
- Section 5 – Limitations
- Section 6 – References
- Appendices



2. SITE DESCRIPTION

2.1 Study Area

The survey area was Lot E26 Meares Avenue and was bounded by Meares Avenue, Challenger Avenue, Gilmore Avenue and Wellard Road. A small fenced Water Corporation infrastructure area on the Meares Avenue side of the survey area was not surveyed. The survey area was approximately 38 hectares in size (about 450 metres average width by 850 metres long).

2.2 The Geomorphology Of The Survey Area

The Swan Coastal Plain consists of a series of geomorphological elements which are sub-parallel to the present coastline (McArthur and Bettenay, 1960). Each of these geomorphic elements have distinctive geology, vegetation, topography and soils.

The Lot E26 Meares Avenue survey area lies in one of these elements, the Spearwood Dune System (McArthur and Bettenay, 1960). It is the middle one of three main aeolian deposits on the Swan Coastal Plain that can be arranged in age sequence. The Spearwood Dune System consists of a core of limestone overlain by yellow sand (Churchward and McArthur, 1980). There has been differential wind erosion that has produced two distinctly different landscapes that have been recognised as two units, the Cottesloe and Karrakatta units. The Cottesloe unit, on the western side, consists of yellow brown sands and exposed limestone. The Karrakatta unit, on the eastern side, has deep yellow brown sands. The Lot E26 Meares Avenue survey area lies in the Cottesloe unit (Churchward and McArthur, 1980).

2.3 Regional Botanical Context

Beard (1980) defined boundaries for botanical provinces, districts and subdistricts for Western Australia on the basis of his vegetation mapping of the State. In this framework, the study area lies in the Drummond Botanical Subdistrict (more or less equivalent to the Swan Coastal Plain and part of the Dandaragan Plateau) of the Darling Botanical District of the South Western Botanical Province of Western Australia.



Heddle *et al.* (1980) mapped the vegetation of part of the Drummond Botanical Sub-district at a very broad scale, describing a series of vegetation complexes. These are related groups of vegetation associations found on particular landform-soil units (geomorphic elements, (refer 2.2). They mapped a total of 38 vegetation complexes on the Swan Coastal Plain. The Lot E26 Meares Avenue survey area is located in the Cottesloe Complex - Central and South. This complex supports heaths on the limestone outcrops, while the deeper sands support a mosaic of woodland of tuart and an open forest of tuart-jarrah-marri. The distinctive dominance of tuart distinguishes this complex from the Cottesloe-North complex (Heddle *et al.* 1980).

More recently, an alternative analysis of the plant assemblages on the Swan Coastal Plain south of Gingin Brook was carried out using a floristic approach (Gibson *et al.*, 1994) and was extended in 2000. This work identified 66 floristic community types (FCT's) in four floristic 'Super Groups' for the southern Swan Coastal Plain. These units are defined at a similar level of synthesis to that of Heddle *et al.*, (1980) (Trudgen, 1999). The four 'super groups' of sites correlate closely with the major geomorphological elements on the Swan Coastal Plain (and also to rainfall), with the exception of one group which contained the seasonal wetlands, which includes sites across all geomorphological groups (Gibson *et al.*, 1994).

2.4 Threatened Ecological Communities (TEC's)

The Department of Conservation and Land Management developed a procedure for identifying 'Threatened Ecological Communities' (Department of Environmental Protection 2000; English and Blythe 1997). Threatened Ecological Communities (TEC's) are assigned to one of four categories: 'Presumed Totally Destroyed'; 'Critically Endangered'; 'Endangered' or 'Vulnerable' (Department of Environmental Protection, 2000).

On the Swan Coastal Plain, twenty five potential threatened ecological communities, delineated by a number of floristic and other studies, have been assessed for threatened ecological community status. Of these, twenty four have been confirmed as 'Threatened' (DEP 2000). Sixteen of these TEC are Floristic Community Types (FCT's) as identified by Gibson *et al.* (1994).



3. Botanical Survey

3.1 Field Investigations

The Lot E26 Meares Avenue flora survey was conducted by a qualified botanist between the 20th of September and the 9th of October 2006. The specimens were identified at the Western Australian Herbarium under instruction from 360 Environmental Pty Ltd. The flora in the study area was surveyed and vegetation recorded while walking between the vegetation recording sites, mapping the vegetation and when conducting general flora searches.

All plant species present were recorded at each vegetation quadrat sampling site (sites KM11 and KM2, see Figure 2). At the vegetation releve sampling sites, dominant and subdominant species and some associated species were recorded. In both cases, where a plant species was not well known, a specimen was collected and allocated a specimen number.

Plant species were recorded elsewhere in the study area if they had not been recorded at the vegetation sampling sites or if they were of particular interest. Again, where a plant species was not well known, a specimen was collected and allocated a specimen number. GPS coordinates were recorded (using a Magellan Meridian hand held GPS unit) whenever it was considered there was a possibility that the plant species may be of special interest.

To complete the flora survey, east-west flora search traverses were made from side to side of the survey area, spaced about 50 metres with the result that all of the survey area was covered by a general traverse.

The specimens collected were pressed, dried and identified. The identifications were made by comparison to specimens in the reference and research collections of the Western Australian Herbarium, by the use of keys in various papers and books and by relevant experts on various groups of flora of the Swan Coastal Plain (refer the acknowledgments section).



The Department of Environment and Conservation Declared Rare and Priority Flora List (Atkins 2006; definitions in Appendix 1) was consulted as required to confirm the status of plant species in the survey area.

3.2 Methods of the Flora Survey

After a brief examination of the vegetation in the survey area, locations were selected for survey quadrats and relevés that were representative of observed variations in the vegetation and habitat. Suitable sites for the more detailed quadrats were limited because many of the vegetation units were quite weedy and in a poor condition.

Two 10 m x 10 m quadrats (KM1 and KM2, refer Figure 2) were marked out with a field measuring tape between wooden stakes which were pushed into the ground at the quadrat corners. The 10 m x 10 m quadrat dimensions were used firstly because a 100m² sample area on the Swan Coastal Plain is considered to capture most species in a given plant community and also because that was the quadrat size as used for the Gibson *et al.* (1994) Swan Coastal Plain survey and therefore enables the Lot E26 Meares Avenue data set to be comparable with the Gibson *et al.* Swan Coastal Plain data set.

Each quadrat was photographed. A description of the quadrat location, the habitat, surface soil texture and colour were all recorded and the time since the site was last burnt was estimated. The vegetation structure was described using a modification of Specht's vegetation description table by Aplin (1979; Appendix 2). To obtain more representative data for the overstorey cover, the tree layer(s) cover was estimated over a larger area around the quadrats. The condition of vegetation in the quadrat was described using the Trudgen (1988) scale (see Appendix 3). All plant species occurring in the site area were recorded along with their height, percentage cover and specimen number if collected.

Eleven relevés were recorded to describe vegetation units. The relevé descriptions were similar to those of the quadrats, but the area described was 'open' (not a measured 10m x 10m space) and not all plant species in the relevé area were recorded, but rather the dominant, subdominant and some associated species were recorded.

There is a limit to the accuracy of the assignment of the different strata in the vegetation descriptions to structural units (for example, low open woodland, low woodland, low open forest, open shrubland, shrubland etc.). Referral of a stratum to a structural category depends on assessment of its cover. Such estimation is imprecise and it is not unusual for



different observers to give quite different estimates of the cover of a species, or stratum in a stand. However, descriptive exercises such as that carried out for this report require only a moderate level of accuracy.

The cover estimate of each plant species recorded in the quadrats was based on estimating species projected canopy cover. The assumption was made that for most species, canopy cover and projected foliar cover are reasonably similar, or that the difference is less than the level of accuracy of the estimates.

3.3 Vegetation Mapping

Vegetation units were recorded generally between plant community and plant association level. The vegetation unit boundaries were drawn on a computer generated aerial photograph while traversing the study area, using GPS coordinate readings to locate actual boundary positions. The orthorectified aerial photography was supplied by 360 Environmental Pty Ltd.

The vegetation mapping unit descriptions were based on the quadrat and releve descriptions.

3.4 Determining Vegetation Unit Floristic Community Types

Floristic Community Types were inferred for the vegetation units in the Lot E26 Meares Avenue survey area by reviewing the FCT's in the Spearwood landform unit and their recorded distribution on the Swan Coastal Plain and by comparing the species list of the survey area vegetation units with the Gibson *et al.* (1994) two way table showing species frequency by community type. The species lists for the survey area vegetation units was also compared to the DEC's updated species frequency tables.

Inferring Floristic Community Types by comparing the two way table of species frequency by community type with the species in the vegetation units in the survey area is a complex task and therefore of limited reliability.

Once the Lot E26 Meares Avenue sites was assigned to a Floristic Community Type, a table of Floristic Communities Types on the Swan Coastal Plain and their TEC status



(Department of Environmental Protection, 2000) was consulted to determine if any of the Lot E26 Meares Avenue sites were TEC's. No new TEC's have been assessed for the western part of the Swan Coastal Plain (which includes the survey area) since the publication of Bush Forever Vol 2 (B.J. Keighery, *pers. comm.*).

3.5 Flora of the Survey Area

3.5.1. Flora List for the Survey Area

One hundred and ten (110) species of native flowering plants and two (2) native Gymnosperms (one native cycad (the Zamia Palm, *Macrozamia riedlei*) and one native pine (*Callitris canescens*) were recorded from the survey area. In addition, a high number of weed species (thirty seven (37) were recorded from the survey area. A list of all the species recorded from the survey area is provided in Appendix 4.

Of the native flowering species recorded, forty four (44) were monocotyledons and sixty-five (65) were dicotyledons.

The monocotyledon families that were well represented by native species in the survey area were Cyperaceae (sedges) with nine (9) native species, Anthericaceae with eight (8) native species, Dasypogonaceae with seven (7) native species and Orchidaceae (orchids) with six (6) native species. Twelve (12) Poaceae (grasses) species were recorded, but nine (9) of these were weeds.

The dicotyledon families that were well represented by native species in the survey area were the Proteaceae (*Banksia* family, ten (10) native species), the Papilionaceae (pea family, ten (10) native species), the Asteraceae (daisy family, five (5) native species and five (5) weeds), and the Mimosaceae (Acacia family with, five (5) native species).

A relatively low number of annual or ephemeral native plants (particularly herbs) were recorded during the survey. The significant weed cover in most parts of the survey area would have impacted on the presence or abundance of these plants.



3.5.2. Declared Rare Flora (DRF) and Priority Flora Recorded in the Survey Area

No DRF species were recorded in the survey area during the survey work carried out for this report.

No Priority species were recorded during the survey.

3.5.3. Species of Conservation Significance Recorded from the Survey Area

None of the species recorded in the survey area were considered to be "Significant Flora of the Perth Metropolitan Region" (Department of Environmental Protection 2000, see Table 13, pages 51 to 55).

3.5.4. Other Species of Conservation Significance Recorded from the Survey Area

No other species recorded in the survey area are considered of special conservation significance.

3.5.5. Declared Rare Flora (DRF) and Priority Flora Previously Recorded in the Lot E26 Meares Ave Locality, and not Recorded in this Survey

Declared Rare Flora (DRF) and Priority flora that have been previously recorded in the Lot E26 Meares Avenue locality are shown in Table 1 below. None of these species were recorded in the survey area.



Table 1. Declared Rare Flora (DRF) and Priority Flora that have been previously recorded in the Lot E26 Meares Avenue locality.

Species/Taxon	Conservation	Species/Taxon	Conservation
<i>Acacia aphylla</i>	R	<i>Crassula colorata</i> var.	P2
<i>Caladenia huegelii</i>	R	<i>Angianthus micropodioides</i>	P3
<i>Diuris drummondii</i>	R	<i>Aotus cordifolia</i>	P3
<i>Diuris micrantha</i>	R	<i>Dillwynia dillwynioides</i>	P3
<i>Diuris purdiei</i>	R	<i>Aponogeton hexatepalus</i>	P4
<i>Drakaea elastica</i>	R	<i>Cyanicula ixiooides</i> subsp.	P4
<i>Drakaea micrantha</i>	R	<i>Hydrocotyle lemnoides</i>	P4
<i>Thelymitra stellata</i>	R	<i>Dodonaea hackettiana</i>	P4
<i>Lepidium</i>	P1	<i>Jacksonia sericea</i>	P4
<i>Picris compacta</i>	P1		
<i>Ptilotus sericostachyus</i>	P1		

3.6 VEGETATION OF THE SURVEY AREA

3.6.1. Introduction to Vegetation Descriptions

The vegetation units described for the Lot E26 Meares Avenue survey area are considered to be mostly described at the plant community to vegetation association level.

Some areas assigned to a particular unit on the vegetation map, while having similar vegetation to the description of that unit, are variable in either structure, species dominance or floristics. Some stands of some of the vegetation units occurring in the areas mapped for vegetation units are quite small and as a result are not shown on the vegetation map.

The vegetation unit codes that discriminate the mapped vegetation units are derived from the generic and species names of the more abundant genera or species in the different strata present in the unit (see Table 2).



Table 2. Abbreviations for species names used in vegetation unit codes for the Lot E26 Meares Avenue vegetation map.

Code	Species name	Code	Species name
<i>Af</i>	<i>Allocasuarina fraseriana</i>	<i>Em</i>	<i>Eucalyptus marginata</i> subsp. <i>marginata</i>
<i>Ba</i>	<i>Banksia attenuata</i>	<i>Eg</i>	<i>Eucalyptus gomphocephala</i>
<i>Cc</i>	<i>Corymbia calophylla</i>	<i>Gv</i>	<i>Grevillea vestita</i> subsp. <i>vestita</i>
<i>Ds</i>	<i>Dryandra sessilis</i>		

3.6.2 Description of the Vegetation for Lot E26 Meares Ave

Nine vegetation units were defined and mapped for the Lot E26 Meares Ave survey area. These could be classified into four broader vegetation groups: Jarrah-Banksia woodlands; Tuart woodlands; Marri woodlands; and finally shallow limestone shrublands. The tuart woodlands included Jarrah and Banksia elements and are therefore closely related to the Jarrah-Banksia woodlands group. The Jarrah-Banksia vegetation units covered the largest part of the survey area (see Figure 2). Small areas of Tuart woodland vegetation occurred at both the northern and southern ends of the survey area. The Marri woodland vegetation occurred on the lower interdunal slopes, with large areas of these woodlands occurring on the eastern side and southern end of the survey area. The limestone shrubland vegetation occurred in the central parts of the survey area. The vegetation in these areas were very disturbed in parts which made their description more difficult. Extensive past clearing had occurred in these areas. One of the limestone shrubland units was a *Grevillea vestita* heath which was re-growth vegetation. *Dryandra sessilis* shrublands occurred further to the north in the central survey area and were associated with old disturbance.

The detailed site descriptions on which the vegetation unit descriptions were based are set out in Appendices 5 and 6 and described in the following sections.



Figure 2. Vegetation units of Lot E26 Meares Avenue survey area - Legend

Jarrah-Banksia woodlands

Em

Eucalyptus marginata subsp. *marginata* low open forest over *Banksia grandis*, *Banksia attenuata* scattered low trees over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei*, *Acacia pulchella* scattered shrubs over *Gompholobium tomentosum*, *Hibbertia hypericoides* scattered low shrubs over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* very open grassland with *Conostylis aculeata* very open herbland.

EmBa

(*Eucalyptus gomphocephala* scattered trees over) *Eucalyptus marginata* subsp. *marginata* low woodland over *Banksia attenuata*, (*Banksia grandis*) low woodland over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei* scattered shrubs to open shrubland over *Gompholobium tomentosum* scattered low shrubs over *Desmocladius asper*, *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* (perennial veldt grass) open grassland to grassland.

EmAf

Eucalyptus marginata subsp. *marginata*, *Allocasuarina fraseriana* low woodland over *Banksia attenuata*, *B. grandis* scattered low trees to low open woodland over *Jacksonia furcellata* scattered tall shrubs over *Acacia pulchella* var. *glaberrima*, *Macrozamia riedlei* scattered shrubs to open shrubland over **Ehrharta calycina* closed grassland with **Trifolium campestre* var. *campestre*, **Lupinus* sp. very open herbland.

EgEm

Eucalyptus gomphosephala scattered trees to open woodland over *Eucalyptus marginata* subsp. *marginata* low woodland over *Banksia attenuata*, *Allocasuarina fraseriana* low open woodland over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei*, *Xanthorrhoea preissii* open shrubland over *Hibbertia hypericoides*, *Gastrolobium capitatum* scattered low shrubs over *Lepidosperma squamatum*, *Desmocladius asper* very open sedgeland and *Conostylis aculeata* very open herbland.



Tuart woodlands

Eg

Eucalyptus gomphocephala woodland over *Eucalyptus marginata* subsp. *marginata* low open woodland to low woodland over *Banksia attenuata* (*Banksia grandis*) low open woodland over *Jacksonia furcellata* scattered tall shrubs over *Xanthorrhoea preissii* high open shrubland over *Macrozamia riedlei* and *Acacia pulchella* var. *glaberrima* open shrubland over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* grassland with *Conostylis aculeata* open herbland.

Marri woodlands

Cc

Corymbia calophylla, (*Eucalyptus marginata* subsp. *marginata*) woodland over *Jacksonia furcellata* scattered tall shrubs over to high open shrubland over *Macrozamia riedlei*, *Xanthorrhoea preissii* open shrubland over *Leucopogon propinquus* scattered low shrubs over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* grassland.

Limestone shrublands

Gv

Grevillea vestita subsp. *vestita* heath over *Desmocladius asper* scattered sedges and *Conostylis aculeata* scattered herbs with **Ehrharta calycina* grassland.

EgDs

Eucalyptus gomphocephala scattered trees over *Dryandra sessilis* var. *cygnorum* high shrubland to open scrub over *Jacksonia furcellata* scattered tall shrubs over *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina* grassland with *Conostylis aculeata* very open herbland.

AfDs

(*Eucalyptus gomphocephala* scattered trees over) *Allocasuarina fraseriana* low open woodland over *Banksia attenuata* low woodland over *Jacksonia furcellata*, *Dryandra sessilis* var. *cygnorum* scattered tall shrubs over *Macrozamia riedlei* scattered shrubs over



Acacia pulchella var. *glaberrima*, *Pimelea rosea*, *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina* grassland and *Conostylis aculeata*, **Trifolium campestre* var. *campestre* very open herbland.

Habitat and Soil: Very gently sloping, mid-slope of low ridge. Yellow siliceous sands (Spearwood Unit).

Notes: This vegetation unit was described at quadrat KM1 and relevés KMR2 and KMR5 (Photograph 1; detailed site descriptions provided in Appendix 5 and 6). The cover of Jarrah and *Banksia attenuata* was variable. The vegetation condition was generally Poor to Good. The vegetation retains its basic structure, is very weedy and structure impacted.



Photograph 1. Vegetation unit EmBa (quadrat KM1): (*Eucalyptus gomphocephala* scattered trees over) *Eucalyptus marginata* subsp *marginata* low woodland over *Banksia attenuata*, (*Banksia grandis*) low woodland over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei* scattered shrubs to open shrubland over *Gompholobium tomentosum* scattered low shrubs over *Desmocladus asper*, *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* open grassland to grassland.

EmAf

Eucalyptus marginata subsp. *marginata*, *Allocasuarina fraseriana* low woodland over *Banksia attenuata*, *B. grandis* scattered low trees to low open woodland over *Jacksonia furcellata* scattered tall shrubs over *Acacia pulchella* var. *glaberrima*, *Macrozamia riedlei* scattered shrubs to open shrubland over **Ehrharta calycina* closed grassland with **Trifolium campestre*, **Lupinus* sp. very open herbland.

Habitat and Soil: Very gentle, NW facing slope of very low rise. Yellow siliceous sand.

Notes: This vegetation unit was described at quadrat KMR9 (detailed site description provided in Appendix 6). It differed by having *Allocasuarina fraseriana* in the low woodland strata. Vegetation condition was Poor to Very Poor. It included an **Ehrharta calycina*, **Trifolium campestre*, blue lupin closed grassland/herbland of weeds. Also, native herbs were probably missing and a very open area indicated past disturbance.



Photograph 2. Vegetation unit EgEm (quadrat KM2): *Eucalyptus gomphocephala* scattered trees to open woodland over *Eucalyptus marginata* subsp. *marginata* low woodland over *Banksia attenuata*, *Allocasuarina fraseriana* low open woodland over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei* open shrubland over *Hibbertia hypericoides* scattered low shrubs over very open sedgeland.



EgEm

Eucalyptus gomphocephala scattered trees to open woodland over *Eucalyptus marginata* subsp. *marginata* low woodland over *Banksia attenuata*, *Allocasuarina fraseriana* low open woodland over *Jacksonia furcellata* scattered tall shrubs to high shrubland over *Macrozamia riedlei*, *Xanthorrhoea preissii* open shrubland over *Hibbertia hypericoides*, *Gastrolobium capitatum* scattered low shrubs over *Lepidosperma squamatum*, *Desmocladius asper* very open sedgeland and *Conostylis aculeata* very open herbland.

Habitat and Soil: Gentle west facing lower slope of low dune (adjacent to lowest point between two dunes). Orange-brown siliceous sand.

Notes: This vegetation unit was described at quadrat KM2 (Photograph 2; detailed site description provided in Appendix 5). It was similar to the EmBa vegetation unit but had a higher Tuart cover. Vegetation condition was Good to Very Good.

Tuart woodlands

Eg

Eucalyptus gomphocephala woodland over *Eucalyptus marginata* subsp. *marginata* low open woodland to low woodland over *Banksia attenuata* (*Banksia grandis*) low open woodland over *Jacksonia furcellata* scattered tall shrubs over *Xanthorrhoea preissii* high open shrubland to high shrubland over *Macrozamia riedlei* and *Acacia pulchella* var. *glaberrima* open shrubland to shrubland over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* grassland with *Conostylis aculeata*, *Burchardia congesta* open herbland.

Habitat and Soil: Gentle north-west facing slope of low rise (low dune). Brown siliceous sands.

Notes: This vegetation unit was described at quadrat KMR3 (Photograph 3; detailed site description provided in Appendix 6). Vegetation condition was Poor to Good where the releve was recorded and Poor to Very Poor in parts of surrounding area.



Photograph 3. Vegetation unit Eg (releve KMR3): *Eucalyptus gomphocephala* woodland over *Eucalyptus marginata* subsp. *marginata* low open woodland to low woodland over *Banksia attenuata* (*Banksia grandis*) low open woodland over *Jacksonia furcellata* scattered tall shrubs over *Xanthorrhoea preissii* high open shrubland to high shrubland over *Macrozamia riedlei* and *Acacia pulchella* var. *glaberrima* open shrubland to shrubland over scattered sedges and **Ehrharta calycina* grassland.

Marri woodlands

Cc

Corymbia calophylla, (*Eucalyptus marginata* subsp. *marginata*) woodland over *Jacksonia furcellata* scattered tall shrubs over to high open shrubland over *Macrozamia riedlei*, *Xanthorrhoea preissii* open shrubland over *Leucopogon propinquus* scattered low shrubs over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* grassland.

Habitat and Soil: Lower slopes of dune. Yellow-brown siliceous sand.



Photograph 4. Vegetation unit Cc (relevé KMR1): *Corymbia calophylla*, (*Eucalyptus marginata* subsp. *marginata*) woodland over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei*, *Xanthorrhoea preissii* open shrubland over *Leucopogon propinquus* scattered low shrubs over scattered sedges and **Ehrharta calycina* grassland.



Photograph 5. Revele KMR7 (vegetation unit Cc).

Notes: This vegetation unit was described at releves KMR1, KMR4 and KMR7 (Photographs 4 and 5; detailed site description provided in Appendix 6). This vegetation unit was dominated by Marri (*Corymbia calophylla*), but sometimes included scattered Jarrah. Revele KMR4 was recorded in a swale area where *Jacksonia furcellata* formed a high open shrubland to high shrubland. Vegetation condition was Very Poor (very weedy and with a poor cover of native species).

Limestone shrublands

Gv

Grevillea vestita subsp. *vestita* heath over *Desmocladus asper* scattered sedges and *Conostylis aculeata* scattered herbs with **Ehrharta calycina* grassland.

Habitat and Soil: Gentle south-facing mid slope of lower dune. Yellow coarse siliceous sand.

Notes: This vegetation unit was described at releve KMR6 (Photograph 6; detailed site description provided in Appendix 6). Vegetation condition was Very Poor (vegetation in



area was possibly regrowth). Old burnt stumps in the area indicated past clearing and a large area adjacent to the releve KMR6 vegetation had been cleared in the past and was presently a perennial veldt grass (**Ehrharta calycina*) closed grassland.

EgDs

Eucalyptus gomphocephala scattered trees over *Dryandra sessilis* var. *cygnorum* high shrubland to open scrub over *Jacksonia furcellata* scattered tall shrubs over *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina* grassland with *Conostylis aculeata* very open herbland.

Habitat and Soil: Gentle, west-facing upper slope of low dune. Yellow-orange siliceous sand.

Notes: This vegetation unit was described at releve KMR8 (Photograph 7; detailed site description provided in Appendix 6). Vegetation condition was Poor.



Photograph 6. Vegetation unit Gv (releve KMR6): *Grevillea vestita* subsp. *vestita* heath over *Desmocladius asper* scattered sedges and *Conostylis aculeata* scattered herbs with **Ehrharta calycina* grassland.



Photograph 7. Vegetation unit EgDs (releve KMR8): *Eucalyptus gomphocephala* scattered trees over *Dryandra sessilis* var. *cygnorum* high shrubland to open scrub over *Jacksonia furcellata* scattered tall shrubs over *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina* grassland.

AfDs

(*Eucalyptus gomphocephala* scattered trees over) *Allocasuarina fraseriana* low open woodland over *Banksia attenuata* low woodland over *Jacksonia furcellata*, *Dryandra sessilis* var. *cygnorum* scattered tall shrubs over *Macrozamia riedlei* scattered shrubs over *Acacia pulchella* var. *glaberrima*, *Pimelea rosea* subsp. *rosea*, *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina* grassland and *Conostylis aculeata*, **Trifolium campestre* var. *campestre* very open herbland.

Habitat and Soil: Gentle, west-facing upper slope and crest of low ridge (dune). Yellow-orange siliceous sand.

Notes: This vegetation unit was described at releve KMR10 (detailed site description provided in Appendix 6). Vegetation condition was Poor. (There was a closed grassland of **Ehrharta calycina* and herb species were not recorded).



3.7 Vegetation condition

The condition of vegetation in the Lot E26 Meares Avenue survey area was mostly in the range of 'Good' to 'Very Poor' (Figure 3; see Appendix 3 for an outline of the classification). Some 'Completely Degraded' areas were also recorded. Small patches of vegetation in 'Very Good' condition also occurred. The main factor affecting the vegetation condition was weed cover.

Perennial veldt grass (**Ehrharta calycina*) formed a grassland and sometimes a closed grassland over most of the survey area and was the most dominant and widespread weed. Other weeds that were common in the survey area included **Eragrostis curvula* (love grass; mainly in discrete patches of closed grassland), **Euphorbia terracina* (Geraldton carnation weed), **Avena barbata* (wild oats), **Bromus diandrus* and **Trifolium campestre* var *campestre*. Weed cover was generally greatest around the outside part of the survey area (adjacent to the surrounding roads). The high weed cover in the survey area had impacted greatly on the annual herb strata and this strata was often species-poor.

Some physical disturbance occurred in various places in the survey area in the form of sumps (near the road boundaries), small excavated holes and low mounds of soils. A number of tracks dissected the survey area. A large old cleared area (Completely Degraded – closed grassland/herbland of weeds) was located in the south-central part of the survey area (see Figure 3).

Discrete occurrences of other aggressive weed species

The location of patches or individuals of some aggressive weeds were recorded during the survey. These are shown in Table 3 below. **Eragrostis curvula* (love grass) formed closed grasslands in some large areas, generally near the boundaries of the survey area.

Jarrah health and leafminer

It was noted that the crowns of many of the jarrah trees in the survey area were very brown and the trees appeared to be in poor health (see Photograph 1). Closer inspection of the crowns showed the leaves to be browned by what appeared to be intensive leafminer damage. Jarrah leafminer is a moth, *Perthida glyphopa* (Western Australian



Department of Agriculture, 2006). The larvae emerge from eggs laid on the lower-surface of the leaves and feed from late May to September on the leaves. The larvae feed between the leaf surfaces and produce rust to brown coloured blotch mines. Severe infestations occur commonly along forest edges, in clearings and on partly cleared farmland (Western Australian Department of Agriculture, 2006). Jarrah is the main host tree. To confirm the jarrah leaf damage in the survey area is being caused by leafminer, it would be necessary to take leaf specimens to the Department of Environment and Conservation or the Department of Agriculture.

Banksia deaths and dieback

Dead *Banksia* trees were recorded at four sites in the survey area (refer Table 4). Between 1 and 6 dead trees were recorded at each location. One group of deaths was around a sump and the deaths may be related to the sump. No other obvious signs of jarrah dieback were noted. An accredited dieback interpreter would need to survey the areas of dead *Banksia*'s to determine if dieback was in the survey area.

Table 3 Location of discrete occurrences of other aggressive weed species

Weed name	Common name	Nos	Location	Notes
<i>Acacia longiflora</i>	Sydney golden wattle	1	388215E; 6431298N	
<i>Acacia longiflora</i>		1	388213E; 6430753N	
<i>Acacia longiflora</i>		1	388208E; 6430753N	
<i>Acacia iteaphylla</i>	Flinders Range wattle	1	388442E; 6431309N	
<i>Acacia iteaphylla</i>		1	388495E; 6431102N	
<i>Asparagus officinalis</i>	Asparagus	1	388313E; 6431480N	on verge
<i>Asparagus officinalis</i>		1	388373E; 6431456N	
<i>Asparagus officinalis</i>		>5	388339E; 6431442N	
<i>Cortaderia selloana</i>	Pampass grass	1	388170E; 6431058N	
<i>Cynodon dactylon</i>	Couch		388161E; 6431109N	5m diam area
<i>Dimorphotheca ecklonis</i>	Veldt daisy		388530E; 6431425N	
<i>Dimorphotheca ecklonis</i>		many	388539E; 6431166N	
<i>Dimorphotheca ecklonis</i>			388510E; 6431114N	3m x 3m area
<i>Eragrostis curvula</i>	Love grass		388267E; 6431467N	
<i>Eragrostis curvula</i>			388530E; 6431425N	large area
<i>Eragrostis curvula</i>			388539E; 6431166N	50m x 50m area
<i>Eragrostis curvula</i>		10	388147E; 6430891N	
<i>Eragrostis curvula</i>			388313E; 6431480N	on verge
<i>Eragrostis curvula</i>		1	388166E; 6431150N	edge of track

Weed name	Common name	Nos	Location	Notes
<i>Eragrostis curvula</i>		1	388456E; 6430732N	
<i>Eragrostis curvula</i>		1	388120E; 6430811N	
<i>Eragrostis curvula</i>		2	388521E; 6430957N	
<i>Eragrostis curvula</i>		1	388256E; 6431423N	
<i>Eragrostis curvula</i>		1	388420E; 6431413N	
<i>Euphorbia terracina</i>	Geraldton carnation weed		388120E; 6430811N	60m x 60m area
<i>Euphorbia terracina</i>			388326E; 6430845N	50m diam area
<i>Euphorbia terracina</i>			388504E; 6430948N	40m diam area
<i>Euphorbia terracina</i>			388565E; 6431047N	60m long area
<i>Gazania linearis</i>	Gazania		388261E; 6431490N	
<i>Gazania linearis</i>		1	388359E; 6431431N	
<i>Gazania linearis</i>		1	388256E; 6431450N	
<i>Gazania linearis</i>			388554E; 6431004N	scattered in 40m x 20m area
<i>Schinus terebinthifolia</i>	Japanese pepper		388524E; 6430831N	
<i>Schinus terebinthifolia</i>			388524E; 6430831N	



Table 4. Location of recorded Banksia deaths

Description	Notes	Location
2 dead <i>Banksia attenuata</i> 's and 1 dead jarrah (possibly fire impacted)		388352E; 6431426N
1 <i>Banksia grandis</i>	recently dead (dead leaves attached)	388185E; 6431452N
1 <i>B. grandis</i>	recently dead (dead leaves attached)	388296E; 6430747N
5 x <i>B. attenuata</i> and 1 x <i>B. grandis</i>	recent deaths; on the edge of a sump	388575E; 6431139N



3.8 FLORISTIC COMMUNITY TYPES AND THREATENED ECOLOGICAL COMMUNITIES

3.8.1 Inferred Floristic Community Types (FCT's) and Threatened Ecological Communities (TEC's)

Review of the Department of Environment and Conservation FCT data shows that Spearwood FCT's 21a, 24, 25 and 28 occur in the locality of the Lot E26 Meares Avenue survey area. FCT 25 has been recorded mostly south of Mandurah and FCT's 24 and 28 have been recorded mainly north from about Kwinana. FCT 21a has been recorded mostly south of Perth and in the eastern part of the Spearwood unit and in the Bassendean unit. Comparison of the species lists for quadrats KM1 and KM2 (jarrah-banksia woodland units) with Gibson *et al.*'s (1994) sorted two-way table and the DEC's updated species frequency tables, showed that the quadrats had similarities with all of the FCT's 21a, 24, 25 and 28. However, they would appear to be closest to FCT 28.

The tuart woodland vegetation units had a similar set of species as the Jarrah-banksia woodland units and would probably come out near FCT28. The limestone shrubland units, with *Dryandra sessilis*, *Hakea prostrata* and *Allocasuarina humilis* species present, were most similar to FCT's 24 and 28. None of the Spearwood FCT's 21a, 24, 25 and 28 have been given Threatened Ecological Community status.

3.8.2 Threatened Ecological Communities (TEC's) Previously Recorded in the Locality

A search of the Department of Environment and Conservation's TEC database showed that two TEC's had been recorded within five kilometres of the Lot E26 Meares Avenue survey area (refer Table 5). The vegetation in the Lot E26 Meares Avenue survey area does not have close similarities with either of these TEC's.



Table 5 TEC's recorded within five kilometres of the Lot E26 Meares Avenue survey area

TEC	TEC Description	Status
26a	<i>Melaleuca huegelii-Melaleuca systema</i> shrublands on limestone ridges	Endangered
19b	Woodlands over sedgeland in holocene dune swales of the southern Swan Coastal Plain	Critically Endangered

3.9 FLORA AND VEGETATION CONSERVATION

3.9.1 Flora Conservation Values

The flora conservation values for a survey area include general flora values and values for species of particular conservation significance or interest.

The general value for flora of an area can be understood as the sum of the value of the populations of all the individual species in it. This is a value that all areas with native flora have, even if they do not have any species of particular interest. That is, it recognises the intrinsic value of areas of native vegetation for flora. This value will obviously vary depending on the size of the area, the flora habitat diversity, the commonness of the particular flora habitats present and the overall flora present. While a description of this value can be made, such as low, moderate, high or very high, it would be difficult to quantify. This value for a particular size of area increases as the number of flora species increases, which generally increases with habitat diversity. The general conservation value for flora of an area will be similar to that of the adjoining areas of similar size that have similar ranges of habitat (Morgan and Trudgen, 2001)

The conservation value for species of conservation significance will vary for areas that have a similar general value because the number of species (or taxa) of conservation significance can vary fairly widely in areas of similar size and flora habitat diversity. It is a special value rather than a general value.



3.9.2. Flora Conservation Values in the Survey Area

One hundred and twelve (112) native species were recorded from the survey area. This is a modest number for the size of the survey area (approximately 38 hectares) on Spearwood sands. The generally poor condition of the vegetation in the survey area (mostly between Good to Very Poor) due to the high weed cover, particularly the high cover of **Ehrharta calycina*, would have significantly impacted on the presence of ephemeral herb species as well as smaller shrubs. The survey was undertaken during early to mid Spring and so seasonal conditions were good for flora surveying and the number of ephemerals herbs should have been optimal at that time of year.

In summary, the number of species recorded in the Lot E26 Meares Avenue survey area suggests a 'moderate general' value for flora.

No Declared Rare Flora or Priority taxa were recorded in the survey area and no species was recorded that is considered to be 'Significant Flora of the Perth Metropolitan Region' (Department of Environmental Protection 2000). Therefore, the conservation value for species of conservation significance in the survey area could be considered to be low.

3.9.3 Vegetation Conservation Values

The vegetation units in the Lot E26 Meares Avenue survey area were inferred to be FCT's 28 or 24, which are not TEC units (see section 3.8.1 above). Of the TEC's that occur in the locality (TEC26a and 19b) neither were found to occur in the Lot E26 Meares Avenue survey area. The fact that no TEC's appear to occur in the survey area suggests moderate vegetation conservation values for the survey area.

Tuart occurred in the survey area in some vegetation units as tuart open woodland and in other units as a scattered trees in the tree strata.

Tuart is endemic to the Swan Coastal Plain where it grows mainly on the Quindalup and Spearwood Dunes, from Jurien Bay in the north to Sabina River east of Busselton, with some outlier populations near the Murray, Swan, Serpentine and Canning Rivers (Tuart Response Group, 2002). The Tuart Response Group (2002) concluded that while Tuart as



a species seems to be well represented in parks and reserves, the conservation status of tuart is less clear when considered relative to firstly the presently described six structural tuart ecosystems and secondly the composition of the flora associated with tuart.

Another important factor impacting on tuart conservation is that tuart dominated communities have been significantly impacted by grazing, frequent fire, weed invasion and other threatening processes resulting in this vegetation being in a more disturbed condition than surrounding vegetation (Keighery *et al.*, 2002; Trudgen, 1991). For this reason Keighery *et al.* (2002) argued that areas of tuart dominated vegetation in good condition should be a priority for retention and protection. It should be noted that the tuart units in the survey area were in 'Good' to 'Very Good' condition in one small unit and otherwise ranged between 'Very Poor' to 'Good'.

Taking these points into consideration, the tuart vegetation units in the survey area would have moderate to high conservation value.

The vegetation complex, based on major landform elements, that occurs in the survey area is the Cottesloe Complex – Central and South.

The original ('pre-1750') extent of this Complex is shown in Table 6. The remaining area of this Complex as a percentage of its pre-1750 extent and the remaining area of this Complex in secure tenure as a percentage of its pre-1750 extent are also shown in Table 6. It can be seen that the remaining area of the Cottesloe Complex – Central and South is 41.1 percent, while its remaining area in secure tenure is 8.8 percent.

'Representation of ecological communities' is one of the six criteria for the identification of regionally significant natural areas identified by the EPA (EPA, 2003). The National Objectives and Targets for Biodiversity Conservation 2001-2005 recognised a standard level of native vegetation retention of at least 30 percent of the pre-clearing extent of the ecological communities. While the Cottesloe Complex – Central and South has more than 40 percent of pre-1750 extent remaining, the situation is not secure. This is because to meet the target for the conservation of remnant Cottesloe Complex – Central and South, almost 75 percent of the remaining (as at the time of the data compilation in 2002) area of the Complex would have to be protected. A further target that has been adopted nationally for representation of ecological communities is that at least 15 percent of the remaining area of the Vegetation Complexes be in secure tenure (Gary Whissen, *pers. comm.*). It can be seen from Table 6 (2002 data) that less than 15 percent of the Cottesloe Complex – Central and South is in secure tenure.



'Diversity' is another criteria for the identification of regionally significant natural areas in the System 6 and Part System 1 region (EPA, 2003). The Lot E26 Meares Avenue survey area contains just the one landform unit, with a modest diversity of vegetation units.

'Rarity' (of 'communities' or species) is a third criteria for the identification of regionally significant natural areas in the System 6 and Part System 1 region (EPA, 2003). The extent and variety of tuart vegetation in the survey area means that 'rarity' of communities in the survey area is moderate. It should be noted that TEC's, DRF or Priority flora species were not recorded in the survey area.

Table 6. Remnant vegetation of the Swan Coastal Plain Bioregion within the System 6/part System 1 (adapted from Table 4, Appendix 3, EPA (2003)).

Vegetation Complex	Total pre-1750 extent (ha)	% remaining (1997/98) in the System 6/part System 1 area	% remaining of pre-1750 extent in secure tenure
Cottesloe Complex – Central and south	44,995	41.1	8.8

While there are no TEC's in the survey area, the vegetation has additional value because of the presence of tuart vegetation units and the fact that less than 15 percent of the Cottesloe Complex – Central and South is in secure tenure. The vegetation in the survey area is considered to have some rarity value and modest diversity value. Against this, the vegetation has high weed cover and the vegetation condition varies between 'Very Poor' to 'Good'.

Therefore, the overall vegetation conservation value in the survey area might be considered to be 'moderate' to 'high'.



4 ACKNOWLEDGEMENTS

Mr Brian Morgan for undertaking the botanical field work and development of information.

Ms Britta Mathews assisted with the field work and entered the data.

Mrs Lorraine Cobb identified most of the plant specimens. Mr Allen Lowrie identified *Stylidium* and *Drosera* specimens and Mr Andrew Brown identified the orchids. Mr Mike Hussey helped with the identification of a number of specimens (including the Epacrids).

Thanks to Karen Clarke and the DEC for providing the FCT species frequency tables for viewing.

Thanks to Mr Malcolm Trudgen for useful discussions.



5 LIMITATIONS

The major limitation of the flora survey is that any such survey is a sampling procedure of a variable environment with plant populations of variable growth habit, life span and flowering season. Some species, including annuals, are only available for collection for part of the year. This means that to locate all species that grow in an area is a substantial task, the success of which is related to the time available and the size and diversity of habitat in the survey. Consequently, it is possible that there are species present in the survey area that were not recorded during this survey as they have only low abundance on the land, or were not flowering at the time of the survey. However, this limitation was minimised by conducting this survey during early to mid Spring when most annual species were present and in some stage of flowering.

Given the limitations of the flora survey, it is likely that this survey recorded more than 90 percent of the vascular flora in the survey area. That is, while the flora survey was relatively thorough, it was possible that some species occurring in the survey area were not recorded.



6 REFERENCES

- Aplin, T.E.H. 1979. 'The Flora' In: *Environment and Science*, B.J. O'Brien (ed.). University of WA Press, Perth.
- Atkins, K.J. 2006. *Declared Rare and Priority Flora List for Western Australia..* Department of Conservation and Land Management, Woodvale.
- Beard, J. S. 1980. A new phytogeographic map of Western Australia. *Western Australian Herbarium Research Notes* 3, 37-58.
- Churchward, H. M. and McArthur, W. M. 1980. 'Landforms and Soils of the Darling System, Western Australia.' In: *Atlas of Natural Resources, Darling System Western Australia..*, M.J. Mulcahy (ed.) pp25-36 and accompanying map. Department of Conservation and Environment, Perth.
- Department of Environmental Protection. 2000. *Bush Forever Vol. 2 Directory of Bush Forever Sites.* Dept of Environmental Protection, Perth.
- Environmental Protection Authority. 2003. *Guidance for the assessment of environmental Factors (In accordance with the Environmental Protection Act 1986).* No. 10. January 2003. Western Australia.
- English, V., and Blyth, J. 1997. *Identifying and conserving threatened ecological communities (TECs) in the South West Botanical Province.* ANCA National Reserves System Cooperative Program: Project Number N702, Australian National Conservation Agency, Canberra.
- Gibson, N., Keighery, B.J., Keighery, G.J., Burbidge, A.H., and Lyons, M.N. 1994. *A Floristic Survey of the Southern Swan Coastal Plain.* Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc).



- Heddle, E.M., Loneragan, O.W., and Havel, J.J. (1980) 'Vegetation complexes of the Darling System, Western Australia.' In: *Atlas of Natural Resources, Darling System Western Australia.*, M.J. Mulcahy (ed.) pp37-76 and accompanying map. Department of Conservation and Environment, Perth.

- Keighery, B. J., Keighery, G. J. and Shepherd, D. 2002. The distribution and conservation of tuart and the community with which it lives. In *Tuart and the Tuart Communities*. Eds: Keighery, B. J. and Longman, V. M. Wildflower Society of Western Australia.

- McArthur, W.M., and Bettenay, E. 1960 *The development and distribution of soils on the Swan Coastal Plain, Western Australia*. CSIRO Soil Publication No 16.

- Morgan, B. R. and Trudgen, M. E. 2001. A flora and vegetation survey of a site on the Burrup Peninsula for a proposed dimethyl ether project. (Unpublished report prepared for PPK Environment and Infrastructure).

- Trudgen, M. 1991. A flora and vegetation survey of the coast of the City of Mandurah. Unpublished report. Department of Planning and Urban development, Western Australia.

- Trudgen, M. 1999. A flora and vegetation survey of Lots 46 and 47 Maralla Road and Lexia Avenue, Ellenbrook. Unpublished report prepared by M.E.Trudgen and Associates for The Crown Solicitors Office, Government of Western Australia.

- Tuart Response Group. 2002. Status report on the conservation and protection of Tuart. Western Australia.



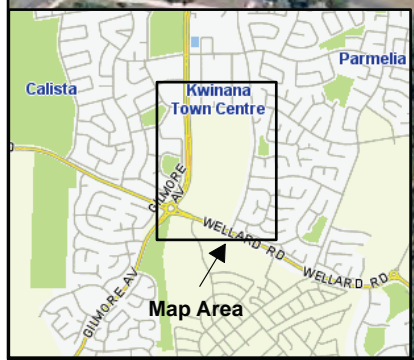
FIGURE 1.

Locality Map



N

0 12.525 50
Meters
Map Projection: GDA94



Satterley Property Group
 KWINANA TOWN CENTRE FLORA SURVEY
Site Location

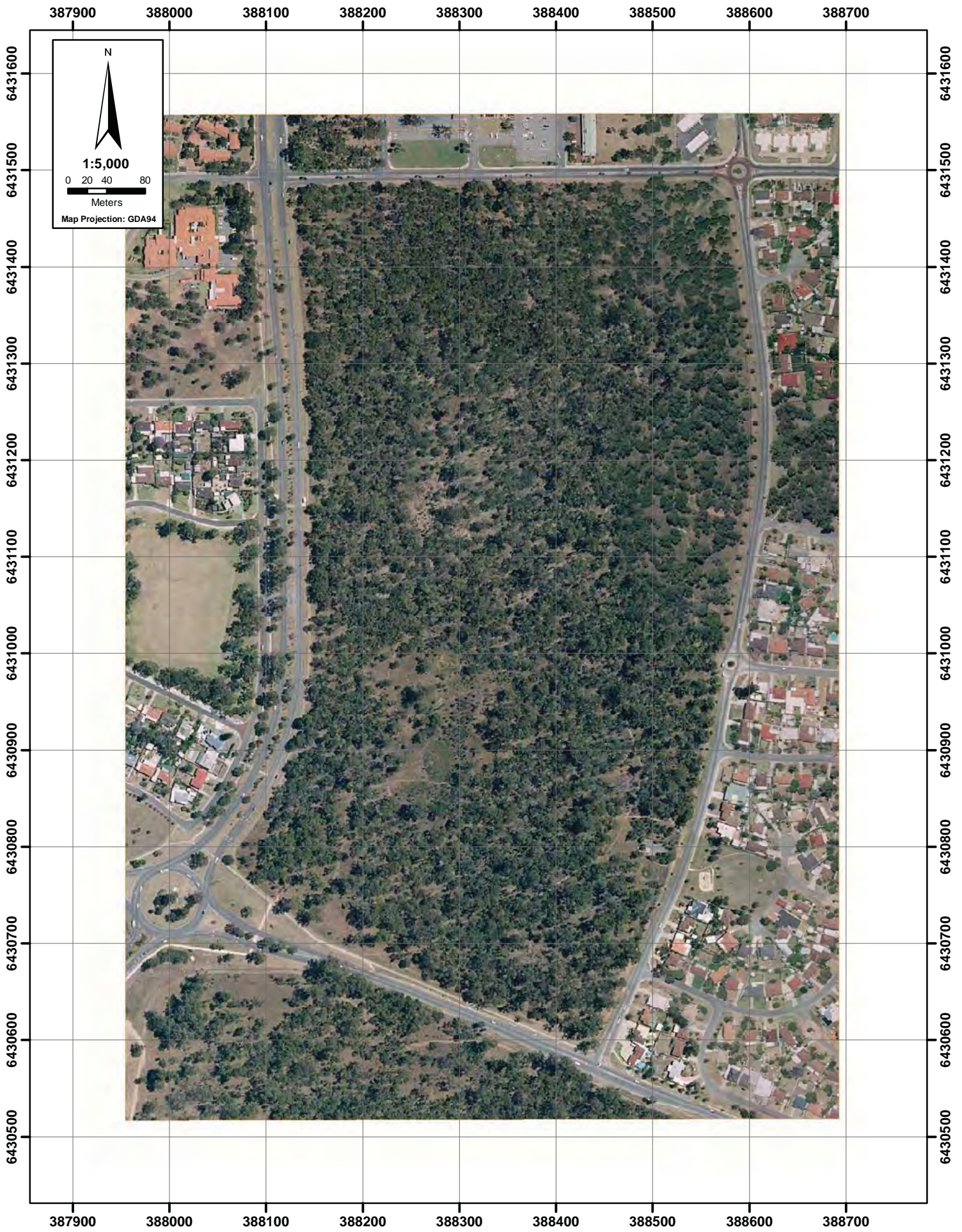
360 Environmental Document Reference: 70-1AB November 2006

Figure 1



FIGURE 2.

Flora Survey



Satterley Property Group
 KWINANA TOWN CENTRE FLORA SURVEY
Flora Survey Area

Figure 2



Figure 3.

Vegetation condition



Jarrah-Banksia woodlands

Em *Eucalyptus marginata* subsp. *marginata* low open forest over *Banksia grandis*, *Banksia attenuata* scattered low trees over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei*, *Acacia pulchella* scattered shrubs over *Gompholobium tomentosum*, *Hibbertia hypericoides* scattered low shrubs over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* very open grassland with *Conostylis aculeata* very open herbland.

EmBa (*Eucalyptus gomphocephala* scattered trees over) *Eucalyptus marginata* subsp. *marginata* low woodland over *Banksia attenuata*, (*Banksia grandis*) low woodland over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei* scattered shrubs to open shrubland over *Gompholobium tomentosum* scattered low shrubs over *Desmocladius aspera*, *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* (perennial veldt grass) open grassland to grassland.

EmAF *Eucalyptus marginata* subsp. *marginata*, *Allocasuarina fraseriana* low woodland over *Banksia attenuata*, *B. grandis* scattered low trees to low open woodland over *Jacksonia furcellata* scattered tall shrubs over *Acacia pulchella*, *Macrozamia riedlei* scattered shrubs to open shrubland over **Ehrharta calycina* closed grassland with **Trifolium campestre*, **Lupinus* blue very open herbland.

EgEm *Eucalyptus gomphocephala* scattered trees to open woodland over *Eucalyptus marginata* subsp. *marginata* low woodland over *Banksia attenuata*, *Allocasuarina fraseriana* low open woodland over *Jacksonia furcellata* (=KM2-10) scattered tall shrubs over *Macrozamia riedlei*, *Xanthorrhoea preissii* open shrubland over *Hibbertia hypericoides*, *Gastrolobium capitatum* scattered low shrubs over *Lepidosperma squamatum*, *Desmocladius aspera* very open sedgeland and *Conostylis aculeata* very open herbland.

Tuart woodlands

Eg *Eucalyptus gomphocephala* woodland over *Eucalyptus marginata* subsp. *marginata* low open woodland to low woodland over *Banksia attenuata* (*Banksia grandis*) low open woodland over *Jacksonia furcellata* scattered tall shrubs over *Xanthorrhoea preissii* high open shrubland over *Macrozamia riedlei* and *Acacia pulchella* open shrubland over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* grassland with *Conostylis aculeata* open herbland.

Marri woodlands

Cc *Corymbia calophylla*, (*Eucalyptus marginata* subsp. *marginata*) woodland over *Jacksonia furcellata* scattered tall shrubs over to high open shrubland over *Macrozamia riedlei*, *Xanthorrhoea preissii* open shrubland over *Leucopogon* ? prop scattered low shrubs over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* grassland.

Limestone shrublands

Gv *Grevillea vestita* subsp. *vestita* heath over *Desmocladius aspera* scattered sedges and *Conostylis aculeata* scattered herbs with **Ehrharta calycina* grassland.

EgDs *Eucalyptus gomphocephala* scattered trees over *Dryandra sessilis* high shrubland to open scrub over *Jacksonia furcellata* scattered tall shrubs over *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina* grassland with *Conostylis aculeata* very open herbland.

AIDs (*Eucalyptus gomphocephala* scattered trees over) *Allocasuarina fraseriana* low open woodland over *Banksia attenuata* low woodland over *Jacksonia furcellata*, *Dryandra sessilis* scattered tall shrubs over *Macrozamia riedlei* scattered shrubs over *Acacia pulchella*, *Pimelea rosea*, *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina* grassland and *Conostylis aculeata*, **Trifolium campestre* very open herbland.





APPENDIX 1.



The Department of Environment and Conservation Priority Flora Categories (from Atkins 2006).

Declared Rare Flora - Extant Taxa

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.

Declared Rare Flora - Presumed Extinct Flora

Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such.

Priority One - Poorly Known Taxa.

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, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

Priority Two - Poorly Known Taxa.

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 (ie. not currently endangered). Such taxa are under consideration for declaration as "rare flora", but are in urgent need of further survey.

Priority Three - Poorly Known Taxa.

Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. 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 study.



Priority Four - Rare Taxa.

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.



APPENDIX 2.



Vegetation structural table of Trudgen based on Aplin's (1979) modification of Specht's classification

Life form and height of tallest stratum	Projective foliage cover of tallest stratum as %	Description
Trees over 30 metres	70 -100	High closed forest
	30 -70	High open forest
	10 - 30	high woodland
	2 -10	high open woodland
	under 2	Scattered tall trees
Trees 10 - 30 metres	70 -100	Closed forest
	30 -70	Open forest
	10 - 30	Woodland
	2 -10	Open woodland
	under 2	Scattered trees
Trees under 10 metres	70 -100	Low closed forest
	30 - 70	Low open forest
	10 - 30	Low woodland
	2 -10	Low open woodland
	under 2	Scattered low trees
Shrubs over 2 metres	70 - 100	Closed scrub
	30 - 70	Open scrub
	10 - 30	High shrubland
	2 -10	High open shrubland
	under 2	Scattered tall shrubs
Shrubs 1 - 2 metres	70 - 100	Closed heath
	30 - 70	Open heath
	10 - 30	Shrubland
	2 -10	Open shrubland
	under 2	Scattered shrubs
Shrubs under 1 metre	70 - 100	low closed heath
	30 - 70	low open heath
	10 - 30	low shrubland
	2 -10	Low open shrubland
	under 2	Low scattered shrubs
Herbs/Sedges/Grasses	70 - 100	Closed herb, sedge, grassland
	30 - 70	Herb, sedge, grassland
	10 - 30	Open herb, sedge, grassland
	2 -10	Very open herb, sedge, g'land



under 2

Scattered herbs sedges,

grasses

Grasslands then divided into:

Tussock grasslands (perennial tussock species, e.g. Eragrostis species);

Hummock grasslands (Triodia and Plectrachne species that form hummocks)

Curly spinifex grassland (Plectrachne pungens, which does not form hummocks) (follows J.S. Beard).

Annual tussock grassland (e.g. annual Sorghum species).



APPENDIX 3.



Vegetation condition scale (Department of Environmental Protection, 2000).

Pristine (1).

Pristine or nearly so, no obvious signs 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. 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 very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate to it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.

Degraded (5).

Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.

Completely degraded (6).

The structure of 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.



APPENDIX 4.



Flora list for the Lot E26 Meares Ave survey area.

Notes:

1. The numbers in front of the plant families are the numbers for families used at the Western Australian Herbarium.
2. An asterisk (*) beside the taxon name indicates an introduced species (weed).
3. The 'priority status' column shows the conservation code of any rare or priority plants in the list.

FAMILY/TAXA	COMMON NAMES	PRIORITY STATUS
GYMNOSPERMAE		
Class CYCADOPSIDA (Cycads)		
016 ZAMIACEAE		
<i>Macrozamia riedlei</i>		
Class PINOPSIDA (conifers)		
018 CUPRESSACEAE		
<i>Callitris ?canescens</i>		
ANGIOSPERMAE (flowering plants)		
Class LILIOPSIDA (Monocotyledons)		
031 POACEAE		
<i>Austrodanthonia occidentalis</i>		
<i>Austrostipa flavescens</i>		
* <i>Avena barbata</i>		
* <i>Briza maxima</i>		
* <i>Briza minor</i>		
* <i>Bromus diandrus</i>		
* <i>Cortaderia selloana</i>		
* <i>Cynodon dactylon</i>		
* <i>Ehrharta calycina</i>		
* <i>Eragrostis curvula</i>		
* <i>Lagurus ovatus</i>		
<i>Poa porphyroclados</i>		
032 CYPERACEAE		
<i>Ficinia nodosa</i>		
<i>Isolepis cernua var. setiformis</i>		
<i>Lepidosperma pubisquameum</i>		
<i>Lepidosperma scabrum</i>		
<i>Lepidosperma squamatum</i>		
<i>Mesomelaena pseudostygia</i>		
<i>Schoenus ?clandestinus</i>		
<i>Schoenus curvifolius</i>		
<i>Schoenus grandiflorus</i>		



FAMILY/TAXA	COMMON NAMES	PRIORITY STATUS
032 CYPERACEAE (cont) <i>Tetraria octandra</i>		
039 RESTIONACEAE <i>Desmocladus asper</i> <i>Desmocladus flexuosus</i>		
052 JUNCACEAE <i>Luzula meridionalis</i>		
054B ASPARAGACEAE * <i>Asparagus officinalis</i>		
054C DASYPOGONACEAE <i>Acanthocarpus preissii</i> <i>Lomandra caespitosa</i> <i>Lomandra hermaphrodita</i> <i>Lomandra maritima</i> <i>Lomandra micrantha</i> <i>Lomandra ?micrantha</i> <i>Lomandra preissii</i> <i>Lomandra suaveolens</i>		
054D XANTHORRHOEACEAE <i>Xanthorrhoea brunonis</i> <i>Xanthorrhoea preissii</i>		
054E PHORMIACEAE <i>Dianella revoluta</i> var. <i>divaricata</i>		
054F ANTHERICACEAE <i>Caesia micrantha</i> <i>Chamaescilla corymbosa</i> var. <i>corymbosa</i> <i>Corynotheca micrantha</i> var. <i>?elongata</i> <i>Dichopogon capillipes</i> <i>Sowerbaea laxiflora</i> <i>Thysanotus arenarius</i> <i>Thysanotus manglesianus</i> <i>Tricoryne elatior</i>		
054J COLCHICACEAE <i>Burchardia congesta</i>		



FAMILY/TAXA NAMES	COMMON STATUS	PRIORITY
055 HAEMODORACEAE <i>Anigozanthos manglesii</i> <i>Conostylis aculeata</i> <i>Haemodorum paniculatum</i>		
060 IRIDACEAE * <i>Gladiolus caryophyllaceus</i> <i>Patersonia occidentalis</i> * <i>Romulea rosea</i>		
066 ORCHIDACEAE <i>Caladenia discoidea</i> <i>Caladenia flava</i> subsp. <i>flava</i> <i>Caladenia latifolia</i> <i>Diuris magnifica</i> <i>Pterostylis sanguinea</i> <i>Thelymitra</i> sp.		
Class MAGNOLIOPSIDA (Dicotyledons)		
070 CASUARINACEAE <i>Allocasuarina fraseriana</i> <i>Allocasuarina humilis</i>		
090 PROTEACEAE <i>Banksia attenuata</i> <i>Banksia grandis</i> <i>Dryandra lindleyana</i> var. <i>lindleyana</i> <i>Dryandra sessilis</i> var. <i>cygnorum</i> <i>Grevillea vestita</i> subsp. <i>vestita</i> <i>Hakea prostrata</i> <i>Persoonia saccata</i> <i>Petrophile linearis</i> <i>Synaphea spinulosa</i> subsp. <i>spinulosa</i> <i>Xylomelum occidentale</i>		
103 POLYGONACEAE <i>Muehlenbeckia adpressa</i>		
106 AMARANTHACEAE <i>Ptilotus drummondii</i> var. <i>drummondii</i> <i>Ptilotus polystachyus</i>		



FAMILY/TAXA NAMES	COMMON STATUS	PRIORITY
113 CARYOPHYLLACEAE		
* <i>Petrorhagia dubia</i>		
119 RANUNCULACEAE		
<i>Clematis pubescens</i>		
136 FUMARIACEAE		
* <i>Fumaria capreolata</i>		
143 DROSERACEAE		
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		
<i>Drosera pallida</i>		
<i>Drosera porrecta</i>		
<i>Drosera</i> sp.		
149 CRASSULACEAE		
<i>Crassula colorata</i> var. <i>acuminata</i>		
<i>Crassula colorata</i> var. <i>colorata</i>		
<i>Crassula decumbens</i> var. <i>decumbens</i>		
163 MIMOSACEAE		
<i>Acacia applanata</i>		
<i>Acacia cochlearis</i>		
* <i>Acacia iteaphylla</i>		
* <i>Acacia longifolia</i>		
<i>Acacia pulchella</i> var. <i>glaberrima</i>		
<i>Acacia saligna</i>		
<i>Acacia stenoptera</i>		
165 PAPILIONACEAE		
<i>Bossiaea eriocarpa</i>		
<i>Gastrolobium capitatum</i>		
<i>Gompholobium tomentosum</i>		
<i>Hardenbergia comptoniana</i>		
<i>Hovea trisperma</i>		
<i>Isotropis cuneifolia</i> subsp. <i>cuneifolia</i>		
<i>Jacksonia furcellata</i>		
<i>Jacksonia sternbergiana</i>		
<i>Kennedia coccinea</i>		
<i>Kennedia prostrata</i>		
* <i>Lupinus angustifolius</i>		
* <i>Lupinus cosentinii</i>		
* <i>Lupinus luteus</i>		



FAMILY/TAXA NAMES	COMMON STATUS	PRIORITY
165 PAPILIONACEAE (cont)		
* <i>Trifolium arvense</i> var. <i>arvense</i>		
* <i>Trifolium campestre</i> var. <i>campestre</i>		
167 GERANIACEAE		
* <i>Geranium molle</i>		
<i>Geranium solanderi</i>		
* <i>Pelargonium capitatum</i>		
168 OXALIDACEAE		
* <i>Oxalis pes-caprae</i>		
175 RUTACEAE		
<i>Philotheca spicata</i>		
185 EUPHORBIACEAE		
* <i>Euphorbia terracina</i>		
<i>Poranthera microphylla</i>		
194 ANACARDIACEAE		
* <i>Schinus terebinthifolia</i>		
215 RHAMNACEAE		
<i>Cryptandra arbutiflora</i>		
226 DILLENIACEAE		
<i>Hibbertia hypericoides</i>		
<i>Hibbertia racemosa</i>		
243 VIOLACEAE		
<i>Hybanthus calycinus</i>		
263 THYMELAEACEAE		
<i>Pimelea rosea</i> subsp. <i>rosea</i>		
273 MYRTACEAE		
<i>Corymbia calophylla</i>		
<i>Eucalyptus gomphocephala</i>		
<i>Eucalyptus marginata</i> subsp. <i>marginata</i>		
281 APIACEAE		
<i>Eryngium pinnatifidum</i>		
<i>Trachymene pilosa</i>		
<i>Xanthosia huegelii</i>		



FAMILY/TAXA	COMMON NAMES	PRIORITY STATUS
288 EPACRIDACEAE <i>Astroloma pallidum</i> <i>Leucopogon propinquus</i>		
293 PRIMULACEAE * <i>Anagallis arvensis</i>		
305 ASCLEPIADACEAE * <i>Gomphocarpus fruticosus</i>		
313 LAMIACEAE <i>Hemiandra glabra subsp. glabra</i> * <i>Lavandula stoechas</i>		
316 SCROPHULARIACEAE * <i>Misopates orontium</i>		
320 OROBANCHACEAE * <i>Orobanche minor</i>		
331 RUBIACEAE <i>Opercularia hispidula</i> <i>Opercularia vaginata</i>		
334 VALERIANACEAE * <i>Centranthus macrosiphon</i>		
341 GOODENIACEAE <i>Scaevola canescens</i> <i>Stylidium saxifragoides</i>		
343 STYLIDIACEAE <i>Stylidium schoenoides</i> <i>Stylidium striatum</i>		



FAMILY/TAXA	COMMON NAMES	PRIORITY STATUS
345 ASTERACEAE		
<i>Brachyscome iberidifolia</i>		
* <i>Dimorphotheca ecklonis</i>		
* <i>Gazania linearis</i>		
* <i>Hypochaeris glabra</i>		
<i>Lagenophora huegelii</i>		
<i>Ozothamnus cordatus</i>		
<i>Podolepis gracilis</i>		
<i>Podolepis lessonii</i>		
* <i>Sonchus oleraceus</i>		
* <i>Ursinia anthemoides</i>		



APPENDIX 5.



Quadrat descriptions and species lists for the Lot E26 Meares Avenue survey area

Note: these sites descriptions were recorded for mapping notes and do not have a complete species list, but list representative species under 'Associated species'.

Kwinana Meares St Site KM1
Described by BRM **Date** 20/09/2006 **Type:** Q 10x10
Season: E **Uniformit** Jarrah and
Banksia attenuata
Location Near north-east corner of survey area.
MGA Zone 50 388419 mE 6431400 mN
Habitat Very gently sloping, north-facing crest of low dune.
Soil Yellow siliceous sands (Spearwood Unit).
Rock Type na
Vegetation (Eucalyptus gomphocephala scattered trees over) Eucalyptus marginata subsp marginata low woodland over *Banksia attenuata* low woodland over *Jacksonia furcellata* scattered tall shrubs over *Acacia pulchella* scattered shrubs over *Gompholobium tomentosum* scattered low shrubs over *Desmocladius asper*, *Lepidosperma pubisquameum* scattered sedges and **Ehrharta calycina* (perennial veldt grass) grassland.
Veg Cond Poor to Good (MET). Retains basic structure, but very weedy and structure impacted.
Fire Age More than 5-6 years since fire
Notes Quadrat on dune ridge top but ridge crest is to south. Cover of jarrah and *Banksia attenuata* is variable. *Banksia* cover much lower outside quadrat.

Species List:

Quad	Name	Cove	C Class	Height	Specimen	Notes
	<i>Acacia pulchella</i> var. <i>glaberrima</i>	+		80cm	KM1-6	<i>Acacia pulchella</i>
	<i>Banksia attenuata</i>	30-40%		7-8m		<i>Banksia</i>
	<i>Banksia grandis</i>	+		25m		<i>Banksia grandis</i>
	<i>Burchardia congesta</i>	+		35cm		<i>Burchardia</i>
	<i>Caesia micrantha</i>	+		35cm	(=KGC12)	<i>Caesia</i>
	<i>Caladenia flava</i> subsp. <i>flava</i>	+		12cm		<i>Caladenia flava</i>
	<i>Conostylis aculeata</i>	+		15cm		<i>Conostylis</i>
	<i>Desmocladius asper</i>	1%		15cm		<i>Desmocladius</i>
	<i>Dichopogon capillipes</i>	+		30cm		<i>Dichopogon</i>
	<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>	+		2cm	KM1-1	<i>Drosera</i>
	<i>Drosera</i> sp.	+		15cm	KM1-10	<i>Drosera</i> climber
	<i>Ehrharta calycina</i>	25-35%		1.1m		<i>Ehrharta</i>
	<i>Eryngium pinnatifidum</i>	+		30cm	KM1-4	<i>Eryngium</i>
	<i>Eucalyptus marginata</i> subsp. <i>marginata</i>	15-20%		10-12m		<i>Eucalyptus</i>



<i>marginata</i>				
<i>Euphorbia terracina</i>	2-3%	40-70cm		<i>Euphorbia</i>
<i>terracina</i>				
<i>Geranium molle</i>	+	12cm	KM1-15	<i>Geranium</i>
<i>Gompholobium tomentosum</i>	+	40cm		<i>Gompholobium</i>
<i>Hardenbergia comptoniana</i>		1.1m		<i>Hardenbergia</i>
<i>comp</i>				
<i>Hibbertia hypericoides</i>	+	10cm	KM1-16	<i>Hibbertia</i>
<i>hypericoides</i>				
<i>Hibbertia racemosa</i>	+	10cm	(KGC??)	<i>Hibbertia</i>
<i>racemosa</i>				
<i>Hypochaeris glabra</i>	+	2cm		<i>Hypochaeris</i>
<i>glabra</i>				
<i>Isotropis cuneifolia subsp. cuneifolia</i>	+	25cm		<i>Isotropis</i>
<i>cuneifolia</i>				
<i>Kennedia prostrata</i>		20cm		<i>Kennedia</i>
<i>prostrata</i>				
<i>Lepidosperma pubisquameum</i>	+	40cm	KM1-11	<i>Lepidosperma</i>
<i>pubi</i>				
<i>Leucopogon propinquus</i>	+	12cm	KM1-17,27	
<i>Astrolobium ? pallidum</i>				
<i>Lomandra caespitosa</i>	+	30cm	KM1-5	<i>Lomandra</i>
<i>?caespitosa</i>				
<i>Lomandra hermaphrodita</i>	+	25cm	KM1-12	<i>Lomandra</i>
<i>hermaphrodite</i>				
<i>Lomandra maritima</i>	+	35cm	KM1-14	<i>Lomandra ?</i>
<i>hermaph #2</i>				
<i>Lomandra micrantha</i>			KM1-5A	
<i>Lomandra preissii</i>	+	45cm	KM1-13	<i>Lomandra</i>
<i>preissi</i>				
<i>Lomandra suaveolens</i>	+	15cm	KM1-2	<i>Lomandra</i>
<i>Luzula meridionalis</i>	+	30cm	KM1-7	<i>Luzula</i>
<i>Opercularia vaginata</i>	+	20cm	KM1-9	<i>Opercularia</i>
<i>Orobanche minor</i>	+	15cm		<i>Orobanche</i>
<i>Patersonia occidentalis</i>	+	70cm		<i>Patersonia</i>
<i>occidentalis</i>				
<i>Podolepis gracilis</i>	+	20cm	(=KGC6)	<i>white daisy</i>
<i>Pterostylis sanguinea</i>	+	30cm	KM1-18	<i>Pterostylus?</i>
<i>vittata/</i>				
<i>Sonchus oleraceus</i>	+	3cm		<i>Sonchus</i>
<i>oleracea</i>				
<i>Sowerbaea laxiflora</i>	+	25cm		<i>Sowerbaea flat</i>
<i>leaf</i>				
<i>Thysanotus manglesianus</i>	+	40cm	KM1-3	<i>Thysanotus ?</i>
<i>mang</i>				
<i>Tricoryne elatior</i>	+	25cm	KM1-8	<i>Tricoryne elatior</i>
<i>Trifolium campestre var. campestre</i>	2-3%	10cm	(=KGC16)	<i>Trifolium</i>
<i>campestre</i>				



<i>Ursinia anthemoides</i>	+	20cm	<i>Ursinia</i>
<i>Anigozanthos manglesii</i>		30cm	<i>Anigozanthus</i>
<i>mang</i>			
<i>Dianella revoluta</i> var. <i>divaricata</i>		35cm	<i>Dianella</i>
<i>Drosera pallida</i>		40cm	KM1-25,28
<i>Drosera climber</i>			
<i>Dryandra lindleyana</i> var. <i>lindleyana</i>		30cm	<i>Dryandra lind</i>
<i>Eucalyptus gomphocephala</i>		4m	<i>Eucalyptus</i>
<i>Jacksonia furcellata</i>		2.5m	KM1-30 <i>Jacksonia</i>
<i>furcellata</i>			
<i>Lagurus ovatus</i>			KM1-21 <i>Lagurus grass</i>
<i>(fox tail)</i>			
<i>Lepidosperma squamatum</i>		50cm	KM1-20 <i>Lepidosperma</i>
<i>squamatum</i>			
<i>Lupinus</i> sp.			<i>blue lupin</i>
<i>Macrozamia riedlei</i>		1.2m	<i>Zamia</i>
<i>Oxalis pes-caprae</i>		15cm	<i>Oxalis (sour</i>
<i>grass)</i>			
<i>Pimelea rosea</i> subsp. <i>rosea</i>		30cm	(=KGC4) <i>Pimelea rosea</i>
<i>Poranthera microphylla</i>		15cm	KM1-24 <i>Lomandra</i>
<i>Scaevola canescens</i>		20cm	<i>Scaevola</i>
<i>canescens</i>			
<i>Schoenus grandiflorus</i>		45cm	(=KGC3) ? <i>Schoenus</i>
<i>grandiflorus</i>			
<i>Stylidium saxifragoides</i>			KM1-22 <i>Stylidium</i>
<i>Xanthorrhoea preissii</i>		1.3m	<i>Xanthorrhoea</i>
<i>preissii</i>			

Kwinana Mears St Site KM2
Described by BRM **Date** 20/09/2006 **Type:** Q 10x10
Season: **Uniformit**
Location 200 metres from central north end, west.
MGA Zone 50 388245 mE 6431326 mN
Habitat Gentle west-facing lower slope of low dune (adjacent to lowest point between two dunes)
Soil Orange-brown siliceous sand.
Rock Type na
Vegetation *Eucalyptus gomphosephala* scattered trees to open woodland over *Eucalyptus marginata* subsp. *marginata* low woodland over *Banksia attenuata*, *Allocasuarina fraseriana* low open woodland over *Jacksonia furcellata* scattered tall shrubs to high shrubland over *Macrozamia riedlei*, *Xanthorrhoea preissii* open shrubland over *Hibbertia hypericoides*, *Gastrolobium capitatum* scattered low shrubs over *Lepidosperma squamatum*, *Desmocladius asper* very open sedgeland and *Conostylis aculeata* very open herbland.
Veg Cond (MET) Good to Very Good. (Some **Ehrharta calycina* (perennial veldt grass))
Fire Age More than 5-6 years since last fire.
Notes 30x30 not sampled on upslope side, just along 'swale' between dunes. Pegged with



small wooden stakes. 1 cm leaf litter.

Species List:

Quad	Name	Cove	C Class	Height	Specimen	Notes
	<i>Acacia applanata</i>	+		20cm	(=KGC24)	<i>Acacia app</i>
	<i>Acacia stenoptera</i>	+		30cm		<i>Acacia</i>
	<i>stenoptera</i>					
	<i>Allocasuarina fraseriana</i>	+		70cm		<i>Allocas fras</i>
	<i>Anagallis arvensis</i>	+		5cm		<i>Anagallis arven</i>
	<i>Avena barbata</i>	+		30cm		<i>Avena barbata</i>
	<i>Banksia attenuata</i>	5-10%		7-8m		<i>Banksia att</i>
	<i>Burchardia congesta</i>	+		40cm		<i>Burchardia umb</i>
	<i>Caesia micrantha</i>	+		35cm	(=KGC12)	<i>Caesia</i>
	<i>mircrantha</i>					
	<i>Caladenia flava subsp. flava</i>	+		20cm		<i>Caladenia flava</i>
	<i>Chamaescilla corymbosa var. corymbosa</i>	+		15cm	(=KGC23)	<i>Chamaescilla</i>
	<i>comp</i>					
	<i>Conostylis aculeata</i>	4-5%				<i>Conostylis acul</i>
	<i>Desmocladius asper</i>	5-6%		20cm		<i>Des aspera</i>
	<i>Drosera pallida</i>	+		30cm	KM2-4	<i>Drosera climber</i>
	<i>Dryandra lindleyana var. lindleyana</i>	1%		15cm		<i>Dryandra lind</i>
	<i>Ehrharta calycina</i>	5-10%		60-80cm		<i>Erharta caly</i>
	<i>Eryngium pinnatifidum</i>	+		25cm		<i>Eryngium</i>
	<i>Eucalyptus gomphocephala</i>	15%		16-26m		<i>Euc gomph</i>
	<i>Eucalyptus marginata subsp. marginata</i>	40-50%		11-14m		<i>Euc marg</i>
	<i>Euphorbia terracina</i>	+		30cm		<i>Euph terr</i>
	<i>Geranium solanderi</i>	+		15cm	KM2-2	<i>Geranium</i>
	<i>Hardenbergia comptoniana</i>	1-2%		45cm		<i>Hard comp</i>
	<i>Hibbertia hypericoides</i>	+				<i>Hibb hyper</i>
	<i>Hovea trisperma</i>	+		40cm	KM2-8	<i>Gastrolobium?</i>
	<i>cap</i>					
	<i>Hypochaeris glabra</i>	+		3cm		<i>Hypochaeris rad</i>
	<i>Jacksonia furcellata</i>	1-2%		5m	KM2-10	<i>Jacksonia furc</i>
	<i>Kennedia prostrata</i>	+		15cm		<i>Kennedia</i>
	<i>prostrata</i>					
	<i>Lagenophora huegelii</i>	+		10cm	KM2-1	<i>Lagenophora</i>
	<i>Lepidosperma squamatum</i>	3-4%		45cm	(=KM1-20)	<i>Lepido</i>
	<i>squam</i>					
	<i>Leucopogon propinquus</i>	+		20cm	KM2-6	<i>Leucopogon</i>
	<i>Lomandra micrantha</i>	+		30cm	KM2-9	<i>Lomandra thin</i>
	<i>leaves</i>					
	<i>Lomandra preissii</i>	+		30cm	(=KM1-13)	
	<i>Lomandra preissi</i>					
	<i>Lomandra suaveolens</i>	+		25cm	KM2-3	<i>Lomandra</i>
	<i>stalkless</i>					
	<i>Luzula meridionalis</i>	+		35cm	(=KGC15)	<i>Luzula</i>
	<i>Macrozamia riedlei</i>	1-2%		70cm-		<i>zamia</i>
	<i>Orobanche minor</i>	+		15cm		<i>Orobanche</i>
	<i>Pterostylis sanguinea</i>	+		25cm	KM2-7	<i>Pterostylis</i>



<i>Sonchus oleraceus</i>	+	15cm	
<i>Sonchus oleracea</i>			
<i>Sowerbaea laxiflora</i>	+	30cm	<i>Sowerbaea</i>
<i>laxiflora</i>			
<i>Thysanotus manglesianus</i>	+	30cm	<i>Thysanotus ?</i>
<i>mang</i>			
<i>Trifolium campestre var. campestre</i>	+	12cm	(=KGC16) <i>Trifolium</i>
<i>comp.</i>			
<i>Xanthorrhoea preissii</i>	8-10%	1.2m	<i>Xanthorrhoea</i>
<i>Briza minor</i>		15cm	<i>Briza minima</i>
<i>Dianella revoluta var. divaricata</i>		45cm	<i>Dianella revoluta</i>
<i>Gompholobium tomentosum</i>		60cm	<i>Gomph tom</i>
<i>Isotropis cuneifolia subsp. cuneifolia</i>		30cm	<i>Isotropis</i>
<i>cuneifolia</i>			
<i>Lomandra caespitosa</i>		20cm	KM2-11 <i>Lomandra ?</i>
<i>caes</i>			
<i>Lomandra suaveolens</i>		20cm	KM2-13 <i>Lomandra</i>
<i>narrow flat</i>			
<i>Opercularia vaginata</i>		60cm	KM2-16
<i>Persoonia saccata</i>		30cm	KM2-17 <i>Opercularia</i>
<i>Podolepis gracilis</i>		20cm	(=KGC6) <i>Podolepis</i>
<i>daisy</i>			
<i>Schoenus grandiflorus</i>		45cm	(=KGC3) <i>Schoenus</i>
<i>grandiflorus</i>			
<i>Stylidium saxifragoides</i>		20cm	(=KM1-22)
<i>Stylidium</i>			
<i>Stylidium schoenoides</i>		35cm	KM2-15 <i>tall Stylidium</i>
<i>Ursinia anthemoides</i>		25cm	<i>Ursinia</i>



APPENDIX 6.



Releve descriptions and species lists for the Lot E26 Meares Ave survey area

Note: these sites descriptions were recorded for mapping notes and do not have a complete species list, but list representative species under 'Associated species'.

Lot E26 Meares St, Kwinana Survey Site KMR1

Described by BRM Date 20/09/06

Location: near south-west corner of survey area.

Photos: BM100: 6,7

AMG Zone 50 388179, 6430897

Habitat: lower slopes of dune.

Soil: yellow-brown siliceous sand.

Rock Type

Vegetation: (*Eucalyptus gomphocephala* scattered trees) over *Corymbia calophylla*, *Eucalyptus marginata* subsp. *marginata* woodland over *Jacksonia furcellata* scattered tall shrubs over to high open shrubland over *Macrozamia riedlei*, *Xanthorrhoea preissii* open shrubland over *Hovea trisperma*, *Leucopogon propinquus* scattered low shrubs over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* grassland.

Assoc. species: *Conostylis aculeata*, *Burchardia congesta*, *Hardenbergia comptoniana*, *Sowerbaea laxiflora*, **Oxalis pes-caprae*, *Desmocladius asper*, *Hibbertia racemosa*.

Veg Condition (MET): Very Poor (very weedy, poor cover of native species).

Fire Age: More than 3 years since fire.

Notes

Lot E26 Meares St, Kwinana Survey - Site KMR2

Described by BRM Date 20/09/06

Location: East side near southern end of survey area.

Photos: BM100: 11-13

AMG Zone 50 388493, 6430928

Habitat: gentle north-facing slope of low sandy rise.

Soil: yellow- brown siliceous sand

Rock Type

Vegetation: *Eucalyptus gomphocephala* (tuart) scattered trees over *Eucalyptus marginata* subsp. *marginata* low woodland over *Banksia attenuata*, *Banksia grandis* low open woodland over *Macrozamia riedlei* scattered shrubs over *Gompholobium tomentosum*, *Pimelea rosea* subsp. *rosea* scattered low shrubs over *Desmocladius asper*, *Lepidosperma squamatum*, *Schoenus grandiflorus* very open sedgeland and **Ehrharta calycina* very open to open grassland with *Conostylis aculeata* very open herbland.

Assoc. species: *Lomandra suaveolens*, *Lepidosperma scabrum*, *Burchardia congesta*, *Sowerbaea laxiflora*, *Dryandra lindleyana* var. *lindleyana*, *Bossiaea eriocarpa*, *Hardenbergia comptoniana*, *Leucopogon propinquus*, *Caladenia latifolia*, *Caesia micrantha*, *Acacia stenoptera*.

Veg Condition:(MET) Good (moderate cover of perennial veldt grass).

Fire Age: More than 5-6 years since fire

Notes

Lot E26 Meares St, Kwinana Survey - Site KMR3

Described by BDM and BRM Date 21/09/06



Location: South-west corner of survey area.

Photos BM100: 22-24

AMG Zone 50 388417, 6430653

Habitat: gentle, north-west facing slope of low rise (low dune).

Soil: brown siliceous sand.

Rock Type

Vegetation: *Eucalyptus gomphocephala* woodland over *Eucalyptus marginata* subsp. *marginata* low open woodland to low woodland over *Banksia attenuata*, (*Banksia grandis*) low open woodland over *Jacksonia furcellata* scattered tall shrubs over *Xanthorrhoea preissii* high open shrubland to high shrubland over *Macrozamia riedlei* and *Acacia pulchella* var. *glaberrima* open shrubland to shrubland over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* grassland with *Conostylis aculeata*, *Burchardia congesta* open herbland.

Assoc. species: *Caesia micrantha*, *Hardenbergia comptoniana*, *Dianella revoluta*, *Sowerbaea laxiflora*, *Hakea prostrata*.

Veg Condition: Poor to Good. (Poor to Very Poor in parts of surrounding area).

Fire Age: More than 5-6 years since fire.

Notes

Lot E26 Mears St, Kwinana Survey - Site KMR4

Described by BDM and BRM **Date** 21/09/06

Location: near south west corner of survey area.

Photos: BM100: 25-27

AMG Zone 50 388349, 6430731

Habitat: narrow, flat interdune area

Soil: yellow- brown siliceous sands

Rock Type

Vegetation: *Corymbia calophylla*, (*Eucalyptus marginata* subsp. *marginata*) woodland over *Banksia attenuata*, *Banksia grandis* low open woodland over *Jacksonia furcellata* high open shrubland to high shrubland (patches of high shrub) over *Macrozamia riedlei*, *Xanthorrhoea preissii* scattered shrubs over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* grassland with *Conostylis aculeata* open herbland.

Assoc. species: *Burchardia congesta*, *Sowerbaea laxiflora*, *Hardenbergia comptoniana*, *Desmocladius asper*, *Caesia micrantha*, *Hibbertia racemosa*, *Luzula meridionalis*, *Pterostylis sanguinea*, *Caladenia flava* subsp. *flava*.

Veg Condition (MET): Poor

Fire Age: More than 5 to 7 years since fire.

Notes

Lot E26 Mears St, Kwinana Survey - Site KMR5

Described by BRM **Date** 21/09/06

Location: near south-east corner

Photos

AMG Zone 50 388208, 6430839

Habitat: gentle south-west facing lower slope of low dune.

Soil: yellow- brown coarse siliceous sand.

Rock Type

Vegetation: *Eucalyptus gomphocephala* scattered trees over *Eucalyptus marginata*



subsp. *marginata* low woodland over *Banksia attenuata*, (*B. grandis*) low open woodland to low woodland over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei* open shrubland over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina* closed grassland.

Assoc. species: *Gompholobium tomentosum*, *Acacia saligna*, *Sowerbaea laxiflora*, *Burchardia congesta*, *Conostylis aculeata*, *Kennedia prostrata*.

Veg Condition (MET): Poor to Very Poor (very weedy: grassland to closed grassland of weeds).

Fire Age: More than 5 to 6 years since fire.

Notes: Similar to vegetation unit KM1? This unit (KMR5) varies to KMR5a: *Eucalyptus marginata* subsp. *marginata* low woodland over *Banksia grandis* scattered low trees to low open woodland over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei* scattered shrubs over *Acacia pulchella* var. *glaberrima* scattered low shrubs over *Schoenus grandiflorus*, *Desmocladius asper* scattered sedges with **Ehrharta calycina* closed grassland.

Lot E26 Mears St, Kwinana Survey - Site KMR6

Described by BRM **Date** 21/09/06

Location:

Photos BM100: 28-29

AMG Zone 50 388281, 6430887

Habitat: gentle, south-facing mid slope of lower dune

Soil: yellow coarse siliceous sand

Rock Type

Vegetation: *Grevillea vestita* subsp. *vestita* heath over *Desmocladius asper* scattered sedges and *Conostylis aculeata* scattered herbs with **Ehrharta calycina* grassland.

Assoc. species: *Leucopogon propinquus*, *Sowerbaea laxiflora*, *Dryandra lindleyana* subsp. *lindleyana*, *Lomandra maritima*, *Dianella revoluta* var. *divaricata*.

Veg Condition (MET): Very Poor (regrowth???) ? Unsure of level of disturbance and original vegetation - old burnt stumps in area (past clearing) and adjacent cleared areas are presently perennial veldt grass closed grassland.

Fire Age:

Notes:

Lot E26 Mears St, Kwinana Survey - Site KMR7

Described by BRM **Date** 21/09/06

Location: North-east corner of survey area.

Photos: BM100: 30

AMG Zone 50 388554, 6431406

Habitat: very gentle, north-facing slope of low flat interdunal area.

Soil: yellow- brown siliceous sand

Rock Type

Vegetation: *Corymbia calophylla*, (*Eucalyptus marginata* subsp. *marginata*) woodland over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei* (*Acacia pulchella* var. *glaberrima*) scattered shrubs to open shrubland over **Ehrharta calycina*, **Eragrostis curvula* grassland.

Assoc. species: *Pimelea rosea* subsp. *rosea*, *Hardenbergia comptoniana*, *Caesia micrantha*, *Caladenia latifolia*, **Euphorbia terracina*, *Sowerbaea laxiflora*.



Veg Condition (MET): Poor to Very Poor.

Fire Age:

Notes:

Lot E26 Mears St, Kwinana Survey - Site KMR8

Described by BRM **Date** 21/09/06

Location: central

Photos: BM100: 202-203

AMG Zone 50 388284, 6431161

Habitat: gentle, west facing upper slope of low dune.

Soil: yellow-orange siliceous sand.

Rock Type: some exposed limestone (less than 5% soil surface cover).

Vegetation: *Eucalyptus gomphocephala* scattered trees over *Dryandra sessilis* var. *cygnorum* high shrubland to open scrub over *Jacksonia furcellata* scattered tall shrubs over *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina* grassland with *Conostylis aculeata* very open herbland.

Assoc. species: *Hakea prostrata*, *Allocasuarina humilis*, *Burchardia congesta*, *Lomandra caespitosa*, *Acacia pulchella* var. *glaberrima*, *Kennedia prostrata*.

Veg Condition: (MET) Poor.

Fire Age: more than 7 years since fire.

Notes: at 388314E, 6431149N vegetation varies to: *Eucalyptus gomphocephala* scattered trees over *Allocasuarina fraseriana* low open woodland over *Dryandra sessilis* var. *cygnorum*, *Jacksonia furcellata* scattered tall shrubs over *Acacia pulchella* var. *glaberrima*, *Grevillea vestita* subsp. *vestita* low open shrubland over *Desmocladius asper* very open sedgeland and *Opercularia vaginata*, *Scaevola canescens* herbland.

Lot E26 Mears St, Kwinana Survey - Site KMR9

Described by BRM **Date** 08/10/06

Location: north-west corner

Photos

AMG Zone 50 388159, 6431451

Habitat: very gentle, north-west-facing slope of very low rise.

Soil: yellow siliceous sand

Rock Type

Vegetation: *Eucalyptus marginata* subsp. *marginata*, *Allocasuarina fraseriana* low woodland over *Banksia attenuata*, *B. grandis* scattered low trees to low open woodland over *Jacksonia furcellata* scattered tall shrubs over *Acacia pulchella* var. *glaberrima*, *Macrozamia riedlei* scattered shrubs to open shrubland over **Ehrharta calycina* closed grassland with **Trifolium campestre*, **Lupinus* sp. very open herbland.

Assoc. species: *Burchardia congesta*, *Hardenbergia comptoniana*, *Gompholobium tomentosum*, *Conostylis aculeata*.

Veg Condition: (MET) Poor to Very Poor (**Ehrharta calycina*, **Trifolium campestre*, blue lupin closed grassland/herbland of weeds). Probably native herbs missing. Also a very open area, indicating past disturbance.

Fire Age: More than 5 years since last fire.

Notes

Lot E26 Mears St, Kwinana Survey - Site KMR10

Described by BRM **Date** 08/10/06



Location: Central

Photos

AMG Zone 50 388284, 6431107

Habitat: gentle, west-facing upper slope and crest of low ridge (dune).

Soil: yellow- orange siliceous sand

Rock Type

Vegetation: (*Eucalyptus gomphocephala* scattered trees over *Allocasuarina fraseriana* low open woodland over *Banksia attenuata* low woodland over *Jacksonia furcellata*, *Dryandra sessilis* var. *cygnorum* scattered tall shrubs over *Macrozamia riedlei* scattered shrubs over *Acacia pulchella* var. *glaberrima*, *Pimelea rosea* subsp. *rosea*, *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina* grassland and *Conostylis aculeata*, **Trifolium campestre* very open herbland.

Assoc. species: *Hovea trisperma*, *Stylidium striatum*, *Podolepis gracilis*, *Podolepis lessonii*.

Veg Condition (MET): Poor (closed grassland of **Ehrharta calycina*) and herbs etc missing.

Fire Age:

Notes: at 388270E, 6431217N, vegetation varies to (KMR10a):

(*Allocasuarina fraseriana* low open woodland) over *Banksia attenuata* low open woodland over *Dryandra sessilis*, *Hakea prostrata*, *Jacksonia furcellata* scattered tall shrubs over *Acacia pulchella* var. *glaberrima* scattered shrubs over *Hibbertia racemosa* scattered low shrubs to low open shrubland over **Ehrharta calycina* grassland and *Conostylis aculeata*, *Tricoryne elatior*, *Brachyscome iberidifolia* very open herbland. Poor to Very Poor (Completely Degraded in parts): signs of past disturbance.

Lot E26 Mears St, Kwinana Survey - Site KMR11

Described by BRM **Date** 08/10/06

Location: north end

Photos

AMG Zone 50 388259, 6431390

Habitat: very gentle, south-facing interdunal slope.

Soil:

Rock Type

Vegetation: *Eucalyptus marginata* subsp. *marginata* low open forest over *Banksia grandis*, *Banksia attenuata* scattered low trees over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei*, *Acacia pulchella* var. *glaberrima* scattered shrubs to open shrubland over *Gompholobium tomentosum*, *Hibbertia hypericoides*, *Bossiaea eriocarpa*, *Gastrolobium capitatum* scattered low shrubs to low open shrubland over *Lepidosperma squamatum* scattered sedges and **Ehrharta calycina*, **Briza maxima* very open grassland with *Conostylis aculeata*, **Trifolium campestre* var. *campestre* very open herbland.

Assoc. species: *Petrophile linearis*, *Dryandra lindleyana* var. *lindleyana*, *Burchardia congesta*, *Hardenbergia comptoniana*, *Stylidium schoenoides*, *Drosera porrecta*, *Thysanotus manglesianus*.

Veg Condition (MET): Poor (very weedy).

Fire Age: More than 5 years since fire.

Notes

ATTACHMENT 2D

Parmelia Avenue, Parmelia

Spring 2009

Flora and Vegetation

Survey

May 2010

Prepared for:
Satterley Property Group and
Department of Housing

Document Reference	Revision	Prepared by	Reviewed by	Submitted to Client Copies	Date
819 AC	A: Internal Draft	BM, SB	TC	-	-
819 AC	B: Client Draft	BM, SB, KP	TC	Electronic (email)	8 April 2010
819 AC	C: Client FINAL	BM, SB, KP	TC	Hard copy, CD copy	11 May 2010

Disclaimer

This report has been prepared for the sole use and benefit of Satterley Property Group on behalf of Department of Housing (the "Clients"). This report is issued in accordance with, and is subject to, the terms of the contract between the Clients and 360 Environmental Pty Ltd, including, without limitation, the agreed scope of the report. To the extent permitted by law, 360 Environmental Pty Ltd shall not be liable in contract, tort (including, without limitation, negligence) or otherwise for any use of, or reliance on, this report by any person or organisation other than the Clients. 360 Environmental Pty Ltd considers the contents of this report to be current as at the date it was produced. This report, including each opinion, conclusion and recommendation it contains, should be considered in the context of the report as a whole. The opinions, conclusions and recommendations in this report are limited by its agreed scope. More extensive, or different, investigation, sampling and testing may have produced different results and therefore different opinions, conclusions and recommendations. Subject to the terms of the contract between the Clients and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating this report, or any part of it, is prohibited (except to the extent required by law) without the prior written consent of 360 Environmental Pty Ltd.

© Copyright 2010 360 Environmental Pty Ltd ACN 109 499 041



Executive Summary

A flora and vegetation survey within Lot 9001 Parmelia Avenue, Parmelia was conducted in spring 2009, covering an area of approximately 42 hectares. Findings of the 2009 survey were as follows:

- One hundred and twenty-five native species of flowering plants and one native cycad were recorded in the survey area. Fifty-three non-native species were also recorded.
- The species richness is low, with an average of 41.7 species per quadrat.
- No Declared Rare Flora or Priority Flora were recorded in the survey area. *Stylidium ireneae* (Priority 4) had been previously recorded in the north-eastern corner of the survey area, however, it was not recorded in the 2009 survey.
- The vegetation included a total of 10 vegetation units within the broader categories of :
 - *Eucalyptus gomphocephala* (Tuart) woodlands on the crest and upper slopes
 - *Eucalyptus gomphocephala* (Tuart) mixed woodlands on the upper slopes
 - *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri) woodland on the mid slopes
 - *Eucalyptus marginata* (Jarrah) - *Banksia* spp. woodland on the mid slopes
 - *Corymbia calophylla* woodland on the lower slopes
 - *Dryandra sessilis* scrub on the upper slopes.
- The vegetation in the Parmelia survey area bushland was considered to be mostly in 'Good' condition or 'Good to Degraded' condition.
- The weed *Ehrharta calycina* (perennial veld grass) formed a grassland in most parts of the survey area.
- Many Jarrah trees appear to be in poor health, believed to be caused by damage by the larvae of leafminer (*Perthida glyphopa*).
- A small number of *Banksia* spp. deaths were recorded in the survey area, possibly indicating the presence of the dieback fungus *Phytophthora cinnamomi*. A Dieback survey by accredited 'dieback interpreters' would be required to confirm if Dieback (caused by *Phytophthora* spp.) was present.
- *Lomandra maritima* and *Lomandra hermaphrodita* plants were recorded in the survey area. These plants are important habitat for the Graceful Sun Moth which is a protected species under the *Environment Protection and Biodiversity Conservation Act 1999* which may be present on the site.
- A PATN analysis of the Parmelia quadrat data showed that the sites displayed affinity with a number of floristic communities, but principally Floristic Community Type 21a and 28 (FCT21a and FCT28).



- PATN analysis of one site (PQ1) also showed affinity with Floristic Community Type 25 (FCT 25). FCT25 is a Priority Ecological Community (PEC) Priority 3.
- The Parmelia survey area is also along what is described as mostly contiguous bushland corridor that runs north-south and joins with another regionally significant corridor at Rockingham. The Parmelia site links the Bush Forever site 67 to this corridor.
- The Parmelia survey area was assessed as regionally significant for flora and vegetation on the following grounds:
 - Representation of ecological communities (less than 10% of Karrakatta Central and South Complex in the Perth Metropolitan Area is protected (DEC, 2000b)); and
 - maintaining ecological linkages (part of contiguous or largely contiguous Rockingham linkage corridors (DEC, 2000b).



Table of Contents

1	Introduction	1
1.1	Background.....	1
1.2	Purpose of the survey.....	1
1.3	The Survey Area.....	1
2	Site Description and Background Information	2
2.1	Climate.....	2
2.2	Geomorphology.....	2
2.3	Botanical Information.....	2
3	Methodology	5
3.1	Flora Survey.....	5
3.2	Vegetation Survey.....	6
3.3	Vegetation Mapping.....	7
3.4	Floristic Community Types and PATN Analysis of Vegetation Units.....	7
3.5	Identification of Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs).....	9
3.6	Flora and Vegetation and Regional Significance.....	9
4	Flora	10
4.1	Flora List for the Survey Area.....	10
4.2	Declared Rare Flora (DRF).....	10
4.3	Priority Flora Species.....	10
4.4	Other Species of Conservation Significance.....	11
5	Vegetation	12
5.1	Vegetation Description.....	12
5.2	Vegetation of the Parmelia Survey Area.....	12
5.3	Vegetation Condition and Weeds.....	16
5.4	<i>Lomandra</i> spp. Occurrence: Host Plants of the Graceful Sun Moth.....	17
6	Floristic Analysis	19
6.1	Data Compatability.....	19
6.2	Determination of Floristic Community Types (FCT) by Classification.....	19
6.3	Determination of Floristic Community Types (FCT) Using Nearest Neighbours Method.....	19
6.4	Combining the Results: Assignment of Floristic Community Types (FCT) to the Parmelia Quadrat Sites.....	19
6.5	Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs).....	20
7	Regional Significance Assessment	21
8	Conclusion and Recommendations	22
9	Acknowledgements	24
10	References	25
11	Limitations	27

List of Tables



Table 1	Declared Rare and Priority Flora previously recorded within a 10 km radius of the Parmelia survey area (from DEC DEFL and WAHERB database searches, Sept 2009).
Table 2	Abbreviations for species names that were used in vegetation unit codes.
Table 3	Summary of Parmelia PATN Analysis results.
Table 4	Summary of Floristic Community Types occurring in the Parmelia survey area.
Table 5	Summary of Parmelia survey area vegetation units and FCTs.
Table 6	Regional Significance Assessment: Parmelia Avenue, Parmelia.

List of Plates

Plate 1	Vegetation unit EgDs at site PR9.
Plate 2	Vegetation unit CcEg at releve site PR1.
Plate 3	Vegetation unit CcEg at quadrat PQ1.
Plate 4	Vegetation unit EmCcBa at quadrat PQ5.
Plate 5	Vegetation unit EmCcBm at quadrat PQ6.
Plate 6	Vegetation unit EmAfBa at quadrat PQ2.
Plate 7	Vegetation unit CcEmBa at releve site PR8.
Plate 8	Vegetation unit DsJf recorded at releve PR3.
Plate 9	A closed grassland of perennial veldt grass, <i>Ehrharta calycina</i> , at releve site PR10.
Plate 10	Part of the old quarry area. Regrowth and remnant <i>Eucalyptus gomphocephala</i> (Tuart) trees are common in the area.
Plate 11	The old quarry area has been used for recreation (trail bike riding and 4WD driving). Some rubbish dumping has occurred in the area.
Plate 12	This leaf damage is thought to be caused by Jarrah leafminer (<i>Perthida glyphopa</i>). The leaf damage was extensive in the survey area, resulting in the browned appearance of the Jarrah (<i>Eucalyptus marginata</i>) tree crowns.
Plate 13	The browned crowns of Jarrah trees (<i>Eucalyptus marginata</i>) in the Parmelia survey area, caused by Jarrah leafminer.



List of Figures

- Figure 1 Location of the 2009 Parmelia survey area.
- Figure 2 The Parmelia survey area and SCP vegetation complexes (adapted from Heddle et al., 1980).
- Figure 3 Locations of rare flora and TEC/PECs previously recorded in the Parmelia site locality.
- Figure 4 Vegetation units in the Parmelia survey area
- Figure 5 Vegetation condition map for the Parmelia survey area
- Figure 6 Locations of *Lomandra spp.*

List of Appendices

- Appendix 1 The Department of Environment and Conservation Declared Rare Flora and Priority Categories (from Atkins 2006).
- Appendix 2 Vegetation Structural Table of Trudgen Based on Aplin's (1979) Modification of Specht's Classification.
- Appendix 3 Vegetation Condition Scale and Descriptions.
- Appendix 4 "FCT Analysis Parmelia Sites" by Ted Griffin.
- Appendix 5 Flora List for the Parmelia Survey Area.
- Appendix 6 Releve Descriptions and Species Lists for Parmelia Ave, Parmelia.
- Appendix 7 Quadrat Descriptions and Species List for the Parmelia Survey Area.
- Appendix 8 *Lomandra maritima* and *Lomandra hermaphrodita* locations recorded opportunistically during the Parmelia survey
- Appendix 9 Figures
- Appendix 10 Plates



1 Introduction

1.1 Background

360 Environmental Ltd Pty was commissioned by Department of Housing to undertake a flora and vegetation survey of remnant vegetation within Lot 9001 Parmelia Avenue, Parmelia (Figure 1). The Spring survey was undertaken between the 22 September and 3 November 2009.

1.2 Purpose of the survey

The purpose of the survey was to list the flora and describe and map the vegetation and its condition in the survey area. The survey also aimed to assess the flora and vegetation values in accordance with the Environmental Protection Authority's (2004) *Guidance for the assessment of Environmental Factors – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (No 51)*.

1.3 The Survey Area

The survey area is located at Pt Lot 9001 Parmelia Avenue, Parmelia and is bounded by Parmelia Avenue (in parts), St Vincent's Primary School and Bush Forever Site 67 on the west side, Challenger Avenue to the north, the Perth to Mandurah rail line and Bollard Bullrush Swampto to the east and Tuart and Wellard Roads on the southern side (Figure 1).

The survey area was approximately 49 hectares in size.



2 Site Description and Background Information

2.1 Climate

The Swan Coastal Plain, which includes the survey area, has a Mediterranean type climate with hot, dry summers and mild, wet winters. The mean annual rainfall for the survey area locality (Medina Research Station, 4 kilometres north-west of the survey area) is 780 mm (Bureau of Meteorology [BOM] 2010). Over 75% of this falls between May and September. The mean daily maximum temperatures range from 18.2 °C in July to 31.2 °C in February (BOM, 2010).

2.2 Geomorphology

The Swan Coastal Plain consists of a series of geomorphological elements which are sub parallel to the present coastline (McArthur and Bettenay, 1960; Churchward and McArthur, 1980). Each of these geomorphic elements has distinctive geology, vegetation, topography and soils.

The Parmelia survey area lies in one of these elements, the Spearwood Dune System (McArthur and Bettenay, 1960). The Spearwood Dune System is the middle of three main aeolian deposits on the Swan Coastal Plain that can be arranged in age sequence. The Spearwood Dune System consists of a core of limestone overlain by yellow sand (Churchward and McArthur, 1980). There has been differential wind erosion that has produced two distinctly different landscapes that have been recognised as two units within the Spearwood Dune System, the Cottesloe and Karrakatta units. The Cottesloe unit, on the western side, consists of yellow brown sands and exposed limestone. The Karrakatta unit, on the eastern side, has deep yellow brown sands. The Parmelia survey area lies in a narrow section of the Karrakatta unit, with the Cottesloe unit just to the west and the Herdsman unit and Bassendean Dune System just to the east (Churchward and McArthur, 1980).

2.3 Botanical Information

2.3.1 Vegetation

Beard (1980) defined boundaries for botanical provinces, districts and subdistricts for Western Australia on the basis of his vegetation mapping of the State. In this framework, the survey area lies in the Drummond Botanical Subdistrict (more or less equivalent to the Swan Coastal Plain and part of the Dandaragan Plateau) of the Darling Botanical District of the South Western Botanical Province of Western Australia.



Heddle *et al* (1980) mapped the vegetation of part of the Drummond Botanical Sub district at a broad scale, describing a series of vegetation complexes. These are related groups of vegetation associations found on particular landform-soil units (geomorphic elements, see above). They mapped a total of 38 vegetation complexes on the Swan Coastal Plain. The Parmelia survey area is located in a narrow section of the Karrakatta Complex - Central and South (Figure 2). This complex is predominantly open forest of *Eucalyptus gomphocephala* (Tuart) – *Eucalyptus marginata* (Jarrah) – *Corymbia calophylla* (Marri) and woodlands of Jarrah – *Banksia* spp. (Heddle *et al.*, 1980).

The Heddle *et al.* (1980) map of vegetation complexes on the Swan Coastal Plain shows the eastern part of the survey area lying within the mapped Herdsman Complex (wetland) (Figure 2). This classification of the survey area is incorrect, as only the disturbed north-eastern and south eastern corners of the survey area might have been in the Herdsman Complex. It is likely that, in this case, the interpreted Herdsman Complex boundary locations are in error. The bushland section of the survey area ranged from dune crest and upper slope to lower slope (all dryland).

Adjacent to the Herdsman Complex on the eastern side of the Parmelia survey area is Bassendean Complex - Central and South and to the west of the survey area is Cottesloe - Central and South Complex (Figure 2).

More recently, an alternative analysis of the plant assemblages on the Swan Coastal Plain south of Gingin Brook was carried out using a floristic approach (Gibson *et al.*, 1994) and was extended in 2000. This work identified 66 floristic community types in four floristic 'Super Groups' for the southern Swan Coastal Plain. These units are defined at a similar level of synthesis to that of Heddle *et al.* (1980) (Trudgen, 1999). The four 'super groups' of sites correlate closely with the major geomorphological elements on the Swan Coastal Plain (and also to rainfall), with the exception of one group which contained the seasonal wetlands, which includes sites across all geomorphological groups (Gibson *et al.*, 1994).

2.3.2 Ecological Communities

The Department of Conservation and Land Management has developed a procedure for identifying 'Threatened Ecological Communities' (Department of Environmental Protection 2000b; English and Blythe 1997). Threatened Ecological Communities (TECs) are assigned to one of four categories: 'Presumed Totally Destroyed'; 'Critically Endangered'; 'Endangered' or 'Vulnerable' (Department of Environmental Protection, 2000b).

On the Swan Coastal Plain, 25 potential Threatened Ecological Communities, delineated by a number of floristic and other studies, have been confirmed for threatened ecological community status. Of these, 24 have been confirmed as 'threatened' (Department of Environmental Protection 2000b). 16 of these Threatened



Ecological Communities are Floristic Community Types as identified by Gibson *et al.* (1994).

Priority Ecological Communities (PECs) include 'possible threatened ecological communities that do not meet survey criteria or are not adequately defined' (Department of Environment and Conservation [DEC], unpublished). These are added to the DEC's PECs list under Priorities 1, 2 and 3. Priority 4 status is given to "Ecological Communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. Conservation dependent ecological communities are placed in Priority 5 (DEC, unpublished). The list of PECs (DEC, unpublished) includes some that are Floristic Community Types (FCT's) as identified by Gibson *et al.* (1994).

A search of the DEC's TEC and PEC database found that there were a number of TECs and PECs recorded within a 5 km radius of the survey area (Figure 3):

- TEC SCP26a (Endangered): '*Melaleuca huegelii* *Melaleuca acerosa* (currently *M. systena*) shrublands on limestone ridges (Gibson *et al.* 1994 type 26a)';
- TEC SCP19b (Critically Endangered): 'Sedgeland in Holocene dune swales on the southern Swan Coastal Plain'.
- PEC SCP25 (Priority 3): 'Southern Swan Coastal Plain *Eucalyptus gomphocephala* - *Agonis flexuosa* woodlands (type 25)';
- PEC SCP21c (Priority 3): 'Low lying *Banksia attenuata* woodlands or shrublands (type 21c)';
- PEC SCP22 (Priority 3): '*Banksia ilicifolia* woodlands, southern Swan Coastal Plain type 22'.

PEC SCP25 has been inferred for the vegetation in Bush Forever Site 67, west of the survey area's north-west corner (Figures 1 and 3).

2.3.3 Rare Flora

A search of DEC's Threatened Flora database and DEC's Declared Rare and Priority Flora list, found that 21 DRF and Priority species have been previously recorded within a 10 km radius of the survey area (Figure 3; Table 1).



3 Methodology

3.1 Flora Survey

3.1.1 General Survey Methods

The Parmelia flora survey was conducted between 22 September and 3 November, 2009.

The flora in the study area was surveyed by recording the vegetation in the study area, walking between the vegetation recording sites, mapping of the vegetation and conducting general flora searches.

All plant species present were recorded at each of the quadrats sampled (sites PQ1 to PQ6, see Figure 4). At releve and mapping note sampling sites, dominant and subdominant species and some associated species were recorded. In the case of both quadrats and releves, where a plant species was not well known, a specimen was collected and allocated a specimen number.

Plant species were recorded elsewhere in the study area if they had not been recorded at the quadrat or releve sampling sites or if they were of particular interest. Again, where a plant species was not well known, a specimen was collected and allocated a specimen number. GPS coordinates were recorded (using a Magellan Meridian hand held GPS unit) whenever it was considered there was a possibility that the plant species may be of special interest.

The specimens collected were pressed, dried and identified. The identifications were made by comparison to specimens in the reference and research collections of the Western Australian Herbarium, by the use of keys in various papers and books and by relevant experts on various groups of flora that occur on the Swan Coastal Plain.

The DEC Declared Rare and Priority Flora List (Atkins 2006; definitions in Appendix 1) was consulted as required to confirm the status of plant species in the survey area.

3.1.2 Limitations

The major limitation of the flora survey is that any such survey is a sampling procedure of a variable environment with plant populations of variable growth habit, life span and flowering season. Some species, including annuals, are only available for collection for part of the year. This means that to locate all species that grow in an area is a substantial task, the success of which is related to the time available and the size and diversity of habitat in the survey. Consequently, it is possible that there are species present in the survey area that were not recorded during this survey as they have only low abundance on the land, or were not flowering at the time of the survey. However,



this limitation was minimised by conducting this survey during Spring when most annual species were present and in some stage of flowering.

Given the limitations of the flora survey, it is likely that this survey recorded more than 85 to 90% of the vascular flora in the survey area. That is, while the flora survey was relatively thorough, it was possible that some species occurring in the survey area were not recorded.

3.2 Vegetation Survey

3.2.1 Methods

After a brief examination of the vegetation in the survey area, locations were selected for survey quadrats and relevés that were representative of observed variations in the vegetation and habitat. Suitable sites for the more detailed quadrats were limited because of the high weed cover in the survey area.

Six 10 m x 10 m quadrats (PQ1 to PQ6, see Figure 4) were marked out with a field measuring tape between short star pickets which were pushed into the ground to within 15 cm of the surface at each of the quadrat corners. A yellow plastic safety cap was pushed onto the top of each star picket. The 10 m by 10 m quadrat dimensions were used firstly because a 100m² sample area on the Swan Coastal Plain is considered to capture most species in a given plant community and secondly because that was the quadrat size used to collect data for the Gibson *et al.* (1994) Swan Coastal Plain study, with which the Parmelia survey data set needed to be compatible for the purpose of analysis.

Each quadrat was photographed. A description of the quadrat location, the habitat, surface soil texture and colour were all recorded and the time since the site was last burnt was estimated. The vegetation structure was described using a modification of Specht's vegetation description table by Aplin (1979; Appendix 2). To obtain more representative data for the overstorey cover, the tree layer(s) cover was estimated over a larger area around the quadrats. The condition of vegetation in the quadrat was described using the Trudgen (1988) vegetation condition classification, but the vegetation condition was later converted to the Keighery classification outlined in Bush Forever (Department of Environmental Protection, 2000B; Appendix 3). All plant species occurring in a quadrat were recorded, along with their height, percentage cover and specimen number if collected.

Twelve relevés were recorded to also describe vegetation units. The relevé descriptions were similar to those of the quadrats, but the area described was 'open' (not a measured 10 m x 10 m space) and not all plant species in the relevé area were recorded, but rather the dominant, subdominant and some associated species were recorded. Mapping notes are an abbreviated form of relevés descriptions.



3.2.2 Limitations

There is a limit to the accuracy of the assignment of the different strata in the vegetation descriptions to structural units (for example, low open woodland, low woodland, low open forest, open shrubland, shrubland). Referral of a stratum to a structural category depends on assessment of its cover. Such estimation is imprecise and it is not unusual for different observers to give quite different estimates of the cover of a species, or stratum in a stand. However, descriptive exercises such as that carried out for this report require only a moderate level of accuracy.

The cover estimate of each plant species recorded in the quadrats was based on estimating species projected canopy cover. The assumption was made that for most species, canopy cover and projected foliar cover are reasonably similar, or that the difference is less than the level of accuracy of the estimates.

3.3 Vegetation Mapping

3.3.1 Methods

Vegetation units were recorded generally between plant community and plant association level. The vegetation unit boundaries were drawn on a computer generated aerial photograph while traversing the study area, using GPS coordinate readings to locate actual boundary positions. Orthorectified aerial photography at 1:5000 was used for the survey area.

The vegetation mapping unit descriptions were based on the quadrat, releve and mapping note descriptions.

3.4 Floristic Community Types and PATN Analysis of Vegetation Units

3.4.1 Introduction

The floristic analysis compared the similarity of species presence/absence data collected at the six Parmelia quadrats with the data for 509 sites recorded across the Swan Coastal Plain by Gibson *et al.* (1994).

3.4.2 Data Storage and Handling

The Parmelia vegetation quadrat data was entered into a specially designed computer database developed by E. A. Griffin and M. Trudgen using Microsoft Access.



3.4.3 Data Preparation and Compatibility

To conduct the analysis on the Parmelia quadrat data and the Gibson *et al.* (1994) dataset, it was first necessary to reconcile the names of the flora species. This step was necessary because of changes in the nomenclature over the last ten years and the potential for survey specific variations in the application of names. The reconciliation involved reducing some infra-specific names to the relevant species name, combining some taxa where confusion is known to have occurred in field observations and identifications and omitting some names (mostly where a taxon had only been identified to genus).

The Parmelia data was compatible with the Gibson *et al.* (1994) data. Both datasets were based on data collected from quadrats of the same size (10 m by 10 m). However, the Gibson *et al.* (1994) quadrats were visited and recorded twice, including a Spring visit, compared to the single Spring recording for the Parmelia sites. Weed species were included in both the Gibson *et al.* (1994) and Parmelia datasets.

3.4.4 PATN Analysis

Mr Ted Griffin conducted the Parmelia quadrat PATN analysis.

Following the reconciliation of species names between the Parmelia survey and the Gibson *et al.* (1994) Swan Coastal Plain survey, the PATN analysis was conducted on the combined datasets. This analysis grouped the Parmelia survey sites with the most floristically similar sites from the combined dataset. Each of the Parmelia sites could then be allocated the Gibson *et al.* Floristic Community Type (FCT) of the most similar sites from the Gibson *et al.* dataset.

The methods of the PATN analysis are set out in more detail in a report prepared by Mr Ted Griffin that is included in full in Appendix 4.

3.4.5 Limitations of the Floristic Analysis

It has been found in other floristic analysis that the addition of new sites to the Gibson *et al.* (1994) data set to produce a combined classification may disrupt the original classification of sites (Griffin and Trudgen, 2004). The more data that is added, the higher the level of disruption. If this occurs it can make it difficult to assign the new sites to the Floristic Community Types of Gibson *et al.* (Griffin and Trudgen, 2004).

Another limitation in conducting a PATN floristic analysis using the above methods may arise depending on the degree of success in reconciling the two data sets. A further limitation may arise from any significant differences in data collection methods between the two surveys. However, this is unlikely to have occurred in this case, as the collection methods were similar between the two surveys.



3.5 Identification of Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs).

Once the Parmelia quadrats were each assigned to a Floristic Community Type, a table of Floristic Community Types on the Swan Coastal Plain and their TEC status (Department of Environmental Protection, 2000b) was consulted to determine if any of the Parmelia vegetation sites were TECs. No new TECs have been assessed for the western part of the Swan Coastal Plain (which includes the survey area) since the publication of Bush Forever Vol 2 (B.J. Keighery, *pers. comm.*).

To determine if any of the Parmelia FCT's were PEC's, a list of PEC's (DEC unpublished) was consulted.

3.6 Flora and Vegetation and Regional Significance

Regional significance of the Parmelia flora and vegetation was assessed against the criteria for the determination of regional significance of natural areas set out in Guidance Statement No. 10 (EPA, 2006).



4 Flora

4.1 Flora List for the Survey Area

One hundred and twenty-five species of native flowering plants and one native cycad (the *Zamia Palm*, *Macrozamia riedlei*) were recorded in the Parmelia survey area. In addition, 53 non-native species were recorded from the survey area. Species recorded at the Parmelia site are shown in Appendix 5. The list of non-native species is comprehensive, but not exhaustive for the survey area.

Of the native flowering plants recorded in the Parmelia survey, 55 were monocotyledons and 70 were dicotyledons.

The monocotyledon families that were well represented by native species in the survey area were the *Cyperaceae* with ten native species, the *Anthericaceae* with ten native species, the *Dasyopogonaceae* with nine native species and the *Orchidaceae* with seven native species.

The dicotyledon families that were well represented by native species in the survey area were the *Proteaceae* (Banksia family, eleven native species) and the *Papilionaceae* (pea family, ten native species).

The number of native species recorded in the Parmelia survey is probably a low to moderate number for the vegetation type and the size of the survey area (49 ha). The species richness of quadrats was low, with an average of 41.7 species (including weeds) across the six quadrats. This compares with the average quadrat numbers from the Gibson *et al.* (1984) survey of 54.6 (FCT21a), 52.8 (FCT25) and 55.2 (FCT28).

4.2 Declared Rare Flora (DRF)

No Declared Rare Flora were recorded in the Parmelia survey area.

4.3 Priority Flora Species

No Priority flora were recorded in the Parmelia survey area.

Stylidium ireneae (Priority 4) had been previously recorded in the north-eastern corner of the survey area (DEC records, Table 1). An intensive search was carried out at the given location coordinate. A road, verge lawn, sump and railway cutting now occupy the specified location. There is no remnant vegetation at this location. A search for *Stylidium ireneae* was made in the bushland adjacent to and nearest the target location, but it was not recorded.



4.4 Other Species of Conservation Significance

No other regionally significant species or other species of significance were recorded in the Parmelia survey area.



5 Vegetation

5.1 Vegetation Description

The vegetation units described are considered to be mostly described at the vegetation association level.

The vegetation unit codes that discriminate the mapped vegetation units are derived from the generic and species names of the more abundant genera or species in the different strata present in each unit (Table 2). For example, the vegetation unit 'EmAfBa' has its code derived from three of the dominant species in that unit: 'Em' (*Eucalyptus marginata*), 'Af' (*Allocasuarina fraseriana*) and 'Ba' (*Banksia attenuata*).

5.2 Vegetation of the Parmelia Survey Area

The Parmelia survey area vegetation included (Figure 4):

- *Eucalyptus gomphocephala* (Tuart) woodlands on the crest and upper slopes
- *Eucalyptus gomphocephala* (Tuart) mixed woodlands on the upper slopes
- *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri) woodland on the mid slopes
- *Eucalyptus marginata* (Jarrah) - *Banksia* spp. woodland on the mid slopes
- *Corymbia calophylla* (Marri) woodland on the lower slopes
- *Dryandra sessilis* scrub on upper slopes.

A total of 11 vegetation units were described in the Parmelia survey area within these broader groupings (Figure 4). Vegetation units are described in detail in Section 5.2.1 (below):

5.2.1 Vegetation Units

5.2.1.1 *Eucalyptus gomphocephala* (Tuart) woodlands

Vegetation Unit EgDs

Eucalyptus gomphocephala (Tuart) woodland over *Banksia sessilis* var. *cygnorum*, *Jacksonia furcellata*, *Hakea prostrata* high open shrubland to high shrubland over *Grevillea vestita*, *Acacia pulchella* var. *glaberrima* open shrubland over **Ehrharta calycina*, **Euphorbia terracina*, *Conostylis candicans* subsp. *candicans*, **Lupinus cosentinii* closed grassland/herbland.

Habitat and Soil: Gentle to moderate, west-facing upper slope of broad, high dune. Yellow sand. Some limestone.

Notes: This vegetation unit was recorded at releves PR9 and PR4 and mapping note



MN3 (see descriptions in Appendices 5 and 6; Plate 1).

5.2.1.2 *Eucalyptus gomphocephala* (Tuart) mixed woodlands

Vegetation Unit CcEg

Eucalyptus gomphocephala (Tuart) scattered tall trees over *Corymbia calophylla* (Marri) open woodland over *Allocasuarina fraseriana*, *Banksia grandis* scattered low trees over *Jacksonia furcellata* high open shrubland over *Acacia pulchella* var. *glaberrima* open shrubland over *Macrozamia riedlei* scattered shrubs over **Ehrharta calycina* grassland and **Lupin cosentinii*, **Euphorbia terracina* open herbland.

Habitat and Soil: Upper slope and crest of dune. Yellow sand.

Notes: This vegetation was recorded at quadrat PQ1 and releve PR1 in the northern part of the survey area (see descriptions in Appendices 5 and 6, Plates 2 and 3).

Vegetation Unit EgCcBg

Eucalyptus gomphocephala (Tuart) open woodland over *Allocasuarina fraseriana*, *Corymbia calophylla* (patches) open woodland over *Banksia grandis* scattered low trees over *Jacksonia furcellata* scattered tall shrubs to high open shrubland over *Acacia pulchella* var. *glaberrima*, *Macrozamia riedlei* open shrubland over **Ehrharta calycina*, **Briza maxima* closed grassland with *Conostylis aculeata* subsp. *aculeata* very open herbland.

Habitat and Soil: Very gentle, east facing upper slope of broad dune. Yellow sand. Limestone seen within approx 50 m.

Notes: This vegetation was recorded at releve PR10 in the north-west corner of the survey area (see descriptions in Appendix 6).

Vegetation Unit EgEmBa

Eucalyptus gomphocephala (Tuart) scattered trees over *Eucalyptus marginata* subsp. *marginata* (Jarrah) woodland over *Banksia grandis*, *Banksia attenuata* low open woodland over *Jacksonia furcellata* scattered tall shrubs to high open shrubland over *Acacia pulchella* var. *glaberrima*, *Macrozamia riedlei* open shrubland over **Ehrharta calycina* closed grassland and **Lupin cosentinii*, **Euphorbia terracina* open herbland.

Habitat and Soil: Upper slope of broad, high dune. Pale yellow-brown sand over yellow sand.

Notes: This vegetation was recorded at releve site PR2 (see description in Appendix 6).



5.2.1.3 *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri) – *Banksia* spp. woodlands

Vegetation Unit EmCcBa

Eucalyptus marginata subsp. *marginata* (Jarrah), *Corymbia calophylla* (Marri) open woodland over *Banksia attenuata*, *Banksia grandis* low open woodland over *Macrozamia riedlei*, *Acacia pulchella* var. *glaberrima* open shrubland over *Pimelea rosea*, *Gompholobium tomentosum* low open shrubland over *Desmocladus flexuosus*, *Lepidosperma pubisquameum* very open sedgeland and **Ehrharta calycina*, **Briza maxima* grassland.

Habitat and Soil: Very gentle, south-facing upper slope to crest of broad, high dune. Yellow-brown sand over yellow sand.

Notes: This vegetation was recorded at site PQ5 (see descriptions in Appendix 7); Plate 4).

Vegetation Unit EmCcBm

Eucalyptus marginata subsp. *marginata* (Jarrah), *Corymbia calophylla* (Marri) woodland over *Banksia attenuata*, *Banksia menziesii*, *Banksia grandis* low open woodland to low woodland (much of it regrowth (?after fire)) over *Jacksonia sternbergiana* scattered tall shrubs over *Acacia pulchella* var. *glaberrima* open shrubland over *Leucopogon propinquus* scattered low shrubs over *Tetraria octandra*, open sedgeland and **Ehrharta calycina*, (**Briza maxima*) grassland with *Conostylis aculeata* subsp. *aculeata* very open herbland.

Habitat and Soil: Gentle, south to south-east facing slope of broad dune. Grey sand over yellow sand.

Notes: This vegetation was recorded at quadrat PQ6 and releve site PR6 (see descriptions in Appendices 5 and 6; Plate 5).

5.2.1.4 *Eucalyptus marginata* (Jarrah) - *Banksia* spp. woodland

Vegetation Unit EmAfBa

Eucalyptus marginata subsp. *marginata* (Jarrah), *Allocasuarina fraseriana* low woodland over *Banksia attenuata* low open woodland to low woodland over *Acacia pulchella* var. *glaberrima* open shrubland to shrubland over *Gompholobium tomentosum*, *Petrophile linearis* low open woodland over *Lepidosperma pubisquameum*, *Luzula meridionalis*, *Desmocladus flexuosus* scattered sedges and **Ehrharta calycina* grassland with *Conostylis aculeata* subsp. *aculeata* very open herbland.



Habitat and Soil: Gentle to moderate, south-east facing mid to lower slope of broad dune. White sand over yellow sand.

Notes: This vegetation was recorded at quadrat PQ2 and mapping note site PMN1 (see descriptions in Appendices 5 and 6; Plate 6).

Vegetation Unit EmBa

Eucalyptus marginata subsp. *marginata* (Jarrah) open woodland over *Banksia attenuata* (*Banksia menziesii*, *Banksia grandis*) low woodland over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei*, *Acacia pulchella* var. *glaberrima* open shrubland over *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina* open to closed grassland.

Habitat and Soil: Moderate, east-facing mid slope of dune. Pale yellow sand over yellow sand.

Notes: This vegetation was recorded at releve site PR12 (see descriptions in Appendix 6).

5.2.1.5 *Corymbia calophylla* (Marri) woodland

Vegetation Unit CcBg

Corymbia calophylla (Marri), (*Eucalyptus marginata* subsp. *marginata* (Jarrah)) open forest over *Banksia grandis* scattered low trees over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei*, *Acacia pulchella* var. *glaberrima* open shrubland over *Pimelea rosea*, *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina*, **Lagurus ovatus*, **Briza maxima* closed grassland.

Habitat and Soil: Gentle to moderate, east facing lower slope of broad high dune. Grey sand over yellow sand.

Notes: This vegetation was recorded at releve site PR11 (see descriptions in Appendix 6).

Vegetation Unit CcEmBa

Corymbia calophylla (Marri), *Eucalyptus marginata* subsp. *marginata* (Jarrah) open forest over *Banksia attenuata*, *Banksia grandis* scattered low trees over *Macrozamia riedlei* scattered shrubs over **Ehrharta calycina*, **Briza maxima* grassland

Habitat and Soil: Moderate, east-facing mid to lower slope of high dune. Yellow sand.

Notes: This vegetation was recorded at releve site PR8 (see descriptions in Appendix 6; Plate 7).



5.2.1.6 *Dryandra sessilis* scrub

Vegetation Unit DsJf

(Regrowth after fire) *Banksia sessilis* var. *cygnorum*, *Jacksonia furcellata* open to closed scrub over *Acacia pulchella* var. *glaberrima*, *Olearia axillaris*, *Macrozamia riedlei* open shrubland over **Ehrharta calycina* closed grassland.

Habitat and Soil: Upper slope to crest of high broad dune. Yellow sand.

Notes: A small area of this vegetation was recorded at releve site PR3 (see descriptions in Appendix 6; Plate 8).

5.3 Vegetation Condition and Weeds

5.3.1 Vegetation Condition

The vegetation in the Parmelia survey area bushland was considered to be mostly in 'Good' condition or 'Good to Degraded' condition (Figure 5; Appendix 3 for vegetation condition classification). The weed **Ehrharta calycina* (perennial veld grass) formed a grassland in most parts of the survey area (Plate 9). The structure of the native vegetation had been significantly impacted with loss of species from the herb and low shrub strata. This impact on structure was considered to be less on the lower slopes where more native species survived. The impact on the native vegetation structure by **Ehrharta calycina* is considered, at present, to be largely reverseable if a weed treatment program was undertaken, as it is thought that most of the original species remain in the survey area. The 'Good to Degraded' description in Figure 5 indicates that the vegetation varies in condition between Good and Degraded.

Cleared areas around the Mandurah-Perth railway line corridor were Completely Degraded. A former limestone quarry covered a large area in the central-southern part of the survey area (Figure 4). The old quarry area included large cleared and excavated areas, widespread remnant or regrowth *Eucalyptus gomphocephala* (Tuart) trees and small patches of regrowth vegetation or remnant vegetation (mostly 'Degraded', some 'Good' condition) (Plates 10 and 11).

There was an unusually high density of rabbit burrows in the survey area and this level of rabbit activity would also have impacted on the condition of the vegetation.

5.3.2 Weed Occurrences

A total of 53 weed species were recorded in the Parmelia survey area. *Ehrharta calycina* (perennial veld grass) was the most significant weed in the area. **Briza maxima* (blowfly grass) also occurred widely throughout the area, but is a less aggressive



weed. **Bromus diandrus*, **Euphorbia terracina* and **Lupinus* spp. were other common weeds in the survey area.

Other notable weed species that occurred at a small number of locations in the survey area were **Eragrostis curvula* (love grass), **Zantedeschia aethiopica* (arum lily), **Acacia iteaphylla* (Flinders Range wattle), **Acacia longifolia* (Sydney Golden wattle) and **Watsonia* sp.

5.3.3 Jarrah Health and Leafminer

It was noted that the crowns of many of the jarrah trees in the survey area were brown and the trees appeared to be in poor health. Closer inspection of the crowns showed the leaves to be browned by what appeared to be intensive leafminer damage (Plates 12 and 13). Jarrah leafminer is a moth, *Perthida glyphopa* (Department of Agriculture and Food (DAF) 2010). The larvae emerge from eggs laid on the lower-surface of the leaves and feed from late May to September on the leaves. The larvae feed between the leaf surfaces and produce rust to brown coloured blotch mines. Severe infestations occur commonly along forest edges, in clearings and on partly cleared farmland (DAF 2010). Jarrah is the main host tree. To confirm the presence of Leafminer in the survey area, leaf specimens would be required to be diagnosed by the DEC or DAF.

A similarly intense infestation of Jarrah leafminer occurred in nearby bushland on Meares Avenue, Kwinana (360 Environmental, 2006).

5.3.4 Dieback (*Phytophthora* sp.)

Only a few locations of a small number of *Banksia* spp. deaths were recorded in the survey area.

The deaths and decline of *Banksia* trees may indicate the presence of the Dieback fungus *Phytophthora cinnamomi*. However, other agents such as fire and drought (including falling water tables), as well as other pathogens, may also be responsible for the *Banksia* tree deaths. To determine if Dieback is present, a dieback survey by accredited 'dieback interpreters' would be required.

5.4 *Lomandra* spp. Occurrence: Host Plants of the Graceful Sun Moth

The Graceful Sun Moth (*Synemon gratiosa*, Family *Castniidae*) is endemic to Western Australia, and is currently considered restricted to the Swan Coastal Plain between the Wanneroo area in northern Perth, south to Mandurah (approximately 60 km south of Perth). The Graceful Sun Moth is listed as under the *Environment Protection and Biodiversity Conservation Act 1999* and is also currently listed on Schedule 1 (fauna



that is rare or is likely to become extinct) of the Western Australian *Wildlife Conservation Act 1950*.

The Graceful Sun Moth is thought to breed exclusively on *Lomandra spp.*, probably *L. hermaphrodita*. Two known food plants for the Graceful Sun Moth are *Lomandra hermaphrodita* and *L. maritima* (Department of the Environment, Water, Heritage and the Arts, 2010).

Both *Lomandra maritima* and *Lomandra hermaphrodita* plants were recorded opportunistically in the Parmelia surey area (Figure 6; Appendix 8). Only six *Lomandra maritima* plants were recorded at three main locations. *Lomandra hermaphrodita* was recorded at nine locations and was considered to be sparsely scattered over the site.



6 Floristic Analysis

This section outlines the results of the floristic analysis conducted by Mr Ted Griffin using the 2009 Parmelia survey data and the Gibson *et al.* (1994) data. It is based on a detailed report prepared by Mr Ted Griffin, Appendix 4.

6.1 Data Comparability

A limitation of the PATN analysis was the condition of the vegetation sampled at the Parmelia survey area, with the high weed cover and loss of structure reflected in the lower species counts for the quadrats. However, Mr Ted Griffin assessed that the Parmelia sites appeared to have similar numbers of species from groups such as Orchids to those of the Gibson *et al.* (1994) sites. Overall though, Griffin (2010) concluded that the Parmelia data set may have comparability limitations which may affect the analysis results (Appendix 4).

6.2 Determination of Floristic Community Types (FCT) by Classification

The results of the PATN analysis classification are shown in the dendrogram in Appendix 4. This shows that the Parmelia sites combined with a portion of the Gibson *et al.* FCT21a sites but also joined with a portion of FCT28 sites.

6.3 Determination of Floristic Community Types (FCT) Using Nearest Neighbours Method

Griffin found that the nearest neighbour analysis suggested that the Parmelia sites belong to a number of floristic communities, but principally FCT28 and FCT21a (see Appendix 4).

6.4 Combining the Results: Assignment of Floristic Community Types (FCT) to the Parmelia Quadrat Sites

Griffin's summary of the analysis results is shown in Table 3 (reproduced from Griffin's report, see Appendix 4).

In interpreting the PATN analysis results Griffin noted that "It is common for the classification '(dendrogram)' to indicate a simple result and the nearest neighbour analysis to be less conclusive. This is more a product of the classification process often suggesting an over simplified view than of inconsistency of the analyses" (see Appendix 4). Griffin (*pers. comm.*) has previously noted that the nearest neighbour analysis is more easily interpreted and reliable than the classification analysis and has



given more weight to the nearest neighbour analysis assignment of vegetation sites to FCT's.

The Parmelia sites were found to have affinity with a number of Floristic Community Types, particularly FCT's 21a and 28, and also 25 which are summarised in Table 4.

6.5 Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs)

6.5.1 Assessment of Parmelia Ecological Communities

The results of the PATN analysis indicated that the Parmelia site's Floristic Community Types showed affinity with FCT21a and FCT28, both of which are not considered TECs or PECs. The PATN analysis nearest neighbour method also showed that one quadrat location, PQ1, showed affinity with FCT21a, 28 and FCT25. FCT25 is a PEC Priority 3 (Table 4).

The Parmelia quadrats covered a range of the vegetation units recorded at the Parmelia survey area. However, at the time of the field work it was considered that locations suitable for quadrats and vegetation analysis (sites where the vegetation condition was adequate for reliable analysis) were very limited. Consequently a quadrat wasn't located in the Tuart mapped units EgDs, EgCcBg and EgEmBa and the small, disturbed scrub unit DsJf. Table 5 relates the quadrat FCT's to the mapped vegetation units. Some inferred FCT's have been included.

6.5.2 TECs and PECs Previously Recorded in the Locality

PEC SCP25 (Priority 3) was inferred in Bush Forever site 67 near the north-west corner of the Parmelia survey area (Figure 3).



7 Regional Significance Assessment

Flora and vegetation values in the survey area were assessed for regional significance (Table 6) using the criteria for determination of regional significance of natural areas set out in Bush Forever (DEC, 2000a) and the EPA Guidance Statement No. 10 (EPA, 2006).

The Parmelia survey area was assessed as regionally significant for flora and vegetation on the following grounds (Table 6):

- Representation of ecological communities (less than 10% of Karrakatta Central and South Complex in the Perth Metropolitan Area is protected (DEC, 2000b)); and
- maintaining ecological linkages (part of contiguous or largely contiguous Rockingham linkage corridors (DEC, 2000b).

The vegetation at the Parmelia survey area is Karrakatta Central and South Complex, of which 18% of its original extent in the Perth Metropolitan Area (PMA) remains, but only 5.6% of its original extent in the PMA has some existing protection (DEC, 2000b). DEC has a modified objective for Constrained Areas (which includes the Swan Coastal Plain portion of the Perth Metropolitan Region) being to seek to:

- retain at least 10% of the pre-clearing extent of the ecological community where >10% of the ecological community remains, or
- retain all remaining areas of each ecological community where <10% of this ecological community remains. (EPA, 2006)

The Parmelia survey area is located along what is described as a 'mostly contiguous bushland corridor' that runs north-south and joins with another regionally significant corridor at Rockingham. The Parmelia site links the Bush Forever site 67 to this corridor.



8 Conclusion and Recommendations

Findings of the 2009 survey were as follows:

- One hundred and twenty-five native species of flowering plants and one native cycad were recorded in the survey area. Fifty-three non-native species were also recorded.
- The species richness is low, with an average of 41.7 species per quadrat.
- No Declared Rare Flora or Priority Flora were recorded in the survey area. *Stylidium ireneae* (Priority 4) had been previously recorded in the north-eastern corner of the survey area, however, it was not recorded in the 2009 survey.
- The vegetation included a total of 10 vegetation units within the broader categories of :
 - *Eucalyptus gomphocephala* (Tuart) woodlands on the crest and upper slopes;
 - *Eucalyptus gomphocephala* (Tuart) mixed woodlands on the upper slopes;
 - *Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri) woodland on the mid slopes;
 - *Eucalyptus marginata* (Jarrah) - *Banksia* spp. woodland on the mid slopes;
 - *Corymbia calophylla* (Marri) woodland on the lower slopes; and
 - *Dryandra sessilis* scrub on the upper slopes.
- The vegetation in the Parmelia survey area bushland was considered to be mostly in 'Good' condition or 'Good to Degraded' condition.
- The weed *Ehrharta calycina* (perennial veld grass) formed a grassland in most parts of the survey area.
- Many Jarrah trees appear to be in poor health, believed to be caused by damage by the larvae of leafminer (*Perthida glyphopa*).
- A small number of *Banksia* spp. deaths were recorded in the survey area, possibly indicating the presence of the dieback fungus *Phytophthora cinnamomi*. A Dieback survey by accredited 'dieback interpreters' would be required to confirm if Dieback (caused by *Phytophthora* spp.) was present.
- *Lomandra maritima* and *Lomandra hermaphrodita* plants were recorded in the survey area. These plants are important habitat for the Graceful Sun Moth which is a protected species under the *Environment Protection and Biodiversity Conservation Act 1999* which may be present on the site.
- A PATN analysis of the Parmelia quadrat data showed that the sites displayed affinity with a number of floristic communities, but principally Floristic Community Type 21a and 28 (FCT21a and FCT28).
- PATN analysis of one site (PQ1) also showed affinity with Floristic Community Type 25 (FCT 25). FCT25 is a Priority Ecological Community (PEC) Priority 3.



- The Parmelia survey area is also along what is described as mostly contiguous bushland corridor that runs north-south and joins with another regionally significant corridor at Rockingham. The Parmelia site links the Bush Forever site 67 to this corridor.
- The Parmelia survey area was assessed as regionally significant for flora and vegetation on the following grounds:
 - Representation of ecological communities (less than 10% of Karrakatta Central and South Complex in the Perth Metropolitan Area is protected (DEC, 2000b)); and
 - maintaining ecological linkages (part of contiguous or largely contiguous Rockingham linkage corridors (DEC, 2000b).



9 Acknowledgements

Plant identifications were undertaken by Brian Morgan and Cate Tauss. Andrew Brown identified the orchid specimens.

Mr Ted Griffin ran the PATN analysis and gave advice on the interpretation of the results. His report is included in full in Appendix 4.



10 References

360 Environmental PL, 2006. *Flora and vegetation survey of Lot E26 Meares Ave, Kwinana*. (Unpublished report.).

Aplin, T.E.H., 1979. 'The Flora' In: *Environment and Science*, B.J. O'Brien (ed.). University of WA Press, Perth.

Atkins, K.J., 2006. *Declared Rare and Priority Flora List for Western Australia*. Department of Conservation and Land Management, Woodvale.

Beard, J. S., 1980. *A new phytogeographic map of Western Australia*. Western Australian Herbarium Research Notes 3, 37-58.

Bureau of Meteorology, 2010. *Bureau of Meteorology - Medina Weather Observations 1982 – 2009*, Australian Government. Accessed February 2010, from <http://www.bom.gov.au/>

Churchwood, H. M. and McArthur, W. M., 1980. *Landforms and soils of the Darling System, Western Australia*. In *Atlas of Natural Resources Darling System Western Australia*. Dept of Conservation and Environment. University of Western Australia Press.

Department of Agriculture and Food (DAF), 2010. *Jarrah Leafminer* *Perthida glyphopa*. Government of Western Australia. Accessed 01 March 2010, from http://agspsrv34.agric.wa.gov.au/ento/pestweb/Query1_1.idc?ID=-520630506

Department of Environmental Protection, 2000a. *Bush Forever Vol. 1 Policies, Principals and Processes*. Dept of Environmental Protection, Perth.

Department of Environmental Protection, 2000b. *Bush Forever Vol. 2 Directory of Bush Forever Sites*. Dept of Environmental Protection, Perth.

Department of the Environment, Water, Heritage and the Arts, 2010. *Synemon gratiosa — Graceful Sun Moth*. Australian Government. Accessed 01 March 2010, from http://www.environment.gov.au/cgi-bin/sprat/public/publicspecies.pl?taxon_id=66757

English, V., and Blyth, J., 1997. *Identifying and conserving threatened ecological communities (TECs) in the South West Botanical Province*. ANCA National Reserves System Cooperative Program: Project Number N702, Australian National Conservation Agency, Canberra.

Environmental Protection Authority, 2004. *Guidance for the Assessment of Environmental Factors (in accordance with the Environmental Protection Act 1986)*.



Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia No. 51. June 2004. Western Australia.

Environmental Protection Authority, 2006. *Guidance for the Assessment of Environmental Factors Western Australia (in accordance with the Environmental Protection Act 1986). Level of Assessment for Proposals Affecting Natural Areas Within the System 6 Region and Swan Coastal Plain Portion of the System 1 Region.* No. 10. June 2006.

Gibson, N., Keighery, B.J., Keighery, G.J., Burbidge, A.H., and Lyons, M.N., 1994. *A Floristic Survey of the Southern Swan Coastal Plain.* Unpublished report for the Australian Heritage Commission prepared by the Department of Conservation and Land Management and the Conservation Council of Western Australia (Inc).

Griffin, T. and Trudgen, M., 2004. *Floristic analysis of quadrat data from remnant native vegetation at Pearce RAAF Airbase.* (Unpublished report prepared for Ecoscape (Australia) Pty Ltd).

Hedde, E.M., Loneragan, O.W., and Havel, J.J., 1980. *Vegetation complexes of the Darling System, Western Australia.* In: Atlas of Natural Resources, Darling System Western Australia., M.J. Mulcahy (ed.) pp37-76 and accompanying map. Department of Conservation and Environment, Perth.

McArthur, W. M. and Bettenay, E., 1960. *The development and distribution of the soils of the Swan Coastal Plain, Western Australia.* Soil Publication No. 16. CSIRO. Melbourne.

Trudgen, M. E., 1988. *A report on the Flora and Vegetation of the Port Kennedy Area.* Unpublished report prepared for Bowman Bishaw and Associates, West Perth.

Trudgen, M., 1999. *A flora and vegetation survey of Lots 46 and 47 Maralla Road and Lexia Avenue, Ellenbrook.* Unpublished report prepared by M.E.Trudgen and Associates for The Crown Solicitors Office, Government of Western Australia. Associates for The Crown Solicitors Office, Government of Western Australia.



1 1 Limitations

This report is produced strictly in accordance with the scope of services set out in the contract or otherwise agreed in accordance with the contract. 360 Environmental Pty Ltd (360 Environmental) makes no representations or warranties in relation to the nature and quality of soil and water other than the visual observation and analytical data in this report.

In the preparation of this report, 360 Environmental has relied upon documents, information, data and analyses ("client's information") provided by the client and other individuals and entities. In most cases where client's information has been relied upon, such reliance has been indicated in this report. Unless expressly set out in this report, 360 Environmental has not verified that the client's information is accurate, exhaustive or current and the validity and accuracy of any aspect of the report including, or based upon, any part of the client's information is contingent upon the accuracy, exhaustiveness and currency of the client's information. 360 Environmental shall not be liable to the client or any other person in connection with any invalid or inaccurate aspect of this report where that invalidity or inaccuracy arose because the client's information was not accurate, exhaustive and current or arose because of any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to 360 Environmental.

Aspects of this report, including the opinions, conclusions and recommendations it contains, are based on the results of the investigation, sampling and testing set out in the contract and otherwise in accordance with normal practices and standards. The investigation, sampling and testing are designed to produce results that represent a reasonable interpretation of the general conditions of the site that is the subject of this report. However, due to the characteristics of the site, including natural variations in site conditions, the results of the investigation, sampling and testing may not accurately represent the actual state of the whole site at all points.

It is important to recognise that site conditions, including the extent and concentration of contaminants, can change with time. This is particularly relevant if this report, including the data, opinions, conclusions and recommendations it contains, are to be used a considerable time after it was prepared. In these circumstances, further investigation of the site may be necessary. It should further be recognised that potential future impacts on site environmental conditions relating to global warming are beyond the scope of this investigation. Potential impacts may include, but are not limited to, changes in weather patterns that result in flooding or drought, subsequent changes in soil conditions, distribution of flora and fauna, altered vector impacts and increased fire hazards. Further investigation of the site in relation to these factors may be required.

This report has been prepared for the sole use and benefit of Satterley Property Group and the Department of Housing.



Any reliance placed on the whole or any part of this report by any person or organisation other than Satterley Property Group and the Department of Housing shall be at the sole risk of that person or organisation.

Subject to the terms of the contract between Satterley Property Group on behalf of the Department of Housing and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating this report, or any part of it, is prohibited (except to the extent required by law) without the prior written consent of 360 Environmental Pty Ltd.



TABLES

Table 1. Declared Rare and Priority Flora previously recorded within a 10 km radius of the Parmelia survey area (from DEC DEFL and WAHERB database searches, Sept 2009).

Taxon	Status ^a
<i>Caladenia huegelii</i>	R
<i>Diuris micrantha</i>	R
<i>Diuris purdiei</i>	R
<i>Drakaea elastica</i>	R
<i>Verticordia plumosa</i> var. <i>ananeotes</i>	R
<i>Boronia juncea</i> subsp. <i>juncea</i>	P1
<i>Eremaea asterocarpa</i> subsp. <i>brachyclada</i>	P1
<i>Johnsonia pubescens</i> subsp. <i>cygnorum</i>	P2
<i>Aotus cordifolia</i>	P3
<i>Cyathochaeta teretifolia</i>	P3
<i>Dillwynia dillwynioides</i>	P3
<i>Jacksonia gracillima</i>	P3
<i>Stylidium longitubum</i>	P3
<i>Synaphea</i> sp. Serpentine (G.R. Brand 103)	P3
<i>Aponogeton hexatepalus</i>	P4
<i>Dodonaea hackettiana</i>	P4
<i>Eucalyptus rudis</i> subsp. <i>cratyantha</i>	P4
<i>Jacksonia sericea</i>	P4
<i>Parsonsia diaphanophleba</i>	P4
<i>Stylidium ireneae</i>	P4
<i>Verticordia lindleyi</i> subsp. <i>lindleyi</i>	P4

a. See Appendix 1 for Rare flora status classification definitions.

Table 2. Abbreviations for species names that were used in vegetation unit codes.

Code	Species Name
Af	<i>Allocasuarina fraseriana</i>
Ba	<i>Banksia attenuata</i>
Bg	<i>Banksia grandis</i>
Bm	<i>Banksia menziesii</i>
Bs	<i>Banksia sessilis</i> var. <i>cygnorum</i>
Cc	<i>Corymbia calophylla</i>
Eg	<i>Eucalyptus gomphocephala</i>
Em	<i>Eucalyptus marginata</i>
Jf	<i>Jacksonia furcellata</i>

Table 3. Summary of Parmelia PATN Analysis results. (Adapted from report by EA Griffin, see Appendix 4).

Site	Dendrogram FCT	NNB FCT	Summary FCT
PQ02	21a	21a	21a
PQ01	21a	28, 25, 21a	28, 25, 21a
PQ03	21a	28, 21a	28,21a
PQ05	21a	21a, 28	21a, 28
PQ04	21a	28	28
PQ06	21a	28, 21a	28, 21a

Table 4. Summary of Floristic Community Types occurring in the Parmelia survey area.

FCT	Generalised description	Predominant landform	Status
FCT21a	Central <i>B. attenuata</i> - <i>E. marginata</i> woodlands	Bassendean/Spearwood	
FCT25	Southern <i>E. gomphocephala</i> - <i>A. flexuosa</i> woodlands	Spearwood	PEC(3)
FCT28	Spearwood <i>B. attenuata</i> or <i>B. attenuata</i> - <i>Eucalyptus</i> woodlands	Spearwood	

Table 5. Summary of Parmelia survey area vegetation units and FCTs.

Mapped Vegtn unit	Broad classification	Site	FCT*
CcBg	<i>Corymbia calophylla</i> (Marri) woodland		21a *
CcEg	<i>E. gomphocephala</i> (Tuart) woodland and mixed <i>E. gomphocephala</i> woodlands	PQ1	28,25,21a
DsJf	<i>Dryandra sessilis</i> scrub	PR3	25? *
EgCcBg	<i>E. gomphocephala</i> (Tuart) woodland and mixed <i>E. gomphocephala</i> woodlands	PR10	25? *
EgDs	<i>E. gomphocephala</i> (Tuart) woodland and mixed <i>E. gomphocephala</i> woodlands	PR9	25? *
EgEmBa	<i>E. gomphocephala</i> (Tuart) woodland and mixed <i>E. gomphocephala</i> woodlands		28,21a *
EmAfBa	<i>Eucalyptus marginata</i> (Jarrah) - <i>Banksia</i> spp. woodland	PQ2, PQ3	21a, (28)
EmBa	<i>Eucalyptus marginata</i> (Jarrah) - <i>Banksia</i> spp. woodland	PQ4	28
EmCcBa	<i>Eucalyptus marginata</i> (Jarrah) - <i>Corymbia calophylla</i> (Marri) woodland	PQ5, PQ6	21a, 28
EmCcBm	<i>Eucalyptus marginata</i> (Jarrah) - <i>Corymbia calophylla</i> (Marri) woodland		21a *

* FCTs inferred

Table 6. Regional Significance Assessment: Parmelia Avenue, Parmelia

Criterion	Comment
(i) Representation of ecological communities	
Vegetation complexes	Bush Forever (SCP part of PMA): Karrakatta Central and South Complex: 18% of pre-1750 extent; 5.6% existing protection, 8% proposed BF protectn (DEC, 2000a). (System6+part System 1: Karrakatta C-S Complex: 29.5% of pre-1750 extent; 2.5% in reserve (EPA, 2006)).
Floristic community types	Three FCTs represented at Parmelia (FCTs 21a, 25, 28)
Size and shape	About 42 hectares in generally rectangular shape
Vegetation condition	Mostly Good or Good to Degraded (Bush Forever)
Conclusion	The Bush Forever (PMA) Karrakatta Central and South Complexes has less than 10% of original extent in reserve = Regionally Significant.
(ii) Diversity	
Vegetation Complexes	One Complex. Is near boundary of three other vegetation Complexes.
FCTs	Vegetation units mainly group with three FCT's.
Vegetation units	Ten vegetation units
Flora	126 native plant species recorded. Low to moderate number for size of area. Species richness: quadrats had low species richness (avge 41.7 spp. incl. weeds; impacted by high weed cover)
Conclusion	Moderate values for diversity
(iii) Rarity	
Flora	No DRF or Priority species. No other species of regional significance.
Vegetation :TECs	No TEC's present. Analysis showed some vegetation has affinity with PEC SCP25. Other tuart vegetation inferred as PEC25.
Conclusion:	Moderate values for rare vegetation.
(iv) Maintaining ecological processes	
Linkage	Part of contiguous or largely contiguous Rockingham corridors (Bush Forever, DEC 2000b). Regionally significant linkage values.
Protected areas	No
Creekline/river/estuary	No. One small seasonal dampland on north boundary. Upslope of Bollard Bullrush Swamp, but separated by rail corridor.
Conclusion:	Regionally significant for maintaining ecological linkages.
(v) Scientific or evolutionary importance	Moderate.
(vi) General criteria for protection	None
Summary:	Regionally significant for: <ul style="list-style-type: none"> ● representation of ecological communities and ● maintaining ecological linkages



APPENDICES



Appendix 1

The Department of Environment and Conservation Declared Rare Flora and Priority Categories (from Atkins, 2006)



The Department of Environment and Conservation Declared Rare Flora and Priority Flora Categories (from Atkins 2006)

Declared Rare Flora - Extant Taxa

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.

Declared Rare Flora - Presumed Extinct Flora

Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such.

Priority One - Poorly Known Taxa.

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, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

Priority Two - Poorly Known Taxa.

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 (ie. not currently endangered). Such taxa are under consideration for declaration as "rare flora", but are in urgent need of further survey.

Priority Three - Poorly Known Taxa.

Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. 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 study.



Priority Four - Rare Taxa.

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.



Appendix 2

Vegetation Structural Table of Trudgen Based on Aplins's (1979) Modification of Specht's Classification



Vegetation Structural Table of Trudgen based on Aplin's (1979) Modification of Specht's Classification

Life form and height of tallest stratum	Projective foliage cover of tallest stratum as %	Description
Trees over 30 metres	70 - 100	High closed forest
	30 - 70	High open forest
	10 - 30	high woodland
	2 - 10	high open woodland
	under 2	Scattered tall trees
Trees 10 - 30 metres	70 - 100	Closed forest
	30 - 70	Open forest
	10 - 30	Woodland
	2 - 10	Open woodland
	under 2	Scattered trees
Trees under 10 metres	70 - 100	Low closed forest
	30 - 70	Low open forest
	10 - 30	Low woodland
	2 - 10	Low open woodland
	under 2	Scattered low trees
Shrubs over 2 metres	70 - 100	Closed scrub
	30 - 70	Open scrub
	10 - 30	High shrubland
	2 - 10	High open shrubland
	under 2	Scattered tall shrubs
Shrubs 1 - 2 metres	70 - 100	Closed heath
	30 - 70	Open heath
	10 - 30	Shrubland
	2 - 10	Open shrubland
	under 2	Scattered shrubs
Shrubs under 1 metre	70 - 100	low closed heath
	30 - 70	low open heath
	10 - 30	low shrubland
	2 - 10	Low open shrubland



	under 2	Low scattered shrubs
Herbs/Sedges/Grasses	70 - 100	Closed herb, sedge, grassland
	30 - 70	Herb, sedge, grassland
	10 - 30	Open herb, sedge, grassland
	2 -10	Very open herb, sedge, g'land
	under 2	Scattered herbs sedges, grasses

Grasslands then divided into:

- Tussock grasslands (perennial tussock species, e.g. Eragrostis species);
- Hummock grasslands (Triodia and Plectrachne species that form hummocks)
- Curly spinifex grassland (Plectrachne pungens, which does not form hummocks) (follows J.S. Beard).
- Annual tussock grassland (e.g. annual Sorghum species).



Appendix 3

Vegetation Condition Scale and Description



Vegetation condition scale and descriptions

(from Keighery 1994, reproduced in Department of Environmental Protection 2000)

Pristine (1) : Pristine or nearly so, no obvious signs 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. 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 very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.

Degraded (5) : Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.

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.



Appendix 4

“FCT Analysis Parmelia Sites” by Ted Griffin

1.0 INTRODUCTION

1.1 Purpose of this report

The current report is intended to help clarify the assignment of Floristic Community type (FCT) designation to vegetation community (site) data. FCTs were defined by Gibson et al (1994) based on site data collected from vegetation on the Swan Coastal Plain. In particular, the potential that a Threatened Ecological Community (English and Blyth 1997) is represented by the data collected needs to be clarified.

1.2 Location of Binningup Sites

The sites were apparently from the Parmelia area.

1.3 Brief background to floristic analysis of vegetation on the Swan Coastal Plain

Floristic analysis (ie., analysis of variation in vegetation based on the species present, rather than description of structural variation and dominance) as a significant component of the understanding of the variation present in the native vegetation of the Swan Coastal Plain dates to Gibson *et al* (1994 – all references to the SCP survey in the current report refer to this publication), the first publication to document the floristics of the vegetation of a large part of the Swan Coastal Plain. While the SCP survey is based on a very significant amount of work, it must be viewed as a “first pass” survey, limited, in the context of the great variety of vegetation present in the very large area surveyed, by the relatively limited number (509) of sites (quadrats) it is based on. To a limited degree, this limitation has subsequently been addressed in an “update” to the work of the SCP survey (which describes additional units). However, there is no detailed publication of the results of this update available and the additional data used are not readily available in an appropriate form (ie., one that would enable ready comparison of new data to the overall data set).

The units described by the SCP survey are a series of “floristic community types”, a “unit” whose rank is defined by the use within a study. The SCP survey surveyed a very large survey area and defined a relatively small number of floristic community types. Consequently, the floristic community types they have described are of a very high order (see Trudgen 1999, volume 1, for further discussion of this point). This is an extremely important point to fully grasp in interpreting the analysis presented by the SCP survey and in understanding the meaning of analysis of other data sets when they are compared to the floristic community types of the SCP survey.

The important effects of the limited size data set used by the SCP survey and of the relatively small number of floristic community types defined by them, can be summarised by the following points:

1. the definition of all but two of the Threatened Ecological Communities for vegetation on the Swan Coastal Plain (English and Blyth 1997) has been based on the floristic community types of the SCP survey. It therefore follows, that with two exceptions, only vegetation units from one study that are different at a very high order of floristics are treated as rare by Government. No account is taken of other important differences, such as differences in structure and dominance;

2. for the definition of floristic community types to be robust, a sufficient sized database is needed to give adequate precision in their definition. About half of the floristics community types (or sub types) of the SCP survey are based on less than 10 sites. It is likely that with a larger data set there would be significant alteration in the classification of those floristic community types from the SCP survey based on small numbers of sites.
3. as noted above, many (if not most) of the floristic community types defined by the SCP survey are very broad. They contain very significant variation in floristics, structure and dominance. Some (or in more highly cleared parts of the Swan Coastal Plain much) of this variation may be rare by any reasonable definition, but it is currently “buried” within larger groups;
4. there is likely to be significant variation not sampled by the SCP survey. This includes some variation at a high level of floristic difference (see Trudgen 1999, volume 1, for an example of this) and undoubtedly quite significant (large!) amounts of variation at “medium” and “low” levels.
5. the document, and its use by Government, has focussed attention in the environmental impact assessment process on the high level of units described, deflecting attention from the layers of variation beneath these units that also have significant conservation value.

From these points it is obvious that there is a need for a major “upgrade” to the floristic analysis of the vegetation of the Swan Coastal Plain to provide a more detailed floristic classification that considers not only more of the variation present, but explicitly recognises more of the variation present in formally described units.

Obviously, such a reworking would have some effect on what vegetation is considered rare on the Swan Coastal Plain. It needs to be stressed that it would be very unlikely to find that any of the vegetation currently considered to be rare on the basis of the SCP survey’s classification was not rare. On the other hand, it is likely that such a review would very probably consider to be rare some vegetation which is not currently considered rare.

1.4 Data provided

It is very important in comparing different sets of floristic data that they are comparable in the application of names, in the intensity of the survey (ie., the effort of searching resulting in similar proportion of the flora at sites being recorded) and in the size of the site recorded. If the data from different data sets is not comparable in these ways, it reduces the clarity of the results of the analyses carried out. If the discrepancy in the comparability of the data sets is large, the results may become meaningless.

A brief observation suggest that these Parmelia sites appears to have similar number of species from groups such as Orchids.

2.0 METHODS

2.1 Data Preparation

The data from the Parmelia sites were provided into a standard MS Access based database designed for this type of data. One virtue of the database is that the species recorded at each site are stored against standard codes (numbers, those used by the Western Australian Herbarium) for each species. This facilitates ready comparison of data from different surveys stored in the same system.

After the data were incorporated into the database (containing the data from other projects), a process of reconciliation of flora species names with those used in the SCP survey was undertaken. This step was necessary at least because of changes in nomenclature over the last ten years and the potential of survey specific variations in the application of names. The reconciliation involved:

- reducing some infra-specific names to the relevant species name,
- combining some taxa where confusion is known to have occurred in field observations and identifications, and
- omitting some names (mostly, where a species had only been identified to genus).

The reconciliation process was relatively straight forward as most of the names had already been standardised. Most reconciliation was to conform with the methods that the SCP survey used to manage confusing taxa plus some nomenclatural changes (see Appendix).

2.2 Comparability of datasets

It was concluded that the datasets were probably not compatible to obtain reliable determinations.

2.3 Comparisons made

The data from the 6 sites plus the 509 sites from the SCP survey of the southern part of the Swan Coastal Plain (south of Gingin) were combined. This enabled various analyses to be performed.

The main purpose was intended to assign the individual sites to the Floristic Community Types (FCTs) defined in the SCP survey.

These data are provided in BM_Parmelia.mdb.)

2.4 Analyses carried out

The approach was the use of numerical classification techniques (PATN) based on the similarity of the floristic composition of the Parmelia sites to sites in the SCP survey data set.

2.4.1 PATN

Several modules of the numerical classification package PATN (Belbin 1987) were used for the analyses. The parameter values were the same as used by the SCP survey used to ensure consistency of analysis with that study.

The PATN modules used were ASO (calculation of similarity matrix), FUSE (classification based on the results of ASO), DEND (representation of classification) and NNB (determination of sites most similar to each site – nearest neighbours). The results of the analyses were imported into a database (BM_Eglington.mdb) so that site characteristics and previous classifications (eg., Floristic Community Types derived in earlier classifications) could be associated and various analyses based on these data could be performed.

The assignment of floristic community types to the Parmelia sites was made by summarising the results of two different methods:

- the classification, and
- the ten nearest neighbours.

Experience demonstrates that the results of these are likely to vary, but that from nearest neighbours is likely to make more sense.

To the classification dendrogram of the combined dataset the FCT assigned by the SCP survey was associated with the SCP survey sites. The apparent FCTs were assigned to the Parmelia sites by interpreting the position of these sites in the dendrogram (particularly by the way they joined to the SCP sites).

The 10 sites in the combined data set that were most similar to each of the Parmelia sites were obtained from the nearest neighbour method (NNB). By associating those nearest neighbours from the SCP survey, the most likely FCTs for each of the Parmelia sites were determined.

An attempt was then made to reconcile these different assignments of a Floristic Community Type.

3.0 LIMITATIONS

It has been found in earlier projects that the addition of new sites to the SCP survey data set to produce a combined classification disrupts the original classification. The more data added, the higher the level of the disruption. This problem can make it difficult to assign Floristic Community Types to new sites using this method.

Secondly, it is common for new data to group to their cohorts. In some cases this has proven to result from common deficiencies in the data, ie. whole groups of species missing. This absence tends to draw them together. The more sites in the added batch, the tighter they draw together.

The analyses are conducted without personal knowledge of the sites and no photographs were provided.

4.0 RESULTS

4.1 Determination of floristic community type by classification

The classifications suggested that the sites appeared to belong to one FCT, 21a (Figure 1). They combine with a portion of the SCP sites from 21a. Interestingly they join a portion of the sites from FCT 28.

Figure 1. Relevant portions of Dendrogram

site	FCT	sp	dendrogram
HARRY-5	21a	52	
WELL-2	21a	71	
PAGA-4	21a	53	
PAGA-7	21a	68	
PQ02		39	
TAM-1	21a	45	
WELL-1	21a	48	
PQ01		34	
PQ03		48	
PQ05		39	
PQ04		47	
PQ06		43	
KING-1	28	65	
KING-2	28	51	
SHENT-1	28	46	
TRIG-3	28	64	
WARI-1	28	76	
WARI-2	28	61	
TRIG-4	28	40	
NEER-3	28	45	
NEER-4	28	49	

Table 2 provides a summary of the “most likely” FCT for this classification.

4.2 Determination of floristic community type using Nearest Neighbour method

The nearest neighbour analysis suggests that the sites also belong to a number of communities but principally FCT 28 and 21a.

Table 1. Results of Nearest Neighbour analysis

s	s1	fct1	v1	s2	fct2	v2	s3	fct3	v3	s4	fct4	v4	s5	fct5	v5
PQ01	PQ03		0.425	PQ05		0.4857	PQ06		0.5342	TRIG-3	28	0.5833	NEER-3	28	0.5844
PQ02	PQ05		0.4133	TAM-1	21a	0.4146	PQ06		0.4359	WELL-1	21a	0.4588	PQ04		0.5
PQ03	PQ05		0.3953	PQ04		0.4066	PQ01		0.425	TRIG-3	28	0.5	PQ06		0.5056
PQ04	PQ03		0.4066	PQ05		0.4074	PQ06		0.5	PQ02		0.5	KING-2	28	0.5319
PQ05	PQ03		0.3953	PQ04		0.4074	PQ02		0.4133	PQ06		0.4684	CRAMPT-1	21a	0.4725
PQ06	PQ02		0.4359	PQ05		0.4684	PQ04		0.5	TRIG-3	28	0.5048	PQ03		0.5056

Table 1 (cont)

s	s6	fct6	v6	s7	fct7	v7	s8	fct8	v8	s9	fct9	v9	s10	fct10	v10
PQ01	C71-4	25	0.6	PQ04		0.6	CRAMPT-1	21a	0.6	rowe01	11	0.617	CRAMPT-2	21a	0.6211
PQ02	PQ03		0.5294	KERO-2	24	0.5443	WOODV-2	28	0.5663	WARI-2	28	0.5714	HARRY-5	21a	0.573
PQ03	SHENT-1	28	0.5106	WOODV-2	28	0.5106	PQ02		0.5294	CRAMPT-	21a	0.5446	TRIG-5	24	0.5484
PQ04	SHENT-1	28	0.5506	TRIG-3	28	0.5701	C71-3	21a	0.5758	WARI-2	28	0.5769	WELL-2	21a	0.5789
PQ05	PQ01		0.4857	WELL-1	21a	0.4884	SHENT-1	28	0.5	CRAMPT-	21a	0.505	TAM-1	21a	0.5181
PQ06	SHENT-1	28	0.5172	PQ01		0.5342	TAM-1	21a	0.5349	CRAMPT-	21a	0.5385	HARRY-5	21a	0.5484

s – the site being compared

s1 to s10 – the 1st to 10th most similar sites

f1 to f10 – the FCT of the similar sites (only for SCP sites)

v1 to v10 – the dissimilarity value between the site and the similar sites (values above 0.6 tend to indicate low similarity)

4.3 Combining the results

It is common for the classification to indicate a simple result and the nearest neighbour analysis to be less conclusive. This is more a product of the classification process often suggesting an over simplified view than of inconsistency of the analyses.

There appeared to be reasonable accord in that the classification (Figure 1) suggested a relationship with some of the FCT 28 sites as well as 21a.

Table 2 Summary of results

Site	Dendrogram FCT	NNB FCT	Summary FCT
PQ02	21a	21a	21a
PQ01	21a	28, 25, 21a	28, 25, 21a
PQ03	21a	28,21a	28,21a
PQ05	21a	21a, 28	21a, 28
PQ04	21a	28	28
PQ06	21a	28,21a	28,21a

4.0 REFERENCES

- Belbin, L. (1987) *PATN Reference Manual* (313p), *Users Guide* (79p), *Command Manual* (47p), and *Example Manual* (108p). CSIRO Division of Wildlife and Ecology, Lynham, ACT.
- English, V., and Blyth, J. (1997) *Identifying and conserving threatened ecological communities (TECs) in the South West Botanical Province*. ANCA National Reserves System Cooperative Program: Project Number N702, Australian National Conservation Agency, Canberra
- Gibson, N.G., Keighery, B.J., Keighery, G.J., Burbidge, A.H. and Lyons, M (1994). *A Floristic Survey of the Southern Swan Coastal Plain*. Unpublished report by the Department of Conservation and Land Management and the Conservation Council of Western Australia to the Australian Heritage Commission.
- Trudgen, M.E. (1999). *A flora and vegetation survey of Lots 46 and 47 Maralla Road and Lexia Avenue, Ellenbrook*. Volumes 1-4. Unpublished report prepared for the Crown Solicitors Office, Government of Western Australia. December 1999.

5.0 APPENDIX

Appendix 1 Species combinations made to assist in reconciling taxonomic changes and identification difficulties between this survey and SCP data.

	name	Lookup
008	<i>Pteris vittata</i>	<i>Pterostylis vittata</i>
031	<i>Aira caryophyllea</i>	<i>Aira caryophyllea/cupaniana</i> group
031	<i>Avena barbata</i>	<i>Avena barbata/fatua</i>
031	<i>Vulpia fasciculata</i>	omitted
032	<i>Lepidosperma pubisquameum</i>	<i>Lepidosperma angustatum/squamatum</i>
054C	<i>Lomandra</i> sp.	omitted
054F	<i>Chamaescilla corymbosa</i>	<i>Chamaescilla spiralis/corymbosa</i>
054F	<i>Thysanotus patersonii</i>	<i>Thysanotus patersonii/manglesianus</i>
054J	<i>Burchardia congesta</i>	<i>Burchardia umbellata/congesta</i>
055	<i>Conostylis aculeata</i> subsp. <i>aculeata</i>	<i>Conostylis aculeata</i>
055	<i>Haemodorum</i> sp.	omitted
060	<i>Gladiolus</i> sp.	<i>Gladiolus caryophyllaceus</i>
066	<i>Caladenia flava</i> subsp. <i>flava</i>	<i>Caladenia flava</i>
066	<i>Pterostylis vittata/sanguinea</i>	<i>Pterostylis vittata</i>
090	<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>	<i>Dryandra nivea</i>
090	<i>Banksia sessilis</i> var. <i>cygnorum</i>	<i>Dryandra sessilis</i>
106	<i>Ptilotus stirlingii</i> var. <i>stirlingii</i>	<i>Ptilotus stirlingii</i>
113	<i>Petrorhagia dubia</i>	<i>Petrorhagia velutina</i>
143	<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>	<i>Drosera erythrorhiza</i>
143	<i>Drosera pallida/menziesii</i>	<i>Drosera pallida</i>
149	<i>Crassula colorata</i> var. <i>acuminata</i>	<i>Crassula colorata</i>
163	<i>Acacia pulchella</i> var. <i>glaberrima</i>	<i>Acacia pulchella</i>
165	<i>Hovea trisperma</i>	<i>Hovea trisperma</i> var. <i>trisperma</i>
165	<i>Lupinus angustifolius</i>	omitted
165	<i>Lupinus cosentinii</i>	omitted
165	<i>Trifolium</i> sp.	omitted
185	<i>Monotaxis grandiflora</i> var. <i>grandiflora</i>	<i>Monotaxis grandiflora</i>
273	<i>Eucalyptus calophylla</i>	<i>Corymbia calophylla</i>
273	<i>Eucalyptus marginata</i> subsp. <i>marginata</i>	<i>Eucalyptus marginata</i>



Appendix 5

Flora List for the Parmelia Survey Area



Flora list for the Parmelia survey area

Notes:

1. The numbers in front of the plant families are the numbers for families used at the Western Australian Herbarium.
2. An asterisk (*) beside the taxon name indicates an introduced species exotic to Western Australia (weed).
3. ** beside the taxon name indicates a species native to Western Australia, but not native to the survey area.
4. The 'status' column shows the conservation status of significant flora species on the list. DRF = Declared Rare Flora; P1 to P5 = Priority 1 to Priority 5 (see definitions in Appendix 1); RS = other regionally significant flora

FAMILY/TAXA	COMMON NAMES	PRIORITY STATUS
-------------	--------------	-----------------

GYMNOSPERMAE

Class CYCADOPSIDA (Cycads)

016A ZAMIACEAE

Macrozamia riedlei

ANGIOSPERMAE (flowering plants)

Class LILIOPSIDA (Monocotyledons)

031 POACEAE

*Aira caryophyllea

Amhipogon turbinatus

Austrodanthonia occidentalis

Austrostipa flavescens

*Avena barbata

wild oats

*Briza maxima

blowfly grass

*Briza minor

*Bromus diandrus

*Cynodon dactylon

couch

*Ehrharta calycina

perennial veld grass

*Ehrharta longiflora

annual veld grass

*Eragrostis curvula

love grass

*Lagurus ovatus

*Lolium rigidum

rye grass

Poa porphyroclados

*Vulpia fasciculata

032 CYPERACEAE

Ficinia nodosa

*Isolepis marginata

Lepidosperma pubisquameum

Lepidosperma scabrum



FAMILY/TAXA	COMMON NAMES	PRIORITY STATUS
032 CYPERACEAE (continued)		
Lepidosperma squamatum		
Mesomelaena pseudostygia		
Schoenus clandestinus		
Schoenus grandiflorus		
Schoenus sp.		
Schoenus subfascicularis		
Tetraria octandra		
035 ARACEAE		
*Zantedeschia aethiopica	Arum lily	
039 RESTIONACEAE		
Desmocladius flexuosus		
Hypolaena exsulca		
Lyginia barbata		
040 CENTROLEPIDACEAE		
Centrolepis mutica		
052 JUNCACEAE		
Luzula meridionalis		
054C DASYPOGONACEAE		
Acanthocarpus preissii		
Calectasia narragara		
Dasypogon bromeliifolius		
Lomandra caespitosa		
Lomandra hermaphrodita		
Lomandra maritima		
Lomandra micrantha		
Lomandra preissii		
Lomandra suaveolens		
054D XANTHORRHOEACEAE		
Xanthorrhoea brunonis		
Xanthorrhoea preissii		
054E PHORMIACEAE		
Dianella revoluta var. divaricata		



FAMILY/TAXA	COMMON NAMES	PRIORITY STATUS
054F ANTHERICACEAE		
Caesia micrantha		
Chamaescilla corymbosa		
Corynotheca micrantha		
Dichopogon capillipes		
Laxmannia squarrosa		
Sowerbaea laxiflora		
Thysanotus arenarius		
Thysanotus patersonii		
Thysanotus sparteus		
Tricoryne elatior		
054G ASPHODELACEAE		
*Trachyandra divaricata	dune onion weed	
054J COLCHICACEAE		
Burchardia congesta		
055 HAEMODORACEAE		
Anigozanthos manglesii		
Conostylis aculeata subsp. aculeata		
Conostylis candicans subsp. candicans		
Haemodorum paniculatum		
Phlebocarya ciliata		
060 IRIDACEAE		
*Freesia alba x leichtlinii		
*Gladiolus ?angustus		
*Gladiolus caryophyllaceus		
Patersonia occidentalis		
*Romulea rosea	Guildford grass	
*Watsonia sp.		
066 ORCHIDACEAE		
Caladenia discoidea		
Caladenia flava subsp. flava	cowslip orchid	
Caladenia latifolia		
Diuris magnifica	donkey orchid	
Microtis media subsp. quadrata		
Pterostylis nana complex	snail orchid	
Pterostylis vittata		



FAMILY/TAXA	COMMON NAMES	PRIORITY STATUS
Class MAGNOLIOPSIDA (Dicotyledons)		
070 CASUARINACEAE		
Allocasuarina fraseriana		
087 MORACEAE		
*Ficus carica	edible fig	
090 PROTEACEAE		
Banksia attenuata		
Banksia dallaneyi var. dallaneyi	formerly Dryandra lindleyana	
Banksia grandis		
Banksia menziesii		
Banksia sessilis var. cygnorum	parrot bush; formerly Dryandra sessilis	
Grevillea vestita		
Hakea lissocarpha		
Hakea prostrata		
Persoonia saccata		
Petrophile linearis		
Synaphea spinulosa subsp. spinulosa		
105 CHENOPODIACEAE		
Rhagodia baccata subsp. baccata		
106 AMARANTHACEAE		
Ptilotus polystachyus		
Ptilotus sericostachyus subsp. sericostachyus		
Ptilotus stirlingii var. stirlingii		
110 AIZOACEAE		
*Carpobrotus edulis	pigface	
110A MOLLUGINACEAE		
Macarthuria australis		
113 CARYOPHYLLACEAE		
*Petrobhagia dubia		
119 RANUNCULACEAE		
Clematis linearifolia		



FAMILY/TAXA	COMMON NAMES	PRIORITY STATUS
136 FUMARIACEAE		
* <i>Fumaria capreolata</i>		
138 BRASSICACEAE		
* <i>Heliophila pusilla</i>		
143 DROSERACEAE		
<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>		
<i>Drosera macrantha</i> subsp. <i>macrantha</i>		
<i>Drosera pallida</i>		
<i>Drosera stolonifera</i>		
149 CRASSULACEAE		
<i>Crassula colorata</i> var. <i>acuminata</i>		
* <i>Crassula glomerata</i>		
163 MIMOSACEAE		
<i>Acacia huegelii</i>		
* <i>Acacia iteaphylla</i>	Flinders Range wattle	
* <i>Acacia longifolia</i>	Sydney Golden wattle	
<i>Acacia pulchella</i> var. <i>glaberrima</i>		
<i>Acacia saligna</i>		
<i>Acacia stenoptera</i>		
165 PAPILIONACEAE		
<i>Bossiaea eriocarpa</i>		
* <i>Chamaecytisus palmensis</i>	tagasaste; tree lucerne	
<i>Daviesia triflora</i>		
<i>Gompholobium tomentosum</i>		
<i>Hardenbergia comptoniana</i>		
<i>Hovea pungens</i>		
<i>Hovea trisperma</i>		
<i>Isotropis cuneifolia</i> subsp. <i>cuneifolia</i>		
<i>Jacksonia furcellata</i>		
<i>Jacksonia sternbergiana</i>		
<i>Kennedia prostrata</i>		
* <i>Lotus angustissimus</i>		
* <i>Lupinus angustifolius</i>		
* <i>Lupinus cosentinii</i>		
* <i>Trifolium arvense</i>		
* <i>Trifolium campestre</i>		



FAMILY/TAXA	COMMON NAMES	PRIORITY STATUS
165 PAPILIONACEAE (continued)		
*Trifolium dubium		
*Vicia sativa		
167 GERANIACEAE		
*Geranium dissectum		
*Geranium molle		
Geranium retrorsum		
*Pelargonium capitatum		
Pelargonium sp.		
168 OXALIDACEAE		
*Oxalis pes-caprae	sour sob	
175 RUTACEAE		
Philothea spicata		
185 EUPHORBIACEAE		
*Euphorbia terracina	Geraldton carnation weed	
Monotaxis grandiflora var. grandiflora		
Phyllanthus calycinus		
Poranthera microphylla		
226 DILLENIACEAE		
Hibbertia hypericoides		
Hibbertia racemosa		
243 VIOLACEAE		
Hybanthus calycinus		
263 THYMELAEACEAE		
Pimelea rosea		
273 MYRTACEAE		
Corymbia calophylla	Marri	
Eucalyptus gomphocephala	Tuart	
Eucalyptus marginata subsp. marginata	Jarrah	
281 APIACEAE		
Eryngium pinnatifidum subsp. pinnatifidum		
Homalosciadium homalocarpum		



FAMILY/TAXA	COMMON NAMES	PRIORITY STATUS
281 APIACEAE (continued)		
Trachymene pilosa		
Xanthosia huegelii		
288 EPACRIDACEAE		
Astroloma pallidum		
Leucopogon propinquus		
302 LOGANIACEAE		
Logania vaginalis		
313 LAMIACEAE		
Hemiandra glabra subsp. chimaera		
Hemiandra glabra subsp. glabra		
315 SOLANACEAE		
*Solanum linnaeanum		
*Solanum nigrum	Deadly night shade	
320 OROBANCHACEAE		
*Orobanche minor		
331 RUBIACEAE		
Opercularia vaginata		
334 VALERIANACEAE		
*Centranthus macrosiphon		
339 CAMPANULACEAE		
*Wahlenbergia capensis		
340 LOBELIACEAE		
Lobelia tenuior		
341 GOODENIACEAE		
Dampiera linearis		
Scaevola canescens		
343 STYLIDIACEAE		
Stylidium piliferum		
Stylidium schoenoides		



FAMILY/TAXA	COMMON NAMES	PRIORITY STATUS
345 ASTERACEAE		
* <i>Arctotheca calendula</i>	capeweed	
* <i>Conyza sumatrensis</i>		
* <i>Dimorphotheca ecklonis</i>	veld daisy	
* <i>Gazania linearis</i>		
* <i>Hypochaeris glabra</i>		
<i>Lagenophora huegelii</i>		
<i>Olearia axillaris</i>		
<i>Ozothamnus cordatus</i>		
<i>Podolepis gracilis</i>		
<i>Senecio pinnatifolius</i> var. <i>latilobus</i>		
* <i>Sonchus oleraceus</i>		
* <i>Ursinia anthemoides</i>		



Appendix 6

Releve Descriptions and Species Lists for Parmelia Avenue, Parmelia



Releve descriptions and species lists for the Parmelia Avenue, Parmelia area

Note: these sites descriptions were recorded for mapping notes and do not have a complete species list, but list representative species under 'Associated species'.

I. RELEVES

Parmelia Ave, Parmelia - Site PR1

Described by: BRM **Date:** 22/09/2009

Location: Parmelia Ave

Photo: BM100: 283

AMG: Zone 50 389701mE, 6431224mN (WGS84)

Habitat: Upper slope and crest of dune.

Soil: Yellow sand.

Vegetation: *Eucalyptus gomphocephala* (Tuart) scattered tall trees over *Corymbia calophylla* (Marri) open woodland over *Allocasuarina fraseriana*, *Banksia grandis* scattered low trees over *Jacksonia furcellata* high open shrubland over *Acacia pulchella* var. *glaberrima* open shrubland over *Macrozamia riedlei* scattered shrubs over **Ehrharta calycina* grassland and **Lupin cosentinii*, **Euphorbia terracina* open herbland.

Assoc. species: *Hardenbergia comptoniana*; *Acanthocarpus preissii*; *Kennedia prostrata*; *Corynotheca micrantha*; *Conostylis aculeata* subsp. *aculeata*, *Gompholobium tomentosum*, *Geranium* sp, *Lepidosperma scabrum*, *Pimelea rosea*; **Trifolium campestre*, *Caesia micrantha*; *Tricoryne elatior*; *Senecio pinnatifolius* var. *latilobus*; *Eryngium pinnatifidum* subsp. *pinnatifidum*; **Sonchus oleraceus*; *Lomandra micrantha*; *Rhagodia baccata* subsp. *baccata*; *Burchardia congesta*; *Banksia sessilis* var. *cygnorum*; *Lomandra caespitose*.

Veg Condition (BF): Good to Degraded: high weed cover (**Ehrharta calycina*; **Euphorbia terracina*, **Lupin cosentinii*) and low shrub and herb strata not intact.

Fire Age: More than 4-5 years since last fire event (1.5m to 1.8m high *Acacia pulchella* var. *glaberrima*)

Parmelia Ave, Parmelia - Site PR2

Described by: BRM **Date:** 25/09/2009

Location: Parmelia Ave

AMG: Zone 50 389611mE, 6430946mN (WGS84)

Habitat: Upper slope of broad, high dune

Soil: Pale yellow-brown sand over yellow sand.

Vegetation: *Eucalyptus gomphocephala* (Tuart) scattered trees over *Eucalyptus marginata* subsp. *marginata* (Jarrah) woodland over *Banksia grandis*, *Banksia attenuata* low open woodland over *Jacksonia furcellata* scattered tall shrubs to high open shrubland over *Acacia pulchella* var. *glaberrima*, *Macrozamia riedlei* open shrubland over **Ehrharta calycina* closed grassland and **Lupin cosentinii*, **Euphorbia terracina* open herbland.



Veg Condition (BF): Good (to Degraded) (scattered patches of Very Good to Good). High weed cover (**Ehrharta calycina*); loss of herb layer.

Fire Age: approximately 3-4 years since last fire

Parmelia Ave, Parmelia - Site PR3

Described by: BRM **Date:** 25/09/2009

Location: Parmelia Ave

Photo: BM100: 322-325

AMG: Zone 50 389535mE, 6430914mN (WGS84)

Habitat: Upper slope to crest of high broad dune.

Soil: Yellow sand.

Vegetation: (Regrowth after fire) *Banksia sessilis* var. *cygnorum*, *Jacksonia furcellata* open to closed scrub over *Acacia pulchella* var. *glaberrima*, *Olearia axillaris*, *Macrozamia riedlei* open shrubland over **Ehrharta calycina* closed grassland.

Assoc. species: **Lupinus cosentinii*, **Lupinus angustifolius*; *Senecio pinnatifolius* var. *latilobus*; *Hemiandra glabra* subsp. *glabra*; *Crassula colorata* var. *acuminata*, *Conostylis candicans* subsp. *candicans*, *Burchardia congesta*; *Haemodorum paniculatum*; *Caesia micrantha*, *Hardenbergia comptoniana*; *Sowerbaea laxiflora*.

Veg Condition (BF): Good (high weed cover, lost herb layer)

Fire Age: approximately 3-4 years since last fire

Parmelia Ave, Parmelia - Site PR4

Described by: BRM **Date:** 11/10/2009

Location: Parmelia Ave

Photo: BM100: 42

AMG: Zone 50 389491mE, 6430509mN (WGS84)

Habitat: Gentle to moderate, east facing upper slope of high dune.

Soil: Yellow-orange sand.

Rock Type: some limestone outcropping.

Vegetation: *Eucalyptus gomphocephala* (Tuart) woodland over *Banksia attenuata* scattered low trees over *Banksia sessilis* var. *cygnorum*, *Jacksonia furcellata* high open shrubland to high shrubland over *Acacia pulchella* var. *glaberrima* scattered low shrubs over **Ehrharta calycina*, **Briza maxima* grassland with **Euphorbia terracina* herbland.

Assoc. species: *Hardenbergia comptoniana*, *Conostylis candicans* subsp. *candicans*

Veg Condition (BF): Good to Degraded (high weed cover >90%).

Fire Age: More than 4-5 years since last fire.

Parmelia Ave, Parmelia - Site PR5

Described by: BRM **Date:** 25/09/2009

Location: Parmelia Ave

Photo: BM100: 43-45

AMG: Zone 50 389446mE, 6430441mN (WGS84)

Habitat: Gentle, east facing upper slope of high dune.

Soil: Pale grey sand over yellow sand.

Vegetation: *Eucalyptus gomphocephala* (Tuart) scattered trees over *Eucalyptus marginata* ssp. *marginata* (Jarrah), (*Corymbia calophylla* (Marri)) low open woodland to low woodland over *Banksia menziesii*, *Banksia attenuata*, *Allocasuarina fraseriana* low woodland over *Jacksonia sternbergiana*, *Jacksonia furcellata* scattered tall shrubs to high open shrubland over *Macrozamia riedlei* scattered shrubs over *Pimelea rosea* scattered low shrubs over **Ehrharta calycina*, **Briza maxima* grassland with *Conostylis aculeata* subsp. *aculeata*, *Sowerbaea laxiflora* very open herbland.

Assoc. species: **Eragrostis curvula* (love grass), *Burchardia congesta*, *Hardenbergia comptoniana*; **Gladiolus caryophyllaceus*; **Romulea rosea*.

Veg Condition (BF): Good (loss of structure (shrub, herbs) and high weed cover).

Fire Age: More than 4-5 years since last fire.

Parmelia Ave, Parmelia - Site PR6

Described by: BRM **Date:** 11/10/2009

Location: Parmelia Ave

Photo: BM100: 46-48 (BM100: 49 – looking the other way)

AMG: Zone 50 389478mE, 6430415mN (WGS84)

Habitat: Moderate, east facing upper slope of high dune.

Vegetation: *Eucalyptus marginata* subsp. *marginata* (Jarrah), *Corymbia calophylla* (Marri) woodland over *Banksia menziesii*, *Banksia attenuata* low woodland over *Jacksonia sternbergiana* high open shrubland over *Acacia pulchella* var. *glaberrima*, *Macrozamia riedlei* open shrubland over *Gompholobium tomentosum* scattered low shrubs over **Ehrharta calycina*, (**Briza maxima*) grassland with *Conostylis aculeata* subsp. *aculeata* very open herbland.

Assoc. species: *Dianella revoluta* var. *divaricata*; *Burchardia congesta*; *Xanthorrhoea preissii*; *Schoenus clandestinus*; *Drosera stolonifera*; *Desmocladius* sp.; *Caesia micrantha*

Veg Condition (BF): Good (loss of shrub, herb layers/structure; high weed cover).

Fire Age: More than 5 years since last fire?

Parmelia Ave, Parmelia - Site PR7

Described by: BRM **Date:** 11/10/2009

Location: Parmelia Ave

AMG: Zone 50 389505mE, 6430275mN (WGS84)

Habitat: Moderate, east facing mid-slope of high dune.

Soil: Pale grey surface sand over yellow sand.

Vegetation: *Eucalyptus marginata* subsp. *marginata* (Jarrah), *Corymbia calophylla* (Marri) low woodland over *Banksia attenuata*, *Banksia grandis*, *Banksia menziesii* low woodland over *Jacksonia sternbergiana* scattered tall shrubs over *Acacia pulchella* var. *glaberrima*, *Macrozamia riedlei* open shrubland over **Ehrharta calycina* grassland.

Assoc. species: *Hardenbergia comptoniana*, *Dichopogon capillipes*, *Burchardia congesta*, *Conostylis aculeata* subsp. *aculeata*, *Drosera erythrorhiza* subsp. *erythrorhiza*.

Veg Condition (BF): Good (low shrub/herb layers not intact, high weed cover).



Fire Age: More than 4-5 years since last fire event

Parmelia Ave, Parmelia - Site PR8

Described by: BRM **Date:** 11/10/2009

Location: Parmelia Ave

Photo: BM100: 53-54

AMG: Zone 50 389592mE, 6430461mN (WGS84)

Habitat: Moderate, east-facing mid to lower slope of high dune.

Soil: Yellow sand.

Vegetation: *Corymbia calophylla* (Marri), *Eucalyptus marginata* subsp. *marginata* (Jarrah) open forest over *Banksia attenuata*, *Banksia grandis* scattered low trees over *Macrozamia riedlei* scattered shrubs over **Ehrharta calycina*, **Briza maxima* grassland

Assoc. species: **Gladiolus caryophyllaceus*, *Conostylis aculeata* subsp. *aculeata*, *Hardenbergia comptoniana*, *Burchardia congesta*, *Gompholobium tomentosum*, *Luzula meridionalis*

Veg Condition (BF): Good to Degraded (high weed cover, loss of strata).

Fire Age: More than 4-5 years since last fire event

Parmelia Ave, Parmelia - Site PR9

Described by: BRM **Date:** 18/10/2009

Location: Parmelia Ave

Photo: BM100: 67-70

AMG: Zone 50 389293mE, 6430740mN (WGS84)

Habitat: Gentle to moderate, west-facing upper slope of broad, high dune.

Soil: Yellow sand.

Rock Type: Some limestone.

Vegetation: *Eucalyptus gomphocephala* (Tuart) woodland over *Banksia sessilis* var. *cygnorum*, *Jacksonia furcellata*, *Hakea prostrata* high open shrubland to high shrubland over *Grevillea vestita*, *Acacia pulchella* var. *glaberrima* open shrubland over **Ehrharta calycina*, **Euphorbia terracina*, *Conostylis candicans* subsp. *candicans*, **Lupinus cosentinii* closed grassland/herbland.

Assoc. species: **Bromus diandrus*, **Lolium rigidum*, *Hardenbergia comptoniana*, *Clematis linearifolia*, **Briza maxima*, *Austrostipa flavescens*, *Tricoryne elatior*, *Acanthocarpus preissii*, *Rhagodia baccata* subsp. *baccata*, **Pelagonium capitatum*, *Xanthorrhoea preissii*, *Gompholobium tomentosum*, *Macrozamia riedlei*, **Eragrostis curvula*, *Banksia attenuata*, *Pimelea rosea*.

Veg Condition (BF): Good (high weed cover, loss of shrub and herb layer integrity).

Fire Age: More than 5 years since last fire event.

Parmelia Ave, Parmelia - Site PR10

Described by: BRM **Date:** 2/11/2009

Location: Parmelia Ave

AMG: Zone 50 389652mE, 6431180mN (WGS84)



Photo: BM100: 126

Habitat: Very gentle, east facing upper slope of broad dune.

Soil: Yellow sand.

Rock Type: Limestone seen within approx 50m

Vegetation: *Eucalyptus gomphocephala* (Tuart) open woodland over *Allocasuarina fraseriana*, *Corymbia calophylla* (patches) open woodland over *Banksia grandis* scattered low trees over *Jacksonia furcellata* scattered tall shrubs to high open shrubland over *Acacia pulchella* var. *glaberrima*, *Macrozamia riedlei* open shrubland over **Ehrharta calycina*, **Briza maxima* closed grassland with *Conostylis aculeata* subsp. *aculeata* very open herbland.

Assoc. species: **Lupinus angustifolius*, **Lupinus cosentinii*, **Trifolium campestre*, *Caesia micrantha*, *Hardenbergia comptoniana*, *Hybanthus calycinus*, **Euphorbia terracina*, *Tricoryne elatior*, *Gompholobium tomentosum*

Veg Condition (BF): Good to Degraded (closed grassland of **Ehrharta calycina*).

Parmelia Ave, Parmelia - Site PR11

Described by: BRM **Date:** 2/11/2009

Location: Parmelia Ave

AMG: Zone 50 389821mE, 6430878mN (WGS84)

Habitat: Gentle to moderate, east facing lower slope of broad high dune.

Soil: Grey sand over yellow sand.

Vegetation: *Corymbia calophylla* (Marri), (*Eucalyptus marginata* subsp. *marginata* (Jarrah)) open forest over *Banksia grandis* scattered low trees over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei*, *Acacia pulchella* var. *glaberrima* open shrubland over *Pimelea rosea*, *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina*, **Lagurus ovatus*, **Briza maxima* closed grassland.

Veg Condition (BF): Good (grassland of **Ehrharta calycina*).

Parmelia Ave, Parmelia - Site PR12

Described by: BRM **Date:** 2/11/2009

Location: Parmelia Ave

AMG: Zone 50 389822mE, 6430940mN (WGS84)

Habitat: Moderate, east-facing mid slope of dune.

Soil: Pale yellow sand over yellow sand.

Vegetation: *Eucalyptus marginata* subsp. *marginata* (Jarrah) open woodland over *Banksia attenuata* (*Banksia menziesii*, *Banksia grandis*) low woodland over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei*, *Acacia pulchella* var. *glaberrima* open shrubland over *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina* open to closed grassland.

Assoc. species: *Hardenbergia comptoniana*, *Hovea trisperma*, *Hibbertia racemosa*, *Lomandra suaveolens*, *Conostylis aculeata* subsp. *aculeata*, **Ursinia anthemoides*, **Vulpia* sp., *Laxmannia squarrosa*, *Ozothamnus cordatus*.

Veg Condition (BF): Good (closed grassland of **Ehrharta calycina*)



II. MAPPING NOTES

Parmelia Ave, Parmelia - Site: PMN1

Described by: BRM **Date:** 2/11/2009

Location: Parmelia Ave

AMG: Zone 50 390055mE, 6431210mN (WGS84)

Habitat: Gentle to moderate, south-east facing slope of broad dune.

Vegetation: *Eucalyptus marginata* subsp. *marginata* (Jarrah), *Allocasuarina fraseriana* low woodland over *Banksia attenuata* low open woodland to low woodland over *Acacia pulchella* var. *glaberrima* open shrubland to shrubland over *Gompholobium tomentosum*, *Petrophile linearis* low open woodland over *Lepidosperma pubisquamum*, *Luzula meridionalis*, *Desmocladius flexuosus* scattered sedges and **Ehrharta calycina* grassland with *Conostylis aculeata* subsp. *aculeata* very open herbland.

Assoc. species: *Persoonia saccata*, *Hardenbergia comptoniana*, *Macrozamia riedlei*, *Hovea tri trisperma*, **Hypochaeris glabra*, *Xanthorrhoea preissii*, *Xanthorrhoea brunonis*, *Jacksonia furcellata*, *Dampiera linearis*, *Hibbertia hypericoides*, *Burchardia congesta*, *Stylidium piliferum*.

Parmelia Ave, Parmelia - Site: PMN3

Described by: BRM **Date:** 2/11/2009

Location: Parmelia Ave

AMG: Zone 50 389645mE, 6431262mN (WGS84)

Habitat: Gentle, north facing slope of broad dune.

Vegetation: (regrowth after disturbance such as road construction) *Eucalyptus gomphocephala* (Tuart) scattered trees over *Allocasuarina fraseriana* open woodland over *Jacksonia furcellata*, (*Banksia sessilis* var. *cygnorum*) high shrubland over *Acacia pulchella* var. *glaberrima* open shrubland over *Gompholobium tomentosum* scattered low shrubs over **Ehrharta calycina*, **Lagurus ovatus* grassland and *Hemiandra glabra* subsp. *chimaera*, *Hemiandra glabra* subsp. *glabra* very open herbland.

Assoc. species: *Hybanthus calycinus*, *Allocasuarina fraseriana*, **Lupinus angustifolius*, **Euphorbia terracina*, *Ptilotus polystachyus*, **Gladiolus caryophyllaceus*, **Ursinia anthemoides*, **Briza maxima*.

Veg Condition (BF): Good to Degraded (grassland of weeds; regrowth after physical disturbance).



Appendix 7

Quadrat Descriptions and Species List for the Parmelia Survey Area



Quadrat descriptions and species lists for the Parmelia survey area

Parmelia Avenue	Site PQ01	Date 22/09/200	Type Q	Q 10x10
Described BRM				
Season E			Uniformit	
Location	North-eastern 'corner'			
MGA Zone	50	389861	mE	6431140 mN
Habitat	Moderate, south-east facing mid slope of high, broad ridge (dune).			
Soil	Yellow-brown sand over yellow sand.			
Rock Type	n/a			
Vegetation	Eucalyptus gomphocephala (Tuart) scattered tall trees over Corymbia calophylla (Marri), (Eucalyptus marginata subsp. marginata (Jarrah)) woodland over Banksia attenuata, Allocasuarina fraseriana low open woodland over Acacia pulchella var. glaberrima, Macrozamia riedlei open shrubland over Pimelea rosea low open shrubland over Tetraria octandra very open sedgeland and *Ehrharta calycina, *Briza maxima grassland with Conostylis aculeata subsp. aculeata very open herbland.			
Veg Condition	(BF) Good to Degraded - high weed cover, herb layer mostly absent.			
Fire	About 4-5 years since last fire.			
Notes	Search intensity thorough; Est. % avail. flora rec. 90%; soil colour at depth evidenced from ant nests.			

SPECIES LIST:

Quad	Name	Cove	C	Height	Specimen	Notes
	Acacia pulchella var. glaberrima	3-4%		0.8-1.5m	PQ1-5	Acacia pulchella
	Allocasuarina fraseriana	+		0.9m (6-7m)		Allocas fras (juv)
	Banksia attenuata	+		0.45m		Banksia atten (juv)
	Bossiaea eriocarpa	+		0.45m		Bossiaea eriocarpa
	Briza maxima	5-10%		0.2-0.4m		Briza max
	Bromus diandrus	?+		0.25m	PQ1-6	hairy grass; not
	Burchardia congesta	+		0.6m		Burchardia congesta
	Caesia micrantha	+		0.3m	(=PR1-6)	Caesia ?micrantha
	Caladenia latifolia	+		0.4m	(=PGC9)	Caladenia ?lat
	Chamaescilla corymbosa	+		0.15m	PQ1-8	Chaemaescilla cory
	Conostylis aculeata subsp. aculeata	5-6%		0.15m	(=PGC2)	Conostylis acculata
	Corymbia calophylla	30-40%		7-8m		Cor calophylla
	Dianella revoluta var. divaricata	+		0.4m		Dianella revolta
	Dichopogon capillipes	+		0.35m		Dichopogon capilepis
	Drosera pallida	+		0.4m	(=PGC6)	Drosera palida
	Drosera stolonifera	+		0.15-0.2m	PQ1-4	Drosera stolonifera
	Ehrharta calycina	30-40%		0.7m		Ehr cal; + dead cov20%
	Eryngium pinnatifidum subsp. pinnatifidum	+		0.3m	(=PR1-9)	Erygium
	Eucalyptus gomphocephala	2-4%		10-12m		Euc gomph; overhanging quadrat
	Eucalyptus marginata subsp. marginata	12-15%		10m		Euc marg
	Geranium retrorsum	+		0.12m	PQ1-9	Geranium; pink flower
	Hardenbergia comptoniana	+		0.3-0.4m		Hard comp
	Hypochaeris glabra	+		0.01m		Hypochaeris glabra
	Lagurus ovatus	+		0.3m		Foxtail grass
	Lomandra sp.	+		0.3m	PQ1-1	Lomandra
	Macrozamia riedlei	2-3%		1m		Zamia reidlei
	Ozothamnus cordatus	+		0.3m	PQ1-7	daisy shrub (broad leaf)
	Pimelea rosea	3-5%		0.4-0.6m	(=PGC12)	Pimelia ?rosea
	Pterostylis vittata/sanguinea	+		0.15m	PQ1-11	Pterostylis sang
	Sowerbaea laxiflora	+		0.3m		Sowerbuyer sax; not flowering
	Tetraria octandra	6-10%		0.4m	PQ1-2	Tetraria oct
	Thysanotus patersonii	+		0.2m	PQ1-10	Thysanotus men/pat
	Trifolium dubium	+		0.05m	(=PR1-4)	Trifolium camp; not flowering



Parmelia Avenue **Site** PQ02
Described BRM **Date** 23/09/200 **Type** Q 10x10
Season E **Uniformit**
Location NE 'corner' of survey area
MGA Zone 50 389958 **mE** 6431196 **mN**
Habitat Gentle, north-east facing mid to lower slope of broad, high dune.
Soil White sand over yellow sand.
Rock Type n/a
Vegetation Eucalyptus marginata subsp. marginata (Jarrah) open woodland over Allocasuarina fraseriana, Banksia attenuata, Banksia menziesii low open woodland over Acacia pulchella var. glaberrima open shrubland over Gompholobium tomentosum low open shrubland over Lepidosperma pubisquameum, Lyginia barbata scattered sedges and *Ehrharta calycina, *Briza maxima grassland.

Veg Condition (BF) Good (quite weedy)

Fire About 3 years since last fire.

Notes Search intensity thorough

SPECIES LIST:

Quad	Name	CoveC	Height	Specimen	Notes
	Acacia pulchella var. glaberrima	8-10%	1.1-1.4m	(=PQ1-5)	Acacia pulchella
	Allocasuarina fraseriana	6-7%	6m		Allocas fras
	Arctotheca calendula	+	0.12m		cape weed
	Banksia attenuata	2%	3-4m		B. atten
	Banksia menziesii	2-3%	6m		B. menz
	Briza maxima	5-6%	0.12m		Briza max
	Briza minor	+	0.12m		Briza min
	Burchardia congesta	+	0.35m	PQ2-7	Burchardia congesta
	Caesia micrantha	+	0.35m	(=PR1-6)	Caesia mic
	Conostylis aculeata subsp. aculeata	2-3%	0.15m	(=PGC2)	Conostylis aciliata
	Crassula colorata var. acuminata	+	0.02m	PQ2-11	Crassula
	Drosera erythrorhiza subsp. erythrorhiza	+	0.01m	PQ2-14	Drosera erythrorhiza; not flowering
	Drosera stolonifera	+	0.3m	(=PQ1-4)	Drosera stolons
	Ehrharta calycina	30-35%	0.6m		Ehr calyc; when fully grown, not flowering
	Eucalyptus marginata subsp. marginata	5-7%	5m		jarrah; include overhanging. 1 tree in quadrat
	Gladiolus caryophyllaceus	+	0.45m		Gladiolus
	Gompholobium tomentosum	4-5%	0.3-0.5m		Gom tom
	Heliophila pusilla	+	0.1m	(=PGC27)	white flower Bossiaea
	Hibbertia racemosa	+	0.35m	PQ2-5	Hib racemosa
	Homalosciadium homalocarpum	+	0.02m	PQ2-8	
	Hovea trisperma	+	0.3m	PQ2-2	Hovea trisperma
	Hypochaeris glabra	1-2%	0.02m		Hypochaeris glabra
	Lepidosperma pubisquameum	+	0.15-0.2m	PQ2-10	Lepidosp publi
	Lomandra caespitosa	+		PQ2-16	
	Lomandra suaveolens	+	0.2m	PQ2-13	Lomandra short
	Lupinus cosentinii	+	0.2m	(=PGC7)	Blue lupin; large leaflet
	Lyginia barbata	+	0.45-0.5m	PQ2-15	upright rush
	Macrozamia riedlei	+	0.6m		Zamia reidlei
	Opercularia vaginata	+	0.15-	(=PGC5)	Opercularia vag
	Petrophile linearis	+	0.35m	(=PGC20)	Petrophile
	Podolepis gracilis	+	0.1m	PQ2-12	daisies (in bud)
	Poranthera microphylla	+	0.02-	PQ2-9	Herb
	Romulea rosea	+	0.25m		Romulea rosea; Guliford grass, pink
	Thysanotus patersonii	+	0.35m		Thysanotus climber; no flowers
	Thysanotus sparteus	+	0.7m	PQ2-3	Thysanotus
	Tricoryne elatior	1%	0.6m	(=PR1-7)	Daisy; large leaf
	Trifolium campestre	+	0.06m	(=PR1-4)	Trifolium cap
	Ursinia anthemoides	+	0.2m		Ursenia art



Parmelia Avenue **Site** PQ03
Described BRM **Date** 23/09/200 **Type** Q 10x10
Season E **Uniformit**
Location Central eastern
MGA Zone 50 389930 **mE** 6431084 **mN**
Habitat Moderate, south-east facing lower slope of broad, high dune.
Soil Light yellow-brown to grey sand over yellow sand.
Rock Type n/a
Vegetation Eucalyptus marginata subsp. marginata (Jarrah), Corymbia calophylla (Marri) woodland over Banksia attenuata, Allocasuarina fraseriana, Banksia grandis low open woodland over Acacia pulchella var. glaberrima open shrubland over Pimelea rosea, Hibbertia racemosa, Bossiaea eriocarpa low open shrubland over Desmodcladus flexuosus, Tetraria octandra scattered sedges and *Ehrharta calycina, *Briza maxima open grassland.

Veg Condition (BF) Good to Very Good - elements of herb layer missing.

Fire About 3 to 4 years since fire.

Notes Search intensity thorough.

SPECIES LIST:

Quad	Name	Cove	C	Heigh	Specime	Notes
	Acacia pulchella var. glaberrima	8-10%		1.4-1.7m	(=PQ1-5)	Acacia pulchella
	Allocasuarina fraseriana	+		1.1m		Allocas fras
	Avena barbata	+		0.35m	PQ3-2	Avena
	Banksia attenuata	1-2%		1.8-2.5m		B. atten (juv)
	Banksia dallanneyi var. dallanneyi	1-2%		0.15m		Dryandra lindleyana
	Banksia grandis	+		6-7m		B. grandis; dead x2
	Bossiaea eriocarpa	4-5%		0.35-0.4m		Bossiaea eriocarp
	Briza maxima	3-5%		0.15-0.3m		Briza max
	Bromus diandrus	? +		0.1m	(=PGC1 -)	hairy grass
	Burchardia congesta	+		0.4m	(=PQ2-7)	Burch congesta
	Caesia micrantha	+		0.3m	PQ3-10	Caesia micrantha
	Caladenia flava subsp. flava	+		0.1m	PQ3-11	Caladenia flava
	Conostylis aculeata subsp. aculeata			0.3m	(=PGC2)	Conostylis acul
	Corymbia calophylla	5-6%		12m		marri; overhanging
	Desmodcladus flexuosus	1%		0.12-0.2m	PQ3-1	Desmodcladus
	Dianella revoluta var. divaricata	+		0.4m		Dianella rev
	Drosera erythrorhiza subsp. erythrorhiza	+		0.01m	PQ3-14	Drosera eryth
	Drosera stolonifera	+		0.25m	(=PQ1-4)	Drosera stolon
	Ehrharta calycina	15-20%		0.6-0.8m		Ehr calyc
	Eryngium pinnatifidum subsp. pinnatifidum	+		0.3m	(=)	Eryngium
	Eucalyptus marginata subsp. marginata	25-30%		10-11m		jarrah
	Gladiolus sp.	+		0.5-0.6m		Gladiolus; not flowering
	Gompholobium tomentosum	+		0.4m		Gom tom
	Hardenbergia comptoniana	+		0.9m		Hard comp
	Heliophila pusilla	+		0.1-0.15m	(=PGC27)	Bossiaea; fine white flower
	Hibbertia hypericoides	+		0.25m		Hib hyp
	Hibbertia racemosa	2-3%		0.15-0.4m	(=PQ2-5)	Hib race
	Homalosciadium homalocarpum	+		0.01m	PQ3-9	
	Hypochoeris glabra	+		0.01m		Hypochoeris glabra
	Jacksonia furcellata	+		1.1-3.5m	(=)	Jacksonia furcelata
	Lagurus ovatus	+		0.3m		Lagurus (foxtail grass)
	Lomandra caespitosa	+		0.35m	PQ3-19	Lomandra
	Lomandra hermaphrodita	+		0.3m	PQ3-13	Lomandra herm SPECIMEN LOST
	Lomandra micrantha	+		0.2m	PQ3-8	Lomandra fine
	Orobanche minor	+		0.15m	PQ3-15	Orobanche
	Ozothamnus cordatus	2-3%		0.4m	(=PQ1-7)	daisy grey large leaf
	Pelargonium capitatum	+		0.03m	PQ3-3	?Pelargonium cap (juv)
	Petrorhagia dubia	+		0.05m	PQ3-17	herb (?Ptilotis ?drum)
	Phyllothea spicata	+		0.45m		Phyllothea spicata
	Pimelea rosea	1-2%		0.6-0.9m	PQ3-6	Pimelia ?rosea
	Scaevola canescens	1-2%		0.15m	(=)	Scaveola canescens
	Sonchus oleraceus	+		0.03m		Sonchus oleracea
	Sowerbaea laxiflora	+		0.3m	PQ3-16	Sawerbaea sax; not



				flowering
Tetraria octandra	+	0.4m	(=PQ1-2)	Tetraria
Thysanotus sparteus	+	0.8m	(=PQ2-3)	Thysanotus tall
Trifolium dubium	+	0.06m	PQ3-5	Trifolium pres comp
Ursinia anthemoides	+	0.1m		Ursenia artenuoides
Xanthorrhoea preissii	+	0.8m	PQ3-12	Xanthor preis

Parmelia Avenue	Site	PQ04				
Described	BRM	Date	25/09/200	Type	Q	10x10
Season	E				Uniformit	
Location						
MGA Zone	50			389671	mE	6430962 mN
Habitat	Gentle, east to south-east facing midslope of broad, high dune.					
Soil	Pale yellow sand over yellow sand.					
Rock Type	n/a					
Vegetation	Eucalyptus marginata subsp. marginata (Jarrah), Corymbia calophylla (Marri) woodland over Banksia attenuata, Banksia grandis low woodland over Jacksonia furcellata, Hakea prostrata scattered tall shrubs over Acacia pulchella var. glaberrima open shubland over Gompholobium tomentosum scattered low shrubs over Lepidosperma squamatum, Desmocladius flexuosus scattered sedges and *Ehrharta calycina, *Briza maxima open grassland with Conostylis aculeata subsp. aculeata, Drosera erythrorhiza subsp. erythrorhiza open herbland.					
Veg Condition	(BF) Good to Very Good - loss of herb layer and high weed cover.					
Fire	About 3-4 years since last fire.					
Notes	Search intensity thorough; NB scattered tuarts not in immediate area					

SPECIES LIST:

Quad	Name	Cove	C	Heigh	Specime	Notes
	Acacia pulchella var. glaberrima	3-4%		1.3m	(=PQ1-5)	Acacia pulchella
	Aira caryophyllea	+		0.05m	PQ4-2	Aira grass
	Avena barbata	+		0.2m	(=PQ3-2)	Avena
	Banksia attenuata	30-35%		6-7m		B. atten
	Banksia grandis	+		2.1m		B. gandis (juv)
	Briza maxima	8-9%		0.15-0.2m		Briza maxa
	Burchardia congesta	+		0.5m		Burchardia congesta
	Caladenia flava subsp. flava	+		0.12m	PQ4-9	Caladenia flava
	Centrolepis mutica	+		0.04m	PQ4-13	Centrolepis
	Chamaescilla corymbosa	+		0.1m		Chamaescilla cor
	Conostylis aculeata subsp. aculeata	7-10%		0.15-0.2m	(=PGC2)	Conostylis aculata
	Corymbia calophylla	+		0.6m		Coryumbia calophylla (juv)
	Crassula colorata var. acuminata	+		0.04m	PQ4-10	Crassula
	Desmocladius flexuosus	+		0.15-0.2m	PQ4-6	Desmocladius
	Drosera erythrorhiza subsp. erythrorhiza	1-2%		0.01m	(=)	Drosera eryth
	Ehrharta calycina	6-10%		0.6m		Ehr. calycine
	Eucalyptus marginata subsp. marginata	1%		2.5m		jarrah (juv)
	Gompholobium tomentosum	1%		0.35m		Gom tom
	Hakea prostrata	1%		2.2m		Hakea prostrata
	Hardenbergia comptoniana	+		0.35m		Harden comp
	Homalosciadium homalocarpum	+		0.02m	PQ4-12	
	Hovea trisperma	+		0.35-0.4m	(=PQ2-2)	Hovea trisperma
	Hypochaeris glabra	+		0.02m		Hypochaeris glab
	Isolepis marginata	+		0.04m	PQ4-11	Isolepis ?marg
	Jacksonia furcellata	+		1.6-2.5m		Jacksonia furcellata
	Lepidosperma scabrum	+		0.45m	PQ4-5	terete Lepidosperma
	Lepidosperma squamatum	+		0.45m	PQ4-7	Lepidosperma; flat leaf
	Lomandra caespitosa	+		0.35m	PQ4-3	Lomandra caes
	Lomandra hermaphrodita	+		0.3m	PQ4-4	Lomandra hermaph; x5 clumps in quad
	Lomandra micrantha	+		0.35m	PQ4-1	Lomandra ?mar
	Lomandra preissii	+		0.3m	PQ4-15	Lomandra priesii
	Lupinus angustifolius	+		0.15m		Lupin; fine leaflet
	Lupinus cosentinii	+		0.3m	(=)	Lupin; broad leaf
	Opercularia vaginata	+		0.4m		Opercularia vag



<i>Ozothamnus cordatus</i>	3-4%	0.4-0.5m	(=PQ1-7)	daisy; large leaf
<i>Petrophile linearis</i>	+	0.4m	(=PGC20)	Petrophile
<i>Pimelea rosea</i>	+	0.3m	(=PGC12)	<i>Pimelea rosea</i>
<i>Romulea rosea</i>	+	0.15m		<i>Romulea rosea</i> ; Guilford grass
<i>Scaevola canescens</i>	+	0.15-0.2m	(=)	<i>Scaevola canesc</i>
<i>Sowerbaea laxiflora</i>	+	0.3m		Sowerberyer sax
<i>Thysanotus patersonii/manglesianus</i>	+	0.2m		<i>Thysanotus</i> climber; sterile
<i>Tricoryne elatior</i>	+	0.5m	PQ4-14	<i>Tricoryne/Thysanotus</i>
<i>Trifolium</i> sp.	+	(=)		<i>Trifolium</i>
<i>Ursinia anthemoides</i>	+	0.12m		<i>Ursinia</i> art
<i>Vulpia fasciculata</i>	+	0.05m	PQ4-16	? <i>Vulpia</i>
<i>Xanthorrhoea preissii</i>	+	1m	PQ4-8	<i>X. preissii</i>
<i>Xanthosia huegelii</i>	+	0.12m	(=PQ5-7)	<i>Xanthosia</i>

Parmelia Avenue	Site	PQ05					
Described	BRM	Date	25/09/200	Type	Q		10x10
Season	E					Uniformit	
Location							
MGA Zone	50			389571	mE		6431074 mN
Habitat	Very gentle, south-facing upper slope to crest of broad, high dune.						
Soil	Yellow-brown sand over yellow sand.						
Rock Type	n/a						
Vegetation	Eucalyptus marginata subsp. marginata (Jarrah), <i>Corymbia calophylla</i> (Marri) open woodland over <i>Banksia attenuata</i> , <i>Banksia grandis</i> low open woodland over <i>Macrozamia riedlei</i> , <i>Acacia pulchella</i> var. <i>glaberrima</i> open shrubland over <i>Pimelea rosea</i> , <i>Gompholobium tomentosum</i> low open shrubland over <i>Desmocladius flexuosus</i> , <i>Lepidosperma pubisquamum</i> very open sedgeland and * <i>Ehrharta calycina</i> , * <i>Briza maxima</i> grassland.						
Veg Condition	(BF) Good to Very Good - high weed cover and loss of structure/species (especially herbs).						
Fire	About 3-4 years since last fire.						
Notes	Search intensity thorough; NB scattered tuarts some distance away						

SPECIES LIST:

Quad	Name	Cove	C	Heigh	Specime	Notes
	<i>Acacia pulchella</i> var. <i>glaberrima</i>	1-2%		1.3-1.8m	(=PQ1-5)	<i>Acacia pulchella</i>
	<i>Acacia stenoptera</i>	+		0.35m	PQ5-2	<i>Acacia ?stenoptera</i>
	<i>Banksia attenuata</i>	+		1.8m		<i>B. attenuata</i> (juv)
	<i>Banksia grandis</i>	+		0.2m		<i>B. grandis</i> (juv); large trees nearby
	<i>Banksia sessilis</i> var. <i>cygnorum</i>	+		1.3m		<i>Dryandra sessilis</i> var.
	<i>Briza maxima</i>	2-3%		0.12-0.2m		<i>Briza</i> max
	<i>Burchardia congesta</i>	+		0.45m		<i>Burchardia congesta</i>
	<i>Caesia micrantha</i>	+		0.3m	(=PQ3-10)	<i>Caesia</i> mic
	<i>Caladenia discoidea</i>	+		0.15-	PQ5-5	bee orchid
	<i>Caladenia flava</i> subsp. <i>flava</i>	+		0.15m	(=)	<i>Caladenia flava</i>
	<i>Chamaescilla corymbosa</i>	+		0.05m	(=)	<i>Chamaescilla corym</i>
	<i>Conostylis aculeata</i> subsp. <i>aculeata</i>	1-2%		0.2m	(=PGC2)	<i>Conostylis aculeata</i>
	<i>Corymbia calophylla</i>	35%		12013m		marri
	<i>Crassula colorata</i> var. <i>acuminata</i>	+		0.02m	PQ5-11	<i>Crassula</i>
	<i>Desmocladius flexuosus</i>	7-8%		0.25-0.3m	PQ5-10	<i>Desmocladius</i>
	<i>Dianella revoluta</i> var. <i>divaricata</i>	+		0.35m		<i>Dianella revoluta</i>
	<i>Drosera erythrorhiza</i> subsp. <i>erythrorhiza</i>	+		0.01m		<i>Drosera</i> eryth
	<i>Drosera stolonifera</i>	+		0.2m		<i>Drosera stolonifera</i>
	<i>Ehrharta calycina</i>	20-25%		0.6m		<i>Ehr calycina</i>
	<i>Eucalyptus marginata</i> subsp. <i>marginata</i>	15-18%		10m		jarrah
	<i>Gladiolus caryophyllaceus</i>	+		0.3m		<i>Galdiolus</i> ; pink flower near quad
	<i>Gompholobium tomentosum</i>	1-2%		0.45m		Gom tom
	<i>Haemodorum</i> sp.	+		1.1m	PQ5-3	<i>Haemodorum</i>
	<i>Hardenbergia comptoniana</i>	1-2%		0.6-0.7m		Hard comp
	<i>Hibbertia racemosa</i>	+		0.2m		<i>Hibbertia racemosa</i>
	<i>Hovea trisperma</i>	+		0.4m	(=PQ2-2)	<i>Hovea trisperma</i>



Hypochaeris glabra	1-2%	0.02m		Hypochaeris glabra
Lepidosperma pubisquameum	+	0.35m	PQ5-6	Lepidosperma
Lomandra caespitosa	+	0.4m	PQ5-4	Lomandra caes; flowering
Macrozamia riedlei	4-5%	1.1m		Zamia
Petrophile linearis	+	0.35m	(=PGC20)	Petrophile
Petrorhagia dubia	+	0.04m	PQ5-9	?Ptilotus ?drummondii
Pimelea rosea	+	0.4m	(=PQ3-6)	Pimelea ?rosea
Pterostylis vittata	+	0.2m	PQ5-1	Pterostylis
Sonchus oleraceus	+	0.06m		Sonchus oleraceus
Sowerbaea laxiflora	+	0.35m		Sawerbeyer sax
Trifolium campestre	2-3%	0.05m	(=PQ3-5)	Trifolium campestre
Ursinia anthemoides	+	0.12m		Ursinia art
Xanthosia huegelii	+	0.1m	PQ5-7	Xanthosia

Parmelia Avenue	Site	PQ06				
Described	BRM	Date	3/11/2009	Type	Q	10x10
Season	E				Uniformit	
Location						
MGA Zone	50			389470	mE	6430297 mN
Habitat	Gentle, south to south-east facing slope of broad dune.					
Soil	Grey sand over yellow sand.					
Rock Type	n/a					
Vegetation	Eucalyptus marginata subsp. marginata (Jarrah), Corymbia calophylla (Marri) woodland over Banksia attenuata, Banksia menziesii, Banksia grandis low open woodland to low woodland (much of it regrowth (?after fire)) over Jacksonia sternbergiana scattered tall shrubs over Acacia pulchella var. glaberrima open shrubland over Leucopogon propinquus scattered low shrubs over Tetraria octandra, (Mesomelaena pseudostygia, Desmocladius flexuosus) open sedgeland and *Ehrharta calycina, (*Briza maxima) grassland with Conostylis aculeata subsp. aculeata very open herbland.					
Veg Condition	(BF) Good - high weed cover generally and some loss of understorey structure.					
Fire	About 4-5 years since last fire.					

Notes**SPECIES LIST:**

Quad	Name	Cove	C	Heigh	Specime	Notes
	Acacia pulchella var. glaberrima	2%		1-1.6m		Ac pulchella
	Avena barbata	+		0.4m	PQ6-4	Avena
	Banksia attenuata	15-18%		6-7m		B. atten
	Banksia menziesii	+		1m		Banksia menz (juv)
	Briza maxima	1-2%		0.2m		Briza max
	Briza minor	+		0.15m		Briza min
	Burchardia congesta	+		0.4m		Burchardia congesta
	Caesia micrantha	+		0.3m		Caesia micrantha
	Chamaescilla corymbosa	+		0.12m		Cham corym
	Conostylis aculeata subsp. aculeata	4-5%		0.3m	(=)	Conostylis aculata
	Corymbia calophylla	+		0.6m		marri (juv)
	Desmocladius flexuosus	+		0.15m	PQ6-2	Desmocladius
	Dichopogon capillipes	+		0.25m		Dichopogon cap
	Drosera stolonifera	+		0.2m	PQ6-6	Drosera ?stolon
	Ehrharta calycina	20-30%		0.9m		Ehr caly. Higher cover in surrounding area.
	Eucalyptus marginata subsp. marginata	20%		7m		jarrah
	Gompholobium tomentosum	+		0.45m		Gom tom
	Hakea lissocarpha	1%		1.4m	PQ6-12	Hakea lissocarpha
	Hardenbergia comptoniana	+		0.4m		Hard comp
	Homaloscladium homalocarpum	+		0.03m	(=)	Apiaceae; basal fruits
	Hovea trisperma	+		0.4m	PQ6-13	?Hovea trisperm
	Hypochaeris glabra	+		0.03m		Hypochaeris glab
	Jacksonia sternbergiana	4-5%		1.8-2.2m		Jacksonia sternberg
	Lagurus ovatus	+		0.2m	PQ6-7	fox tail grass
	Lepidosperma pubisquameum	+		0.4m	PQ6-3	Lomandra micrantha
	Leucopogon propinquus	+		0.45m	PQ6-14	Leucopogon pungens



<i>Lomandra hermaphrodita</i>	+	0.25m	PQ6-9	<i>Lomandra ?maritima</i>
<i>Lomandra sp.</i>	+	0.2m	PQ6-8	<i>Lomandra hermaph</i>
<i>Lupinus cosentinii</i>	+	0.3m	(=)	Lupin; wide leaf
<i>Lyginia barbata</i>	+	0.5m	(=PGC)	?Lyginea
<i>Macrozamia riedlei</i>	1-2%	1.1m		Zamia
<i>Mesomelaena pseudostygia</i>	1-2%	0.6m	(=PGC)	?Mesomal ?pseudo
<i>Monotaxis grandiflora var. grandiflora</i>	+	0.1m	PQ6-15	herb
<i>Pelargonium capitatum</i>	+	0.1m		<i>Pelargonium cap (juv)</i>
<i>Petrophile linearis</i>	+	0.3m		<i>Petrophile linearis</i>
<i>Ptilotus stirlingii var. stirlingii</i>	+	0.35m	PQ6-5	<i>Ptilotus</i>
<i>Tetraria octandra</i>	20-25%	0.4m	PQ6-1	<i>Tetraria oct</i> ; in big clumps
<i>Thysanotus arenarius</i>	+	0.7m	PQ6-10	<i>Thysanotus</i> ; tall
<i>Tricoryne elatior</i>	+	0.3m		<i>Tricoryne elat</i>
<i>Trifolium arvense</i>	+	0.1m	PQ6-11	<i>Trifolium</i> ; pink wly flower
<i>Trifolium campestre</i>	+	0.05-0.1m (=)		<i>Trifolium camp</i>
<i>Ursinia anthemoides</i>	+	0.2m		<i>Ursinia artemis</i>
<i>Xanthorrhoea preissii</i>	+	1m		<i>Xanth preissii</i>



Appendix 8

Lomandra maritima and *Lomanadra hermaphrodita* locations
recorded opportunistically during the Parmelia survey



Lomandra maritima and *Lomanadra hermaphrodita* Locations Recorded Opportunistically During the Parmelia Survey

Table. *Lomandra maritima* and *Lomanadra hermaphrodita* locations recorded opportunistically during the Parmelia survey.

Species	Specimen Numbers	Numbers	Easting	Northing	Notes
<i>Lomandra hermaphrodita</i>	PQ3-13	1?	389930	6431084	<i>Lomandra herm</i> SPECIMEN LOST
	PQ4-4	5	389671	6430962	<i>Lomandra hermaph</i> ; x5 clumps in quad
	PQ6-9	1?	389470	6430297	<i>Lomandra ?maritima</i>
	PGC37	1	389901	6431103	<i>Lom hermaph</i> ; 1 individual, @
	PGC70	2	389492	6430329	<i>Lomandra hermaph</i> ; 2 individuals, @
	PGC80	1	389488	6430364	<i>Lom herm</i> ; 1 individual, @
		4	389499	6430374	<i>L. herm</i> ; 4 individuals, @
		3	389526	6430399	<i>L. herm</i> ; 3 individuals, @
<i>Lomandra maritima</i>		1	389678	6431121	<i>Lomandra hermaph</i> ; 1 individual, @
	PGC102	3	389282	6430699	<i>Lom mar</i> ; 3 individuals, @, with 0.1m radius
		1	389292	6430710	<i>Lom mar</i> ; 1 individual, @
		1	389690	6431224	<i>Lom mar</i> ; 1 individual, @
	1	389871	6431202	<i>Lom maritima</i> ; 1 individual, @	



Appendix 9

Figures

Legend

- Site Boundary
- Environmentally Sensitive Areas
- Bush Forever Site
- Geomorphic Wetlands
- Conservation
- Resource Enhancement
- Multiple Use

THIS DOCUMENT IS THE PROPERTY OF SA BATTERY DEVELOPMENT GROUP. ALL RIGHTS ARE RESERVED. THIS DOCUMENT IS NOT TO BE REPRODUCED, COPIED, OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE EXPRESS WRITTEN PERMISSION OF SA BATTERY DEVELOPMENT GROUP. THE INFORMATION CONTAINED HEREIN IS FOR INFORMATION ONLY AND DOES NOT CONSTITUTE AN OFFER OF ANY FINANCIAL PRODUCT OR SERVICE. SA BATTERY DEVELOPMENT GROUP IS NOT PROVIDING ANY FINANCIAL ADVICE OR RECOMMENDATIONS. THE INFORMATION CONTAINED HEREIN IS NOT TO BE USED AS A BASIS FOR INVESTMENT DECISIONS. THE INFORMATION CONTAINED HEREIN IS NOT TO BE USED AS A BASIS FOR ANY LEGAL ACTION. SA BATTERY DEVELOPMENT GROUP IS NOT PROVIDING ANY LEGAL ADVICE OR RECOMMENDATIONS. THE INFORMATION CONTAINED HEREIN IS NOT TO BE USED AS A BASIS FOR ANY LEGAL ACTION.

SCALE
0 100 200 300 400
1:15,000 @ A4

LOCALITY MAP

COPYRIGHT
THIS DOCUMENT IS THE PROPERTY OF SA BATTERY DEVELOPMENT GROUP. ALL RIGHTS ARE RESERVED. THIS DOCUMENT IS NOT TO BE REPRODUCED, COPIED, OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE EXPRESS WRITTEN PERMISSION OF SA BATTERY DEVELOPMENT GROUP. THE INFORMATION CONTAINED HEREIN IS FOR INFORMATION ONLY AND DOES NOT CONSTITUTE AN OFFER OF ANY FINANCIAL PRODUCT OR SERVICE. SA BATTERY DEVELOPMENT GROUP IS NOT PROVIDING ANY FINANCIAL ADVICE OR RECOMMENDATIONS. THE INFORMATION CONTAINED HEREIN IS NOT TO BE USED AS A BASIS FOR INVESTMENT DECISIONS. THE INFORMATION CONTAINED HEREIN IS NOT TO BE USED AS A BASIS FOR ANY LEGAL ACTION. SA BATTERY DEVELOPMENT GROUP IS NOT PROVIDING ANY LEGAL ADVICE OR RECOMMENDATIONS. THE INFORMATION CONTAINED HEREIN IS NOT TO BE USED AS A BASIS FOR ANY LEGAL ACTION.

METADATA RECORDED	PROJECTION
100%	MDA ZONE 50
HORIZONTAL DATUM	HEIGHT DATUM
GDA 94	NA
CREATED BY	CHECKED BY
GWA	EP
DATE	REVISION
03/03/10	0
09:00	09:00

BATTERY PROPERTY GROUP
LOT 8091 PARMELIA AVE, PARMELIA
Parmelia Development
Parmelia Site Location
Figure 1



Legend

- Site Boundary
- Vegetation Complexes (Hudell et al. 1985)
 - Bowensden Complex - Central And South
 - Bermudiah Complex
 - Cottlesie Complex - Central And South
 - Dentlup Complex
 - Outland Complex
 - Hardman Complex
 - Karrakatta Complex - Central And South
 - Outback Complex
 - Serpentine River Complex
 - Southern River Complex

NOTE THAT POSITION ERRORS CAN BE UP TO SOME AMOUNT
 COORDINATE BOUNDARY SOURCED FROM LANDSAT 200
 VEGETATION COMPLEXES SOURCED FROM DIVERS 2002

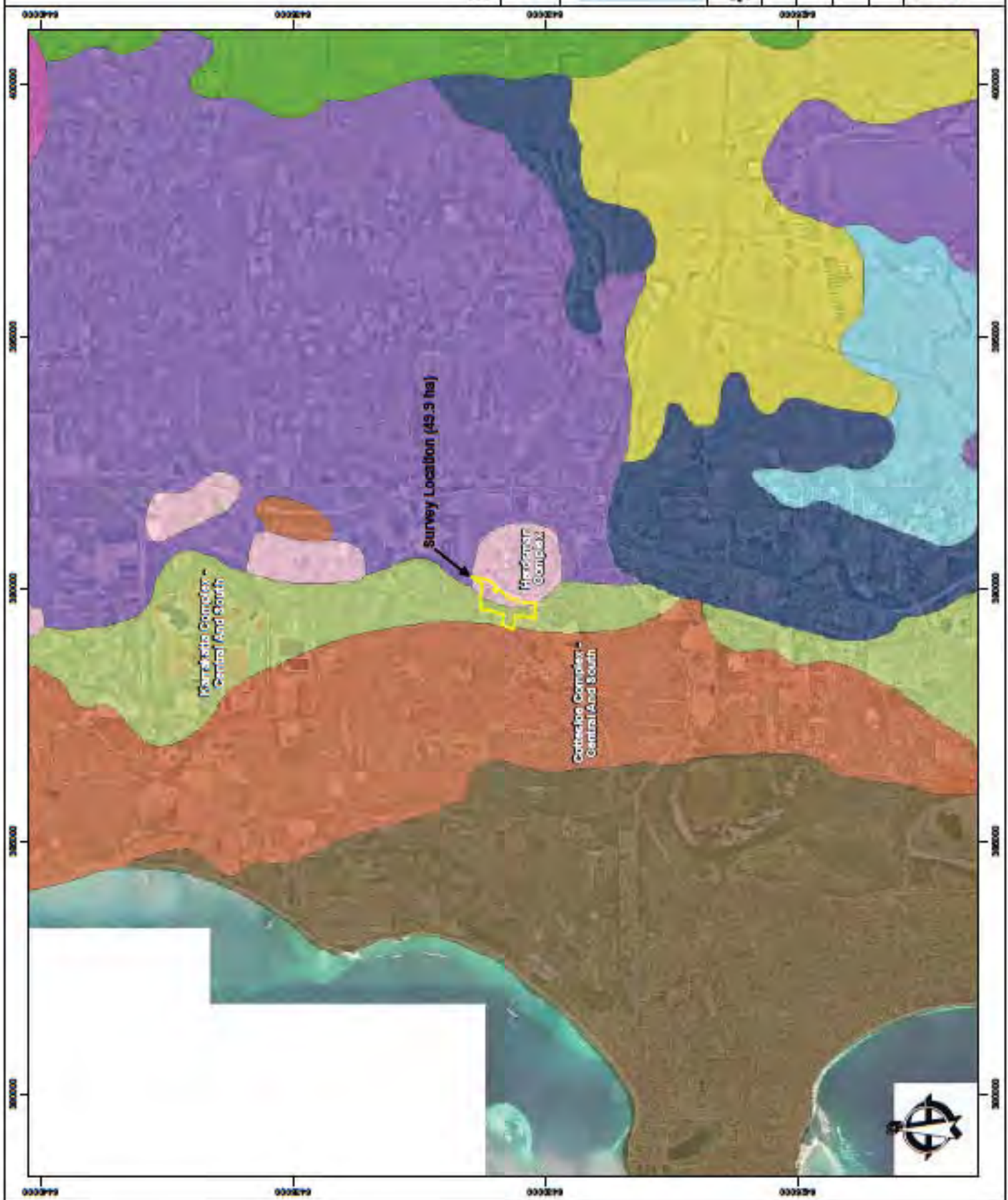
SCALE
 0 500 1000 2000 3000 4000
 Meters
 1:100,000 @ A4

LOCALITY MAP

COPYRIGHT
 THIS DOCUMENT AND ALL INFORMATION CONTAINED HEREIN IS THE PROPERTY OF THE BATTERLEY GROUP. IT IS TO BE USED ONLY FOR THE PURPOSES SPECIFIED IN THE CONTRACT. IT IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN PERMISSION OF THE BATTERLEY GROUP.

METADATA RECORDED	PROJECTION	
100%	UZA ZONE 52	
HORIZONTAL DATUM	HEIGHT DATUM	
GDA 94	NA	
CREATED BY	CHECKED BY	APPROVED
GM	BP	
DATE	VERSION	DRAWING ID
02.03.10	0	010.02

BATTERLEY PROPERTY GROUP
 LOT 1661 PARABELLA AVE, PARABELLA
 Perth WA 6150
 Perth WA Development
 Parabella Survey Area and Vegetation Complexes
 Figure 2



Legend

- Significant Flows:
 - DSF (Red triangle)
 - PH (Yellow triangle)
 - PC (Green triangle)
 - PD (Blue triangle)
 - PA (Purple triangle)
- Site Boundary: Yellow outline
- TECs and PECs:
 - TEC (Purple rectangle)
 - PEC (Green rectangle)

NOTE: THIS PROJECT REPORT CAN BE USE AS A SOURCE OF INFORMATION FOR THE PURPOSES OF THE ENVIRONMENTAL IMPACT STATEMENT (EIS) ONLY. THE INFORMATION CONTAINED HEREIN IS NOT TO BE USED FOR ANY OTHER PURPOSES WITHOUT THE WRITTEN PERMISSION OF THE CONSULTANT. THE CONSULTANT SHALL NOT BE RESPONSIBLE FOR ANY ERRORS OR OMISSIONS IN THIS REPORT.

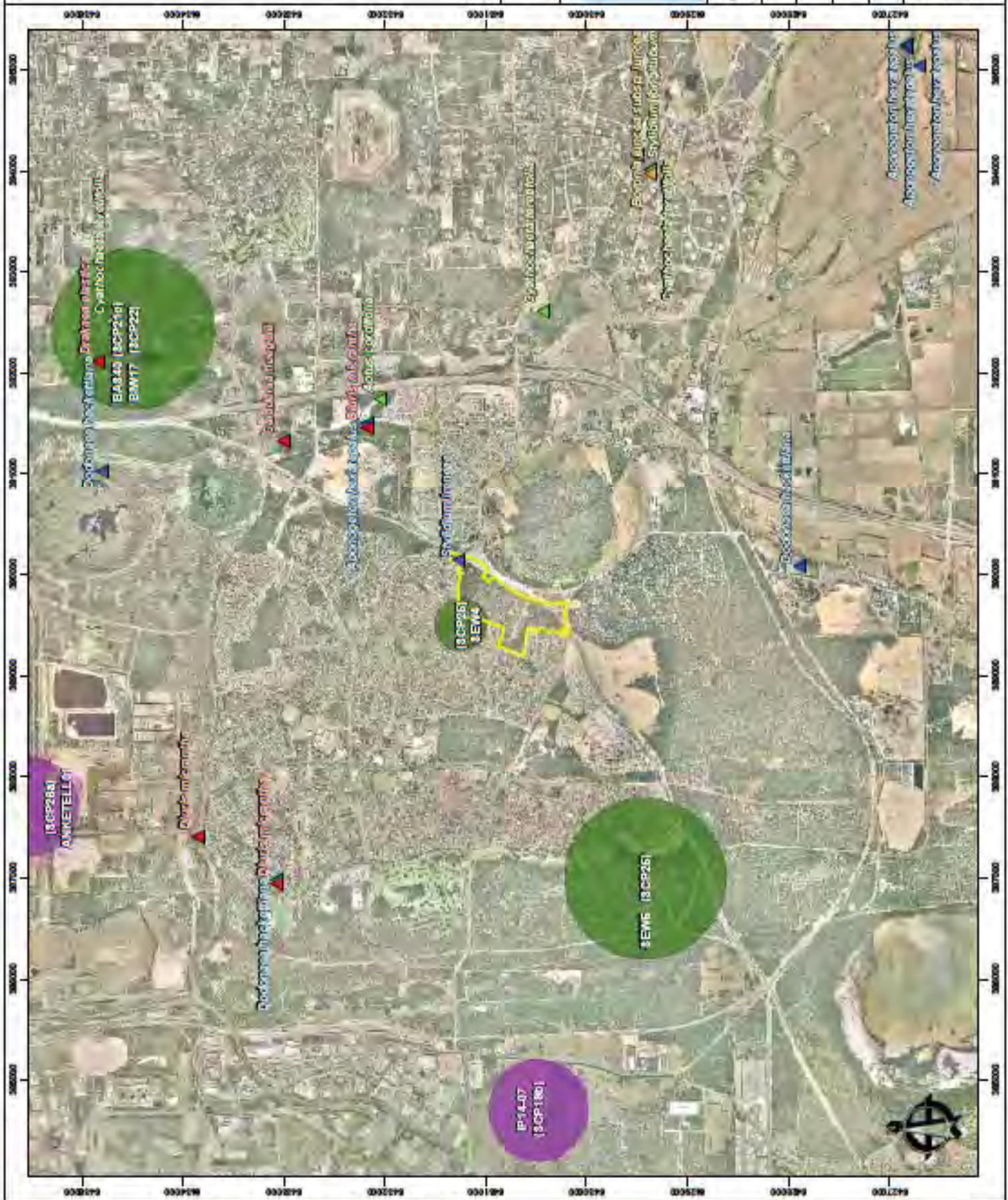
SCALE: 1:50,000

LOCALITY MAP: Shows the project location within the context of the surrounding area, including the locations of BAYUNG and JAWA NGALE.

COPYRIGHT
 This document is the property of the consultant. The information contained herein is confidential and shall not be disclosed to any third party without the written permission of the consultant.

METADATA RECORDED	PROJECTION
100%	UGA ZONE 50
HORIZONTAL DATUM	HEBBIT DATUM
CGA 94	19A
CREATED BY	CHECKED BY
GWA	DP
DATE	REVISION
20.02.10	0
	DATE
	016.03

MATERLEY PROPERTY GROUP
 LOT 1601 PARMELLA AVE, PARMELLA
 Parramatta Development
 TECs, PECs, DSF and Priority Flows taken from the Parramatta site locality - O&G database records
 Figure 3



Legend

- Vegetation Units**
- CD: Completely Degraded
 - C. calophylla (Marr) woodlands
 - Dryandra sessilis scrub
 - E. gomphocarpus (Turk) mixed woodland
 - E. gomphocarpus (Turk) woodland
 - E. marginata (Larrah) - Banksia spp. woodland
 - E. marginata (Larrah) - C. calophylla (Marr) - Banksia spp. woodland

- Quadrat**
- Quadrat
 - ▲ Mapping Note
 - Receive

NOTE THAT POSITION ERRORS CAN BE 15M IN SOME AREAS
 - LOCALITY BOUNDARY SOURCED FROM LANDSAT 2008
 - LOCALITY MAP SOURCED FROM LANDSAT 2008

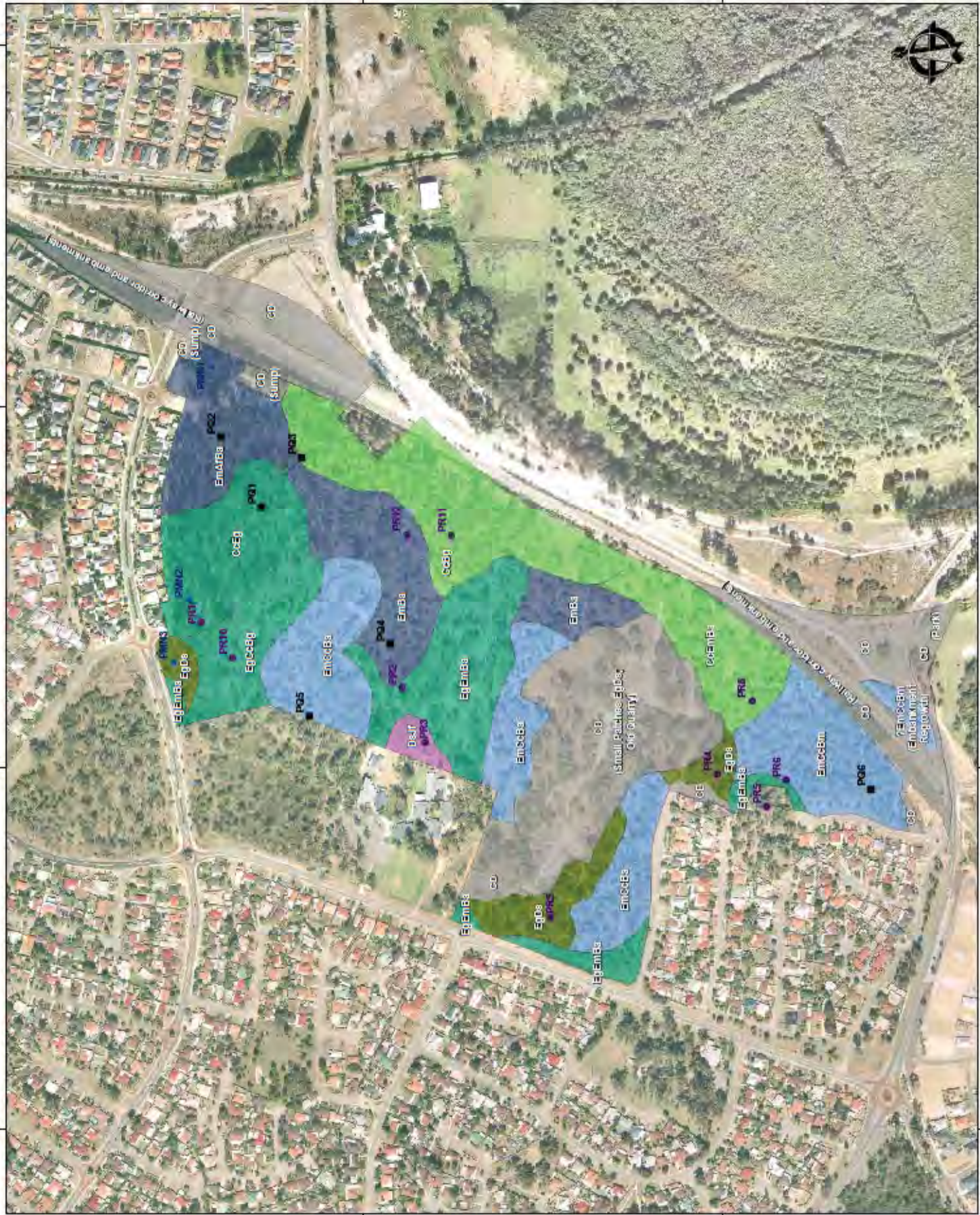


COPYRIGHT

REPRODUCED FROM THE UNIVERSITY OF WASHINGTON
 THE UNIVERSITY OF WASHINGTON HERBARIUM
 THE UNIVERSITY OF WASHINGTON HERBARIUM
 THE UNIVERSITY OF WASHINGTON HERBARIUM

METADATA RECORDED	PROJECTION
100%	MGA ZONE 50
HORIZONTAL DATUM	HEIGHT DATUM
CGDA 94	MGA
CREATED BY	CHECKED BY
DWN	JPT
DATE	REVISION
25.02.10	0
	DRAWING NO.
	813.04

SATURLEY PROPERTY GROUP
 LOT 801 PARABELLA AVE, PARABELLA
 Parasella Development
 Vegetation Units and Quadrat Locations
 Figure 4

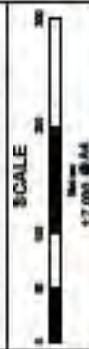


Legend

Vegetation Condition
(Shrub Forest Condition Scale (DEC, 2008))

- P: Pristine
- E: Excellent
- VG: Very Good
- G: Good
- D: Degraded
- CD: Completely Degraded

NOTE THAT POSITION ERRORS CAN BE UP TO 10 METRE AREAS
CANNOT BE IDENTIFIED SOURCES FROM LANDSAT 2008
LOCALITY MAP SOURCED FROM LANDSAT 2008



LOCALITY MAP

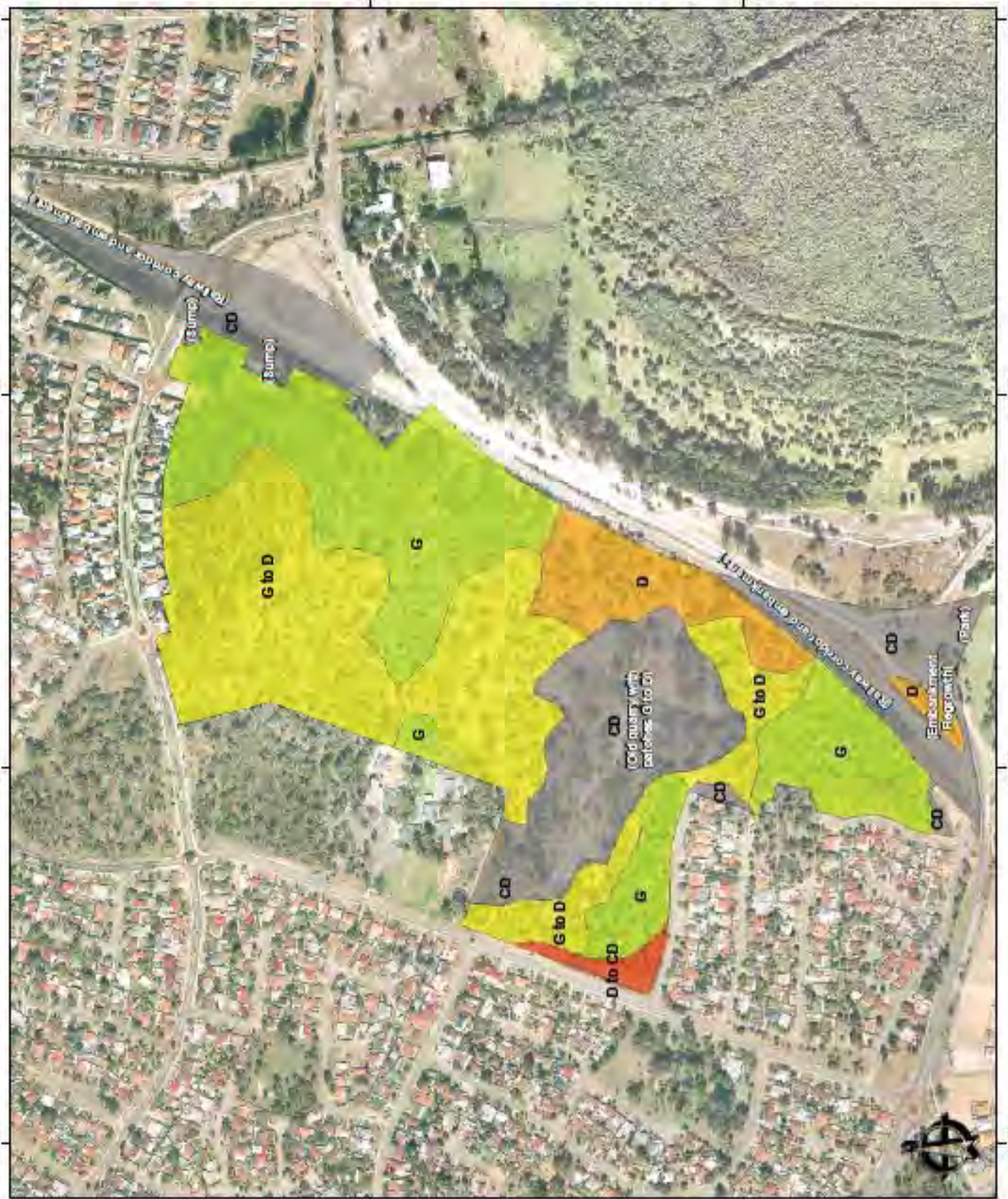


COPYRIGHT

THIS DOCUMENT IS THE PROPERTY OF MR MATTHEW PROPERTY GROUP. THIS DOCUMENT MAY NOT BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN PERMISSION OF MR MATTHEW PROPERTY GROUP.

METADATA RECORDED	PROJECTION
100%	MGA ZONE 50
HORIZONTAL DATUM	HEIGHT DATUM
GDA 94	MSL
CREATED BY	CHECKED BY
GWA	DP
DATE	REVISION
08/03/10	0
	ISSUED BY
	016/02

MATTHEW PROPERTY GROUP
LOT 1601 PARABELLA AVE, PARABELLA
Parabella Development
Vegetation Condition
Figure 8



Legend

- Lomaxville Herpetofauna
- Number of Invertebrates
 - 1-3
 - 4-5
- Lomaxville Reptiles
- Number of Invertebrates
 - 1-3
 - 4-5
- Site Boundary

NOTE THAT POSITION ERRORS CAN BE ONE IN SEVEN AVENUE
 -AERIAL PHOTOGRAPHY SOURCE: WIKI COMMONS 2022



LOCALITY MAP



COPYRIGHT

THIS DOCUMENT IS THE PROPERTY OF M&M CONSULTANTS. THIS DOCUMENT AND ANY MATERIALS CONTAINED HEREIN ARE TO BE USED ONLY FOR THE PROJECT AND SITE SPECIFICALLY IDENTIFIED HEREIN. ANY REUSE OR DISTRIBUTION OF THIS DOCUMENT WITHOUT THE WRITTEN PERMISSION OF M&M CONSULTANTS IS STRICTLY PROHIBITED.

METADATA RECORDED	PROJECTION
100%	UGA ZONE 50
HORIZONTAL DATUM	HERBERT DATUM
OGC 94	NA
CREATED BY	CHECKED BY
GM	SP
DATE	REVISION
23.02.10	0
	DRAWN BY
	016.08

M&M CONSULTANTS
 BATTERLEY PROPERTY GROUP
 LOT 801 PARABELLA AVE, PARABELLA
 Parasella Development
 Locations of Lomaxville spp.
 Figure 8





Appendix 10

Plates



Plate 1. Vegetation unit EgDs at site PR9.



Plate 2. Vegetation unit CoEg at releve site PR1.



Plate 3. Vegetation unit CoEg at quadrat PQ1.



Plate 4. Vegetation unit EmCoBa recorded at quadrat PQ5.



Plate 5. Vegetation unit EmCoBm recorded at quadrat PQ6.



Plate 6. Vegetation unit EmAfBa recorded at quadrat PQ2.



Plate 7 Vegetation unit CcEmBa at releve site PR8.



Plate 8. Vegetation unit Dsjf recorded at releve PR3.



Plate 9. A closed grassland of perennial veldt grass, *Ehrharta oalyoina*, at releve site PR10.



Plate 10. Part of the old quarry area. Regrowth and remnant *Eucalyptus gomphocephala* (Tuart) trees are common in the area.



Plate 11. The old quarry area has been used for recreation (trail bike riding and 4WD driving). Some rubbish dumping has occurred in the area.



Plate 12. This leaf damage is thought to be caused by Jarrah leafminer (*Perthida glyphopa*). The leaf damage was extensive in the survey area, resulting in the browned appearance of the Jarrah (*Eucalyptus marginata*) tree crowns.



Plate 13. The browned crowns of Jarrah trees (*Eucalyptus marginata*) in the Parmelia survey area, caused by Jarrah leafminer.

ATTACHMENT 2E

Bertram Station Precinct

Level 2 Flora and Vegetation Survey

Final Report

Document Control Report Reference	Revision	Prepared by	Reviewed by	Submitted to Client Copies	Date
583 AC	FINAL	SC/JT	TC	2 hard copies, 1 electronic (CD)	11/03/09

Disclaimer

This report has been prepared for the sole use and benefit of Satterley Property Group (the "Client"). This report is issued in accordance with, and is subject to, the terms of the contract between the Client and 360 Environmental Pty Ltd, including, without limitation, the agreed scope of the report. To the extent permitted by law, 360 Environmental Pty Ltd shall not be liable in contract, tort (including, without limitation, negligence) or otherwise for any use of, or reliance on, this report by any person or organisation other than the Client

360 Environmental Pty Ltd considers the contents of this report to be current as at the date it was produced. This report, including each opinion, conclusion and recommendation it contains, should be considered in the context of the report as a whole. The opinions, conclusions and recommendations in this report are limited by its agreed scope. More extensive, or different, investigation, sampling and testing may have produced different results and therefore different opinions, conclusions and recommendations.

Subject to the terms of the contract between the Client and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating this report, or any part of it, is prohibited (except to the extent required by law) without the prior written consent of 360 Environmental Pty Ltd.

© Copyright 2009 360 Environmental Pty Ltd ACN 109 499 041



EXECUTIVE SUMMARY

360 Environmental Pty Ltd (360 Environmental) was commissioned by Satterley Property Group and the Department of Housing to undertake a Level 2 flora and vegetation survey (the survey) of seven areas totalling approximately 15.5ha at a site adjacent to Kwinana Train Station in Bertram (Figure 1). The survey is required to determine the presence of significant flora (including Declared Rare Flora (DRF)) and rare vegetation types (including Threatened Ecological Communities (TECs)) to provide further information for the future planning of the site.

A total of 102 native and 38 exotic plant species were recorded in the course of the survey.

No plant taxa pursuant to section 179 of the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* were located in the areas surveyed (Department of the Environment, Water, Heritage and the Arts, 2008b).

No DRF species, pursuant to subsection 2 of section 23F of the *Wildlife Conservation Act 1950* and as listed by the Department of Environment and Conservation (DEC) (2008a) were located during the survey.

One Declared Plant (*Solanum linnaeanum*) listed under the *Agricultural and Related Resources Protection Act 1976* was observed during the survey.

Six plant communities were recorded over the study area (Figure 2). Floristics did not vary greatly across the survey area, accordingly plant communities were defined more by structural dominants and landforms than by species assemblages.

None of the vegetation communities recorded resembled any of the TECs listed under the *EPBC Act 1999* (2008b) or any of the TECs or Priority Ecological Communities (PECs) listed by the DEC (2008b, 2008c).

Four survey areas (A, B, D, E) were considered to be in poor condition and three survey areas (C, F, G) were considered to be in good condition. The survey areas in poor condition are unlikely to be considered to have significant environmental value and although three areas were considered to be in good condition they contained no flora or vegetation of conservation significance.

Within all seven survey areas, species susceptible to *Phytophthora* related dieback (dieback) were observed to be dead or dying. Although this survey did not specifically survey for the presence of dieback these indicator species may indicated dieback is present at the site. Future earthworks at the site should take this into account to



minimise the potential for spreading this disease. Management for the presence of a *Declared Plant* should also be considered.



Table of Contents

1.	Introduction	1
1.1.	Background	1
1.2.	Scope of Work	1
1.3.	Objectives and Aims	1
1.4.	Report Format	1
2.	Site Description	2
2.1.	Site Location and Features	2
2.2.	Regional Botanical Context	2
3.	Methodology	3
3.1.	Desktop Assessment	3
3.2.	Field Survey	3
4.	Results	4
4.1.	Desktop Assessment	4
4.2.	Flora of the Survey Area	5
4.3.	Vegetation of the Survey Area	7
5.	Discussion	9
5.1.	Flora and Vegetation	9
5.2.	Limitations of the Vegetation Survey	9
6.	Limitation	10
7.	References	12

List of Figures

- Figure 1 Site Location.
Figure 2 Vegetation Communities and Survey Locations.
Figure 3 Vegetation Condition.

List of Tables

- Table 1 Native plant species list observed during the survey.
Table 2 Exotic plant species list observed during the survey.

List of Plates

- Plate 1 *Solanum linnaeanum*. Declared Plant listed under the Agricultural and Related Resources Protection Act 1976.
Plate 2 *Allocasuarina fraseriana* – *Banksia attenuata* woodland (Site A).
Plate 3 Large dead *Banksias* are common at Site A.
Plate 4 Site A is criss-crossed by paths and tracks with associated weed invasion.
Plate 5 *Allocasuarina fraseriana* – *Banksia attenuata* woodland (Site B).
Plate 6 *Xylomelum occidentale* is a locally common tree in the woodland (Site B).
Plate 7 Localised disturbance by children (Site B).
Plate 8 *Banksia attenuata* – *Corymbia calophylla* woodland (Site C).
Plate 9 Open woodland with *Macrozamia riedlei* and *Conostylis* sp. being common understorey species (Site C).
Plate 10 *Banksia attenuata* woodland (Site D).
Plate 11 Degraded *Corymbia calophylla* woodland (Site E).
Plate 12 *Banksia attenuata* – *Banksia menziesii* - *Allocasuarina fraseriana* woodland (Site F).
Plate 13 *Banksia attenuata* – *Banksia menziesii* - *Allocasuarina fraseriana* woodland (Site G).

List of Appendices

- Appendix A Criteria used for the field assessment of vegetation condition



1. Introduction

1.1. Background

360 Environmental Pty Ltd (360 Environmental) was commissioned by Satterley Property Group and the Department of Housing to undertake a Level 2 Flora and Vegetation survey (the survey) of seven areas (the survey areas) within the proposed Bertram Station Precinct (the site) (Figure 1). The survey was required by the client to determine the presence of significant flora (including Declared Rare Flora (DRF)), Priority Flora and rare vegetation types (including Threatened Ecological Communities (TECs)).

1.2. Scope of Work

A flora and vegetation survey of the site, in accordance with Environmental Protection Authority's (EPA) *Guidance for the Assessment of Environmental Factors – Terrestrial Flora and Vegetation Surveys for Environmental Impact in Western Australia – No. 51 (2004)*, was undertaken during October 2008.

1.3. Objectives and Aims

This investigation was undertaken in accordance with 360 Environmental's proposal 583 AA (dated 19 August 2008). This study aimed to:

- Survey and map the vegetation communities.
- Compile a comprehensive species list.
- Identify any flora and vegetation issues that may need to be addressed in any subsequent environmental assessments.

1.4. Report Format

The remainder of this report comprises the following components:

- Section 2 – Site Description
- Section 3 – Methodology
- Section 4 – Results
- Section 5 – Discussion
- Section 6 – Limitations
- Section 7 – References



2. Site Description

2.1. Site Location and Features

The site consists of seven discrete survey areas adjacent to the Kwinana Train Station (Figure 1). The size of the individual survey areas varied between approximately 0.3 hectares (ha) and 4.6ha. The total area surveyed was approximately 15.5ha.

2.2. Regional Botanical Context

The site is located within the Swan Coastal Plain bioregion of the Interim Biogeographic Regionalisation of Australia (IBRA) (Department of Environment, Water, Heritage and the Arts (DEWHA), 2008a). The Swan Coastal Plain bioregion extends from north of Jurien, which is located to the north of Perth, south past Busselton. The Swan Coastal Plain is comprised of two subregions, the Dandaragan Plateau (the SWA1 subregion) and the Perth Coastal Plain (the SWA2 subregion). The survey sites were all located within the Perth Coastal Plain/SWA2 subregion.

The SWA2 subregion occupies a narrow strip between the Indian Ocean and the Darling Scarp extending from Cape Naturaliste in the south to just north of Jurien. The Swan Coastal Plain is a low lying coastal plain dominated by Banksia and Tuart woodlands on sandy soils, *Casuarina obesa* on outwash plains, and paperbark in swampy areas. The outwash plains vegetation and paperbark swamps are now only extensive in the south of the bioregion.



3. Methodology

3.1. Desktop Assessment

The following databases were searched to provide background information on the types and likely presence of conservation significant flora and vegetation communities:

- Department of Environment and Conservation's (DEC) *Declared Rare and Priority Flora Database* (2008a).
- DEWHA's *Environment Protection and Biodiversity Conservation (EPBC) Act 1999 List of Threatened Flora* (2008b).
- DEWHA's *List of Protected Threatened Ecological Communities* (2008b).
- DEC's *Threatened Ecological Community Database* 2008b).
- DEC's *Priority Ecological Community Database* (2008c).

3.2. Field Survey

The vegetation survey of was undertaken on 10 and 31 October 2008 in accordance with *Guidance for the Assessment of Environmental Factors – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004).

The survey involved traversal of the survey areas and setup and of quadrats during which plant specimens were collected for later identification. Specimens were identified and verified using the resources of the State Herbarium and Florabase. Particular emphasis was placed on species verification and assessment against known ranges.

Descriptions were made of the nature of the native vegetation present and distribution. Vegetation was described based on field observations. Ecological condition was assessed according to Trudgen (1988) (Appendix A). Evidence of threatening processes and indicators of plant population health were also noted.

Survey areas A, B, C and G were sampled with two quadrats, survey areas D and F with one quadrat and due to its small size area E had none. A total of ten quadrats were sampled across the seven survey areas (Figure 2). Sampling sites consisted of square 10m x 10m quadrats marked out with measuring tape.

Plants with unknown or uncertain identities were collected and compared with pressed specimens housed at the Western Australian Herbarium to ensure correct identifications. In addition to the plants recorded within quadrats, opportunistic collections were made whenever new species were observed outside quadrats.

4. Results

4.1. Desktop Assessment

4.1.1. Declared Rare and Priority Flora – DEC Database Search

The results of the *DRF and Priority Flora* database searches (DEC, 2008a) indicated there are several DRF and Priority Flora currently known to exist at various locations within 5km of the survey area. These species include:

- *Caladenia huegelii* – DRF
- *Diuris micrantha* – DRF
- *Drakaea elastica* – DRF
- *Eremaea asterocarpa* subsp. *brachyclada* – Priority 1
- *Aotus cordifolia* – Priority 3
- *Cyathochaeta teretifolia* – Priority 3
- *Stylidium longitubum* – Priority 3
- *Aponogeton hexatepalus* – Priority 4
- *Dodonaea hackettiana* – Priority 4

4.1.2. Threatened Ecological Communities – DEC Database Search

Results of the DEC's *Threatened Ecological Community and Priority Ecological Community* database search indicated one record of a TEC (SCP26a, *Melaleuca huegelii* – *Melaleuca acerosa* shrublands on Limestone Ridges) within 5 km of the study area. This community is typified by a lack of trees with the dominant stratum being medium shrubs of *Acacia lissocarpa*, *Dryandra sessilis*, *Grevillea thelmanniana* subsp. *preissii*, *Melaleuca huegelii*, *Melaleuca acerosa* and *Trymalium albicans*.

4.1.3. Environment Protection and Biodiversity Conservation Act 1999 Protected Matters Database search

Results of the *EPBC Act 1999 Protected Matters Database* search (DEWHA, 2008b) indicated five endangered or vulnerable flora species or species habitat that may occur in the area. The search results did not indicated any TECs listed under the *EPBC Act 1999* that may potentially occur in the area. The flora species identified were:

- *Caladenia huegelii* – Endangered
- *Diuris micrantha* – Vulnerable
- *Drakaea elastica* – Endangered
- *Drakaea micrantha* Hopper & A. P. Brown nom. Inval. – Vulnerable



- *Lasiopetalum* sp. Serpentine (S. Paust 1103A) WA – Endangered

4.2. Flora of the Survey Area

102 native plant species were observed to occur within the survey areas (Table 1). The distribution of individual species is related to the interaction of soils, topography, drainage and other variables related to the geography of the area. Some species were confined to individual study areas (e.g. *Caladenia discoidea*, *Xylomelum occidentale*) while others ranged across some or all areas (e.g. *Acacia pulchella*, *Banksia attenuata*, *Petrophile linearis*).

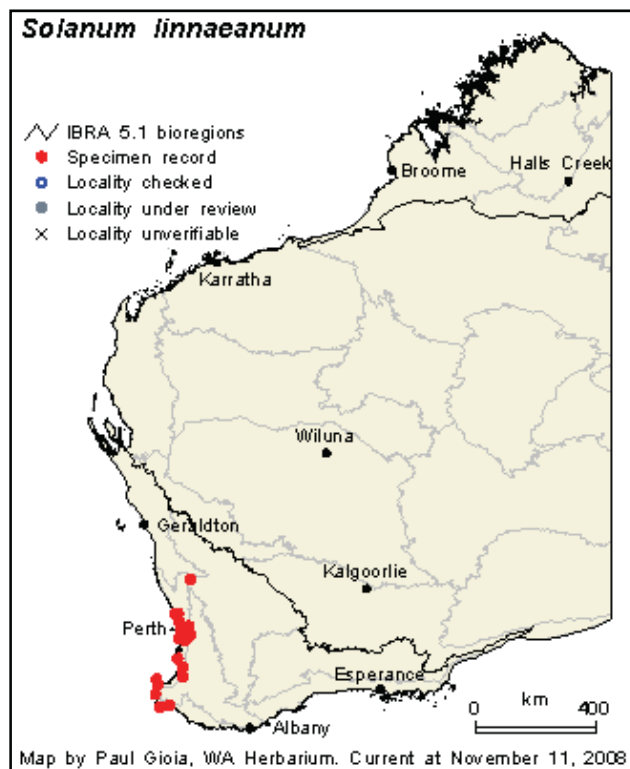
38 exotic plant species (Table 2) were identified. These included a number of recognized agricultural and environmental weeds however there was only one species (*Solanum linnaeanum* – Apple of Sodom) of *Declared Plant* listed under the *Agriculture and Related Resources Protection Act 1976* (Department of Agriculture and Food, 2000) observed during the survey (Plate 1). Most exotic species occur on the edges of the bushlands and along tracks and firebreaks but some are dispersed throughout all bushland areas (e.g. *Gladiolus caryophyllaceus*, *Petrorhagia velutina*).

No plant taxa pursuant to section 179 of the *EPBC Act 1999* were located in the areas surveyed.

No DRF species pursuant to subsection 2 of section 23F of the *Wildlife Conservation Act 1950* and no Priority flora species as listed by the DEC (2008a) were located during the survey.



Plate 1: *Solanum linnaeanum*. Declared Plant listed under the Agricultural and Related Resources Protection Act 1976 (Reproduced from FloraBase, DEC, 2008d).



Distribution Map 1: Distribution of *Solanum linnaeanum* (Reproduced from Flora Base, DEC, 2008d).



4.3. Vegetation of the Survey Area

4.3.1. Vegetation Description

The vegetation found across the sites is essentially a low to tall woodland of *Banksia attenuata* and *Allocasuarina fraseriana* with *Corymbia calophylla*, *Banksia menziesii* and *Xylomelum occidentale*. Understorey elements vary in height, density and species composition. Common understorey shrubs included *Acacia pulchella*, *Dasypogon bromelifolius*, *Hibbertia rhadinopoda* and *Petrophile linearis*. Native herbs include *Burchardia umbellata*, *Conostylis* sps. and *Anigozanthos humilis*.

Floristics did not vary greatly across the survey area, so vegetation descriptions are defined by structural dominants and landforms. Vegetation distributions are presented in Figure 2.

- Area A: *Banksia attenuata* - *Allocasuarina fraseriana* woodland with occasional stands of *Jacksonia furcellata* and *Kunzea glabrescens* above a generally low, multi-species understorey with *Acacia pulchella*, *Hibbertia rhadinopoda*, *Petrophile linearis* and *Xanthorrhoea preissii* common low shrubs. Weeds occur throughout.
- Area B: *Banksia attenuata*- *Allocasuarina fraseriana*- *Xylomelum occidentale* woodland above a generally degraded low, understorey commonly of *Hibbertia rhadinopoda*, *Petrophile linearis* and *Patersonia occidentalis* low shrubs. Weeds occur throughout.
- Area C: Variable *Banksia attenuata*- to a tall woodland of *Corymbia calophylla*. Understorey density and height varies with open areas of low shrubs and herbs below tall trees and taller more dense shrubs occurring below *B. attenuata*. *Hibbertia rhadinopoda*, *Macrozamia riedlei*, *Petrophile linearis* and *Xanthorrhoea preissii* are common shrubs. Weeds occur throughout.
- Area D: *Banksia attenuata*- *Allocasuarina fraseriana* woodland above a generally low, multi-species understorey with *Hibbertia rhadinopoda*, *Patersonia occidentalis* and *Xanthorrhoea preissii* common shrubs. Weeds occur throughout.
- Area E: *Banksia attenuata* – *Corymbia calophylla* -*Allocasuarina fraseriana* woodland above a generally low, weed dominated understorey.
- Area F and Area G: *Banksia attenuata* – *Banksia menziesii* - *Allocasuarina fraseriana* woodland with occasional stands of *Jacksonia furcellata* and *Kunzea glabrescens* above a generally low, multi-species understorey with *Acacia pulchella*, *Hibbertia rhadinopoda*, *Petrophile linearis* and *Xanthorrhoea preissii* common shrubs.



None of the above vegetation descriptions resembled TECs listed under the *EPBC Act 1999*, or TECs or Priority Ecological Communities (PEC) listed by the DEC (2008b, 2008c).

4.3.2. Vegetation Condition

Of the seven survey areas within the site, four (A, B, D and E) were generally considered to be in Poor condition and three (G, F and C) were considered to be in Good condition. However, with survey areas A, B, C, D, E and G there are areas considered to be in poor and very poor condition (Figure 3).

All of the survey areas showed signs of human induced disturbance including walking tracks, dumping of rubbish, weed infestations, car tracks and potentially the presence of *Phytophthora* related dieback (dieback). Although dieback was not specifically assessed for, death of dieback sensitive species (e.g. *Banksia* species) was noted in all locations.



5. Discussion

5.1. Flora and Vegetation

The flora and vegetation at the site has been significantly impacted by human disturbances. The value of four survey areas (A, B, D, E) within the site was observed to be in poor condition. Due to the poor condition, relatively small sizes and no observed TECs or flora of conservation significance it is unlikely the environmental value of the four areas will be considered significant.

Although the remaining three survey areas (C, F, G) were considered to be in good condition, no TECs or flora of conservation significance were observed. In all survey areas there is no flora of vegetation that is specifically protected by State or Commonwealth legislation.

Although not specifically within the scope, the potential presence of dieback was noted within all seven survey areas. During any site works that may occur in the future, management of this should be considered to minimise the potential spread of dieback.

There are also at least nine species of flora observed on the site that are considered important food sources for Carnaby's Cockatoo (*Calyptorhynchus latirostris*). Although not part of the scope the presence of the majority of these species within each area indicates this may be utilised as habitat by Carnaby's Cockatoo.

Finally, the presence and management of the *Declared Plant* (*Solanum linnaeanum*) listed under the *Agricultural and Related Resources Protection Act 1976* should be considered during future site works.

5.2. Limitations of the Vegetation Survey

The survey was undertaken by a qualified botanist in accordance with EPA guidelines and requirements for a Level 2 flora and vegetation survey (EPA, 2004).

The timing of the survey, mid-spring, was ideal for sampling the entire range of plant species. Most species were in flower and it was possible to identify all of the plants collected or observed. However, there may have been some species that had finished flowering and were overlooked.

6. Limitations

This report is produced strictly in accordance with the scope of services set out in the contract or otherwise agreed in accordance with the contract. 360 Environmental makes no representations or warranties in relation to the nature and quality of soil and water other than the visual observation and analytical data in this report.

In the preparation of this report, 360 Environmental has relied upon documents, information, data and analyses (“client’s information”) provided by the client and other individuals and entities. In most cases where client’s information has been relied upon, such reliance has been indicated in this report. Unless expressly set out in this report, 360 Environmental has not verified that the client’s information is accurate, exhaustive or current and the validity and accuracy of any aspect of the report including, or based upon, any part of the client’s information is contingent upon the accuracy, exhaustiveness and currency of the client’s information. 360 Environmental shall not be liable to the client or any other person in connection with any invalid or inaccurate aspect of this report where that invalidity or inaccuracy arose because the client’s information was not accurate, exhaustive and current or arose because of any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to 360 Environmental.

Aspects of this report, including the opinions, conclusions and recommendations it contains, are based on the results of the investigation, sampling and testing set out in the contract and otherwise in accordance with normal practices and standards. The investigation, sampling and testing are designed to produce results that represent a reasonable interpretation of the general conditions of the site that is the subject of this report. However, due to the characteristics of the site, including natural variations in site conditions, the results of the investigation, sampling and testing may not accurately represent the actual state of the whole site at all points.

It is important to recognise that site conditions, including the extent and concentration of contaminants, can change with time. This is particularly relevant if this report, including the data, opinions, conclusions and recommendations it contains, are to be used a considerable time after it was prepared. In these circumstances, further investigation of the site may be necessary. It should further be recognised that potential future impacts on site environmental conditions relating to global warming are beyond the scope of this investigation. Potential impacts may include, but are not limited to, changes in weather patterns that result in flooding or drought, subsequent changes in soil conditions, distribution of flora and fauna, altered vector impacts and increased fire hazards. Further investigation of the site in relation to these factors may be required.



This report has been prepared for the sole use and benefit of Satterley Property Group. Any reliance placed on the whole or any part of this report by any person or organisation other than Satterley Property Group shall be at the sole risk of that person or organisation.

Subject to the terms of the contract between Satterley Property Group and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating this report, or any part of it, is prohibited (except to the extent required by law) without the prior written consent of 360 Environmental Pty Ltd.

7. References

- Department of Agriculture and Food. 2000. *Declared Plants List*.
http://agspsrv95.agric.wa.gov.au/dps/version02/01_plantsearch.asp.
Accessed November 2008.
- Department of Environment and Conservation. 2008a. *Declared Rare and Priority Flora Database*.
- Department of Environment and Conservation. 2008b. *Threatened Ecological Communities Database*. <http://www.dec.wa.gov.au/management-and-protection/threatened-species/wa-s-threatened-ecological-communities.html>.
Accessed November 2008.
- Department of Environment and Conservation. 2008c. *Priority Ecological Communities Database*. <http://www.dec.wa.gov.au/management-and-protection/threatened-species/wa-s-threatened-ecological-communities.html>.
Accessed November 2008.
- Department of Environment and Conservation. 2008d. *Florabase*.
<http://florabase.calm.wa.gov.au/>. Accessed November 2008.
- Department of the Environment, Water, Heritage and the Arts. 2008a. *Interim Biogeographic Regionalisation for Australia*.
<http://www.environment.gov.au/parks/nrs/science/bioregion-framework/ibra/index.html>. Accessed November 2008.
- Department of the Environment, Water, Heritage and the Arts. 2008b. *Environment Protection and Biodiversity Conservation Act 1999 Protected Matters Search Tool*. <http://www.environment.gov.au/cgi-bin/sprat/public/publiclookupcommunities.pl>. Accessed November 2008.
- Environmental Protection Authority. 2004. *Guidance for the Assessment of Environmental Factors No. 51. Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western*. Environmental Protection Authority, Western Australia.
- Muir, B.G. 1977. *Biological Survey of the Western Australian Wheatbelt. Pt. 2. Vegetation and habitat of the Bendering Reserve*. Rec. Western Australian Museum. Supplement. 3.
- Trudgen, M. E. 1988. *A Report on the Flora and Vegetation of the Port Kennedy Area*. Unpublished report prepared for Bowman Bishaw and Associates, West Perth.

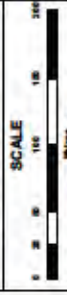


Figures

Legend

- Site Boundary
- Cassette | Boundary

NOTE THAT BOUNDARY LINES CAN BE AFFECTED BY:
 - AIRIAL PHOTOGRAMMETRY DATA FROM LANDSAT 2000
 - CASSETTE BOUNDARIES DERIVED FROM LANDSAT 2000
 - LOCALITY MAP SOURCE: PRELIMINARY 2007



COPYRIGHT

THE LOCATION AND AREA DATA SHOWN ON THIS MAP ARE THE PROPERTY OF SURVEILLANCE & THE
 LAND INFORMATION SYSTEMS DIVISION OF THE DEPARTMENT OF LAND AND SURVEYING
 AND ARE NOT TO BE USED FOR ANY OTHER PURPOSE WITHOUT THE WRITTEN PERMISSION OF THE
 DEPARTMENT OF LAND AND SURVEYING.

METADATA RECORDED	PROJECTION	
100%	MGA ZONE 50	
HORIZONTAL DATUM	HEIGHT DATUM	
GDA 84	M	
CREATED BY	CHECKED BY	APPROVED
GN	EP	
DATE	REVISION	DRAWING NO.
20/02/08	0	003.01

Drawn by Survey Property Group
 Level 2 Flora and Vegetation Survey
 2007/10/04
 Site Location
 Figure 1



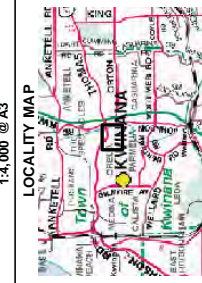
Legend

-  Very Poor Condition
-  Quadrat Location

Descriptions:

- A.** *Banksia attenuata* - *Allocasuarina fraseriana* woodland with occasional stands of *Jacksonia lineolata* and *Kurzia glabrerescens* above a dense *Acacia* understorey. *Hibbertia radiopoda*, *Portophloe* *linearis* and *Xanthorrhoea preissii* common low shrubs. Weeds occur throughout.
- B.** *Banksia attenuata* - *Allocasuarina fraseriana* - generally degraded low, understorey commonly of *Hibbertia radiopoda*, *Portophloe linearis* and *Palaemonia occidentalis* low shrubs. Weeds occur throughout.
- C.** Variable *Banksia attenuata* - to a tall woodland of *Corymbia calophylla*. Understorey dense and high, varies with open areas of low shrubs and herbs below tall trees and taller more dense shrubs occurring below. *B. attenuata*, *Hibbertia linearis* and *Xanthorrhoea preissii* are common shrubs. Weeds occur throughout.
- D.** *Banksia attenuata* - *Allocasuarina fraseriana* woodland with *Hibbertia radiopoda* species *Palaemonia occidentalis* and *Xanthorrhoea preissii* common shrubs. Weeds occur throughout.
- E.** *Banksia attenuata* - *Corymbia calophylla* - *Allocasuarina fraseriana* woodland and above a generally low, weed dominated understorey.
- F.** *Banksia attenuata* - *Banksia menziesii* - *Allocasuarina fraseriana* woodland and above a generally low, weed dominated understorey with *Acacia* multi-species understorey with *Acacia pulchella*, *Hibbertia radiopoda*, *Portophloe linearis* and *Xanthorrhoea preissii* common shrubs.
- G.** *Banksia attenuata* - *Banksia menziesii* - *Allocasuarina fraseriana* woodland and with occasional stands of *Jacksonia lineolata* and *Kurzia glabrerescens* above a generally low, multi-species understorey with *Acacia pulchella*, *Hibbertia radiopoda*, *Portophloe linearis* and *Xanthorrhoea preissii* common shrubs.

NOTE THAT POSITION ERRORS CAN BE ±5M IN SOME AREAS
 -AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2008
 -LOCALITY MAP SOURCED FROM LANDGATE 2007

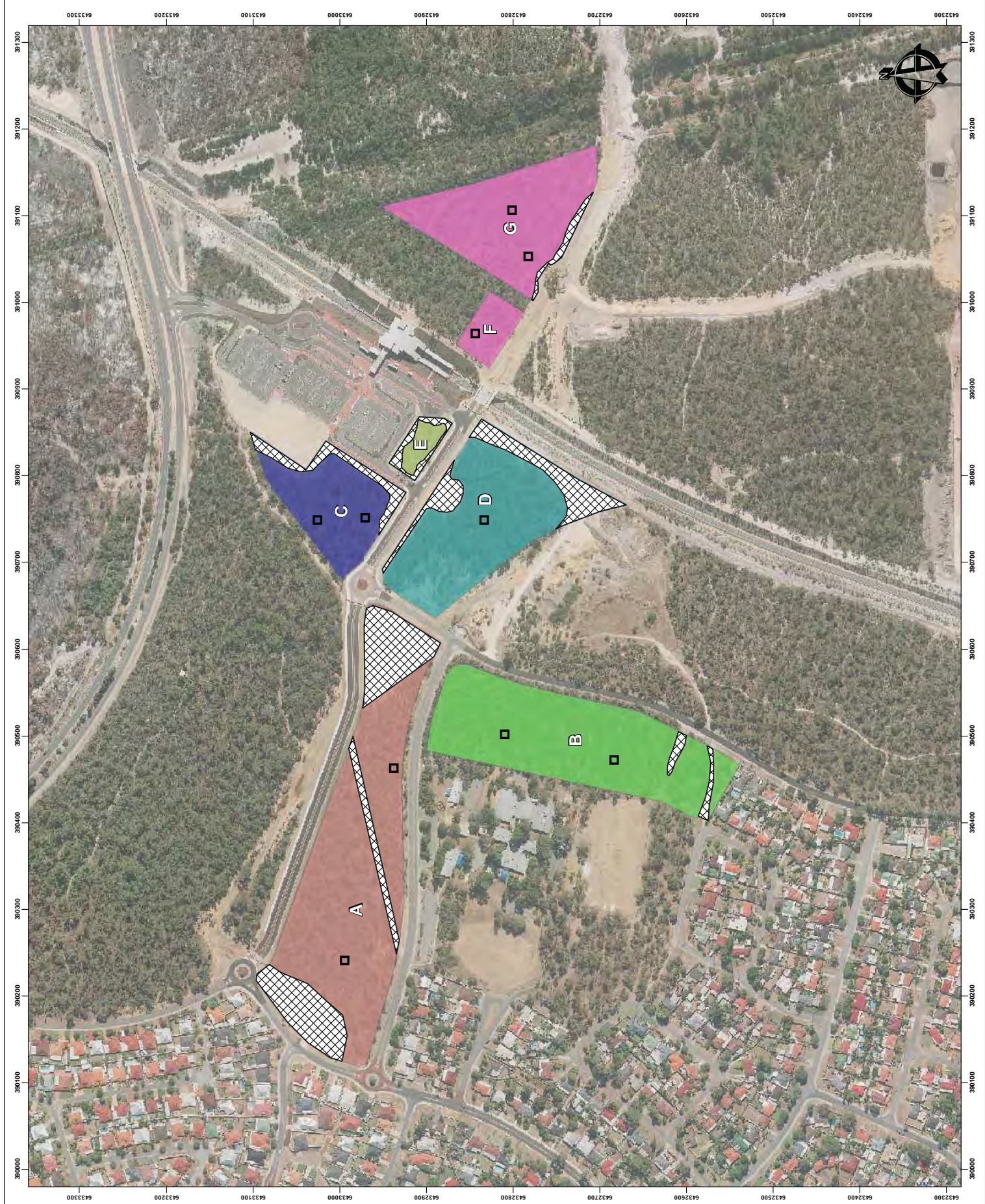


COPYRIGHT

THIS DOCUMENT IS THE PROPERTY OF THE ENVIRONMENTAL HERITAGE AND CONSERVATION DIVISION OF LANDGATE. IT IS TO BE USED ONLY FOR THE PURPOSES OF THE COASTAL 2007 SURVEILLANCE PROGRAM AND NOT FOR ANY OTHER PURPOSE.

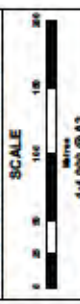
METADATA RECORDED	100%	PROJECTION	MGA ZONE 50
HORIZONTAL DATUM	GD494	HEIGHT DATUM	N/A
CREATED BY	GWb	CHECKED BY	APPROVED
DATE	25.02.09	REVISION	BP
DRAWING NO.	0	DRAWING NO.	583.02

ENVIRONMENTAL HERITAGE AND CONSERVATION DIVISION
 BERT TRAM
 Level 2 Flora and Vegetation Survey
 Figure 2



- Legend**
- Vegetation Condition
(Fractal Scale 10.00)
- Good
 - Poor
 - Very Poor

NOTE THAT POSITION FIXERS CAN BE USED TO CORRECT AERIAL PHOTO GRAPHS PRODUCED FROM LANDSAT 200 LOCALITY MAP SOURCE PRODUCTIONS (200)

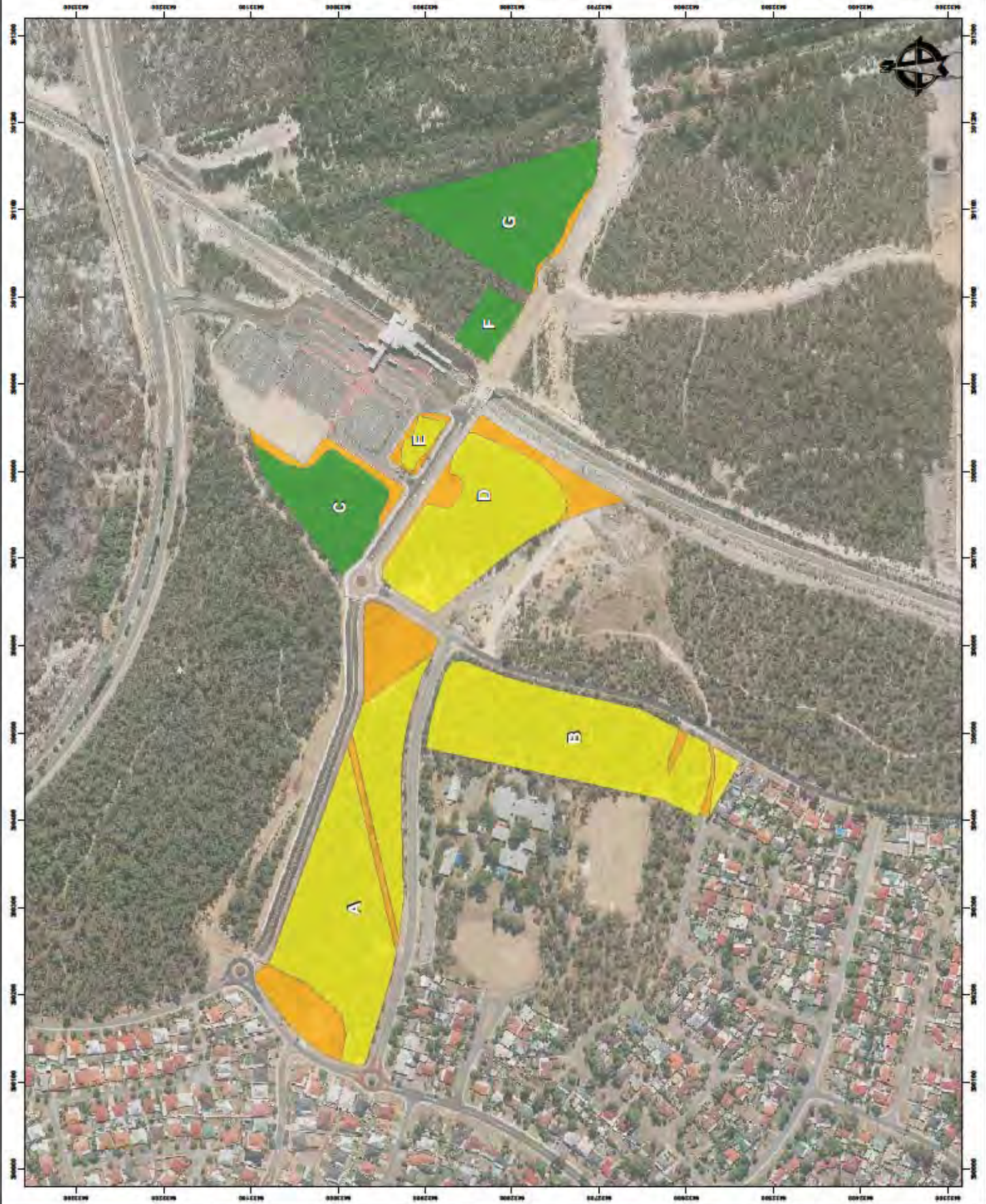


COPYRIGHT

THE GEOLOGICAL SURVEY OF SOUTH AFRICA AND THE SOUTH AFRICAN NATIONAL DEPARTMENT OF ENVIRONMENTAL AFFAIRS AND FORESTRY ARE NOT RESPONSIBLE FOR THE ACCURACY OF THE INFORMATION CONTAINED IN THIS DOCUMENT.

METADATA RECORDED	PROJECTION
100%	MCA ZONE 00
HORIZONTAL DATUM	HEIGHT DATUM
CGTM	N/A
CREATED BY	CHECKED BY
OWN	SP
DATE	REVISION
2012.00	0
	DRAWING NO.
	003.00

DNV / Bentley Property Group
BENTLEY
Level 27 Braam and Ngweniwaye Highway
Pretoria





Tables

**Table 1. Native plant species listed observed during the survey.**

Species	Author	Family	Study Area						
			A	B	C	D	E	F	G
<i>Acacia pulchella</i>	R.Br.	Mimosaceae	1	1	1	1	1	1	1
<i>Acacia saligna</i>	(Labill.) Wendl.	Mimosaceae	1	1	1				
<i>Acianthus reniformis</i>	(R.Br.)Schltr.	Orchidaceae	1		1			1	
<i>Adenanthos cygnorum cygnorum</i>	Diels	Proteaceae	1	1	1			1	1
<i>Agonis flexuosa</i>	(Willd.)Sweet	Myrtaceae		1	1				
<i>Allocasuarina fraseriana</i>	(Miq.) LAS .Johnson	Casuarinaceae	1	1	1	1			
<i>Anigozanthos humilis</i>	Lindl.	Haemodoraceae		1	1			1	1
<i>Astroloma pallidum</i>	R.Br.	Epacridaceae		1	1				1
<i>Banksia attenuata</i>	R.Br.	Proteaceae	1	1				1	1
<i>Banksia ilicifolia</i>	R.Br.	Proteaceae	1	1	1			1	
<i>Banksia menziesii</i>	R.Br.	Proteaceae	1	1	1			1	1
<i>Bossiaea eriocarpa</i>	Benth.	Fabaceae	1	1	1			1	1
<i>Burchardia umbellata</i>	R.Br.	Colchicaceae	1	1	1	1	1	1	1
<i>Caesia occidentalis</i>	R.Br.	Antheriaceae		1					1
<i>Caladenia discoidea</i>	Lindl.	Orchidaceae				1			
<i>Caladenia flava</i>	R.Br.	Orchidaceae	1	1	1	1		1	1
<i>Calandrinia corrigioloides</i>	F.Muell ex. Benth.	Portulacaceae			1	1	1		
<i>Calytrix angulata</i>	Lindl.	Myrtaceae	1			1			1
<i>Calytrix flavescens</i>	Cunn.	Myrtaceae						1	1
<i>Chamelaucium uncinatum</i>	Schauer	Myrtaceae		1	1				
<i>Conostylis aculeata</i>	R.Br.	Haemodoraceae	1		1			1	1
<i>Conostylis setigera</i>	R.Br.	Haemodoraceae		1	1				1
<i>Corymbia calophylla</i>	(Lindl.) KD Hill & L Johnson	Myrtaceae	1	1	1	1	1	1	1
<i>Corynotheca micrantha</i>	(Lindley) J.F. Macbride	Antheriaceae	1	1	1	1			1
<i>Dampiera linearis</i>	de Vriese	Goodeniaceae	1	1	1	1	1	1	1
<i>Dasyogon bromelifolius</i>	R.Br.	Dasyogonaceae	1	1	1			1	1
<i>Daviesia triflora</i>	M.D. Crisp	Fabaceae	1					1	1
<i>Desmocladius flexuosa</i>	(R.Br.)B.G.Briggs & L.A.A.Johnson	Restionaceae	1	1	1	1	1	1	1
<i>Dianella divaricata</i>	R.Br.	Phormiaceae		1	1				1
<i>Drosera erythrorhiza</i>	Lindl.	Droseraceae	1	1	1	1		1	1
<i>Drosera glanduligera</i>	Lehm.	Droseraceae			1			1	1
<i>Drosera menziesii</i>	R. Br. ex DC	Droseraceae		1	1			1	
<i>Dryandra lindleyana</i>	Meisn.	Proteaceae	1	1	1			1	1
<i>Elythanthera brunonis</i>	(Endl.)A.S.George	Orchidaceae	1	1	1			1	1



Species	Author	Family	Study Area						
			A	B	C	D	E	F	G
<i>Eryngium rostratum</i>	Cav.	Apiaceae	1	1		1	1		1
<i>Eucalyptus marginata</i>	Donn ex Smith	Myrtaceae	1	1	1	1	1	1	1
<i>Gastrolobium capitatum</i>	(Benth.) Chandler & Crisp	Fabaceae			1			1	1
<i>Gompholobium artistatum</i>	Benth.	Fabaceae		1	1			1	1
<i>Haemodorum spicatum</i>	R.Br.	Haemodoraceae	1		1			1	
<i>Hardenbergia comptoniana</i>	(Andrews) Benth.	Fabaceae	1	1	1	1			
<i>Hemiandra pungens</i>	R.Br.	Lamiaceae							1
<i>Hibbertia huegii</i>	(Endl.) F. Muell.	Dilleniaceae	1	1				1	
<i>Hibbertia rhadinopoda</i>	F.Muell.	Dilleniaceae		1	1			1	1
<i>Hybanthus calycinus</i>	(DC ex Ging.) F. Muell.	Violaceae	1	1	1	1	1	1	1
<i>Hypocalymma robustum</i>	(Endl.)Lindl.	Myrtaceae	1		1			1	1
<i>Jacksonia furcellata</i>	(Bonpl.)DC	Fabaceae		1	1			1	1
<i>Jacksonia sternbergiana</i>	Huegel	Fabaceae	1	1					1
<i>Johnsonia pubescens</i>	Lindl.	Antheriaceae						1	
<i>Kennedia prostrata</i>	R.Br.	Fabaceae	1		1			1	
<i>Kunzea glabrescens</i>	Tolken	Myrtaceae	1	1	1			1	1
<i>Lagenophora huegii</i>	Benth.	Asteraceae		1		1			1
<i>Laxmannia squarrosa</i>	Lindl.	Antheriaceae			1	1		1	
<i>Lepidobolus preissianus</i>	Nees.	Restionaceae	1						1
<i>Lepidosperma angustatum</i>	R.Br.	Cyperaceae		1	1				
<i>Lepidosperma longitudinale</i>	Labill.	Cyperaceae	1		1	1			1
<i>Leptospermum erubescens</i>	Schauer	Myrtaceae			1				1
<i>Leucopogon polymorphus</i>	Sonder	Epacridaceae	1						1
<i>Leucopogon propinquus</i>	R.Br.	Epacridaceae						1	
<i>Levenhookia stipitata</i>	(Sonder)F.Muell.	Stylidiaceae	1	1		1			1
<i>Loxocarya cinerea</i>	R.Br.	Restionaceae			1		1		
<i>Lyginia barbata</i>	R.Br.	Restionaceae		1				1	1
<i>Macarthuria australis</i>	Huegel ex Endl.	Molluginaceae	1	1				1	1
<i>Macrozamia riedlei</i>	(Gaudich.)Gardner	Zamiaceae		1	1			1	1
<i>Meeboldina coangustata</i>	(Nees.)Briggs&Johnson	Restionaceae			1				
<i>Melaleuca incana</i>	R.Br.	Myrtaceae		1					



Species	Author	Family	Study Area						
			A	B	C	D	E	F	G
<i>Mesomelaena pseudostygia</i>	(Kurek.)K.L.Wilson	Cyperaceae	1			1		1	
<i>Microtis unifolia</i>	(G.Forster)Reichb	Orchidaceae		1			1		
<i>Neurachne alopecuroides</i>	R.Br.	Poaceae	1	1	1		1	1	1
<i>Opercularia vaginata</i>	Labill.	Rubiaceae	1	1		1			1
<i>Patersonia occidentalis</i>	Lindl.	Iridaceae	1	1	1	1	1	1	1
<i>Petrophile linearis</i>	R.Br.	Proteaceae	1		1	1		1	1
<i>Philothea spicatus</i>	(ARich)P.Wilson	Rutaceae	1	1				1	1
<i>Phlebocarya ciliata</i>	R.Br.	Haemodoraceae	1		1			1	1
<i>Phyllanthus calycinus</i>	Labill.	Euphorbiaceae	1	1	1	1	1	1	1
<i>Pimelea imbricata</i>	R.Br.	Thymeleaceae	1	1	1			1	
<i>Pimelea sulphurea</i>	Meisn.	Thymeleaceae		1					1
<i>Podolepis gracilis</i>	(Lehm.)R.A.Graham	Asteraceae				1	1		1
<i>Podolepis lessonii</i>	(Cass.)Benth.	Asteraceae	1		1			1	
<i>Poranthera microphylla</i>	Brongn	Euphorbiaceae	1	1	1				1
<i>Pterostylis vitatta</i>	Lindl.	Orchidaceae	1			1			
<i>Ptilotus manglesii</i>	(Lindl.)F.Muell.	Amaranthaceae	1			1			
<i>Ptilotus polystachyus</i>	(Gaudich.) Muell.	Amaranthaceae	1	1	1	1			
<i>Scaevola canescens</i>	Benth.	Goodeniaceae		1	1	1			
<i>Scaevola phlebopetala</i>	F.Muell.	Goodeniaceae						1	1
<i>Schoenus grandiflorus</i>	(Nees.) F. Muell.	Cyperaceae			1				
<i>Siloxeros humifusus</i>	Labill.	Asteraceae	1		1	1	1	1	1
<i>Sowerbaea laxiflora</i>	Lindl.	Antheriaceae	1	1	1	1		1	1
<i>Stirlingia latifolia</i>	(R.Br.) Steudel	Proteaceae	1		1			1	1
<i>Stylidium brunonianum</i>	Benth.	Stylidiaceae							
<i>Stylidium calcaratum</i>	R.Br.	Stylidiaceae	1	1	1	1	1	1	1
<i>Stylidium carnosum</i>	Endl.	Stylidiaceae			1				
<i>Stylidium repens</i>	R.Br.	Stylidiaceae						1	1
<i>Stylidium schoenoides</i>	DC	Stylidiaceae		1	1			1	1
<i>Thysanotus manglesianus</i>	Kunth	Antheriaceae			1				1
<i>Thysanotus multiflorus</i>	R.Br.	Antheriaceae						1	
<i>Thysanotus sparteus</i>	R.Br.	Antheriaceae				1		1	1
<i>Trachymene pilosa</i>	Smith	Apiaceae	1	1	1	1	1	1	1
<i>Tricoryne elatior</i>	R.Br.	Antheriaceae			1			1	1
<i>Xanthorrhoea brunonis</i>	Endl.	Xanthorrhoeaceae		1	1			1	1
<i>Xanthorrhoea</i>	Endl.	Xanthorrhoeaceae	1	1	1			1	1



Species	Author	Family	Study Area						
			A	B	C	D	E	F	G
<i>preissii</i>									
<i>Xanthosia hueglijii</i>	(Benth.)Steudl.	Apiacea			1			1	1
<i>Xylomelum occidentale</i>	R.Br.	Proteaceae		1					
TOTAL			57	61	69	35	18	62	69

**Table 2. Exotic plant species list observed during the survey.**

Species	Author	Family	Study Area							
			A	B	C	D	E	F	G	
<i>Agave americana</i>	L.	Agavaceae		1						
<i>Aira caryophylloides</i>	L.	Poaceae	1		1					
<i>Anagalis arvensis</i>	L.	Primulaceae	1	1	1	1	1			
<i>Arctotheca calendula</i>	(L.) Levyns	Asteraceae	1	1	1	1	1			
<i>Asphodelus fistulosus</i>	L.	Asphodelaceae			1	1	1			
<i>Avena sativa</i>		Poaceae	1			1	1			
<i>Briza maxima</i>	L.	Poaceae	1	1	1	1	1			
<i>Briza minor</i>	L.	Poaceae	1							1
<i>Bromus diandrus</i>	Roth	Poaceae			1					
<i>Carpobrotus edulis</i>	(L.)N.E.Br.	Aizoaceae	1	1	1	1	1			
<i>Crassula glomerata</i>	P.J.Bergius	Crassulaceae	1	1	1	1	1			1
<i>Cyperus rotundus</i>	L.	Cyperaceae	1			1				
<i>Dimorphotheca ecklonius</i>		Asteraceae	1	1	1					
<i>Ehrharta calycina</i>	Smith	Poaceae	1	1	1	1	1	1	1	1
<i>Eragrostis curvula</i>	(Schrad.) Nees	Poaceae				1				
<i>Erodium moschatum</i>	(L.) L'Her.	Geraniaceae							1	
<i>Euphorbia terracina</i>	L.	Euphorbiaceae				1	1			
<i>Gladiolus caryophyllaceus</i>	(N.L. Burman) Poiret	Iridaceae	1	1	1	1	1	1	1	1
<i>Homeria flaccida</i>	Sweet	Iridaceae	1	1	1	1	1			
<i>Hordeum leporinum</i>	Link	Poaceae			1					
<i>Hypochoeris glabra</i>	L.	Asteraceae	1	1	1	1				
<i>Leptospermum laevigatum</i>	(Gaertn.)F.Muell.	Myrtaceae	1		1					
<i>Lolium perenne</i>	L.	Poaceae							1	
<i>Lupinus consentinii</i>	Guss.	Fabaceae	1	1	1	1	1			
<i>Orobanche minor</i>	Smith	Orobanchaceae	1	1			1			
<i>Pelargonium capitatum</i>	(L.) L'Her.	Geraniaceae	1	1	1	1	1			
<i>Petrorhagia velutina</i>	(Guss.)Bail.&Heywood	Caryophyllaceae	1	1	1	1	1	1	1	1
<i>Romulea rosea</i>	(L.) Ecklon	Iridaceae	1	1		1	1			
<i>Solanum linnaeanum</i>	Hepper & P.M.L.Jaeger	Solanaceae	1							
<i>Solanum nigrum</i>	L.	Solanaceae	1	1	1					
<i>Sonchus oleraceus</i>	L.	Asteraceae	1		1	1				
<i>Stenotaphrum secundatum</i>	(Walter)Kuntze	Poaceae	1		1					
<i>Tolpis barbata</i>	(L.)Gaertn.	Asteraceae		1			1			
<i>Trachyandra divaricata</i>	(Jacq.)Kunth	Asphodelaceae	1	1	1	1	1			
<i>Trifolium campestre</i>	Schreb	Fabaceae	1		1					1
<i>Trifolium hirtum</i>	All.	Fabaceae		1		1				
<i>Ursinia anthemoides</i>	(L.) Poiret	Asteraceae	1	1	1	1	1	1	1	1
<i>Wahlenbergia</i>	(L.)A.D.C.	Campanulaceae	1	1	1	1	1			



Species	Author	Family	Study Area						
			A	B	C	D	E	F	G
<i>capensis</i>									
TOTAL			28	22	25	23	20	6	7

Table 5. Conservation priority plant species within 5 km of the Bertram study area (DEC, 2008).

Species	Conservation Code
<i>Caladenia huegelii</i>	R
<i>Diuris micrantha</i>	R
<i>Drakaea elastic</i>	R
<i>Boronia juncea subsp. juncea</i>	P1
<i>Eremaea asterocarpa subsp. brachyclada</i>	P1
<i>Aotus cordifolia</i>	P3
<i>Cyathochaeta teretifolia</i>	P3
<i>Stylidium ireneae</i>	P3
<i>Aponogeton hexatepalus</i>	P4
<i>Dodonaea hackettiana</i>	P4
<i>Stylidium longitubum</i>	P4



Plates



Plate 2. *Allocasuarina fraseriana* – *Banksia attenuata* woodland (Area A).



Plate 3. Large dead *Banksias* are common at Area A.



Plate 4. Area A is criss-crossed by paths and tracks with associated weed invasion.



Plate 5. *Allocasuarina fraseriana* – *Banksia attenuata* woodland (Area B).



Plate 6. *Xylomelum occidentale* is a locally common tree in the woodland (Area B).



Plate 7. Localised disturbance (Area B).



Plate 8. *Banksia attenuata* – *Corymbia calophylla* woodland (Area C).



Plate 9. Open woodland with *Macrozamia riedlei* and *Conostylis* sp. being common understory species.



Plate 10. *Banksia attenuata* woodland (Area D).



Plate 11. Degraded *Corymbia calophylla* woodland (Area E).



Plate 12. *Banksia attenuata* – *Banksia menziesii* - *Allocasuarina fraseriana* woodland (Site F).



Plate 13. *Banksia attenuata* – *Banksia menziesii* - *Allocasuarina fraseriana* woodland (Area G).



Appendices



Appendix A

Criteria used for the field assessment of vegetation condition (Trudgen, 1988)



Table A1: Appendix 1 Criteria used for the field assessment of remnant vegetation condition (Trudgen, 1988).

Rating	Criteria
Very Good	Evidence of localised low level damage to otherwise healthy bush. Recruitment should be apparent. Weed and grazing damage is confined (<20% of area). Some modification to vegetation structure due to changes in fire regimes may be apparent. Little evidence of logging or fire wood collection.
Good	Evidence of localised high level damage to otherwise low-level damaged bush. Recruitment is localised and the populations of some species may be senescent. Weed and grazing damage is apparent in <50% of the area. Modification to vegetation structure due to changes in fire regimes may be apparent. Gall and mistletoe damage may be apparent. Evidence of logging or fire wood collection.
Poor	Widespread high level damage. Recruitment is disrupted and most woody species appear senescent. Weed and grazing damage may be apparent throughout the area. Modification to vegetation structure due to changes in fire regimes may be apparent. Locally some strata may be absent. Gall and mistletoe damage may be apparent. Evidence of logging or fire wood collection.
Very Poor	Widespread high level damage. Recruitment is disrupted and most woody species appear senescent. Weed and grazing damage may be apparent throughout the area. Modification to vegetation structure due to changes in fire regimes may be apparent. Widespread loss of vertical strata. Gall and mistletoe damage may be apparent. Evidence of logging or firewood collection.
Damage type	Description
High Level	Grazing (domestic and feral), logging, clearing and excavation, die-back, salinisation or other water table modification, road works, flower picking, major structures (eg. managed or fenced areas), mowing, car bodies.
Low Level	Dumping (household, garden etc.), minor structures (eg. sheds), fire wood collection, weed infestation, modified fire regime.

ATTACHMENT 2F



Level 1 Vertebrate Fauna Survey - Kwinana Town Centre

Prepared for:

Department of Housing/
Satterley Property Group

May 2012

● people ● planet ● professional

Document Reference	Revision	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
EBS165-3AB	INTERNAL DRAFT	AH	FD	-	24/05/12
EBS165-3AB	CLIENT REPORT	AH	Client	1 Electronic copy	30/05/12

Disclaimer

This report is issued in accordance with, and is subject to, the terms of the contract between the Client and 360 Environmental Pty Ltd, including, without limitation, the agreed scope of the report. To the extent permitted by law, 360 Environmental Pty Ltd shall not be liable in contract, tort (including, without limitation, negligence) or otherwise for any use of, or reliance on, parts of this report without taking into account the report in its entirety and all previous and subsequent reports. 360 Environmental Pty Ltd considers the contents of this report to be current as at the date it was produced. This report, including each opinion, conclusion and recommendation it contains, should be considered in the context of the report as a whole. The opinions, conclusions and recommendations in this report are limited by its agreed scope. More extensive, or different, investigation, sampling and testing may have produced different results and therefore different opinions, conclusions and recommendations. Subject to the terms of the contract between the Client and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating parts of this report is prohibited (except to the extent required by law) unless the report is produced in its entirety including this cover page, without the prior written consent of 360 Environmental Pty Ltd.

© Copyright 2012 360 Environmental Pty Ltd ACN 109 499 041

Table of Contents

Executive Summary	1
1 Introduction	4
1.1 Background	4
1.2 Existing Environment.....	4
1.3 Study Objectives.....	7
1.4 Scope of Work	7
1.5 Report Format	8
2 Methods	10
2.1 Desktop Study	10
2.2 Survey Timing and Weather	11
2.3 Fauna Survey Team.....	12
2.4 Fauna Habitat Assessment	12
2.5 Survey Locations.....	15
2.6 Site Design and Survey Effort.....	15
2.7 Survey Limitations.....	18
3 Results	20
3.1 Desktop Study	20
3.2 Fauna Survey and Fauna Assemblage	24
4 Conservation Significant Fauna	31
4.1 Threatened Fauna Statutory Framework	31
4.2 Threatened Fauna	34
5 Conclusion and Recommendations	42
5.1 Fauna Summary and Discussion	42
5.2 Recommendations.....	43
6 References	45
7 Report Limitations	47

List of Figures

Figure 1: Mean rainfall and temperature for Medina Research Station recorded between 1983 and 2012 (Bureau of Meteorology, 2012).....	5
Figure 2: Site location Overview	9
Figure 3: Broad Fauna Habitats	13
Figure 4: Significant Tree Survey Results	14
Figure 5: Fauna Survey Locations	17
Figure 6 Conservation Significant Fauna	41
Figure 7: IBRA Bioregions	49

List of Tables

Table 1: Database Sources	10
Table 2: Weather at Time of Survey.....	11
Table 3: Last Five Months of Rainfall (mm) Compared to Average (Medina weather station)	11
Table 4: Survey Location, Including GPS Location (GDA 1994) and Broad Habitat Type	15
Table 5: Limitations and Constraints.....	18
Table 6: Other Surveys in the Area	21
Table 7: Desktop Study Results.....	22
Table 8: Total Fauna	24
Table 9: Bird Species Recorded within Site	26
Table 10: Mammal species recorded within Project area	28
Table 11: Reptile species recorded within Project area	30
Table 12: EPBC Act Categories of Threatened Fauna Species	32
Table 13: WC Act Codes for Threatened Fauna	33
Table 14: DEC Priority Fauna Conservation Codes (DEC 2010).....	33
Table 15: Likelihood of predicted Conservation Significant species occurring in Project Area.....	35

List of Appendices

- Appendix A Interim Biogeographic Regionalisation of Australia Map
- Appendix B Site Location Plates
- Appendix C Environment Protection and Biodiversity Conservation Act 1999 Search
- Appendix D Naturemap Search
- Appendix E Department of Environment and Conservation Search

Executive Summary

Background

360 Environmental Pty Ltd (360 Environmental) was commissioned by Satterley Property Group on behalf of the Department of Housing to undertake baseline surveys for the Site (Kwinana Town Centre). The baseline survey included a Level 1 Vertebrate Fauna Survey. The survey area is approximately 36 hectares (ha) and is bounded by Gilmore, Challenger, Meares Avenues and Wellard Road. The majority of the Site is uncleared bushland. The Site is located in the Town of Kwinana, approximately 32 km south of Perth.

Methods

A total of ten (10) survey sites were established to assess four (4) broad fauna habitat types. Passive detection methods were implemented to identify all vertebrate fauna species across the Site. Emphasis was placed on detecting fauna species of Conservation Significance that may occur within the Site.

Results

Four broad fauna habitat types were identified within the Site. This included Jarrah-Banksia woodlands, Marri woodlands, Tuart woodlands and Limestone shrublands.

During the survey a total of twenty eight (28) bird species, six (6) mammal species, two (2) reptile species and zero (0) amphibians were recorded within the Site.

A desktop study revealed that twelve (12) bird, six (6) native mammal and five (5) reptile species currently listed as Conservation Significant under State and/or Commonwealth legislation and/or the Department of Environment and Conservation (DEC) Priority list were predicted to occur within the Site. One insect of Conservation Significance was also predicted to occur. Analysis of the data prior to the field survey suggested that two of these species may occur within the Site and two of the species were likely to occur within the Site.

During the reconnaissance survey the three species predicted as likely to occur within the Site (Black Cockatoo species and Quenda) were confirmed as being present on Site.

Below are the three species of Conservation Significance recorded at the Site:

- Canaby's Black Cockatoo (*Calyptorhynchus latirostris*) listed as Endangered;
- Forest red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) listed as Vulnerable; and
- Quenda (*Isoodon obesulus*) listed as a Priority 5 species.

Discussion

The fauna species and assemblage recorded at the Site were expected and generally representative for the area. No unexpected species were recorded. The current species list for this Site is not exhaustive and there are likely to be many more species present at the Site, particularly reptiles and bats. However a much higher survey intensity involving trapping techniques would need to be implemented at the Site to record many of these species and these techniques were outside of the scope of work for this report.

Generally, the fauna habitat at the Site is in good condition and provides significant fauna value with large older growth habitat trees such as Tuart, Marri, Jarrah and Banksia being present. Levels of annual weeds within the Site were relatively high at the time of the survey; this lowered the Site's overall condition. The isolated and fragmented nature of the Site does also remove some of the fauna value, with the Site being surrounded on all sides by residential housing. This is particularly true for ground dwelling species such as mammals and reptiles, as it is difficult for some species to persist within a Site of this size and furthermore it makes it difficult for new migrants to move into the area.

That being said it would appear Quenda still persist within the Site. It would be necessary to conduct species specific monitoring at the Site to assess the abundance of Quenda on the Site. As the Quenda is listed as Priority 5 it is only of Conservation Significance at a State level; it is not listed protected under Commonwealth legislation.

Both Carnaby's Black Cockatoo and the Red-tailed Black Cockatoo were recorded at the Site. Both species appeared to be utilising the Site for feeding, however this appeared relatively infrequent with mostly old evidence of feeding being recorded during the Black Cockatoo Survey (360 Environmental 2012). The Red-tailed Black Cockatoo is listed as Vulnerable under Commonwealth legislation and Schedule 1 at a State level. The Carnaby's Black Cockatoo is of greater Conservation Significance being listed as Endangered under Commonwealth legislation and Schedule 1 at a State level. Therefore significant effort should be implemented to minimise or mitigate the habitat clearing at the Site, particularly of the large habitat trees considered significant for the two Black Cockatoo species.

Recommendations

In summary, the recommendations include:

- Minimise the clearing of remnant native vegetation wherever possible. For example, previously disturbed areas should be used in preference to clearing remnant vegetation wherever possible;
- It is recommended that a Fauna removal specialist be engaged to trap for Quenda at the site to confirm their presence and to relocate the species from the Site prior to vegetation clearing. Trapping at the Site will require approval

from the Department of Environment and Conservation. Prior to the translocation taking place it will also be necessary to liaise with the local council to determine an appropriate location for the animals to be released;

- Implement a Flora and Fauna Management Plan for the Site for the clearing and construction period;
- Retain trees that display hollows where possible. These trees may be suitable for breeding of bird species and may become suitable for Black Cockatoo species over time (as the trees grow and the hollows increase in size). If clearing of trees with hollows is unavoidable, it is recommended that hollows are inspected prior to clearing to ensure that hollows are not currently occupied or in use;
- Consider offset of the impacts of clearing of habitat as a last resort after consideration of minimising and otherwise mitigating impacts. Offset could include the purchase of land containing appropriate habitat (including suitable Black Cockatoo habitat);
- Clear habitat in stages to allow fauna to disperse away from the Site; and
- Feral bee control could be implemented on Site to remove feral bees from the hollows of trees that remain on Site.
- It is suggested that no further fauna survey work will be required at the Site (with the exception of Quenda trapping and relocation). A Level 1 Vertebrate Fauna Survey should be sufficient for the Site.

1 Introduction

1.1 Background

360 Environmental Pty Ltd (360 Environmental) was commissioned to undertake a Level 1 Vertebrate Fauna Survey at Lot 26 Meares Avenue, Kwinana (the Site), known as Kwinana Town Centre (Figure 2). The Site is approximately 36 hectares in size and is bounded by Gilmore, Challenger, Meares Avenues and Wellard Road. The Site is composed of uncleared bushland. The vegetation within the survey area can be classified into four broad vegetation groups (360 Environmental 2006). These groups are Jarrah-Banksia woodlands; Tuart woodlands; Marri woodlands; and finally shallow limestone shrublands.

The Department of Housing/ Satterley Property Group has proposed the area be utilised for residential development.

1.2 Existing Environment

1.2.1 Bioregion

1.2.1.1 Site Location

The survey Site is approximately 36 hectares (ha) and is bounded by Gilmore, Challenger, Meares Avenues and Wellard Road, Kwinana. The majority of the Site is uncleared bushland.

1.2.1.2 Regional Context

The Site lies within the Swan Coastal Plain Interim Biogeographic Regionalisation of Australia (IBRA) Bioregion (Appendix A). The Swan Coastal Plain subregion is a low lying coastal plain, mainly covered with woodlands. It is dominated by Banksia or Tuart on sandy soils, *Casuarina obesa* on out-washed plains, and paperbark in swampy areas.

1.2.1.3 Climate

The climate is classified as Warm Mediterranean and rainfall ranges between 600 and 1,000 mm annually. The closest official Bureau of Meteorology (BoM) weather station currently operating is Medina Research Station where climate data is available between 1983 and 2012. The annual average rainfall at the Site is approximately 762.2 mm per annum (Based on annual average rainfall at Medina Research Station).

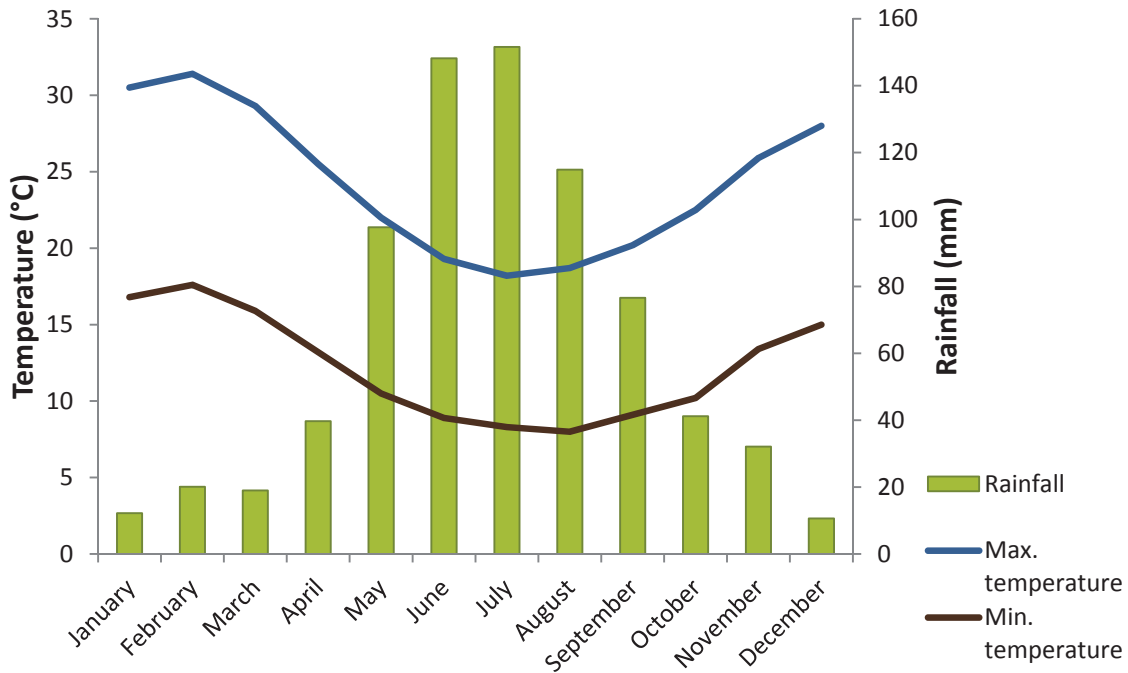


Figure 1: Mean rainfall and temperature for Medina Research Station recorded between 1983 and 2012 (Bureau of Meteorology, 2012).

1.2.1.4 Geology

The Site is located on the Spearwood Dune System. This consists primarily of coastal limestone (Town of Kwinana 2003). The sediment is composed of Quaternary deposits which are unconsolidated or lithified. The Spearwood dune system occurs within the Cottesloe and Karrakatta sands soil unit, which consists of calcareous sands (Bennett Environmental Consulting 2004). The predominant geology of the Site is limestone and calcrete (Department of Water 2012a).

1.2.1.5 Hydrology

The Site is located in the Serpentine River Catchment. This forms part of the Peel-Harvey Drainage Catchment (Cardno 2011). The sandy nature of the soils of this area result in good drainage of surface waters into the groundwater table (GHD 2007). The Perth Groundwater Atlas indicates that the ground water below the Site ranges between approximately five and 10 m below the ground surface (Department of Water 2012b). The major aquifers in the area which may have influences on the Site are Yarragadee North, Leederville, Superficial Swan and Rockingham Sand. These aquifers all have marginal salinity except Yarragadee which has brackish salinity (Department of Water 2012a).

1.2.2 Physical Environment

1.2.2.1 Soils and Landforms

The Kwinana area is located on the Spearwood Dune System (Town of Kwinana 2003). This system comprises red/brown, yellow and pale yellow/grey sands. Regional geological mapping identifies the Site as comprised of sand derived from Tamala Limestone (360 Environmental 2011). This features pale yellow brown, fine-to-coarse grained, sub-angular to well-rounded quartz, with high-to-medium permeability and contribute to groundwater infiltration. Site observations confirm the sandy nature of the soils (360 Environmental 2011). The Site currently features an undulating surface with existing ground levels ranging between approximately seven meters Australian Height Datum (AHD) and 13.5 mAHD (360 Environmental 2011).

1.2.3 Biological Environment

1.2.3.1 Flora and Vegetation

There are four broad vegetation groups present at the Site: Jarrah-Banksia woodlands; Marri woodlands; Tuart woodlands and shallow limestone shrublands. The Jarrah-Banksia vegetation units covered the largest part of the survey area. The Tuart woodlands include Jarrah and Banksia elements and are therefore closely related to the Jarrah-Banksia woodlands group (360 Environmental 2011). The vegetation of the area belongs to the Cottesloe Complex – Central and South vegetation unit (360 Environmental 2011). The vegetation condition on the Site was mostly in the range of 'Good' to 'Very Poor'. Some 'Completely Degraded' areas were also recorded. Small patches of vegetation in 'Very Good' condition also occurred. The main factor affecting the vegetation condition was weed cover. Some physical disturbance has occurred in various places on the Site (360 Environmental 2011).

1.2.3.2 Expected Fauna/ Habitat Assemblage

The vertebrate fauna of the Swan Coastal Plain, as a subset of the species assemblage found elsewhere in the southwest of Western Australia, recognized as being particularly historically diverse. This high species richness comprised some 176 avifauna species (excluding seabirds), 33 species of native mammals (28 non-volant and five bats) and 77 herpetofauna species. Of this total, populations of over half the birds have declined, with 13 considered to be extinct, and only ten of the 28 terrestrial mammals are still found. The primary threats that have led to, and are exacerbating, this decline include the clearing of native bushland, particularly wetlands, the associated encroachment of urban and industrial areas and the influence of feral predators.

Given the threats listed above, it is unsurprising that the results of the decline in native fauna on the Swan Coastal Plain is mostly keenly observed in the greater metropolitan area, although surrounding agricultural zones are also significant. Larger pockets of

remnant bushland may harbour the greatest number of species, although the value of smaller such areas cannot be overlooked, as they often contribute to the movement of animals through urban areas.

Fauna surveys in the Perth area therefore often yield reasonable numbers of avifauna, as they tend to be more active and obvious during the day. The potential for terrestrial vertebrates such as herpetofauna and mammals, which tend to be less easy to observe, to occur often relies on the veracity of habitat assessments. Where habitat assessments are considered to be insufficient, and often where fauna species of elevated Conservation Significance (protected either at State or federal administrative levels) are considered likely to occur, multiple phase Level 2 surveys may be required.

1.3 Study Objectives

The objectives of the Level 1 Vertebrate Fauna Survey were as follows:

- Provide an inventory of the fauna habitats and assemblage of the Site;
- To identify significant constraints associated with the faunal values within the Site;
- To assist the client with the evaluation of potential impacts on vertebrate fauna and/ or habitat of Conservation Significance; and
- Provide recommendations to mitigate fauna impacts.

1.4 Scope of Work

In order to achieve the objective, 360 Environmental undertook a Level 1 Vertebrate Fauna Survey for the Site. The scope of works for the fauna survey included a desktop study followed by a Site visit (Appendix B).

The purpose of the desktop study was to gather background information relevant to the Site by searching literature, data sources and map based information. The reconnaissance survey aimed to verify the accuracy of the desktop study delineate and characterise fauna and faunal assemblages present within the Site and identify potential impacts.

The Level 1 Vertebrate Fauna Survey was planned and implemented in accordance with the EPA *Position Statement No. 3 Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002) and *Guidance Statement No. 56 Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004). To ensure adequate data of a high standard the survey was conducted with reference to the *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA 2010) to meet the EPA and DEC's expectations for undertaking a Level 1 Vertebrate Fauna Survey.


1.5 Report Format

This Report has been structured in the following format:

- Section 1. Introduction;
- Section 2. Methods;
- Section 3. Results;
- Section 4. Conservation Significant Fauna;
- Section 5. Conclusion and Recommendations;
- Section 6. References; and
- Section 7. Report Limitations.



Legend

 Site Boundary

LOCALITY MAP



1:3,000 @ A3 

DRAWING ID: ED01/05-1.01 DATE: 18/04/2013

HORIZONTAL DATUM AND PROJECTION: GDA 1994 MGA Zone 50

CREATED TD	CHECKED AH	APPROVED AH	REVISION D

Department of Housing &atterley Property Group

Level 1 Vertebrate Fauna Survey
Kwinana Town Centre
Site Location



Figure 2

NOTE THAT POSITION BRAGAS CAN BE 400 METER ABOVE
NORMAL AND 200 METER BELOW NORMAL MAP 343
LOCALITY MAP SOURCE FROM GOOGLE EARTH

2 Methods

2.1 Desktop Study

A desktop review was undertaken to collect current data relevant to the Site and its surrounds. This involved a search of available literature and survey data, web based mapping tools and map-based information (Table 1). A desktop survey of species potentially occurring within the Site was performed using data from:

- Searches of the Department of Environment and Conservation (DEC) databases;
- Search of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters database;
- Search of the International Union for Conservation of Nature (IUCN) Red-list;
- Search of Birds Australia *Birdata database*;
- Various reference books (Wilson and Swan [2003]; Pizzey and Knight [1997]; Morcombe [2003]; Simpson and Day [1996]; Van Dyke and Strahan [2008]; Menkhorst and Knight [2004]); and
- Previous fauna survey's in the area.

All species of elevated Conservation Significance recorded or expected to occur on the Site were cross-checked against the Federal EPBC Threatened Matters Database (SEWPaC 2012a) and the Government Gazette Number 12 (Government of Western Australia 2010) for their status under the EPBC Act and *Wildlife Conservation Act 1950* (WC Act).

Table 1: Database Sources

PROVIDER	DATABASE	PARAMETERS
Department of Sustainability, Environment, Water, Population and Communities	Protected Matters Database Search Tool. Accessed 29 February 2012 (Appendix C)	Buffer of one kilometre from the area bounded by coordinates -32.2477, 115.81236, -32.2477, 115.81735, -32.25537, 115.81735, -32.25537, 115.81236, -32.2477, 115.81236
Department of Environment and Conservation	Naturemap (Appendix D)	Buffer of five kilometres centred around 32.250833, 115.814722.
Department of Environment and Conservation	Fauna Search (Appendix E)	Buffer of five kilometres centred around 32.250833, 115.814722.

2.2 Survey Timing and Weather

The primary objectives of the survey were to verify the presence, and provide Site-specific descriptions, of fauna habitats and verify the likelihood of the occurrence of EPBC Act and WC Act listed fauna species within the Site.

A reconnaissance survey was undertaken during the mornings of 21 March, 24 April and 21 May 2012 in accordance with the EPA's Guidance Statement 56 (EPA 2004).

Weather conditions during all survey days were warm and fine (Table 2). The survey was spread throughout autumn in an attempt to record the full fauna assemblage of the area, particularly post major rainfall event. The conditions throughout March and May were still relatively dry (Table 3).

Rainfall occurred on 29 April 2012 (40.8 mm) prior to the final survey trip.

Table 2: Weather at Time of Survey

DATE	MINIMUM TEMPERATURE (°C)	MAXIMUM TEMPERATURE (°C)	RAINFALL 24HRS TO 9AM (MM)	WEATHER
21/03/12	8.6	25.4	0.0	Fine, no cloud
24/04/12	12.2	26.4	0.0	Fine, Light cloud
21/05/12	8.6	25.4	0.0	Fine, no cloud

Table 3: Last Five Months of Rainfall (mm) Compared to Average (Medina weather station)

	JANUARY	FEBRUARY	MARCH	APRIL	MAY
Average (1983 - 2012)	12.1	20.1	18.3	40.3	97.7
Rainfall 2012	18.1	23.6	0.2	69.2	49 (to 23/5/12)

2.3 Fauna Survey Team

360 Environmental's Senior Environmental Scientist Andrew Hide coordinated and operated the field survey and was responsible for fauna identification and documentation during the survey. Andrew has appropriate tertiary qualifications and a minimum of five years of relevant field experience enabling him to competently satisfy EPA requirements for a Level 1 Vertebrate Fauna Survey.

2.4 Fauna Habitat Assessment

A Level 2 Flora and Vegetation survey was conducted at the Site in 2006 (360 Environmental 2006). The survey outlined four broad fauna habitat types recorded within the Site (Figure 3). The figure contains a detailed description of each habitat type. A brief description of each of the four broad fauna habitats is discussed below:

Jarrah-Banksia woodland

Composed primarily of Jarrah (*Eucalyptus marginata*), low open forest over *Banksia grandis* and *Banksia attenuata* low woodland over *Jacksonia furcellata*. The understorey consists of *Macrozamia riedlei* and *Xanthorrhoea preeissii*. In areas scattered Tuart (*Eucalyptus gomphocephala*) trees are present over the Jarrah.

Marri woodlands

Marri *Corymbia calophylla* woodland over *Jacksonia furcellata*, *Macrozamia riedlei* and *Xanthorrhoea preeissii*.

Tuart woodlands

Tuart woodland over Jarrah low open woodland over *Banksia grandis* and *Banksia attenuate* over *Jacksonia furcellata*, *Macrozamia riedlei* and *Xanthorrhoea preeissii*.

Limestone shrubland

Scattered Tuart trees over *Allocasuarina fraseriana* low open woodland over *Banksia attenuata* low woodland over *Jacksonia furcellata*, *Banksia sessilis* scattered tall shrubs. Contains open grassland and herbland.

A significant tree survey conducted in 2012 revealed the distribution of significant tree species, including Tuart, Jarrah, Marri, Banksia and Sheoak throughout the Site. The results of this survey are displayed in Figure 4.



- Legend**
- Site Boundary
 - Fauna Survey Locations



1:3,000 @ A3			
DRAWING ID ED01/05-1.01		DATE 18/04/2013	
HORIZONTAL DATUM AND PROJECTION GDA 1994 MGA Zone 50			
CREATED TD	CHECKED AH	APPROVED AH	REVISION 0
Department of Housing & Afterley Property Group			
Level 1 Vertebrate Fauna Survey Kwinana Town Centre Site Location			
Figure 2			

NOTE THAT POSITION BRINGS CAN BE 4M IN SOME AREAS
LOCAL AND REGIONAL PLANNING MAP 312
LOCALITY MAP SOURCE FROM LOCALITY MAP



Legend

- Carnaby's Black Cookatoo** Site Boundary
- CODE**
- Likely Quenda Digging Locations
 - Sighting Location
 - Feeding Location
- Red-tailed Black Cookatoo**
- CODE**
- Sighting Location
 - ▲ Feeding Location

LOCALITY MAP



1:3,000 @ A3

DRAWING ID ED01/05-1.01		DATE 18/04/2013	
HORIZONTAL DATUM AND PROJECTION GDA 1994 MGA Zone 50			
CREATED TD	CHECKED AH	APPROVED AH	REVISION 0

Department of Housing & afterley Property Group

**Level 1 Vertebrate Fauna Survey
Kwinana Town Centre
Site Location**

Figure 2

NOTE THAT POSITION BRINGS CAN BE 4M IN SOME AREAS
LOCAL AND REGIONAL PLANNING MAP 342
LOCALITY MAP SOURCE FROM LANDSAT 2004

2.5 Survey Locations

The Site reconnaissance survey was comprised of detailed habitat descriptions at specific survey locations as well as traversing the entire Site from length to length to cover all broad habitat types. Survey sites were chosen randomly to remove any bias in site locations and to allow adequate spread throughout the Site (Table 4; Figure 5). Efforts were made to incorporate each broad habitat type within a survey location. All broad fauna habitat types were surveyed during the transect walk throughout the Site. This involved walking up and down the entire length of the Site in order to cover all areas and increase the chance of opportunistically sighting fauna.

Table 4: Survey Location, Including GPS Location (GDA 1994) and Broad Habitat Type

SURVEY LOCATION	ZONE	GPS LOCATION			BROAD HABITAT
		EASTING	NORTHING	PLATE NO	
Site 1	50H	388512	6431248	Plate 1	Marri Woodland
Site 2	50H	388407	6430783	Plate 2	Jarrah-Banksia Woodland
Site 3	50H	388293	6430951	Plate 3	Completely degraded open habitat
Site 4	50H	388306	6431052	Plate 4	Jarrah-Banksia woodland fringing Marri Woodland
Site 5	50H	388285	6431348	Plate 5	Jarrah-Banksia woodland
Site 6	50H	388502	6431378	Plate 6	Marri Woodland
Site 7	50H	388395	6431175	Plate 7	Marri Woodland
Site 8	50H	388201	6430818	Plate 8	Jarrah-Banksia Woodland
Site 9	50H	388480	6430961	Plate 9	Jarrah-Banksia Woodland
Site 10	50H	388241	6431199	Plate 10	Jarrah-Banksia woodland fringing Limestone shrubland

2.6 Site Design and Survey Effort

2.6.1 Systematic Sampling

The principal component of this survey comprised a total of ten (10) systematic survey locations (Figure 5). Each survey location was recorded using a Differential Global Positioning System (DGPS). Survey sites were positioned randomly as such that they sampled all dominant fauna habitats available within the Site and without including bias to their location. Efforts were made to try and include the less dominant fauna habitat types however this was not always possible during the systematic sampling survey.

Sampling at each location involved a detailed fauna search for more than 30 minutes. Sampling was conducted early morning during peak fauna activity and involved searching within a two hectare area around the survey location. This survey method was primarily focused on avian species, but any other fauna species sighted, or any sign of fauna species was recorded. The nomenclature used to record the birds, mammals, amphibians and reptiles species observed within the Site is described below.

- Nomenclature for each bird species recorded was checked against Christidis and Boles (Christidis and Boles 2008);
- Nomenclature for each mammal species recorded was checked against the *Checklist of the mammals of Western Australia* (How et al. 2009);
- Nomenclature for each amphibian species recorded was checked against the *Checklist of the amphibians of Western Australia* (Doughty and Maryan 2010a); and
- Nomenclature for each reptile species recorded was checked against the *Checklist of the reptiles of Western Australia* (Doughty and Maryan 2010b).

Photos were taken at each survey location to provide a visual description of each survey location. Survey location plates are provided in Appendix B. These also give an indication of the habitat present at the Site.

2.6.1.1 Ornithological Survey

At each survey site, as part of the systematic survey, a dedicated bird survey was conducted to identifying bird species within a two hectare area. This involved experienced staff members recording all species seen and heard during peak bird activity for a minimum of 30 minutes per session. Peak bird activity was between sunrise and 9 am. Surveys were not conducted in the afternoon.

Opportunistic sightings of birds were also recorded at all times while traversing the Site.

2.6.2 Non-systematic Fauna Sampling

Within each broad fauna habitat type a non-systematic fauna search was conducted to identify and document additional species (sightings) as well as scats, tracks and diggings. The search involved detailed inspection of fauna habit within the Site such as inspecting leaf litter, rock crevices, potential burrows and nests over approximately two hectares per survey site. The search involved a minimum of 30 search minutes at each broad fauna habitat type and was also conducted opportunistically while walking transects throughout the area.

The survey transect of the Site involved walking throughout each broad fauna habitat at a slow observational pace in an attempt to observe all fauna utilising the habitat within the Site.

NOTE THAT PORTION BIRCHES OVERHANG SOME AREAS AT ALL PROPORTIONS. SOURCE: PROXY PHOTOGRAPHY 200. THESE WILDS ALSO SOURCE FROM SURVEY 200

SCALE
0 25 50 100 150 200
Metres
1:5,000 @A4

LOCALITY MAP

COPYRIGHT
THE INFORMATION ON THIS MAP IS THE PROPERTY OF THE ENVIRONMENTAL MANAGEMENT AUTHORITY. IT IS PROVIDED FOR THE PURPOSE OF THE REPORT AND FOR INFORMATIONAL PURPOSES ONLY. IT IS NOT TO BE USED FOR ANY OTHER PURPOSES WITHOUT THE WRITTEN PERMISSION OF THE ENVIRONMENTAL MANAGEMENT AUTHORITY.

META DATA RECORDED	PROJECTION	
100%	MGA ZONE 50	
HORIZONTAL DATUM	HEIGHT DATUM	
GDA94	NA	
CREATED BY	CHECKED BY	APPROVED
TD	MH	
DATE	REVISION	DRAWING ID
11.04.12	0	LD009-0.04

Legend

BATTERLEY PROPERTY GROUP
 Kwinana Town Centre Environmental Assessment
 Report
 Site Vegetation Units Surveyed During Spring 2006
 Figure 3



Jarrah-Banksia woodlands
 Em *Eucalyptus marginata* subsp. *marginata* low open forest over *Banksia grandis*, *Banksia attenuata* scattered low trees over *Jacaranda fasciculata* scattered tall shrubs over *Macrozamia riefkei*, *Acacia pulchella* scattered shrubs over *Gompholobium tomentosum*, *Hibbertia hypericoides* scattered low shrubs over *Lepidosperma squamatum* scattered sedge and **Ehrharta calycina* very open heathland.

EmBa *Eucalyptus gomphocephala* scattered trees over *Eucalyptus marginata* subsp. *marginata* low woodland over *Banksia attenuata*, (*Banksia grandis*) low woodland over *Jacaranda fasciculata* scattered tall shrubs over *Macrozamia riefkei* scattered shrubs to open shrubland over *Gompholobium tomentosum* scattered low shrubs over *Desmodium aspera*, *Lepidosperma squamatum* scattered sedge and **Ehrharta calycina* (perennial wild grass) open grassland to heathland.

EgEm *Eucalyptus marginata* subsp. *marginata*, *Allocasuarina lasiocarpa* low woodland over *Banksia attenuata*, *B. grandis* scattered low trees to low open woodland over *Jacaranda fasciculata* scattered tall shrubs over *Acacia pulchella*, *Macrozamia riefkei* scattered shrubs to open shrubland over **Ehrharta calycina* closed grassland with **Trifolium ampipetale*, **Lupinus blue* very open heathland.

EgM *Eucalyptus gomphocephala* scattered trees to open woodland over *Eucalyptus marginata* subsp. *marginata* low woodland over *Banksia attenuata*, *Allocasuarina lasiocarpa* low open woodland over *Jacaranda fasciculata* scattered tall shrubs over *Macrozamia riefkei*, *Acacia pulchella* scattered shrubs to open shrubland over *Macrozamia riefkei*, *Ancistrum praesal* open shrubland over *Hibbertia hypericoides*, *Gaeminiobium aspinatum* scattered low shrubs over *Lepidosperma squamatum*, *Desmodium aspera* very open heathland and *Conceyella aculeata* very open heathland.

Tussock woodlands
 Eg *Eucalyptus gomphocephala* woodland over *Eucalyptus marginata* subsp. *marginata* low open woodland to low woodland over *Banksia attenuata* (*Banksia grandis*) low open woodland over *Jacaranda fasciculata* scattered tall shrubs over *Ancistrum praesal* high open shrubland over *Macrozamia riefkei* and *Acacia pulchella* open shrubland over *Lepidosperma squamatum* scattered sedge and **Ehrharta calycina* grassland with *Conceyella aculeata* open heathland.

Mann woodlands
 Cc *Corymbia calophylla*, *Eucalyptus marginata* subsp. *marginata* woodland over *Jacaranda fasciculata* scattered tall shrubs over to high open shrubland over *Macrozamia riefkei*, *Ancistrum praesal* open shrubland over *Leucopogon ?* prop scattered low shrubs over *Lepidosperma squamatum* scattered sedge and **Ehrharta calycina* grassland.

Limestone shrublands
 Gv *Gravilea vesita* subsp. *vesita* heath over *Desmodium aspera* scattered sedge and *Conceyella aculeata* scattered heath with **Ehrharta calycina* grassland.

EgDa *Eucalyptus gomphocephala* scattered trees over *Dryandra reticulata* high shrubland to open scrub over *Jacaranda fasciculata* scattered tall shrubs over *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina* grassland with *Conceyella aculeata* very open heathland.

ADs (*Eucalyptus gomphocephala* scattered trees over) *Allocasuarina lasiocarpa* low open woodland over *Banksia attenuata* low woodland over *Jacaranda fasciculata*, *Dryandra reticulata* scattered tall shrubs over *Macrozamia riefkei* scattered shrubs over *Acacia pulchella*, *Pteris rosea*, *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina* grassland and *Conceyella aculeata*, **Trifolium ampipetale* very open heathland.

2.7 Survey Limitations

Table 5 addresses potential limitations and constraints associated with the Level 1 Fauna Survey. The following limitations have been addressed with reference to Guidance Statement 56 (EPA 2004).

Table 5: Limitations and Constraints

POTENTIAL LIMITATIONS	CONSTRAINT*	COMMENT
Competency and experience of the consultant (s) carrying out the survey	Negligible	The 360 Environmental staff member who completed the field work and prepared this report has appropriate training and experience in conducting Fauna Surveys.
Scope	Negligible	The purpose of a Level 1 Fauna Survey is to conduct a reconnaissance survey to support a desktop study of a particular site in order to compile an inventory of fauna habitats and species and to identify any fauna of elevated Conservation Significance within the proposed Project area.
Proportion of fauna identified, recorded and/ or collected	Negligible	As this is a Level 1 Fauna Survey a suitable amount of diversity has been recorded. A higher diversity of fauna species would require fauna trapping and is not within the scope of a Level 1 Fauna Survey.
Sources of Information	Negligible	Vertebrate fauna information was accessed by searching available literature and survey data; web based mapping tools and map-based information.
Proportion of the task achieved	Negligible	The field component fulfils EPA's requirements for a Level 1 Fauna Survey.
Timing/ weather/season/ cycle	Negligible	A total of three dedicated fauna survey visits were conducted throughout Autumn. The final survey was conducted following a significant rainfall event, increasing the chance of observing the full composition of fauna within the Site. The weather on all survey days was fine.
Disturbances which affected results of the survey	Negligible	Human disturbances are regular throughout the Site. However these are not recent disturbances and therefore would not have affected the survey results.
Intensity of survey effort	Negligible	The intensity of survey effort was sufficient for a Level 1 Fauna Survey.
Completeness	Negligible	The survey was completed in detail over three site visits and the relevant literature and data for the Site was reviewed. Further detail would require a Level 2 Fauna Survey.

POTENTIAL LIMITATIONS	CONSTRAINT*	COMMENT
Resources	Negligible	Adequate resources were available.
Remoteness and/or access problems	Negligible	Access to and within the Site was not an issue.
Availability of contextual information on the region	Negligible	360 Environmental had adequate access to fauna databases to determine which species were likely to be identified within the Survey area.

*Constraint (yes/ no); Significant – greater than 60%; Moderate – 20-60%; Negligible – less than 20%

3 Results

3.1 Desktop Study

3.1.1 Conservation Significant Fauna

A search of the DEC's Threatened and Priority Fauna Database, NatureBase and the EPBC Protected Matters Database search were undertaken to identify fauna species predicted to occur within a buffer of between one (1) and five (5) kilometres of the Site.

A total of one hundred and ten (110) bird species, nine (9) native terrestrial mammal species, thirty four (34) reptile species, six (6) amphibian species and five (5) invasive mammal species were identified as potentially occurring within the Site.

The desktop fauna list was used to determine specially protected fauna under State and/or Commonwealth legislation that may occur within the Site (Table 7).

Conservation Significant fauna predicted to occur in the area comprised a total of twelve (12) bird species, six (6) terrestrial mammal species and five (5) reptile species. One insect of Conservation Significance was also predicted to occur within the Site.

3.1.2 Previous Fauna Surveys

There have been a number of flora and fauna surveys conducted in the Kwinana area. A flora survey was conducted in 2004 by Bennett Environmental Consulting. This survey occurred at the Kwinana Beach area and no Declared Rare or Priority Flora were recorded during the survey (Bennett Environmental Consulting 2004). 360 Environmental conducted a flora survey at the project Site in 2006. No Declared Rare Flora species and no Priority Flora species were identified during the survey. None of the species recorded during the survey were considered of Conservation Significance (360 Environmental 2006). In 2008, Greg Harewood conducted a Level 1 Fauna survey in the East Rockingham area and found evidence of only one species of Conservation Significance, the southern brown bandicoot (Harewood 2008; Table 6). A Black Cockatoo Survey has also been conducted at the Site during 2009 and 2012 (360 Environmental 2009; 360 Environmental 2012).

Table 6: Other Surveys in the Area

	EAST ROCKINGHAM WWTP FAUNA ASSESSMENT	BLACK COCKATOO SURVEY KWINANA TOWN CENTRE
Consultant	Greg Harewood	Tony Kirkby
Duration	31 st July 2008	March 2009 and March 2012
Type	Level 1 Survey	Black Cockatoo Survey
Approx. Distance from Current Survey	10km	At Site
Total Trap Nights	N/A (reconnaissance survey)	N/A (reconnaissance survey)
Amphibians	0	-
Reptiles	3	-
Mammals	3	-
Birds	30	Carnaby's and Forest Red-tailed Black Cockatoo
Total species	36	-
Conservation Significant species recorded	Quenda (Southern Brown Bandicoot)	Carnaby's and Forest Red-tailed Black Cockatoo
No. Conservation Significant species	1	2
Duration	31 July 2008	19 March 2009; 21 March 2012

Table 7: Desktop Study Results

COMMON NAME	SCIENTIFIC NAME	INTERNATIONAL		FEDERAL		STATE	
		IUCN	EPBC	DEC	WCA		
Birds							
Australian Painted Snipe	<i>Rostratula australis</i>	Endangered	Vulnerable	Vulnerable	Schedule 1		
Carnaby's Black Cockatoo	<i>Calyptorhynchus latirostris</i>	Endangered	Endangered	Endangered	Schedule 1		
Cattle Egret	<i>Ardea ibis</i>		Migratory Marine, Migratory Wetland		Schedule 3		
Forest Red-Tailed Black Cockatoo	<i>Calyptorhynchus banksii naso</i>		Vulnerable	Vulnerable	Schedule 1		
Fork-Tailed Swift	<i>Apus pacificus</i>		Migratory Marine		Schedule 3		
Great Egret, White Egret	<i>Ardea alba</i>		Migratory Marine, Migratory Wetland		Schedule 3		
Malleefowl	<i>Leipoa ocellata</i>	Vulnerable	Vulnerable, Migratory Terrestrial	Vulnerable	Schedule 1		
Painted Snipe	<i>Rostratula benghalensis s. lat.</i>		Migratory Wetland		Schedule 3		
Rainbow Bee-Eater	<i>Merops ornatus</i>		Migratory Terrestrial		Schedule 3		
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>		Migratory Terrestrial		Schedule 3		
Mammals							
Chuditch	<i>Dasyurus geoffroi</i>	Near Threatened	Vulnerable	Vulnerable	Schedule 1		
Quenda	<i>Isodon obesulus subsp. fusciventer</i>			Priority 5			
Quokka	<i>Setonix brachyurus</i>	Vulnerable	Vulnerable	Vulnerable	Schedule 1		
Red-Tailed Phascogale	<i>Phascogale calura</i>	Near Threatened	Endangered	Endangered	Schedule 1		
Water Rat	<i>Hydromys chrysogaster</i>			Priority 4			
Western Brush Wallaby	<i>Macropus Irma</i>			Priority 4			
Reptiles							

COMMON NAME		SCIENTIFIC NAME	INTERNATIONAL IUCN	FEDERAL EPBC	DEC	STATE WCA
Lined Skink	Lerista lineata				Priority 3	
Rottnest Bobtail	Tiliqua rugosa subsp. konowi				Vulnerable	Schedule 1
Insects						
Graceful Sun Moth	<i>Synemon gratiosa</i>			Endangered		Schedule 1

3.2 Fauna Survey and Fauna Assemblage

The following section summarises the mammals, birds and herpetofauna recorded during the survey. Table 8 summarises the total species recorded during the survey. A more intensive survey including trapping (Level 2 Vertebrate Fauna Survey) would need to be implemented to complete a more comprehensive list for the Site.

Avifauna was recorded the most, as the species is much more active during the day and trapping techniques are usually required to survey the remaining fauna assemblages. Species abundance and diversity at the Site did not differ greatly between the broad habitat types and therefore did not have a significant impact on the fauna distribution at each survey location.

Table 8: Total Fauna

FAUNA GROUP	NUMBER SPECIES
Birds	28
Native Mammals	2
Introduced Mammals	4
Bats	0
Reptiles	2
Amphibians	0
Total	36

3.2.1 Avifauna

A total of 28 bird species were observed during the survey (Table 9), of the potential 110 predicted to occur in the area. Silvereye (*Zosterops lateralis*), Weebill (*Smicrornis brevirostris*), Western Gerygone (*Gerygone fusca*) and Australian Ringneck (*Barnardius zonarius*) were recorded most commonly throughout the Site. Several species were only recorded once, and two of these were identified by a call in the distance.

The Southern Boobook (*Ninox novaeseelandiae*) was recorded opportunistically during a significant tree survey at the Site during wet. The bird flushed from a tree and was observed perching in a Jarrah tree.

Grey Fantail (*Rhipidura albiscapa*), Scarlet Robin (*Petroica boodang*) and Splendid Fairy-wren (*Malurus splendens*) were not regularly sighted throughout the Site. However when they were present within an area they were very obvious.

What appeared to be Stubble Quail (*Coturnix pectoralis*) were observed on two occasions, however as the sighting was so brief it was difficult to confidently identify the species.

Location 1, 5, 6 and 9 recorded the most bird species. These locations were in the north north-east extent of the Site. Habitat within this area was denser and appeared to be of a higher quality.

3.2.1.1 Avifauna of Conservation significance

Fauna sightings were recorded in conjunction with a Black Cockatoo survey conducted during March, April and May. During this time two small flocks of Carnaby's Black Cockatoo were observed at the Site. One small flock was observed just outside the Site within a park to the west. The second small flock was observed just within the Site on a *Banksia attenuata* tree. A small flock of Forest Red-tailed Black Cockatoos were observed flying overhead and heard within the area (not within the Site) on several occasions. Feeding evidence of both Carnaby's Black Cockatoo and Forest Red-tailed Black Cockatoo were observed on Site by Tony Kirkby while conducting the specific Black Cockatoo survey.

Table 9: Bird Species Recorded within Site

COMMON NAME	SCIENTIFIC NAME	CONS SIG	LOC	LOC	LOC	LOC	LOC	LOC	LOC	LOC	LOC	LOC	LOC	LOC	LOC	LOC	OPP. RECORD	TOTAL
			1	2	3	4	5	6	7	8	9	10						
Australian Magpie	<i>Cracticus tibicen</i>		1	3	1						*						3	9
Australian Raven	<i>Corvus coronoides</i>		1	*	*				2		*						3	11
Australian Ringneck	<i>Barnardius zonarius</i>			3					2	2							4	16
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>							1									*	2
Brown Honeyeater	<i>Lichmera indistincta</i>										*							4
Carnaby's Black Cockatoo	<i>Calyptorhynchus latirostris</i>	Yes																6
Galah	<i>Eolophus roseicapillus</i>								3					2				11
Golden Whistler	<i>Pachycephala pectoralis</i>																*	1
Grey Butcher Bird	<i>Cracticus torquatus</i>							1	1								1	3
Grey Currawong	<i>Strepera versicolor</i>																*	1
Grey Fantail	<i>Rhipidura albiscapa</i>		1															2
Silvereye	<i>Zosterops lateralis</i>		5						5	5				2				10
Laughing Kookaburra	<i>Dacelo novaeguineae</i>							1					1	2				3
Little Corella	<i>Cacatua sanguinea</i>							5 [^]									3 [^]	8
Magpie-lark	<i>Grallina cyanoleuca</i>		*										1					1
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>																*	3
Red Wattlebird	<i>Anthochaera carunculata</i>			1									1				2	4
Red-capped Parrot	<i>Purpureicephalus spurius</i>											2	1				4	7
Red-tailed Black Cockatoo	<i>Calyptorhynchus banksii</i>	Yes							1							3	1	5
Rufous Whistler	<i>Pachycephala rufiventris</i>																4	8
Scarlet Robin	<i>Petroica boodang</i>																*	2
Singing Honeyeater	<i>Lichenostomus virescens</i>							1										1
Southern Boobook	<i>Ninox novaeseelandiae</i>			1														1
Splendid Fairy-wren	<i>Malurus splendens</i>		3						1									4
Stubble Quail	<i>Coturnix pectoralis</i>																	1 [#]
Weebill	<i>Smicrornis brevirostris</i>		3									2 [#]						3
Western Gerygone	<i>Gerygone fusca</i>		2	2					3	1							10	21
Yellow-rump thornbill	<i>Acanthiza chrysorrhoa</i>									2							3	15
Total Per Survey Location			17	4	7	7	7	18	33	12	3	17	8					3

* Indicates that the species was heard but not sighted

Indicates that the species was observed briefly and therefore identification is tentative

^ Species observed overhead (not utilising Site)

3.2.2 Mammals

A total of six mammals were recorded within the Site (Table 10). Most of these records were through tracks, scats and diggings at the Site. A total of two native mammal species were observed during the survey of a potential nine (9) predicted to occur in the area. Four introduced mammal species were recorded out of a predicted five (5).

Common Brush-tail Possum (*Trichosurus vulpecula*) scat was observed within three survey locations throughout the Site. Suitable hollows for the species were also observed throughout the Site. What appeared to be Quenda (*Isoodon obesulus*) diggings were observed at location 6 and 9. These diggings differ from that of Rabbit (*Oryctolagus cuniculus*) in that the digging ends in more of a point compared to the Rabbit which is usually more rounded. In order to gain an estimate evidence of Quenda abundance trapping would be required.

Signs of introduced mammal species were obvious throughout the Site. Dog (*Canis lupus*) and potentially Red Fox (*Vulpes vulpes*) prints were common throughout the Site. Presumably the dog prints are a result of residents walking dogs throughout the track network. Several scats that appeared to be Red Fox were observed within the Site. Rabbit diggings and a warren system at Location 7 were recorded at the Site. Feral cats (*Felis catus*) were sighted on two occasions as they were flushed from underneath bushes. It is possible they could be semi domesticated but are recorded as feral as they were taking refuge within the bush.

3.2.2.1 Mammals of Conservation Significance

Although no direct observations of the species were made (only diggings), the Quenda is listed as a Priority 5 species by the DEC and appears to be present at the Site.

Table 10: Mammal species recorded within Project area

COMMON NAME	SCIENTIFIC NAME	CONS SIG	LOC 1	LOC 2	LOC 3	LOC 4	LOC 5	LOC 6	LOC 7	LOC 8	LOC 9	LOC 10	OPP. RECORD	TOTAL	
Cat	<i>Felis catus</i>													2	2
Common Brushtail Possum	<i>Trichosurus vulpecula</i>			*						*		*			3
Dog	<i>Canis lupus</i>		*	*			*				*	*			6
Rabbit	<i>Oryctolagus cuniculus</i>								*						1
Red Fox?	<i>Vulpes Vulpes</i>										*				1
Quenda	<i>Isodon obesulus</i>	Yes						*			*				2
Total Per Survey Location			1	2	0	0	1	2	1	1	3	2			

* Indicates that only evidence of the species was observed (scats, tracks, diggings)

3.2.1 Herpetofauna

A total of two (2) species of reptile were observed during the survey (Table 11) of a potential 34 predicted to occur in the area. No amphibian species were recorded of a total six (6) predicted to occur in the area.

A Bobtail Lizard (*Tiliqua rugosa*) was observed within the Site at Location 8. Several small skink species were observed during the survey, these appeared to be *Menetia greyii*, however this could not be confirmed. This is expected for the Site without implementing more intensive methods such as pit and funnel trapping.

3.2.1.1 Herpetofauna of Conservation Significance

No species found on the Site were of Conservation Significance based on the protected lists under State or Commonwealth legislation or under the DEC's Priority list at the time of reporting.

Table 11: Reptile species recorded within Project area

COMMON NAME	SCIENTIFIC NAME	CONS SIG	LOC 1	LOC 2	LOC 3	LOC 4	LOC 5	LOC 6	LOC 7	LOC 8	LOC 9	LOC 10	OPP. RECORD	TOTAL
Bobtail Lizard	<i>Tiliqua rugosa</i>									1				1
Grey's Skink?	<i>Menetia greyii?</i>			#					#					2
Total Per Survey Location				1					1	1				

Indicates that the species was observed briefly and therefore difficult to identify

4 Conservation Significant Fauna

Four fauna species of Conservation Significance were recorded during the survey and a further 20 may be expected to occur on the basis of DEC, EPBC and other database searches.

One of the bird species observed within the Site is of international Conservation Significance based on the IUCN Red list, and is also protected by National and State legislation.

4.1 Threatened Fauna Statutory Framework

A total of twelve (12) bird species, six (6) native mammal species and five (5) reptile species, listed under State and/or Commonwealth legislation, are predicted to occur within the Site. No amphibians of Conservation Significance are predicted to occur within the Site. One insect species of Conservation Significance was recorded in the wider area during the desktop survey.

4.1.1 Key Statutory Requirements

Native fauna species that are rare, threatened with extinction, or have high conservation value are specially protected by law under the WC Act. In addition, many of these species are listed under the Commonwealth EPBC Act.

4.1.2 Federal Legislation

Fauna species are protected at a Federal level under the EPBC Act. The EPBC Act was developed to provide for the protection of the environment, with specific regard to those aspects of the environment that are matters of national environmental significance (MNES). The EPBC Act promotes the conservation of biodiversity through ecologically sustainable development practices and the ecologically sustainable use of natural resources.

The EPBC Act includes provisions to protect native species (and in particular prevent the extinction and promote the recovery of threatened species) and to ensure the conservation of migratory species protected under international agreements (Japan-Australia Migratory Bird Agreement [JAMBA], China-Australia Migratory Bird Agreement [CAMBA], Republic of Korea-Australia Migratory Bird Agreement [RoKAMBA]).

The significance levels for fauna used in the EPBC Act are those recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN). Table 12 outlines the categories of significance levels.

Table 12: EPBC Act Categories of Threatened Fauna Species

CONSERVATION CODE	CATEGORY
Ex	Extinct - Taxa not defiantly located in the wild during the past 50 years.
ExW	Extinct in the Wild - Taxa known to survive only in captivity.
CE	Critically Endangered - Taxa facing an extremely high risk of extinction in the wild in the immediate future.
E	Endangered - Taxa facing a very high risk of extinction in the wild in the near future.
V	Vulnerable - Taxa facing a high risk of extinction in the wild in the medium-term.
NT	Near Threatened - Taxa that risk becoming Vulnerable in the wild.
CD	Conservation Dependent - Taxa whose survival depends upon ongoing conservation measures. Without these measures. A conservation dependent taxon would be classified as Vulnerable or more severely Threatened.
DD	Data Deficient (Insufficiently Known) - Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.

4.1.3 State Legislation

Western Australia's biodiversity is supported and protected by the following legislation:

- The *Conservation and Land Management Act 1984* (CALM Act);
- The *Environmental Protection Act 1986* (EP Act);
- The WC Act;
- The *Wildlife Conservation Regulations 1970*; and
- The *Wildlife Conservation (Specially Protected Fauna) Notice 2010 (2)*.

The *Wildlife Conservation (Specially Protected Fauna) Notice 2010 (2)* describes categories for fauna classified as Specially Protected in a series of Schedules (Table 13). The DEC produces a supplementary list of Priority Fauna, being species that are not considered Threatened under the *WC Act* but for which the Department feels there is a cause for concern. These species have no special protection, but their presence would normally be considered as potentially significant and the species need further survey and evaluation of their conservation status before consideration can be given to declaration as Threatened Fauna. Levels of Priority are described in Table 14.

Table 13: WC Act Codes for Threatened Fauna

CONSERVATION CODE	CATEGORY
Schedule 1	Fauna that is rare or likely to become extinct are declared to be fauna that is in need of special protection.
Schedule 2	Fauna that is presumed to be extinct are declared to be fauna that is in need of special protection.
Schedule 3	Birds that are identified in the agreement between the governments of Australia and Japan relating to the protection of migratory birds, and birds in danger of extinction, are declared to be fauna that is in need of special protection.
Schedule 4	Fauna that is in need of special protection, otherwise than for the reasons mentioned (in Schedule 1 – 3).

Table 14: DEC Priority Fauna Conservation Codes (DEC 2010)

CONSERVATION CODE	CATEGORY
P1	Priority One Taxa with few, poorly known populations on threatened lands.
P2	Priority Two Taxa with few, poorly known populations on conservation lands. Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown Land, water reserves, etc.
P3	Priority Three Taxa which are known from few specimens or sight records, some of which are on lands not under immediate threat of habitat destruction or degradation.
P4	Priority Four Rare taxa. 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.
P5	Priority Five Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

4.1.4 International Agreements

The EPBC Act also includes management of migratory species that are recognised under international treaties such as the CAMBA, the JAMBA, RoKAMBA and *The Convention on the Conservation of Migratory Species of Wild Animals* (the Bonn Convention). Species included in these agreements are considered to be significant at the global level.

4.2 Threatened Fauna

4.2.1 Predicted Significant Fauna

An assessment was conducted to determine the likelihood of each of the predicted Conservation Significant species listed in Table 15 occurring within the Site. This involved determining background and habitat preference for each of the fauna species, along with the likelihood of each occurring within the Site (Table 15). Based on this information it was determined that there was a total of two predicted conservation species with a moderate possibility of occurring within the site. An additional two (2) predicted Conservation Significant species were determined as having a strong likelihood of occurring in the area. In total three of these species were observed (or their sign) during the Vertebrate Fauna Survey. This included:

- Carnaby's Black Cockatoo;
- Forest Red-tailed Black Cockatoo; and
- Quenda.

There was no evidence of the 'possible' Rainbow Bee-eater being present on Site at the time of the survey.

Table 15: Likelihood of predicted Conservation Significant species occurring in Project Area

SPECIES	CONSERVATION STATUS	PREFERRED HABITAT	EXTENT OF HABITAT IN THE STUDY AREA AND REGION	EXPECTED LIKELIHOOD OF OCCURRENCE
Birds				
Australian Painted Snipe (<i>Rostratula australis</i>)	IUCN: Endangered EPBC: Vulnerable WC: Schedule 1	Common in the south-west in swamps of the Swan Coastal Plain (Johnstone & Storr 1998). Inhabits shallow terrestrial freshwater wetlands (SEWPaC 2012b).	There are no swamps or water bodies present within the Site.	Unlikely
Carnaby's Black Cockatoo (<i>Calyptorhynchus latirostris</i>)	IUCN: Endangered EPBC: Endangered WC: Schedule 1	Forests, woodlands, heathlands, farms. It feeds on banksias, hakeas, dryandras (often on ground) and also exploits pine plantations (Morcombe 2003).	Banksia species are common throughout the Site. There is also the potential for breeding habitat with large Tuart, Jarrah and Marri trees throughout the Site.	Likely
Cattle Egret (<i>Ardea ibis</i>)	EPBC: Migratory Marine, Migratory Wetland WC: Schedule 3	Inhabits paddocks, pastures, croplands, wetlands, tidal mudflats and drains (Pizzey & Knight 1997). Occurs in tropical and temperate grasslands, woodlands and terrestrial wetlands (SEWPaC 2012b).	The Site does not contain any of the preferred habitat of the species, therefore it is unlikely the species will be present at the Site.	Unlikely
Forest Red-Tailed Black Cockatoo (<i>Calyptorhynchus banksii naso</i>)	EPBC: Vulnerable WC: Schedule 1	Inhabits dense Jarrah, Karri and Marri forests which receive more than 600mm of annual rainfall (SEWPaC 2012b). It feeds on the seeds of Marri and Jarrah fruits (SEWPaC 2012b)	Marri and Jarrah are common throughout the Site. There is also the potential for breeding habitat with large Tuart, Jarrah and Marri trees throughout the Site.	Likely
Fork-Tailed Swift (<i>Apus pacificus</i>)	EPBC: Migratory Marine WC: Schedule 3	This species occurs over open country, from semi-deserts to coasts. It sometimes occurs over forests (Pizzey & Knight 1997). This species most commonly occurs over inland plains (SEWPaC 2012b)	Due to its migratory nature this species could occur at the Site. However this is unlikely as the Site does not contain any of the species preferred habitat and is a significant distance from the coast.	Unlikely
Great Egret, White Egret (<i>Ardea alba</i>)	EPBC: Migratory Marine, Migratory Wetland WC: Schedule 3	Swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs (Pizzey and Knight 1997).	As the Site contains no wetlands it is unlikely that the species will be utilising the Site.	Unlikely

SPECIES	CONSERVATION STATUS	PREFERRED HABITAT	EXTENT OF HABITAT IN THE STUDY AREA AND REGION	EXPECTED LIKELIHOOD OF OCCURRENCE
Malleefowl (<i>Leipoa ocellaa</i>)	IUCN: Vulnerable EPBC: Vulnerable, Migratory Terrestrial WC: Schedule 1	Malleefowl occur within mallee, Acacia, paperbark, sheoak, and other scrubs; eucalypt woodland; coastal heaths; mostly on sand or gravel soils with abundant litter and low scrub (Pizzey and Knight 1997; Morcombe 2003).	The Site does not contain the species preferred habitat. Also as the species is primarily a ground dwelling bird it is unlikely to be present a Site surrounded by residential development. Therefore it is unlikely to be present at the Site.	Unlikely
Painted Snipe (<i>Rostratula benghalensis s. lat.</i>)	EPBC: Migratory Wetland WC: Schedule 3	Marsh with moderate cover (Simpson & Day 1996). This species inhabits shallow terrestrial freshwater wetlands (SEWPac 2012b).	As the Site contains no wetlands it is unlikely that the species will be utilising the Site.	Unlikely
Rainbow Bee-Eater (<i>Merops ornatus</i>)	EPBC: Migratory Terrestrial WC: Schedule 3	Occurs in open forests and woodlands, shrublands, sandridges, sandspits, riverbanks, mangroves and in various cleared or semi-cleared habitats, including farmland and areas of human habitation (Higgins 1999).	The Site does not contain any of the preferred habitats of the species. However due to its indifference to habitat types there is a chance it may occur within the Site. However the proposed activity at the Site is unlikely to negatively impact the species.	Possible
White-bellied Sea-Eagle (<i>Haliaeetus leucogaster</i>)	EPBC: Migratory Terrestrial WC: Schedule 3	This species occurs mainly around coasts, islands, estuaries, inlets, large rivers, inland lakes and reservoirs (Pizzey and Knight 1997). This species is also found around terrestrial wetlands in tropical and temperate regions (SWEPA 2012b).	As the Site is not located next to the coast, nor contains any significant water bodies it is unlikely the species will be present or utilising the Site.	Unlikely
Mammals				
Chuditch (<i>Dasyurus geoffroi</i>)	IUCN: Near Threatened EPBC: Vulnerable WC: Schedule 1	This species is able to exist in a variety of environments from denser eucalypt forests and open woodlands to sparser, semi-arid and low-lying scrub (Van Dyck & Strahan 2008). The only remaining habitat suitable for supporting Chuditch numbers is through the cooler south-west corner of the state, in areas with significant concentrations of prey and sufficient logs and hollows for	The Site contains the species preferred habitat and during pre-European settlement the species would likely have occurred at the Site. However due to significant threats on the species such as land clearing and predation by feral species such as the Red Fox and Feral Cat the species is likely to have become extinct at the Site. In addition the lack of	Unlikely

SPECIES	CONSERVATION STATUS	PREFERRED HABITAT	EXTENT OF HABITAT IN THE STUDY AREA AND REGION	EXPECTED LIKELIHOOD OF OCCURRENCE
		nests (Van Dyck & Strahan 2008).	contiguous habitat makes it difficult for the species to survive at the Site or to re-establish at the Site. Therefore although there is a possibility the species is present at the Site it is unlikely.	
Quenda (<i>Isodon obesulus subsp. Fusciventer</i>)	DEC: Priority 5	This species inhabits heathy forest, heath, and coastal scrub (Menkhorst & Knight 2004). The southern brown bandicoot often feeds in forest and woodland that is burnt on a regular basis and also in areas of pasture and cropland adjacent to dense cover.	The Quenda still in habitats remnant vegetation within the outer Perth suburbs. Although the habitat at the Site is not it's preferred habitat it is more than suitable for feeding. The surrounding urban properties are likely to keep Red Fox numbers down and therefore allow the species a chance to survive. Therefore there is a possibility the species is present at the Site.	Possible
Quokka (<i>Setonix brachyurus</i>)	IUCN: Vulnerable EPBC: Vulnerable WC: Schedule 1	This species requires wet ground cover in forest or swampy flats (Menkhorst & Knight 2004). The Quokka is also found in heaths and shrublands (SEWPaC 2012b).	The Site does not contain the preferred habitat for the species. In addition the lack of contiguous habitat at the Site is likely to inhibit the species survival at the Site. Therefore it is unlikely the species will be present at the Site.	Unlikely
Red-Tailed Phascogale (<i>Phascogale calura</i>)	IUCN: Near Threatened EPBC: Endangered WC: Schedule 1	This species is found in woodland habitats in south and central Australia. It is restricted to areas containing mature wandoo or rock oak woodland (Menkhorst & Knight 2004). This species requires hollow-containing eucalyptus trees for breeding (SEWPaC 2012b).	The Site does not contain the species preferred habitat. In addition the Site is well outside the species known distribution. Therefore it is unlikely the species will be present at the Site.	Unlikely
Water Rat (<i>Hydromys chrysogaster</i>)	DEC: Priority 4	The water rat inhabits a wide variety of aquatic habitats including subalpine streams, slow inland rivers, lakes and farm dams (Menkhorst & Knight 2004). This species requires the presence of water.	There are no aquatic habitats present at the Site. Therefore it is unlikely the species will be utilising the Site.	Unlikely
Western Brush Wallaby (<i>Macropus irma</i>)	DEC: Priority 4	This species inhabits dry sclerophyll forest and woodland in the south-west of Western Australia, including some mallee areas (Menkhorst & Knight 2004). The preferred habitat type for this species is open forest or woodland.	The Site contains preferred habitat of the species. However due to the nature of the site (small Site enclosed by residential housing and roads) it is unlikely the species will be present at the Site.	Unlikely

SPECIES	CONSERVATION STATUS	PREFERRED HABITAT	EXTENT OF HABITAT IN THE STUDY AREA AND REGION	EXPECTED LIKELIHOOD OF OCCURRENCE
Reptiles				
Lined Skink (<i>Lerista lineata</i>)	DEC: Priority 3	This species is found on the lower west coast of Western Australia. It inhabits areas containing white sands Storr et al. 1999). Its preferred habitat is sandy coastal heath and shrubland (Wilson & Swan 2003).	The Site does not contain any sandy coastal heath or shrublands therefore it is unlikely the species will be utilising the Site.	Unlikely
Rottnest Bobtail (<i>Tiliqua rugosa</i> subsp. <i>konowi</i>)	WC: Schedule 1	<i>Tiliqua rugosa</i> are found in dry to arid areas of southern Australia in open mallee woodlands, shrublands and coastal dunes. This subspecies is found on Rottnest Island (Wilson & Swan 2003).	As the Site is not located on Rottnest Island it is unlikely the species will be present at the Site.	Unlikely
Insects				
Graceful Sun Moth (<i>Symemon gratiosa</i>)	EPBC: Endangered WC: Schedule 1	The graceful sun moth is found in coastal heathland and <i>Banksia</i> woodland. This species is dependent on its host plants, <i>Lomandra hermaphrodita</i> and <i>Lomandra maritima</i> for survival (SEWPaC 2012b).	Lomandra species are present at the Site, therefore it is possible the species utilises the Site. A Graceful Sun Moth (GSM) survey conducted at the Site in 2010 did not record the species. Therefore it is unlikely the species is present at the Site.	Unlikely

4.2.2 Recorded Significant Fauna

Feeding evidence and sightings of both Carnaby's Black Cockatoo (Listed as Endangered/ Schedule 1) and Forest Red-tailed Black Cockatoo (Listed as Vulnerable/ Schedule 1) were made at the Site. This data was observed during a Black Cockatoo survey conducted during a similar time as the Level 1 Vertebrate Fauna Survey. Detailed findings of the Black Cockatoo Survey are presented within the Black Cockatoo report (360 Environmental 2012).

Evidence of Quenda being present at the Site was observed (diggings).

4.2.3 Migratory Species

The Cattle Egret (*Ardea ibis*), Fork-tailed Swift (*Apus pacificus*), the Great Egret (*Ardea alba*), Painted Snipe (*Rostratula australis*), the Rainbow Bee-eater (*Merops ornatus*) and White-bellied Sea-eagle (*Haliaeetus leucogaster*) are listed as Migratory species under the EPBC Act. The EPBC Database search suggested that these species or their habitat are potentially present at the Site, however inspection of the Site during the reconnaissance survey suggested there was a lack of preferred habitat making their presence at the site unlikely).

The Cattle Egret inhabits moist pastures with tall grass; shallow open wetlands and margins, mudflats (Morcombe 2003).

The Fork-tailed Swift is found over open country, from semi desert to coasts, islands, occasionally over forests and cities (Pizzey and Knight 2002).

The Great Egret has been recorded in a wide range of wetland habitats. These include swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs (Pizzey and Knight 2002).

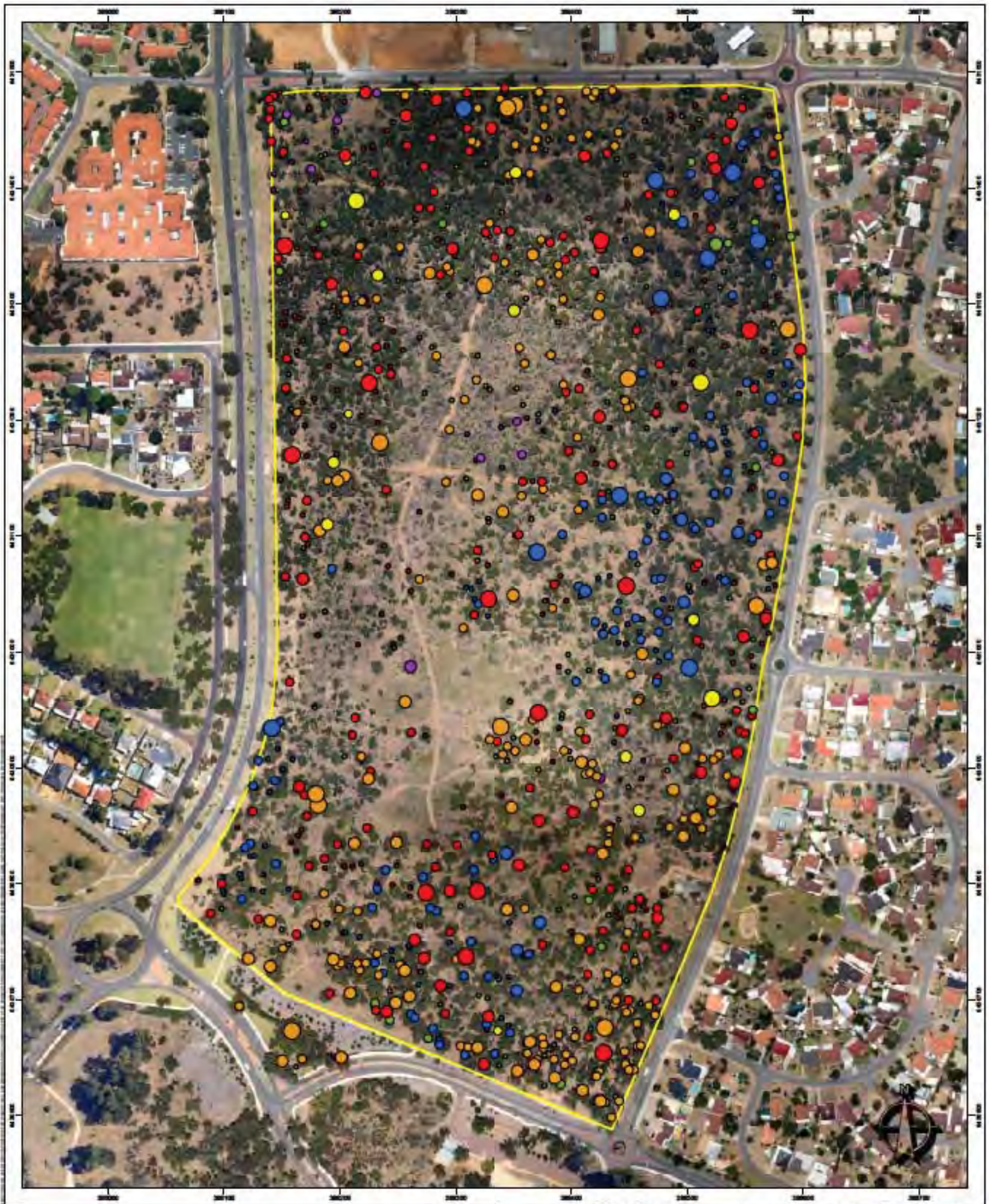
Painted Snipe inhabits surrounds and shallows of wetlands that are well vegetated and contain dense low cover (Morcombe 2003).

The Rainbow Bee-eater has been recorded in open woodlands with sandy loamy soil; sand ridges, sandpits, riverbanks, road cuttings, beaches dunes, cliffs mangroves, rainforests, woodlands and golf courses (Pizzey and Knight 2002).

White-bellied Sea Eagle usually occurs within coastal areas, over islands, reefs, headlands, beaches, bays, estuaries, mangroves, seasonally flooded inland swamps, lagoons and floodplains. It is often found far inland on large pools of major rivers (Morcombe 2003).

Based on these species' widespread distributions and aerial behaviour over a wide variety of habitats, there is potential for these species to be recorded within the Project

area. Conversely, as a result of their wide distribution and indifference to a wide variety of habitats it is considered that clearing on the Site is unlikely to have a significant impact on the species. The proposed area to be cleared is small and therefore is unlikely to impact the conservation status of these migratory species.



Legend

- | | |
|---|---|
|  Site Boundary | Species |
| Trunk Diameter (mm) |  Banksia |
|  400 - 500 |  Jarrah |
|  500 - 600 |  Mann |
|  600 - 1200 |  Sheoak |
|  >1200 |  Stag |
| |  Tuart |

LOCALITY MAP



1:3,000 @ A3

DRAWING ID ED01/05-1.03		DATE 10/05/2013	
HORIZONTAL DATUM AND PROJECTION GDA 1994 MGA Zone 50			
CREATED JJ	CHECKED AH	APPROVED AH	REVISION 0

Department of Housing &atterley Property Group

Level 1 Vertebrate Fauna Survey
Kwinana Town Centre
Significant Tree Results
from Black Cookatoo Survey
Figure 4



NOTE THAT POSITION ERRORS CAN BE ±40 M IN SOME AREAS
LOCAL AND REGIONAL PLANNING AND DESIGN MAP 342
LOCALITY MAP SOURCE FROM LOCALITY MAP 342

5 Conclusion and Recommendations

5.1 Fauna Summary and Discussion

Database searches for the Site revealed that a total of 23 species of Conservation Significance are predicted to occur within the Site. This was composed of twelve (12) bird species, six (6) native mammal species and five (5) reptile species, listed under State and/or Commonwealth legislation. No amphibians of Conservation Significance are predicted to occur within the area. One insect species of Conservation Significance, the Graceful Sun Moth was predicted to occur within the Site. A Graceful Sun Moth (GSM) survey conducted at the Site in 2010 did not record the species. Therefore it is unlikely the species is present at the Site and should not require further survey work.

A desktop study of the data revealed that there is a possibility that two species may occur within the Site, based on habitat and location, and that two Conservation Significant species were likely to be present at the Site. A reconnaissance Site visit revealed that the Carnaby's Black Cockatoo and Forest Red-tailed Black Cockatoo were present at the Site and appeared to be utilising the location. It also appeared that Quenda were utilising the Site with two observations of diggings that appeared to be made by Quenda.

In addition to the Level 1 Vertebrate Fauna Survey a Black Cockatoo survey has also been conducted at the Site during early 2012. This revealed that both Carnaby's Black Cockatoo and Forest Red-tailed Black Cockatoo are utilising the Site to an extent for feeding and were sighted within the area.

The fauna and fauna assemblage recorded at the Site was expected and generally representative for the area. No unexpected species were recorded. The current species list for this Site is not exhaustive and there are likely to be many more species present at the Site, particularly reptiles and bats. However a much higher survey intensity involving trapping techniques would need to be implemented at the Site to record many of these species. Surveying the Site in spring is also likely to yield a greater fauna records. A reconnaissance survey in spring was not essential with many of the species expected to be in the area being recorded.

Generally, the fauna habitat at the Site is in good condition and provides significant fauna value with large older growth habitat trees such as Tuart, Marri, Jarrah and Banksia being present. Levels of annual weeds within the Site were relatively high at the time of the survey; this lowered the Site's overall condition. The isolated and fragmented nature of the Site does also remove some of the fauna value, with the Site being surrounded on all sides by residential housing. This is particularly true for ground dwelling species such as mammals and reptiles, as it is difficult for some species to persist within

a Site of this size and furthermore it makes it difficult for new migrants to move into the area.

That being said it would appear Quenda still persist within the Site. It would be necessary to conduct species specific monitoring at the Site to assess the abundance of Quenda on the Site. As the Quenda is listed as Priority 5 it is only of Conservation Significance at a State level; it is not listed protected under Commonwealth legislation.

Both Carnaby's Black Cockatoo and the Red-tailed Black Cockatoo were recorded at the Site. Both species appeared to be utilising the Site for feeding, however this appeared relatively infrequent with mostly old evidence of feeding being recorded during the Black Cockatoo Survey (360 Environmental 2012). The Red-tailed Black Cockatoo is listed as Vulnerable under Commonwealth legislation and Schedule 1 at a State level. The Carnaby's Black Cockatoo is of greater Conservation Significance being listed as Endangered under Commonwealth legislation and Schedule 1 at a State level. Therefore significant effort should be implemented to minimise or mitigate the habitat clearing at the Site, particularly of the large habitat trees considered significant for the two Black Cockatoo species.

5.2 Recommendations

In summary, the recommendations include:

- Minimise the clearing of remnant native vegetation wherever possible. For example, previously disturbed areas should be used in preference to clearing remnant vegetation wherever possible;
- It is recommended that a Fauna removal specialist be engaged to trap for Quenda at the site to confirm their presence and to relocate the species from the Site prior to vegetation clearing. Trapping at the Site will require approval from the Department of Environment and Conservation. Prior to the translocation taking place it will also be necessary to liaise with the local council to determine an appropriate location for the animals to be released;
- Implement a Flora and Fauna Management Plan for the Site for the clearing and construction period;
- Retain trees that display hollows wherever possible. These trees may be suitable for breeding of bird species and may become suitable for Black Cockatoo species over time (as the trees grow and the hollows increase in size). If clearing of trees with hollows is unavoidable, it is recommended that hollows are inspected prior to clearing to ensure that hollows are not currently occupied or in use;
- Consider offset of the impacts of clearing of habitat as a last resort after consideration of minimising and otherwise mitigating impacts. Offset could

include the purchase of land containing appropriate habitat (including suitable Black Cockatoo habitat);

- Clear habitat in stages to allow fauna to disperse away from the Site; and
- Feral bee control could be implemented on Site to remove feral bees from the hollows of trees that remain on Site.
- It is suggested that no further fauna survey work will be required at the Site (with the exception of Quenda trapping and relocation). A Level 1 Vertebrate Fauna Survey should be sufficient for the Site.

6 References

- 360 Environmental 2006. Kwinana Town Centre. Spring Flora Survey.
- 360 Environmental 2011. Lots E26, 303 and 9014 Gilmore Avenue, Kwinana. Environmental Assessment Report.
- 360 Environmental 2012. Black Cockatoo Survey – Kwinana Town Centre.
- Bennett Environmental Consulting Pty Ltd 2004. Flora Assessment of Proposed Perth Seawater Desalination Plant Kwinana.
- Bureau of Meteorology 2012. Climate Data Online. Accessed 29 February 2012, <http://www.bom.gov.au/climate/data/>
- Christidis and Boles 2008, Checklist of Bird species.
- Department of Water 2012a. Hydrogeological Atlas. Available from: <http://www.water.wa.gov.au/idelve/hydroatlas/loiQuery.jsp?ts=1330504521115&d=hydroatlas&bb=115.8079555441048,-32.2578048,115.8227261558952,-32.2462802&k=NONE&w=587&h=458&z=8388.298375546936&x=115.81452305633188&y=-32.25123728777293&i=261&j=197> Accessed 29 February 2012
- Department of Water 2012b. Perth Groundwater Atlas Available from: <http://www.water.wa.gov.au/idelve/gwa/> Accessed 29 February 2012
- Doughty, P. and Maryan, B. 2010a. Checklist of the Amphibians of Western Australia. Department of Terrestrial Zoology, Western Australian Museum, Welshpool, Western Australia.
- Doughty, P. and Maryan, B. 2010b. Checklist of the Reptiles of Western Australia. Department of Terrestrial Zoology, Western Australian Museum, Welshpool, Western Australia.
- Environmental Protection Authority 2002. Terrestrial Biological Surveys as an Element of Biodiversity Protection. Government of Western Australia
- Environmental Protection Authority 2004. Guidance for the Assessment of Environmental Factors No 56, Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia. Government of Western Australia
- Environmental Protection Authority 2010. Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment. Government of Western Australia
- GHD 2007. Department for Planning & Infrastructure. Report for Kwinana Intermodal Terminal.
- Government of Western Australia 2010. Wildlife Conservation (Specially Protected Fauna) Notice 2010(2), in Government Gazette, WA, available online at: <http://www.dec.wa.gov.au/content/view/full/852/2010/> accessed 10 January 2012

- Harewood, G 2008. Fauna Survey. East Rockingham WWTP Site & Pipeline Corridor
- Higgins, P.J. (ed.) 1999. Handbook of Australian, New Zealand and Antarctic Birds. Volume Four - Parrots to Dollarbird. Melbourne: Oxford University Press.
- Johnstone R E & Storr G M 1998, Handbook of Western Australian Birds, Volume 1 Non-Passerines, WA Museum, Perth.
- Menkorst P and Knight F 2004. A Field Guide to the Mammals of Australia. Second Edition. Oxford University Press, United Kingdom.
- Morcombe 2003. Field guide to Australian birds, Second edition. Steve Parish Publishing.
- Pizzey, G and Knight, F 1997. The Field Guide to the Birds of Australia, Angus and Robertson, NSW.
- SEWPaC (Department of Sustainability, Environment, Water, Population and Communities) 2012. EPBC Act Protected Matters Report.
- SEWPaC (Department of Sustainability, Environment, Water, Population and Communities) (2012b). Species Profile and Threats Database (SPRAT) <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>. Accessed 19 March 2012
- Simpson K and Day, N (1996). The Claremont Field Guide to the Birds of Australia, Penguin Books Australia Ltd, Castle Hill.
- Storr, GM, Smith, LA and Johnstone, RE 1999 Lizards of Western Australia I: Skinks. The West Australian Museum, Perth.
- Town of Kwinana 2003. Town of Kwinana Rural Strategy. Available online at: <http://www.kwinana.wa.gov.au/Documents/Your-Property/Planning/Appendix-3-Rural-Strategy-Part-1-Chapter-1-Physica.aspx> Accessed 21 May 2012.
- Van Dyke, S and R. Strahan (eds) (2008). The Mammals of Australia, Third Edition. Reed New Holland, NSW.
- Wilson, S and Swan, G (2003). A Complete Guide to Reptiles of Australia. Reed New Holland, NSW.

7 Report Limitations

This report is produced strictly in accordance with the scope of services set out in the contract or otherwise agreed in accordance with the contract. 360 Environmental makes no representations or warranties in relation to the nature and quality of environmental aspects discussed in this report other than the visual observation and analytical data in this report.

In the preparation of this report, 360 Environmental has relied upon documents, information, data and analyses (“client’s information”) provided by the client and other individuals and entities. In most cases where client’s information has been relied upon, such reliance has been indicated in this report. Unless expressly set out in this report, 360 Environmental has not verified that the client’s information is accurate, exhaustive or current and the validity and accuracy of any aspect of the report including, or based upon, any part of the client’s information is contingent upon the accuracy, exhaustiveness and currency of the client’s information. 360 Environmental shall not be liable to the client or any other person in connection with any invalid or inaccurate aspect of this report where that invalidity or inaccuracy arose because the client’s information was not accurate, exhaustive and current or arose because of any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to 360 Environmental.

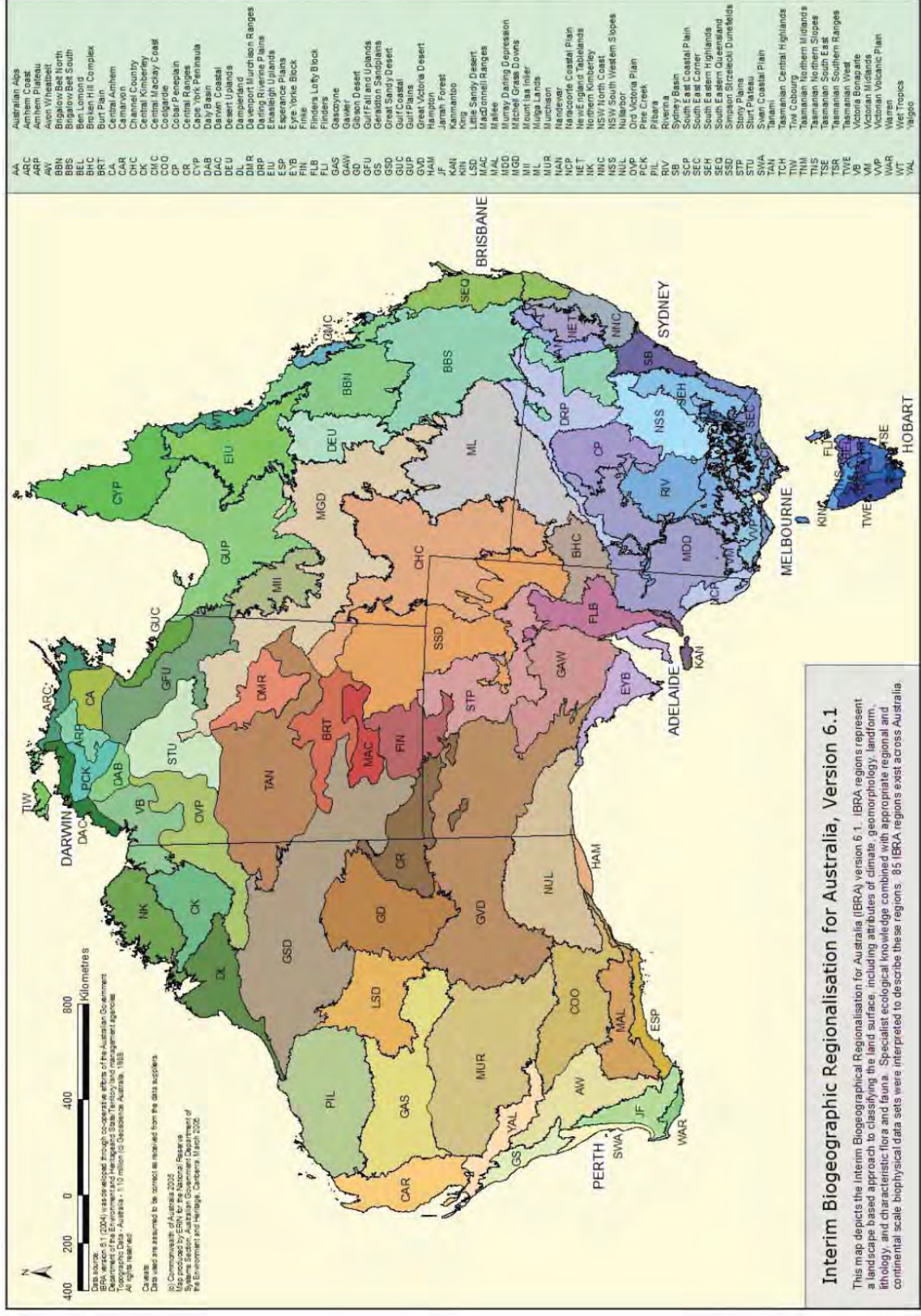
Aspects of this report, including the opinions, conclusions and recommendations it contains, are based on the results of the investigation, sampling and testing set out in the contract and otherwise in accordance with normal practices and standards. The investigation, sampling and testing are designed to produce results that represent a reasonable interpretation of the general conditions of the site that is the subject of this report. However, due to the characteristics of the site, including natural variations in site conditions, the results of the investigation, sampling and testing may not accurately represent the actual state of the whole site at all points.

It is important to recognise that site conditions, including the extent and concentration of contaminants, can change with time. This is particularly relevant if this report, including the data, opinions, conclusions and recommendations it contains, are to be used a considerable time after it was prepared. In these circumstances, further investigation of the site may be necessary.

Subject to the terms of the contract between the Client and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating parts of this report is prohibited (except to the extent required by law) unless the report is produced in its entirety including this page, without the prior written consent of 360 Environmental Pty Ltd.

APPENDIX A: IBRA MAP

Figure 7: IBRA Bioregions



APPENDIX B: SITE LOCATION PLATES

Plate 1: Site 1

North



West



East

South



Plate 2: Site 2

North



West



East



South



Plate 3: Site 3

North



West



East



South



Plate 4: Site 4

North



West



East



South



Plate 5: Site 5

North



West



East



South



Plate 6: Site 6

North



West



East



South



Plate 7: Site 7

North



West



East



South

Plate 8: Site 8

North



West



East



South

Plate 9: Site 9

North



West



East



South

Plate 10: Site 10

North



West



East



South



APPENDIX C: EPBC SEARCH



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 about the EPBC Act including significance guidelines, forms and application process details can be found at <http://www.environment.gov.au/epbc/assessmentsapprovals/index.html>

Report created: 29/02/12 17:34:07

[Summary](#)

[Details](#)

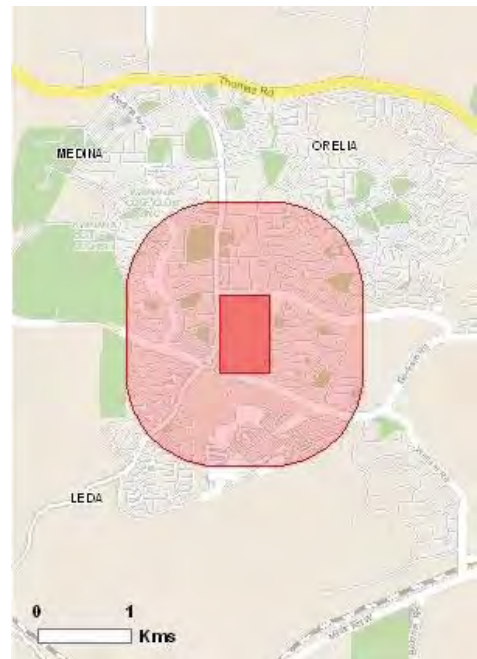
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



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

[Coordinates](#)

Buffer: 1.0Km



Summary

Matters of National Environment 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 - see <http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html>

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International	3
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	None
Threatened Species:	10
Migratory Species:	9

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. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage/index.html>

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. Information on EPBC Act permit requirements and application forms can be found at <http://www.environment.gov>.

Commonwealth Lands:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

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

Place on the RNE:	1
State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	1
Nationally Important Wetlands:	None

Details

Matters of National Environmental Significance

Wetlands of International Significance (RAMSAR)		Resource Information
Name		Proximity
Becher point wetlands		pstream from Ramsar
Forrestdale thomsons lakes		Within 10km of Ramsar
Peel-yalgorup system		pstream from Ramsar
Threatened Species		Resource Information
Name	Status	Type of Presence
BIRDS		

Name	Status	Type of Presence
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo 7034	ulnerable	Species or species habitat may occur within area
Calyptorhynchus latirostris Carnaby s Black-Cockatoo, Short-billed Black-Cockatoo 9 23	Endangered	Species or species habitat likely to occur within area
_eipoa ocellata Malleefowl 934	ulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe 77037	ulnerable	Species or species habitat may occur within area

INSECTS

Synemon gratiosa Graceful Sun Moth 7 7	Endangered	Species or species habitat may occur within area
---	------------	--

MAMMA S

Dasyurus geoffroii Chuditch, Western uoll 330	ulnerable	Species or species habitat likely to occur within area
Phascogale calura Red-tailed Phascogale 31	Endangered	Species or species habitat may occur within area
Setonix brachyurus uokka 229	ulnerable	Species or species habitat may occur within area

P ANTS

Centrolepis caespitosa 393	Endangered	Species or species habitat likely to occur within area
_epidosperma rostratum Beaked epidosperma 141 2	Endangered	Species or species habitat likely to occur within area

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 7		Species or species habitat may occur within area
Ardea alba Great Egret, White Egret 9 41		Species or species habitat may occur within area
Ardea ibis Cattle Egret 9 42		Species or species habitat may occur within area

Migratory Terrestrial Species

Haliaeetus leucogaster White-bellied Sea-Eagle 943		Species or species habitat likely to occur within area
_eipoa ocellata Malleefowl 934	ulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater 70		Species or species habitat may occur within

Name	Threatened	Type of Presence area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret	9 41	Species or species habitat may occur within area
Ardea ibis Cattle Egret	9 42	Species or species habitat may occur within area
Rostratula benghalensis s. lat. Painted Snipe	9 vulnerable	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth lands	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	7	Species or species habitat may occur within area
Ardea alba Great Egret, White Egret	9 41	Species or species habitat may occur within area
Ardea ibis Cattle Egret	9 42	Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle	943	Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater	70	Species or species habitat may occur within area
Rostratula benghalensis s. lat. Painted Snipe	9 vulnerable	Species or species habitat may occur within area

Extra Information

Places on the RNE	Resource Information	
Note that not all Indigenous sites may be listed.		
Name	State	Status
Historic		
Woodlands Cottage and Reserve 2 132	WA	Indicative Place

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 Resources Audit,

Name	Status	Type of Presence
Mammals		
Felis catus	Cat, House Cat, Domestic Cat 19	Species or species habitat likely to occur within area
Oryctolagus cuniculus	Rabbit, European Rabbit 12	Species or species habitat likely to occur within area
Vulpes vulpes	Red Fox, Fox 1	Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides	Bridal Creeper, Bridalveil Creeper, Smilax, Florists Smilax, Smilax Asparagus 22473	Species or species habitat likely to occur within area
Brachiaria mutica	Para Grass 79	Species or species habitat may occur within area
Cenchrus ciliaris	Buffel-grass, Black Buffel-grass 20213	Species or species habitat may occur within area
Chrysanthemoides monilifera	Bitou Bush, Boneseed 193	Species or species habitat may occur within area
Genista sp. Genista monspessulana	Broom 73	Species or species habitat may occur within area
Santana camara	antana, Common antana, Kamara antana, Large-leaf antana, Pink Flowered antana, Red Flowered antana, Red-Flowered Sage, White Sage, Wild Sage 1092	Species or species habitat likely to occur within area
Xylocarpus ferocissimum	African Boxthorn, Boxthorn 1923	Species or species habitat may occur within area
Olea europaea	Olive, Common Olive 910	Species or species habitat may occur within area
Pinus radiata	Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine 2070	Species or species habitat may occur within area
Rubus fruticosus aggregate	Blackberry, European Blackberry 40	Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron S.x reichardtii	Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow 497	Species or species habitat likely to occur within area
Salvinia molesta	Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed 13	Species or species habitat likely to occur within area
Tamarix aphylla	Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar 101	Species or species habitat likely to occur within area

Coordinates

-32.2477 11 . 123 , -32.2477 11 . 173 , -32.2 37 11 . 173 , -32.2 37 11 . 123 , -32.2477 11 . 123

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

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

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](#)
- 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.](#)

[© Commonwealth of Australia](#)

[Department of Sustainability, Environment, Water, Population and Communities](#)

GPO Box 7 7

Canberra ACT 2 01 Australia

1 2 274 1111

APPENDIX D: NATUREMAP SEARCH

NatureMap Species Report

Created By Guest user on 19/03/2012

Current Names Only Yes
 Core Datasets Only Yes
 Method 'By Circle'
 Centre 115°48' 53" E,32°15' 03" S
 Buffer 5km
 Group By Kingdom

Kingdom	Species	Records
Animalia	148	1676
Chromista	1	1
Plantae	238	362
Protozoa	8	8
TOTAL	395	2047

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
Animalia				
1.	24260 <i>Acanthiza apicalis</i> (Broad-tailed Thornbill)			
2.	24261 <i>Acanthiza chrysorrhoa</i> (Yellow-rumped Thornbill)			
3.	24262 <i>Acanthiza inornata</i> (Western Thornbill)			
4.	24560 <i>Acanthorhynchus superciliosus</i> (Western Spinebill)			
5.	25535 <i>Accipiter cirrocephalus</i> (Collared Sparrowhawk)			
6.	24281 <i>Accipiter cirrocephalus</i> subsp. <i>cirrocephalus</i>			
7.	25536 <i>Accipiter fasciatus</i> (Brown Goshawk)			
8.	25011 <i>Acritoscincus trilineatum</i>			
9.	25755 <i>Acrocephalus australis</i> (Australian Reed Warbler)			
10.	24312 <i>Anas gracilis</i> (Grey Teal)			
11.	24315 <i>Anas rhynchotis</i> (Australasian Shoveler)			
12.	24316 <i>Anas superciliosa</i> (Pacific Black Duck)			
13.	24561 <i>Anthochaera carunculata</i> (Red Wattlebird)			
14.	24562 <i>Anthochaera lunulata</i> (Western Little Wattlebird)			
15.	24286 <i>Aquila morphnoides</i> subsp. <i>morphnoides</i>			
16.	25566 <i>Artamus cinereus</i> (Black-faced Woodswallow)			
17.	24353 <i>Artamus cyanopterus</i> (Dusky Woodswallow)			
18.	24318 <i>Aythya australis</i> (Hardhead)			
19.	24319 <i>Biziura lobata</i> (Musk Duck)			
20.	25716 <i>Cacatua sanguinea</i> (Little Corella)			
21.	25598 <i>Cacomantis flabelliformis</i> (Fan-tailed Cuckoo)			
22.	24779 <i>Calidris acuminata</i> (Sharp-tailed Sandpiper)			
23.	24784 <i>Calidris ferruginea</i> (Curlew Sandpiper)			
24.	24788 <i>Calidris ruficollis</i> (Red-necked Stint)			
25.	25717 <i>Calyptorhynchus banksii</i> (Red-tailed Black-Cockatoo)			
26.	24734 <i>Calyptorhynchus latirostris</i> (Carnaby's Cockatoo)		T	
27.	24377 <i>Charadrius ruficapillus</i> (Red-capped Plover)			
28.	24321 <i>Chenonetta jubata</i> (Australian Wood Duck)			
29.	24431 <i>Chrysococcyx basalis</i> (Horsfield's Bronze Cuckoo)			
30.	24288 <i>Circus approximans</i> (Swamp Harrier)			
31.	24774 <i>Cladorhynchus leucocephalus</i> (Banded Stilt)			
32.	25675 <i>Colluricincla harmonica</i> (Grey Shrike-thrush)			
33.	24399 <i>Columba livia</i> (Domestic Pigeon)			
34.	25568 <i>Coracina novaehollandiae</i> (Black-faced Cuckoo-shrike)			
35.	25592 <i>Corvus coronoides</i> (Australian Raven)			
36.	25595 <i>Cracticus tibicen</i> (Australian Magpie)			
37.	24422 <i>Cracticus tibicen</i> subsp. <i>dorsalis</i> (White-backed Magpie)			
38.	25596 <i>Cracticus torquatus</i> (Grey Butcherbird)			
39.	25399 <i>Crinia glauerti</i> (Clicking Frog)			
40.	25400 <i>Crinia insignifera</i> (Squelching Froglet)			
41.	25027 <i>Ctenotus australis</i>			
42.	25039 <i>Ctenotus fallens</i>			
43.	25040 <i>Ctenotus gemmula</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
44.	24322 <i>Cygnus atratus</i> (Black Swan)			
45.	30901 <i>Dacelo novaeguineae</i> (Laughing Kookaburra)			
46.	25673 <i>Daphoenositta chrysoptera</i> (Varied Sittella)			
47.	25607 <i>Dicaeum hirundinaceum</i> (Mistletoebird)			
48.	25621 <i>Falco berigora</i> (Brown Falcon)			
49.	25622 <i>Falco cenchroides</i> (Australian Kestrel)			
50.	24472 <i>Falco cenchroides</i> subsp. <i>cenchroides</i>			
51.	25623 <i>Falco longipennis</i> (Australian Hobby)			
52.	24041 <i>Felis catus</i> (Cat)			
53.	25727 <i>Fulica atra</i> (Eurasian Coot)			
54.	25729 <i>Gallinula tenebrosa</i> (Dusky Moorhen)			
55.	25530 <i>Gerygone fusca</i> (Western Gerygone)			
56.	24443 <i>Grallina cyanoleuca</i> (Magpie-lark)			
57.	24293 <i>Haliaeetus leucogaster</i> (White-bellied Sea-Eagle)			
58.	24295 <i>Haliaeetus leucogaster</i> (White-bellied Sea-Eagle)			
59.	25410 <i>Heleioporus eyrei</i> (Moaning Frog)			
60.	25119 <i>Hemiergis quadrilineata</i>			
61.	25734 <i>Himantopus himantopus</i> (Black-winged Stilt)			
62.	24491 <i>Hirundo neoxena</i> (Welcome Swallow)			
63.	24215 <i>Hydromys chrysogaster</i> (Water-rat)		P4	
64.	25366 <i>Hydrophis elegans</i>			
65.	25478 <i>Isoodon obesulus</i> (Southern Brown Bandicoot)			
66.	24153 <i>Isoodon obesulus</i> subsp. <i>fusciventer</i> (Quenda)		P5	
67.	25133 <i>Lerista elegans</i>			
68.	25147 <i>Lerista lineata</i>		P3	
69.	24581 <i>Lichenostomus virescens</i> (Singing Honeyeater)			
70.	25661 <i>Lichmera indistincta</i> (Brown Honeyeater)			
71.	25415 <i>Limnodynastes dorsalis</i> (Western Banjo Frog)			
72.	25378 <i>Litoria adelaidensis</i> (Slender Tree Frog)			
73.	25388 <i>Litoria moorei</i> (Motorbike Frog)			
74.	24133 <i>Macropus irma</i> (Western Brush Wallaby)		P4	
75.	24326 <i>Malacorhynchus membranaceus</i> (Pink-eared Duck)			
76.	25654 <i>Malurus splendens</i> (Splendid Fairy-wren)			
77.	24583 <i>Manorina flavigula</i> (Yellow-throated Miner)			
78.	25758 <i>Megalurus gramineus</i> (Little Grassbird)			
79.	24598 <i>Merops ornatus</i> (Rainbow Bee-eater)			
80.	25188 <i>Morethia adelaidensis</i>			
81.	25189 <i>Morethia boulengeri</i>			
82.	25190 <i>Morethia butleri</i>			
83.	25191 <i>Morethia lineoocellata</i>			
84.	25192 <i>Morethia obscura</i>			
85.	25193 <i>Morethia ruficauda</i> subsp. <i>exquisita</i>			
86.	25194 <i>Morethia ruficauda</i> subsp. <i>ruficauda</i>			
87.	24223 <i>Mus musculus</i> (House Mouse)			
88.	24738 <i>Neophema elegans</i> (Elegant Parrot)			
89.	25197 <i>Notoscincus ornatus</i> subsp. <i>ornatus</i>			
90.	25198 <i>Notoscincus ornatus</i> subsp. <i>wotjulum</i>			
91.	25564 <i>Nycticorax caledonicus</i> (Rufous Night Heron)			
92.	24407 <i>Ocyphaps lophotes</i> (Crested Pigeon)			
93.	24328 <i>Oxyura australis</i> (Blue-billed Duck)			
94.	25679 <i>Pachycephala pectoralis</i> (Golden Whistler)			
95.	25680 <i>Pachycephala rufiventris</i> (Rufous Whistler)			
96.	25681 <i>Pardalotus punctatus</i> (Spotted Pardalote)			
97.	25682 <i>Pardalotus striatus</i> (Striated Pardalote)			
98.	24630 <i>Pardalotus striatus</i> subsp. <i>westraliensis</i>			
99.	24648 <i>Pelecanus conspicillatus</i> (Australian Pelican)			
100.	24659 <i>Petroica goodenovii</i> (Red-capped Robin)			
101.	25697 <i>Phalacrocorax carbo</i> (Great Cormorant)			
102.	24667 <i>Phalacrocorax sulcirostris</i> (Little Black Cormorant)			
103.	25699 <i>Phalacrocorax varius</i> (Pied Cormorant)			
104.	24409 <i>Phaps chalcoptera</i> (Common Bronzewing)			
105.	24099 <i>Phascogale tapoatafa</i> subsp. <i>tapoatafa</i> (Southern Brush-tailed Phascogale)			
106.	24596 <i>Phylidonyris novaehollandiae</i> (New Holland Honeyeater)			
107.	24841 <i>Platalea flavipes</i> (Yellow-billed Spoonbill)			
108.	24750 <i>Platycercus zonarius</i> subsp. <i>semitorquatus</i> (Twenty-eight Parrot)			
109.	24843 <i>Plegadis falcinellus</i> (Glossy Ibis)			
110.	25703 <i>Podargus strigoides</i> (Tawny Frogmouth)			
111.	25704 <i>Podiceps cristatus</i> (Great Crested Grebe)			
112.	24681 <i>Poliiocephalus poliocephalus</i> (Hoary-headed Grebe)			
113.	25722 <i>Polytelis anthopeplus</i> (Regent Parrot)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
114.	25731 <i>Porphyrio porphyrio</i> (Purple Swamphen)			
115.	25199 <i>Proablepharus reginae</i>			
116.	25200 <i>Proablepharus tenuis</i>			
117.	25259 <i>Pseudonaja affinis</i> subsp. <i>affinis</i> (Dugite)			
118.	25264 <i>Pseudonaja nuchalis</i> (Gwardar)			
119.	24245 <i>Rattus rattus</i> (Black Rat)			
120.	24776 <i>Recurvirostra novaehollandiae</i> (Red-necked Avocet)			
121.	25614 <i>Rhipidura leucophrys</i> (Willie Wagtail)			
122.	25534 <i>Sericornis frontalis</i> (White-browed Scrubwren)			
123.	25266 <i>Simoselaps bertholdi</i> (Jan's Banded Snake)			
124.	25267 <i>Simoselaps littoralis</i> (West Coast Banded Snake)			
125.	30948 <i>Smicromis brevirostris</i> (Weebill)			
126.	25597 <i>Strepera versicolor</i> (Grey Currawong)			
127.	25589 <i>Streptopelia chinensis</i> (Spotted Turtle-Dove)			
128.	30951 <i>Streptopelia chinensis</i> subsp. <i>tigrina</i>			
129.	25590 <i>Streptopelia senegalensis</i> (Laughing Turtle-Dove)			
130.	24942 <i>Strophurus spinigerus</i> subsp. <i>spinigerus</i>			
131.	25705 <i>Tachybaptus novaehollandiae</i> (Australasian Grebe)			
132.	24331 <i>Tadorna tadornoides</i> (Australian Shelduck)			
133.	24844 <i>Threskiornis molucca</i> (Australian White Ibis)			
134.	24845 <i>Threskiornis spinicollis</i> (Straw-necked Ibis)			
135.	25202 <i>Tiliqua multifasciata</i> (Central Blue-tongue)			
136.	25203 <i>Tiliqua occipitalis</i> (Western Bluetongue)			
137.	25204 <i>Tiliqua rugosa</i> subsp. <i>aspera</i>			
138.	25205 <i>Tiliqua rugosa</i> subsp. <i>konowi</i>		T	
139.	25206 <i>Tiliqua rugosa</i> subsp. <i>palarra</i>			
140.	25207 <i>Tiliqua rugosa</i> subsp. <i>rugosa</i>			
141.	25549 <i>Todiramphus sanctus</i> (Sacred Kingfisher)			
142.	25723 <i>Trichoglossus haematodus</i> (Rainbow Lorikeet)			
143.	25521 <i>Trichosurus vulpecula</i> (Common Brushtail Possum)			
144.	24808 <i>Tringa nebularia</i> (Common Greenshank)			
145.	24849 <i>Turnix varia</i> subsp. <i>varia</i>			
146.	24852 <i>Tyto alba</i> subsp. <i>delicatula</i> (Barn Owl)			
147.	25227 <i>Varanus tristis</i> subsp. <i>tristis</i> (Racehorse Monitor)			
148.	25765 <i>Zosterops lateralis</i> (Grey-breasted White-eye)			

Chromista

149.	<i>Phytophthora cinnamomi</i>			
lantae				
150.	3525 <i>Acacia rostellifera</i> (Summer-scented Wattle)			
151.	3527 <i>Acacia saligna</i> (Orange Wattle)			
152.	30032 <i>Acacia saligna</i> subsp. <i>saligna</i>			
153.	3557 <i>Acacia stenoptera</i> (Narrow Winged Wattle)			
154.	1208 <i>Acanthocarpus preissii</i>			
155.	184 <i>Aira caryophyllea</i> (Silvery Hairgrass)	Y		
156.	1728 <i>Allocasuarina fraseriana</i> (Sheoak)			
157.	11434 <i>Anigozanthos humilis</i> subsp. <i>humilis</i>			
158.	11261 <i>Anigozanthos manglesii</i> subsp. <i>manglesii</i>			
159.	3686 <i>Aotus cordifolia</i>			
160.	6211 <i>Apium prostratum</i> (Sea Celery)			
161.	141 <i>Aponogeton hexatepalus</i> (Stalked Water Ribbons)		P4	
162.	6334 <i>Astroloma pallidum</i> (Kick Bush)			
163.	17234 <i>Austrostipa compressa</i>			
164.	37421 <i>Austrostipa</i> sp. <i>Marchagee</i> (B.R. Maslin 1407)			
165.	231 <i>Avellinia michelii</i>	Y		
166.	234 <i>Avena fatua</i> (Wild Oat)	Y		
167.	1800 <i>Banksia attenuata</i> (Slender Banksia)			
168.	1819 <i>Banksia grandis</i> (Bull Banksia)			
169.	1834 <i>Banksia menziesii</i> (Firewood Banksia)			
170.	740 <i>Baumea arthropylla</i>			
171.	11381 <i>Boronia ramosa</i> subsp. <i>anethifolia</i>			
172.	3710 <i>Bossiaea eriocarpa</i> (Common Brown Pea)			
173.	244 <i>Briza maxima</i> (Blowfly Grass)	Y		
174.	245 <i>Briza minor</i> (Shivery Grass)	Y		
175.	249 <i>Bromus diandrus</i> (Great Brome)	Y		
176.	250 <i>Bromus hordeaceus</i> (Soft Brome)	Y		
177.	1366 <i>Bulbine semibarbata</i> (Leek Lily)			
178.	12770 <i>Burchardia congesta</i>			
179.	1276 <i>Caesia micrantha</i> (Pale Grass-lily)			
180.	1586 <i>Caladenia discoidea</i> (Dancing Orchid)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
181.	15348 <i>Caladenia flava</i> subsp. <i>flava</i>			
182.	1596 <i>Caladenia huegelii</i> (Grand Spider Orchid)		T	
183.	15361 <i>Caladenia longicauda</i> subsp. <i>calcigena</i>			
184.	17760 <i>Caladenia nobilis</i>			
185.	2846 <i>Calandrinia calyptrata</i> (Pink Purslane)			
186.	2854 <i>Calandrinia granulifera</i> (Pygmy Purslane)			
187.	96 <i>Callitris preissii</i> (Rottnest Island Pine)			
188.	35816 <i>Calothamnus quadrifidus</i> subsp. <i>quadrifidus</i>			
189.	757 <i>Carex preissii</i>			
190.	1162 <i>Cartonema phylloides</i>			
191.	2957 <i>Cassytha racemosa</i> (Dodder Laurel)			
192.	6539 <i>Centaurium erythraea</i> (Common Centaury)	Y		
193.	1125 <i>Centrolepis drummondiana</i>			
194.	2889 <i>Cerastium glomeratum</i> (Mouse Ear Chickweed)	Y		
195.	1280 <i>Chamaescilla corymbosa</i> (Blue Squill)			
196.	7937 <i>Cirsium vulgare</i> (Spear Thistle)	Y		
197.	1885 <i>Conospermum triplinervium</i> (Tree Smokebush)			
198.	6348 <i>Conostephium pendulum</i> (Pearl Flower)			
199.	1418 <i>Conostylis aculeata</i> (Prickly Conostylis)			
200.	11826 <i>Conostylis aculeata</i> subsp. <i>aculeata</i>			
201.	11438 <i>Conostylis candicans</i> subsp. <i>candicans</i>			
202.	1436 <i>Conostylis juncea</i>			
203.	1455 <i>Conostylis setosa</i> (White Cottonhead)			
204.	3137 <i>Crassula colorata</i> (Dense Stonecrop)			
205.	3140 <i>Crassula glomerata</i>	Y		
206.	11345 <i>Crassula thunbergiana</i> subsp. <i>thunbergiana</i>	Y		
207.	6663 <i>Cuscuta epithymum</i> (Lesser Dodder)	Y		
208.	7454 <i>Dampiera linearis</i> (Common Dampiera)			
209.	1218 <i>Dasypogon bromeliifolius</i> (Pineapple Bush)			
210.	3845 <i>Daviesia triflora</i>			
211.	1259 <i>Dianella revoluta</i> (Blueberry Lily)			
212.	314 <i>Digitaria didactyla</i> (Queensland Blue Couch)	Y		
213.	7054 <i>Dischisma arenarium</i>	Y		
214.	12943 <i>Diuris brumalis</i>			
215.	11049 <i>Diuris corymbosa</i>			
216.	1634 <i>Diuris laxiflora</i> (Bee Orchid)			
217.	12939 <i>Diuris magnifica</i>			
218.	12938 <i>Diuris micrantha</i>		T	
219.	4763 <i>Dodonaea hackettiana</i> (Hackett's Hopbush)		P4	
220.	3095 <i>Drosera erythrorhiza</i> (Red Ink Sundew)			
221.	13216 <i>Drosera menziesii</i> subsp. <i>penicillaris</i>			
222.	3131 <i>Drosera stolonifera</i> (Leafy Sundew)			
223.	11485 <i>Ehrharta brevifolia</i> var. <i>cuspidata</i>	Y		
224.	347 <i>Ehrharta calycina</i> (Perennial Veldt Grass)	Y		
225.	1643 <i>Elythranthera brunonis</i> (Purple Enamel Orchid)			
226.	374 <i>Eragrostis cilianensis</i> (Stinkgrass)	Y		
227.	376 <i>Eragrostis curvula</i> (African Lovegrass)	Y		
228.	5615 <i>Eucalyptus decipiens</i>			
229.	5649 <i>Eucalyptus foecunda</i> (Narrow-leaved Red Mallee)			
230.	5659 <i>Eucalyptus gomphocephala</i> (Tuart)			
231.	5708 <i>Eucalyptus marginata</i> (Jarrah)			
232.	5763 <i>Eucalyptus rudis</i> (Flooded Gum)			
233.	29940 <i>Euphorbia maculata</i>	Y		
234.	4648 <i>Euphorbia terracina</i> (Geraldton Carnation Weed)	Y		
235.	894 <i>Fimbristylis velata</i>			
236.	8365 <i>Fumaria bastardii</i>	Y		
237.	907 <i>Gahnia trifida</i> (Coast Saw-sedge)			
238.	7323 <i>Galium murale</i> (Small Goosegrass)	Y		
239.	1520 <i>Gladiolus caryophyllaceus</i> (Wild Gladiolus)	Y		
240.	3957 <i>Gompholobium tomentosum</i> (Hairy Yellow Pea)			
241.	37500 <i>Grammatotheca bergiana</i> var. <i>bergiana</i>	Y		
242.	14282 <i>Gratiola pubescens</i>			
243.	15839 <i>Grevillea preissii</i> subsp. <i>preissii</i>			
244.	12824 <i>Grevillea vestita</i> subsp. <i>vestita</i>			
245.	2175 <i>Hakea lissocarpha</i> (Honey Bush)			
246.	3961 <i>Hardenbergia comptoniana</i> (Native Wisteria)			
247.	3016 <i>Heliophila pusilla</i>	Y		
248.	6710 <i>Heliotropium europaeum</i> (Common Heliotrope)	Y		
249.	6839 <i>Hemiandra pungens</i> (Snakebush)			
250.	5135 <i>Hibbertia hypericoides</i> (Yellow Buttercups)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
251.	5154 <i>Hibbertia perfoliata</i>			
252.	5162 <i>Hibbertia racemosa</i> (Stalked Guinea Flower)			
253.	6222 <i>Homalosciadium homalocarpum</i>			
254.	3968 <i>Hovea trisperma</i> (Common Hovea)			
255.	5216 <i>Hybanthus calycinus</i> (Wild Violet)			
256.	6224 <i>Hydrocotyle blepharocarpa</i>			
257.	6240 <i>Hydrocotyle scutellifera</i>			
258.	5825 <i>Hypocalymma robustum</i> (Swan River Myrtle)			
259.	8086 <i>Hypochoeris glabra</i> (Smooth Catsear)	Y		
260.	910 <i>Isolepis cernua</i> (Nodding Club-rush)			
261.	917 <i>Isolepis marginata</i> (Coarse Club-rush)	Y		
262.	7396 <i>Isotoma hypocrateriformis</i> (Woodbridge Poison)			
263.	3992 <i>Isotropis cuneifolia</i> (Granny Bonnets)			
264.	19700 <i>Isotropis cuneifolia</i> subsp. <i>cuneifolia</i>			
265.	8092 <i>Ixiolaena viscosa</i> (Sticky Ixiolaena)			
266.	1185 <i>Juncus kraussii</i> (Sea Rush)			
267.	1189 <i>Juncus pauciflorus</i> (Loose Flower Rush)			
268.	4044 <i>Kennedia prostrata</i> (Scarlet Runner)			
269.	5832 <i>Kunzea ericifolia</i> (Spearwood)			
270.	20019 <i>Lachnagrostis filiformis</i>			
271.	19955 <i>Lachnagrostis plebeia</i>			
272.	19956 <i>Lachnagrostis preissii</i>			
273.	18585 <i>Lagenophora huegelii</i>			
274.	467 <i>Lagurus ovatus</i> (Hare's Tail Grass)	Y		
275.	28342 <i>Landoltia punctata</i> (Thin Duckweed)			
276.	1309 <i>Laxmannia squarrosa</i>			
277.	7574 <i>Lechenaultia floribunda</i> (Free-flowering Leschenaultia)			
278.	925 <i>Lepidosperma angustatum</i>			
279.	937 <i>Lepidosperma longitudinale</i> (Pithy Sword-sedge)			
280.	15418 <i>Leptoceras menziesii</i>			
281.	6374 <i>Leucopogon conostephioides</i>			
282.	6427 <i>Leucopogon parviflorus</i> (Coast Beard-heath)			
283.	6436 <i>Leucopogon propinquus</i>			
284.	7677 <i>Levenhookia stipitata</i> (Common Stylewort)			
285.	36160 <i>Liparophyllum capitatum</i>			
286.	7408 <i>Lobelia tenuior</i> (Slender Lobelia)			
287.	1223 <i>Lomandra caespitosa</i> (Tufted Mat Rush)			
288.	1231 <i>Lomandra maritima</i>			
289.	1232 <i>Lomandra micrantha</i> (Small-flower Mat-rush)			
290.	1234 <i>Lomandra nigricans</i>			
291.	1239 <i>Lomandra preissii</i>			
292.	1243 <i>Lomandra sericea</i> (Silky Mat Rush)			
293.	1246 <i>Lomandra suaveolens</i>			
294.	1097 <i>Lyginia barbata</i>			
295.	85 <i>Macrozamia riedlei</i> (Zamia)			
296.	13271 <i>Melaleuca huegelii</i> subsp. <i>huegelii</i>			
297.	5959 <i>Melaleuca raphiophylla</i> (Swamp Paperbark)			
298.	5978 <i>Melaleuca teretifolia</i> (Banbar)			
299.	5980 <i>Melaleuca thymoides</i>			
300.	13280 <i>Melaleuca viminea</i> subsp. <i>viminea</i>			
301.	6883 <i>Mentha pulegium</i> (Pennyroyal)	Y		
302.	955 <i>Mesomelaena pseudostygia</i>			
303.	485 <i>Microlaena stipoides</i> (Weeping Grass)			
304.	15419 <i>Microtis media</i> subsp. <i>media</i>			
305.	4662 <i>Monotaxis grandiflora</i> (Diamond of the Desert)			
306.	4666 <i>Monotaxis occidentalis</i>			
307.	2412 <i>Muehlenbeckia adpressa</i> (Climbing Lignum)			
308.	6140 <i>Oenothera mollissima</i>	Y		
309.	14292 <i>Oenothera stricta</i> subsp. <i>stricta</i>	Y		
310.	8149 <i>Olearia rudis</i> (Rough Daisybush)			
311.	12782 <i>Ophioglossum gramineum</i>			
312.	36177 <i>Omduffia albiflora</i>			
313.	7122 <i>Orobancha minor</i> (Lesser Broomrape)	Y		
314.	1667 <i>Paracaleana nigrita</i> (Flying Duck Orchid)			
315.	516 <i>Parapholis incurva</i> (Coast Bargrass)	Y		
316.	527 <i>Paspalum dilatatum</i>	Y		
317.	528 <i>Paspalum distichum</i> (Water Couch)	Y		
318.	1550 <i>Patersonia occidentalis</i> (Purple Flag)			
319.	2273 <i>Persoonia saccata</i> (Snottygobble)			
320.	2299 <i>Petrophile linearis</i> (Pixie Mops)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
321.	18529 <i>Philothea spicata</i> (Pepper and Salt)			
322.	1478 <i>Phlebocarya ciliata</i>			
323.	4675 <i>Phyllanthus calycinus</i> (False Boronia)			
324.	2793 <i>Phytolacca octandra</i> (Red Ink Plant)	Y		
325.	5254 <i>Pimelea leucantha</i>			
326.	18117 <i>Pimelea rosea</i> subsp. <i>rosea</i>			
327.	578 <i>Poa porphyroclados</i>			
328.	8175 <i>Podolepis gracilis</i> (Slender Podolepis)			
329.	8182 <i>Pododthea angustifolia</i> (Sticky Longheads)			
330.	8184 <i>Pododthea gnaphalioides</i> (Golden Long-heads)			
331.	582 <i>Polypogon monspeliensis</i> (Annual Beardgrass)	Y		
332.	583 <i>Polypogon tenellus</i>			
333.	4691 <i>Poranthera microphylla</i> (Small Poranthera)			
334.	1670 <i>Prasophyllum drummondii</i> (Swamp Leek Orchid)			
335.	1676 <i>Prasophyllum hians</i> (Yawning Leek Orchid)			
336.	10853 <i>Prasophyllum plumiforme</i>			
337.	11260 <i>Ptilotus drummondii</i> var. <i>drummondii</i> (Pussytail)			
338.	2751 <i>Ptilotus polystachyus</i> (Prince of Wales Feather)			
339.	2578 <i>Rhagodia baccata</i> (Berry Saltbush)			
340.	18599 <i>Salsola tragus</i>			
341.	6484 <i>Samolus repens</i> (Creeping Brookweed)			
342.	7595 <i>Scaevola anchusifolia</i>			
343.	7603 <i>Scaevola canescens</i> (Grey Scaevola)			
344.	982 <i>Schoenus clandestinus</i>			
345.	25878 <i>Senecio condylus</i>			
346.	2909 <i>Silene gallica</i> (French Catchfly)	Y		
347.	8225 <i>Siloxerus humifusus</i> (Procumbent Siloxerus)			
348.	7022 <i>Solanum nigrum</i> (Black Berry Nightshade)	Y		
349.	7037 <i>Solanum symonii</i>			
350.	9367 <i>Sonchus hydrophilus</i> (Native Sowthistle)			
351.	8231 <i>Sonchus oleraceus</i> (Common Sowthistle)	Y		
352.	1312 <i>Sowerbaea laxiflora</i> (Purple Tassels)			
353.	635 <i>Sporobolus virginicus</i> (Marine Couch)			
354.	2918 <i>Stellaria media</i> (Chickweed)	Y		
355.	19403 <i>Stenopetalum gracile</i>			
356.	2316 <i>Stirlingia latifolia</i> (Blueboy)			
357.	7693 <i>Stylidium brunonianum</i> (Pink Fountain Triggerplant)			
358.	17850 <i>Stylidium irenae</i>		P4	
359.	7774 <i>Stylidium piliferum</i> (Common Butterfly Triggerplant)			
360.	2326 <i>Synaphea polymorpha</i> (Albany Synaphea)			
361.	2329 <i>Synaphea spinulosa</i>			
362.	15532 <i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>			
363.	2791 <i>Tersonia cyathiflora</i> (Button Creeper)			
364.	1708 <i>Thelymitra fuscolutea</i> (Leopard Orchid)			
365.	20731 <i>Thelymitra vulgaris</i>			
366.	20728 <i>Thelymitra xanthotricha</i>			
367.	1319 <i>Thysanotus arenarius</i>			
368.	1339 <i>Thysanotus multiflorus</i> (Many-flowered Fringe Lily)			
369.	1351 <i>Thysanotus sparteus</i>			
370.	6280 <i>Trachymene pilosa</i> (Native Parsnip)			
371.	1481 <i>Tribonanthes australis</i>			
372.	4383 <i>Tribulus terrestris</i> (Caltrop)	Y		
373.	1361 <i>Tricoryne elatior</i> (Yellow Autumn Lily)			
374.	4292 <i>Trifolium campestre</i> (Hop Clover)	Y		
375.	8255 <i>Ursinia anthemoides</i> (Ursinia)	Y		
376.	7111 <i>Veronica persica</i> (Creeping Speedwell)	Y		
377.	722 <i>Vulpia bromoides</i> (Squirrel Tail Fescue)	Y		
378.	724 <i>Vulpia myuros</i> (Rat's Tail Fescue)	Y		
379.	12052 <i>Vulpia myuros</i> forma <i>megalura</i>	Y		
380.	33101 <i>Vulpia myuros</i> forma <i>myuros</i>	Y		
381.	1394 <i>Wurmbea dioica</i> (Early Nancy)			
382.	12072 <i>Wurmbea dioica</i> subsp. <i>alba</i>			
383.	1398 <i>Wurmbea monantha</i>			
384.	1256 <i>Xanthorrhoea preissii</i> (Grass tree)			
385.	6289 <i>Xanthosia huegelii</i>			
386.	2331 <i>Xylomelum occidentale</i> (Woody Pear)			
387.	1049 <i>Zantedeschia aethiopica</i> (Arum Lily)	Y		
roto oa				
388.	38964 <i>Arcyria cinerea</i>			
389.	38967 <i>Arcyria incarnata</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
390.	39019 <i>Didymium clavus</i>			Y
391.	39048 <i>Lycogala epidendrum</i>			
392.	39071 <i>Physarum luteolum</i>			Y
393.	39079 <i>Physarum viride</i>			
394.	39085 <i>Stemonitis lignicola</i>			
395.	39087 <i>Stemonitis splendens</i>			

Conservation Codes

- T Threatened or likely to become extinct
- P Presumed extinct
- A 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 wholly 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 E: DEC SEARCH

NAME	SOURCE_CODE	FAMILY	GENUS	SPECIES	INFRA_NAM	AUTHOR	VERNACULAR	KINGDOM	CONS_CODE	CLASS	DAY	MONTH	YEAR	LOCALITY_NAME	SITE_NAME
Calyptorhynchus latirostris	FAUNA SURVEY	Psittacidae	Calyptorhynchus	latirostris		Carnaby	Carnaby's Cockatoo	Animalia	T	BIRD	07	03	2009	EAST ROCKINGHAM	East Rockingham WWTP
Calyptorhynchus latirostris	BIRD ATLAS2	Psittacidae	Calyptorhynchus	latirostris		Carnaby	Carnaby's Cockatoo	Animalia	T	BIRD	20	07	2000	MEDINA	Thomas Oval, Medina
Calyptorhynchus latirostris	BIRD ATLAS2	Psittacidae	Calyptorhynchus	latirostris		Carnaby	Carnaby's Cockatoo	Animalia	T	BIRD	19	09	2002	POSTANS	The Spectacles
Tiliqua rugosa subsp. konowi	FAUNA SURVEY	Scincidae	Tiliqua	rugosa	subsp. konowi	(Mertens)		Animalia	T	REPTILE	11	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 6.3
Tiliqua rugosa subsp. konowi	FAUNA SURVEY	Scincidae	Tiliqua	rugosa	subsp. konowi	(Mertens)		Animalia	T	REPTILE	09	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 6.5
Falco peregrinus	FAUNA SURVEY	Falconidae	Falco	peregrinus		Tunstall	Peregrine Falcon	Animalia	S	BIRD	07	03	2009	EAST ROCKINGHAM	East Rockingham WWTP
Isodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAMMAL	05	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 6.7
Isodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAMMAL	11	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.3
Isodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAMMAL	06	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 5.5
Isodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAMMAL	05	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.7
Isodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAMMAL	07	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.7

NAME	SOURCE_CODE	FAMILY	GENUS	SPECIES	INFRANAM	AUTHOR	VERNACULAR	KINGDOM	CONS_CODE	CLASS	DAY	MONTH	YEAR	LOCALITY_NAME	SITE_NAME
subsp. fusciventer	SURVEY				fusciventer					MAL				ROCKINGHAM	WWTP TS 3.5
Isoodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	08	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 5.5
Isoodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	05	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.5
Isoodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	10	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.3
Isoodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	07	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 6.7
Isoodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	05	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.7
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	01	11	2001	COOLOONGUP	N end of Lake Cooloongup, Cooloongup (Site 3)
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	01	12	1974	CASUARINA	Mortimer Rd, Wellard.
Isoodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	25	05	2010	LEDA	Leda Wetlands
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	01	11	2001	LEDA	Leda Reserve, Leda (Site 2)
Isoodon obesulus	WAM	Peramelidae	Isoodon	obesulus	subsp.	(Gray)	Quenda	Animalia	5	MAM	22	06	1961	MEDINA	

NAME	SOURCE_CODE	FAMILY	GENUS	SPECIES	INFRAORDER	AUTHOR	VERNACULAR	KINGDOM	CONS_CODE	CLASS	DAY	MONTH	YEAR	LOCALITY_NAME	SITE_NAME
subsp. fusciventer	SPECIMENS				fusciventer					MAL					Bushland opposite Sicklemore Rd, Parmelia/Bertram (Site 1)
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM MAL	01	11	2001	PARMELIA	north of Anketall Rd, across from the Spectacles
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM MAL	06	11	2007	HOPE VALLEY	north of Anketall Rd, across from the Spectacles
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM MAL	03	11	2007	HOPE VALLEY	north of Anketall Rd, across from the Spectacles
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM MAL	04	11	2007	HOPE VALLEY	north of Anketall Rd, across from the Spectacles
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM MAL	09	07	2004	HOPE VALLEY	Alcoa development site on Anketall Rd, E of Abercombe Rd
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM MAL	02	11	2007	HOPE VALLEY	north of Anketall Rd, across from the Spectacles
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM MAL	05	11	2007	HOPE VALLEY	north of Anketall Rd, across from the Spectacles
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM MAL	02	11	2007	KWINANA BEACH	roadside south of Anketall Rd, adjacent to the Spectacles

NAME	SOURCE_CODE	FAMILY	GENUS	SPECIES	INFRAORDER	AUTHOR	VERNACULAR	KINGDOM	CONS_CODE	CLASS	DAY	MONTH	YEAR	LOCALITY_NAME	SITE_NAME
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM MAL	06 11	2007	KWINANA BEACH	roadside south of Anketell Rd, adjacent to the Spectacles	
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM MAL	04 11	2007	KWINANA BEACH	roadside south of Anketell Rd, adjacent to the Spectacles	
Charadrius rubricollis	TFAUNA	Charadriidae	Charadrius	rubricollis		(Gmelin)	Hooded Plover	Animalia	4	BIRD	10 01	1998	COOLOONGUP	Cooloongup Lake, City of Rockingham	
Hydromys chrysogaster	TFAUNA	Muridae	Hydromys	chrysogaster		Geoffroy	Water-rat	Animalia	4	MAM MAL	10 06	1973	MEDINA	Medina	
Macropus irma	TFAUNA	Macropodidae	Macropus	irma		(Jourdan)	Western Brush Wallaby	Animalia	4	MAM MAL	01 01	1989	WELLARD	Leda Nature Reserve, Town of Kwinana	
Notoscincus butleri	FAUNA SURVEY	Scincidae	Notoscincus	butleri		Storr		Animalia	4	REPTI LE	08 03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 1.9	
Notoscincus butleri	FAUNA SURVEY	Scincidae	Notoscincus	butleri		Storr		Animalia	4	REPTI LE	07 03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 3.2	
Lerista lineata	WAM SPECIMENS	Scincidae	Lerista	lineata		Bell		Animalia	3	REPTI LE	05 01	1979	MEDINA	Spectacle Swamp, near Medina	
Lerista lineata	TFAUNA	Scincidae	Lerista	lineata		Bell		Animalia	3	REPTI LE	13 11	2007	THE SPECTACLES	roadside south of Anketell Rd, adjacent to the Spectacles	
Lerista lineata	TFAUNA	Scincidae	Lerista	lineata		Bell		Animalia	3	REPTI LE	05 01	1979	THE SPECTACLES	Spectacle Swamp, near Medina	
Neelaps	TFAUNA	Elapidae	Neelaps	calonotos		(A.M.C.)	Black-	Animalia	3	REPTI			COOLOONGUP	East Rockingham	

NAME	SOURCE_CODE	FAMILY	GENUS	SPECIES	INFRAORDER	AUTHOR	VERNACULAR	KINGDOM	CONS_CODE	CLASS	DAY	MONTH	YEAR	LOCALITY_NAME	SITE_NAME
calonotos						DumØril, Bibron & A. DumØril)	striped Snake			LE					
Neelaps calonotos	WAM SPECIMEN S	Elapidae	Neelaps	calonotos		(A.M.C. DumØril, Bibron & A. DumØril)	Black- striped Snake	Animalia	3	REPTI LE	08	03	2009	COOLOONGUP	East Rockingham
Pletholax gracilis subsp. edelensis	FAUNA SURVEY	Pygopodidae	Pletholax	gracilis	subsp. edelensis	Storr		Animalia	3	REPTI LE	08	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 4.3

ATTACHMENT 2G

Level 1 Vertebrate
Fauna Survey – Lot
9001 Bertram
Road, Parmelia

Prepared for:

Department of Housing/
Satterley Property Group

October 2012

Document Reference	Revision	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
EBS197-2AC	INTERNAL DRAFT	AH/PR	FD	-	11/10/2012
EBS197-2AC	CLIENT REPORT	AH/PR	Client	1 Electronic copy	16/10/2012

Disclaimer

This report is issued in accordance with, and is subject to, the terms of the contract between the Client and 360 Environmental Pty Ltd, including, without limitation, the agreed scope of the report. To the extent permitted by law, 360 Environmental Pty Ltd shall not be liable in contract, tort (including, without limitation, negligence) or otherwise for any use of, or reliance on, parts of this report without taking into account the report in its entirety and all previous and subsequent reports. 360 Environmental Pty Ltd considers the contents of this report to be current as at the date it was produced. This report, including each opinion, conclusion and recommendation it contains, should be considered in the context of the report as a whole. The opinions, conclusions and recommendations in this report are limited by its agreed scope. More extensive, or different, investigation, sampling and testing may have produced different results and therefore different opinions, conclusions and recommendations. Subject to the terms of the contract between the Client and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating parts of this report is prohibited (except to the extent required by law) unless the report is produced in its entirety including this cover page, without the prior written consent of 360 Environmental Pty Ltd.

© Copyright 2012 360 Environmental Pty Ltd ACN 109 499 041

Table of Contents

Executive Summary.....	1
1 Introduction	3
1.1 Project Background and Study Area Location	3
1.2 Study Objectives and Scope	3
1.3 Existing Environment.....	5
1.4 Previous Fauna Surveys.....	8
1.5 Report Format.....	10
2 Methods	11
2.1 Desktop Study	11
2.2 Survey Timing and Weather	11
2.3 Fauna Survey Team.....	12
2.4 Fauna Habitat Assessment	12
2.5 Sampling Locations	12
2.6 Survey Effort	13
2.7 Nomenclature.....	13
2.8 Survey Limitations.....	16
3 Results	18
3.1 Desktop Study	18
3.2 Fauna Habitats	21
3.3 Faunal Assemblage	21
4 Discussion.....	26
4.1 Fauna Habitats	26
4.2 Fauna Assemblage	26
4.3 Fauna of Conservation Significance	26
5 Conclusion and Recommendations	37
6 References.....	38
7 Report Limitations.....	41

List of Figures

Figure 1: Location and Overview of the Site	4
Figure 2: Mean Rainfall and Temperature for Medina Research Station Recorded Between 1983 and 2012 (Bureau of Meteorology, 2012).....	5
Figure 3: Bushland Remnants and Conservation Estate in the Vicinity of the Site.....	9
Figure 4: Fauna Survey Locations	15
Figure 5: Black Cockatoo Habitat Trees Identified at the Site.....	35
Figure 6: Black Cockatoo Activity Recorded at the Site	36

List of Tables

Table 1: Nature Reserves in the Vicinity of the Site.	8
Table 2: Fauna Surveys Undertaken in the Vicinity of the Site.....	10
Table 3: Database Sources	11
Table 4: Weather Conditions in the Three Months Leading Up to the Site Survey.....	12
Table 5: Sampling Location, Including GPS Location (GDA 1994) and Broad Habitat Type.....	13
Table 6: Limitations and Constraints.....	16
Table 7: Fauna Taxa with the Potential to Occur at the Site.....	18
Table 8: Desktop Study Results.....	19
Table 9: Number of Vertebrate Fauna Species recorded at the Site.....	21
Table 10: Avifauna Species Recorded at the Site.....	24
Table 11: Mammal Species Recorded at the Site	25
Table 12: Reptile Species Recorded at the Site.....	25
Table 13: Likelihood of Predicted Conservation Significant Species Occurring at the Site	29

List of Appendices

- Appendix A EPBC Protected Matters Search Database
- Appendix B NatureMap Search
- Appendix C Department of Environment and Conservation Threatened Fauna Search
- Appendix D Site Habitat Plates
- Appendix E Vegetation Types of the Site
- Appendix F State and Federal Level Conservation Codes

Executive Summary

Background

360 Environmental Pty Ltd (360 Environmental) was commissioned by Satterley Property Group on behalf of the Department of Housing to undertake a baseline Level 1 Vertebrate Fauna Survey for Lot 9001 Bertram Road, Parmelia (the Site). The Site of approximately 50 hectares (ha) is located in the suburb of Parmelia, approximately 33 kilometres (km) south of Perth.

Methods

The entire Site was traversed on foot with a total of five sampling locations being used to assess the fauna habitat types. Passive detection methods were used to identify vertebrate fauna species across the Site. Emphasis was placed on detecting fauna species of Conservation Significance that may occur within the Site.

Results

One broad fauna habitat type was identified within the Site:

- Mixed *Eucalyptus* and *Corymbia*. woodlands over variable understorey incorporating *Banksia* spp over mixed understorey.

The desktop survey indicated that a total assemblage of 117 vertebrate fauna species representing 54 families have the potential to occur at the Site. Of these, 21 taxa are listed either at Federal or State level as species of elevated conservation significance.

A total of 28 vertebrate fauna species representing 17 families were recorded across the Site during the field survey. These comprised 24 avifauna species, two introduced mammal species and two reptile species.

On the basis of the known distributions, habitat preferences and the habitats available, six vertebrate fauna species and one insect of elevated conservation significance might reasonably be expected to occur at the Site. These include:

- Two species of Black Cockatoo: Carnaby's (*Calyptorhynchus latisrostris*) and Forest Red-tailed (*Calyptorhynchus banksii naso*);
- Rainbow Bee-eater (*Merops ornatus*);
- Chuditch (*Dasyurus geoffroii*);
- Quenda (*Isodon obesulus*); and
- Lined Skink (*Lerista lineata*).

Conclusions and Recommendations

The faunal values of the Site are considered to be representative of those typically associated with urban bushland remnants on the Swan Coastal Plain. In a spatial

context, numerous other remnants are located in proximity to the Site, both on and off land reserved for conservation purposes. On this basis, impacts to fauna habitats and assemblages are likely to be restricted to the Site and therefore unlikely to extend beyond the boundaries.

Mitigation of impacts to these broad values might include measures such as:

- Implementing a Flora and Fauna Management Plan for the Site for the clearing and construction period;
- Minimising the clearing of remnant native vegetation by utilising previously disturbed areas and retaining native flora species wherever possible;
- Conducting clearing in a staged manner to allow terrestrial fauna time to move away;
- Trapping and removal of individual animals to neighbouring remnant vegetation prior to clearing by a fauna specialist. This will require approval from the Department of Environment and Conservation and liaising with local council to determine an appropriate location for the release of animals; and
- Use of native flora species in landscaping of the Site during development.

Specific impact mitigation measures to be considered relate to protection of habitat for the Black Cockatoo species. Impacts to these species are likely to be considered significant under Federal legislation and typically require stringent measures including:

- Retaining as many trees with a trunk diameter at breast height (DBH) of 500 mm or greater as possible;
- Retain all hollow-bearing trees that may be suitable for breeding of bird species and/or may become suitable for Black Cockatoo species over time. Where clearing of hollow-bearing trees is unavoidable, hollows should be inspected prior to clearing and birds removed to shelter;
- Feral bee control on Site to remove feral bees from the hollows of trees that are retained; and
- Scheduled of clearing operations such that they occur outside Black Cockatoo breeding season.

Where residual impacts to Black Cockatoo habitat remain, it is likely that a scheme to identify and implement an appropriate environmental offset package will be required.

1 Introduction

1.1 Project Background and Study Area Location

360 Environmental Pty Ltd (360 Environmental) was commissioned to undertake a Level 1 Vertebrate Fauna Survey at Lot 9001 Bertram Road, Parmelia (the Site), (Figure 1). The Department of Housing and Satterley Property Group propose to develop the Site for residential development. This technical report is required as part of the approvals process and will be included as an Appendix within the Federal Referral document.

The Site is located in the suburb of Parmelia, approximately 33 kilometres (km) south of Perth. The Site totals approximately 50 hectares (ha) of remnant bushland and is bounded to the north by Challenger Avenue. The western border is marked by Parmelia Avenue (in parts), St Vincent's Primary School and Bush Forever Site 67. The Perth to Mandurah rail line and Bollard Bullrush Swamp lie immediately to the east, and Tuart and Wellard Roads represent the southern boundary.

1.2 Study Objectives and Scope

1.2.1 Objective

The broad objectives of the survey were to provide Site-specific descriptions of fauna habitats and establish the likelihood of fauna species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Wildlife Conservation Act 1950* (WC Act) occurring within the Site.

Specifically, the objectives of the Level 1 Vertebrate Fauna Survey were to:

- Provide an inventory of the fauna habitats and assemblages of the Site;
- To identify significant opportunities and constraints associated with the faunal values within the Site;
- To assist the client with the evaluation of potential impacts on habitat and/or vertebrate fauna of Conservation Significance; and
- Provide recommendations to minimise and mitigate fauna impacts.

1.2.2 Scope

In order to achieve the objectives, 360 Environmental undertook a Level 1 Vertebrate Fauna Survey for the Site. The scope of works for the fauna survey included a desktop study followed by a single Site visit and habitat assessment.

The purpose of the desktop study was to gather background information relevant to the Site by searching literature, data sources and map based information. The Site visit aimed to verify the accuracy of the desktop study, to delineate and characterise fauna

- Legend**
-  Site Boundary
 -  Major Roads
 -  Minor Roads
 -  Bush Forever Sites
 -  EPP Labels

NOT TO SCALE
 DATE: 12/06/2012
 DRAWING NO: E88197-2.01
 PROJECT: SATURLEY PROPERTY GROUP
 LOCALITY MAP DERIVED FROM THE 2011 AERIAL PHOTOGRAPHY
 LOCALITY MAP DERIVED FROM THE 2011 AERIAL PHOTOGRAPHY



DATE	12/06/2012
DRAWING NO	E88197-2.01
HORIZONTAL DATUM AND PROJECTION	
COORDINATE SYSTEM	GDA 1984 MGA Zone 50
CREATED	
BY	AH
APPROVED	PD
REVISION	0

Saturley Property Group
 Lot 9001, Parmelia
 Level 1 Fauna Survey
 Location and Overview of the Site




Figure 1



and faunal assemblages present within the Site, and identify potential impacts.

The Level 1 Vertebrate Fauna Survey was planned and implemented in accordance with Environmental Protection Authority (EPA) *Position Statement No. 3 Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002), and *Guidance Statement No. 56 Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004). To ensure adequate data of a high standard the survey was conducted with reference to the *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA 2010) to meet the EPA and DEC's expectations for undertaking a Level 1 Vertebrate Fauna Survey.

1.3 Existing Environment

1.3.1 Physical Environment

1.3.1.1 Climate

The closest official Bureau of Meteorology (BoM) weather station currently operating is Medina Research Station where climate data is available between 1983 and 2012. The climate is classified as Warm Mediterranean, with mean minima ranging approximately from 10°C to 18°C and maxima from approximately 19°C to 33°C (Figure 2). Rainfall totals approximately 762.2 mm per annum.

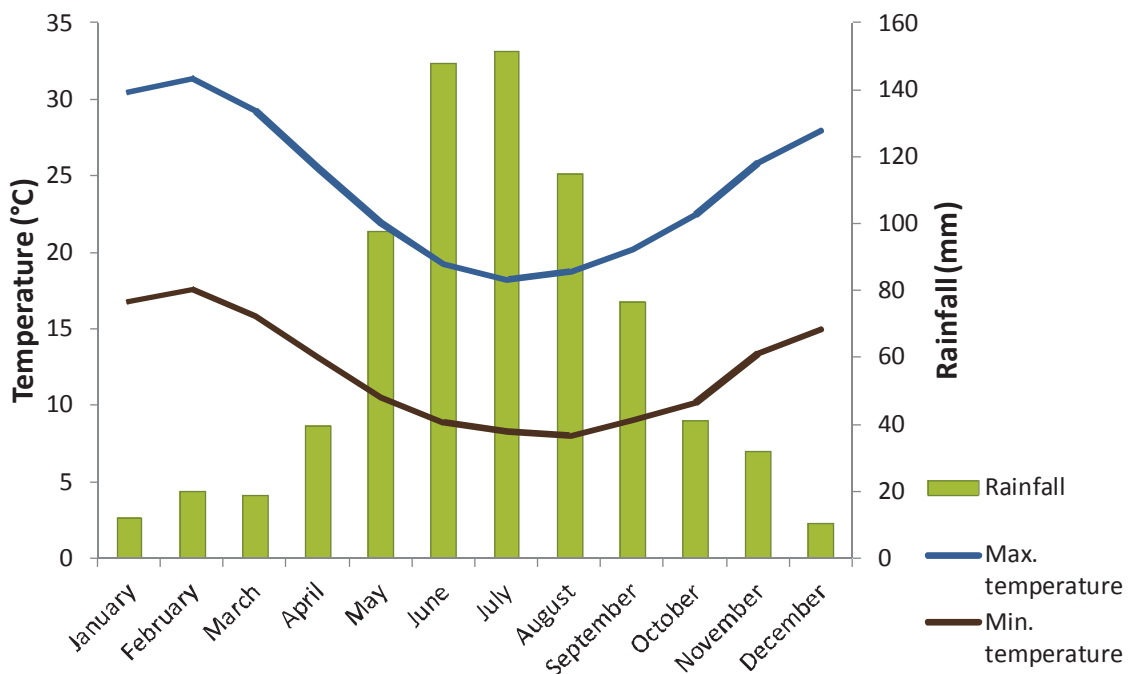


Figure 2: Mean Rainfall and Temperature for Medina Research Station Recorded Between 1983 and 2012 (Bureau of Meteorology, 2012).

1.3.1.2 Geology

The Site is located on the Spearwood Dune System, comprising red/brown, yellow and pale yellow/grey sands underpinned by karstic limestone in the west, and limestone rock in the remainder. The sediment is composed of Quaternary deposits which are unconsolidated or unlithified. The Spearwood dune system incorporates the Cottesloe and Karrakatta calcareous sands soil unit (Bennett Environmental Consulting 2004). The predominant geology underlying the Site is limestone and calcarenite (Department of Water 2012a).

1.3.1.3 Hydrology

The Site is located in the Serpentine River Catchment, and forms part of the Peel-Harvey Drainage Catchment (Cardno 2011). The highly permeable, sandy nature of the soils of this area result in good drainage of surface waters into the groundwater table (GHD 2007). The Perth Groundwater Atlas indicates that the ground water at the Site ranges from approximately 12 m below the ground surface in the east, to in excess of 40 m elsewhere (Department of Water 2012b). The major aquifers in the area which may have influences on the Site are Yarragadee North, Leederville, Superficial Swan and Rockingham Sand. Groundwater salinity ranges up to approximately 1,500 mg/l TDS (Department of Water 2012b).

1.3.1.4 Soils and landforms

The Kwinana area is located on the Spearwood Dune System (Town of Kwinana 2003). This system comprises red/brown, yellow and pale yellow/grey sands. Regional geological mapping identifies the Site as comprised of sand derived from Tamala Limestone (Department of Mines and Petroleum 2012). This features pale yellow brown, fine-to-coarse grained, sub-angular to well-rounded quartz, with high-to-medium permeability and contribute to groundwater infiltration. The Site topography rises from a low point in the east of the Site at approximately 10 m Australian Height Datum (AHD) to approximately 50 m AHD in the south-western corner (Department of Water 2012b).

1.3.2 Biological Environment

1.3.2.1 IBRA Bioregions

The Site lies within the Swan Coastal Plain Bioregion and Perth subregion of the Interim Biogeographic Regionalisation of Australia (IBRA). The Perth subregion (SWA2) is a low lying coastal plain composed of colluvial and Aeolian sands, alluvial river flats and coastal limestone rising to duricrusted Mesozoic sediments in the east. Outwash plains are extensive only in the south, while a complex series of seasonal wetlands and swamps extends from north to south. Vegetation comprises heath and/or Tuart woodlands on limestone, Banksia and Jarrah- Banksia woodlands on Quaternary marine dunes of various ages, Marri on colluvial and alluvial soils, *Casuarina obesa* on out-wash plains, and paperbark (*Melaleuca* spp.) in wetland areas.

1.3.2.2 Flora and vegetation

The predominant vegetation of the Spearwood Dune System is “*Eucalyptus gomphocephala* (Tuart) forest woodland. *E. marginata* and *E. calophylla* (now *Corymbia calophylla*) occur scattered throughout, but it is only in the transition Zone from this system to the Bassendean Dunes that *E. marginata* becomes dominant. Associations with *E. marginata* and following a similar trend in their occurrence are *Banksia attenuata*, *B. menziesli* and *Allocasuarina fraseriana*. The ground cover generally comprises proteaceous and leguminous woody perennials, *Dryandra* spp *Hakea* spp and *Leucopogon* spp” (Town of Kwinana 2003).

A Site specific flora and vegetation survey was completed in 2009 (360 Environmental 2009).

1.3.2.3 Fauna Habitats and Assemblages

The vertebrate fauna of the Swan Coastal Plain is recognized as being particularly diverse, although it is experiencing dramatic decline. Approximately 14% of avifauna species on the Swan Coastal Plain had declined sharply or become locally extinct within 150 years of European settlement (How and Dell 2000). Over half of the small terrestrial mammals had disappeared in the same period, and studies of urban remnants in the late 20th century yielded records of only three species (How and Dell 2000). Reptiles have fared better, but have still declined by conservative estimates of about 30% (How and Dell 2000). The primary threats that have led to, and are exacerbating this decline include the clearing of native bushland, the associated encroachment of urban and industrial areas and the influence of feral predators.

Given the threats listed above, it is unsurprising that the results of the decline in native fauna on the Swan Coastal Plain is most keenly observed in the greater metropolitan area, although those in surrounding agricultural zones are also significant. Larger pockets of remnant bushland may harbour the greatest number of species, although the value of smaller such areas as corridors through which animals are able to migrate are also important (How and Dell 1994).

Fauna surveys in the Perth area often yield reasonable numbers of avifauna due to commonly diurnal activity patterns. Herpetofauna and mammals are less commonly recorded, and establishing their potential to occur often relies on the veracity of habitat assessments. Where habitat assessments are considered to be insufficient, and often where fauna species of elevated Conservation Significance (protected under State or Federal legislation) are considered likely to occur, multiple phase Level 2 surveys may be required.

1.3.3 Conservation Reserves in the Locality

There are four gazetted Nature Reserves in the vicinity of the Site (Figure 3). These are established for wildlife and landscape conservation, scientific study and preservation of

features of archaeological, historic or scientific interest by the Conservation Commission of Western Australia (Environmental Defender's Office WA (EDOWA) 2011).

Table 1: Nature Reserves in the Vicinity of the Site.

RESERVE NAME	LOCATION RELATIVE TO THE SITE	AREA (HA)
Leda Nature Reserve	2 km south	442.8
Banksia Nature Reserve	5 km east	32.5
Modong Nature Reserve	6.5 km east-northeast	155.2
Wandi Nature Reserve	6.5 km northeast	30.3

In addition to these, there are six Bush Forever sites within similar distances. The aim of the Bush Forever programme is to ensure the long-term protection of biodiversity and associated environmental values inherent in remnant bushland across the Perth metropolitan area. The policy recognises the protection and management of significant bushland areas as a fundamental consideration in the planning process, while also seeking to integrate and balance wider environmental, social and economic considerations.

Jandakot Regional Park also lies approximately three kilometres to the northeast. While regional parks have no specific legal status, they generally comprise areas of land that have been identified as having regionally significant conservation, landscape and recreation values. As such these parks therefore provide the opportunity to develop a management approach that incorporates and coordinates these values.

1.4 Previous Fauna Surveys

Several surveys have been completed in the vicinity of the Site recently. These include:

- A targeted Black Cockatoo Survey in July 2012 (360 Environmental 2012a);
- Kwinana Town Centre Level 1 Vertebrate Fauna Survey 2012 (360 Environmental 2012b);
- Kwinana Train Station Precinct Level 1 Vertebrate Fauna Survey 2012 (360 Environmental in publication); and
- Level 1 Vertebrate Fauna Survey in the East Rockingham area (Harewood 2008).

Details of these surveys are provided in Table 2.

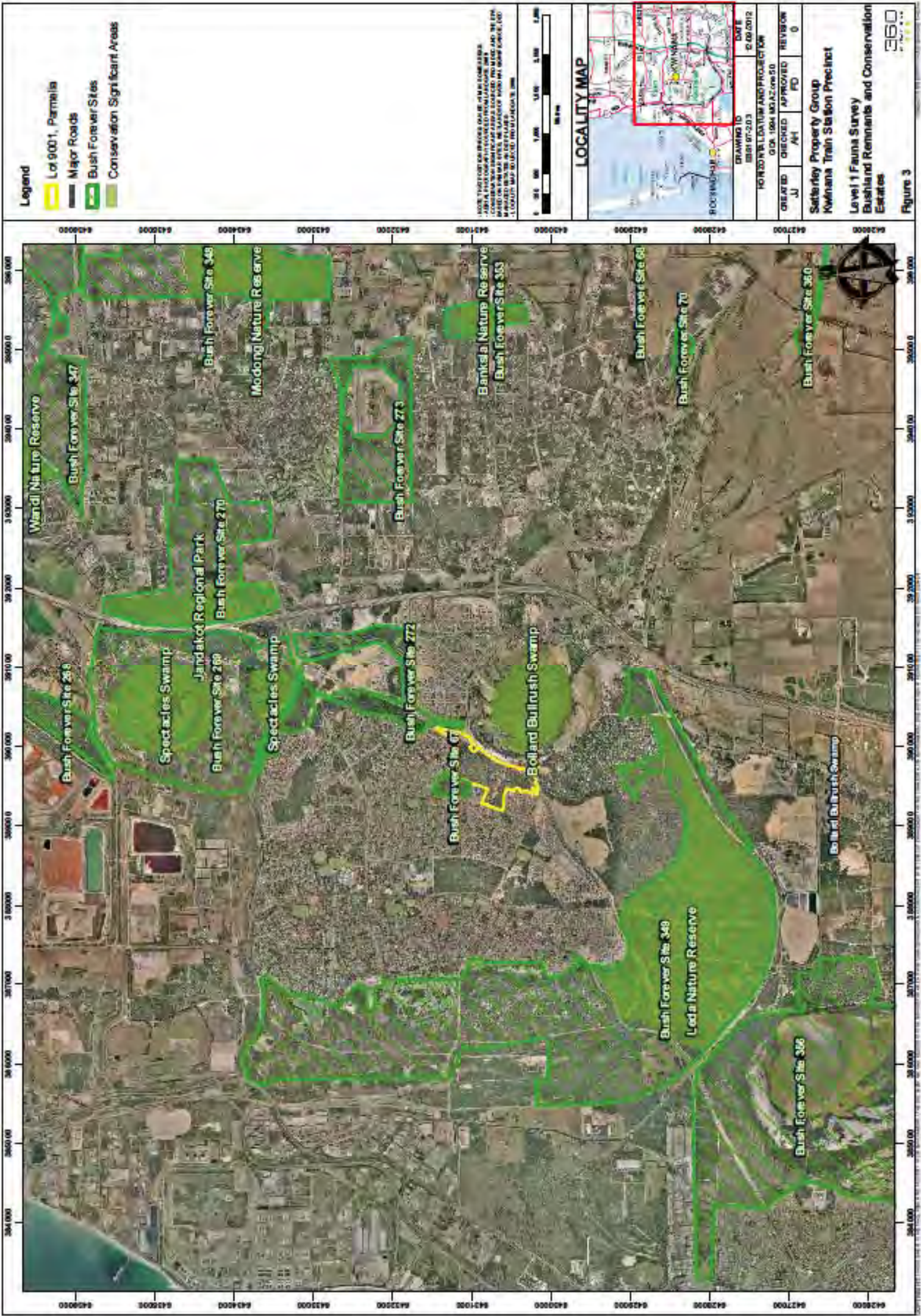


Figure 3

Table 2: Fauna Surveys Undertaken in the Vicinity of the Site.

	EAST ROCKINGHAM WWTP FAUNA ASSESSMENT	BLACK COCKATOO SURVEY AT THE SITE	LEVEL 1 FAUNA SURVEY KWINANA TOWN CENTRE	LEVEL 1 FAUNA SURVEY TRAIN STATION PRECINCT KWINANA
Consultant	Greg Harewood	360 Environmental	360 Environmental	360 Environmental
Timing	July 2008	July 2012	Autumn	Spring
Type	Level 1 Fauna Survey	Black Cockatoo Survey	Level 1 Fauna Survey	Level 1 Fauna Survey
Approx. Distance from Lot 9001	10 km	At Site	3 km	2.3 km
Survey Type	Reconnaissance	Reconnaissance	Reconnaissance	Reconnaissance
Amphibians	0	-	0	0
Reptiles	3	-	2	1
Mammals	3	-	6	4
Birds	30	Carnaby's and Forest Red-tailed Black Cockatoo	28	23
Total species	36	-	36	28
Conservation Significant species recorded	Quenda (Southern Brown Bandicoot)	Carnaby's and Forest Red-tailed Black Cockatoo	Carnaby's Black Cockatoo	Carnaby's Black Cockatoo and Quenda
No. Conservation Significant species	1	2	1	2
Duration	31 July 2008	July 2012	3 Days from March – May 2012	20 July and 7 September 2012

1.5 Report Format

This Report has been structured in the following format:

- Section 1: Introduction;
- Section 2: Methods;
- Section 3: Results;
- Section 4: Conservation Significant Fauna;
- Section 5: Conclusion and Recommendations;
- Section 6: References; and
- Section 7: Report Limitations.

2 Methods

2.1 Desktop Study

The desktop review compiled information from searches of:

- The Department of Environment and Conservation (DEC) NatureMap database;
- The EPBC Protected Matters database;
- The International Union for Conservation of Nature (IUCN) Red-list;
- The Birds Australia *Birdata database*;
- Selected fauna references (Wilson and Swan [2003]; Pizzey and Knight [1997]; Morcombe [2003]; Simpson and Day [1996]; Van Dyck and Strahan [2008]; Menkhorst and Knight [2004]); and
- Literature relating to previous fauna surveys in the area (Section 1.4).

Where appropriate, the parameters for the database searches are listed in Table 3.

All species of elevated Conservation Significance recorded or expected to occur on the Site were cross-checked against the Federal EPBC Protected Matters Database (SEWPaC 2012a) and the Government Gazette Number 12 (Government of Western Australia 2010) for their status under the EPBC Act and WC Act respectively.

Table 3: Database Sources

PROVIDER	DATABASE	PARAMETERS
Department of Sustainability, Environment, Water, Population and Communities	Protected Matters Database Search Tool. Accessed 16 July 2012 (Appendix A)	Buffer of one kilometre centred around -32.25314 115.82928
Department of Environment and Conservation	Naturemap (Appendix B)	Buffer of five kilometres centred around -32.25314 115.82928.
Department of Environment and Conservation	Fauna Search (Appendix C)	Buffer of five kilometres centred around 32.250833, 115.814722.

2.2 Survey Timing and Weather

Sampling activities were undertaken on 27 July 2012. The weather conditions were fine and cool with light winds. The minimum temperature was 2.4°C and the maximum was 19.5°C. No rain was recorded (Table 4).

Mean temperatures in the three months leading up to up to the survey were relatively typical of the long term averages for the time of year (Table 4), although July had a slightly lower mean minimum (-2.8°C) and slightly higher mean maximum (+1.1°C) than the long term average. Of greater significance was the relatively poor rainfall, with the total over three months in 2012 being over 100 mm less than the long term total for the same period. This was primarily due to a shortfall in July of 108.5 mm.

Table 4: Weather Conditions in the Three Months Leading Up to the Site Survey.

MONTH (2012)	MEAN TEMPERATURE (°C)		RAINFALL (MM)
	MINIMA	MAXIMA	
May	10.7	23.0	92.0
June	10.3	19.5	153.2
July	5.4	19.4	39.4
		Total	284.6

2.3 Fauna Survey Team

360 Environmental's Senior Environmental Scientist Andrew Hide coordinated and implemented the field survey. He was responsible for fauna identification and documentation and managed the data analysis and report production. Andrew has a Degree in Natural Resource Management and seven years of relevant field experience.

The report was written by Dr Phil Runham, who has over ten years of experience in conducting fauna surveys for Environmental Impact Assessment.

2.4 Fauna Habitat Assessment

Fauna habitats are typically identified on the basis of landforms in combination with soil types and associated vegetation complexes. Habitats were initially identified on the basis of flora and vegetation survey results (360 Environmental 2009). The fauna habitat present at each sampling location was subsequently verified during the Site reconnaissance survey.

Habitat descriptions were compiled at each sampling location, providing a description of the landform, soil and vegetation type. Photographic records of the habitat at each sampling location included a view to the North, East, South and West (Appendix A).

2.5 Sampling Locations

The Site reconnaissance survey incorporated the verification of potential habitats identified from the flora and vegetation survey (360 Environmental 2009). Sampling locations were selected so as to ensure that all major habitats were sampled and such that the spatial distribution of sampling locations incorporated the entire Site. Each sampling location was recorded using a Differential Global Positioning System (DGPS). Transects were completed throughout the length of the Site to ensure all habitats were identified and to increase the chance of opportunistically sighting fauna.

2.6 Survey Effort

2.6.1 Fauna Sampling

The principal component of the survey comprised five non-systematic sampling locations (Figure 4). Sampling at each location involved a detailed fauna search, comprising raking of leaf litter, and searching rock crevices, potential burrows and nests, for a minimum of 30 minutes. Sampling was conducted in the early morning and involved searching an approximate area of two hectares around the Site to identify and document fauna species (sightings) or secondary signs, such as scats, tracks and diggings.

Table 5: Sampling Location, Including GPS Location (GDA 1994) and Broad Habitat Type

SITE	ZONE	GPS LOCATION		PLATE NO	BROAD HABITAT
		EASTING	NORTHING		
Parm1	50H	389989	6431167	Plate 1	Eucalypt Woodland (Mixed Marri and Jarrah)
Parm2	50H	389799	6430875	Plate 2	Eucalypt Woodland (Mixed Marri and Jarrah)
Parm3	50H	389539	6430444	Plate 3	Eucalypt Woodland (Mixed Marri, Jarrah and Banksia)
Parm4	50H	389525	6430765	Plate 4	Eucalypt Woodland (Tuart Dominated)
Parm5	50H	389673	6431120	Plate 5	Eucalypt Woodland (Tuart Dominated)

2.6.1.1 Ornithological Census

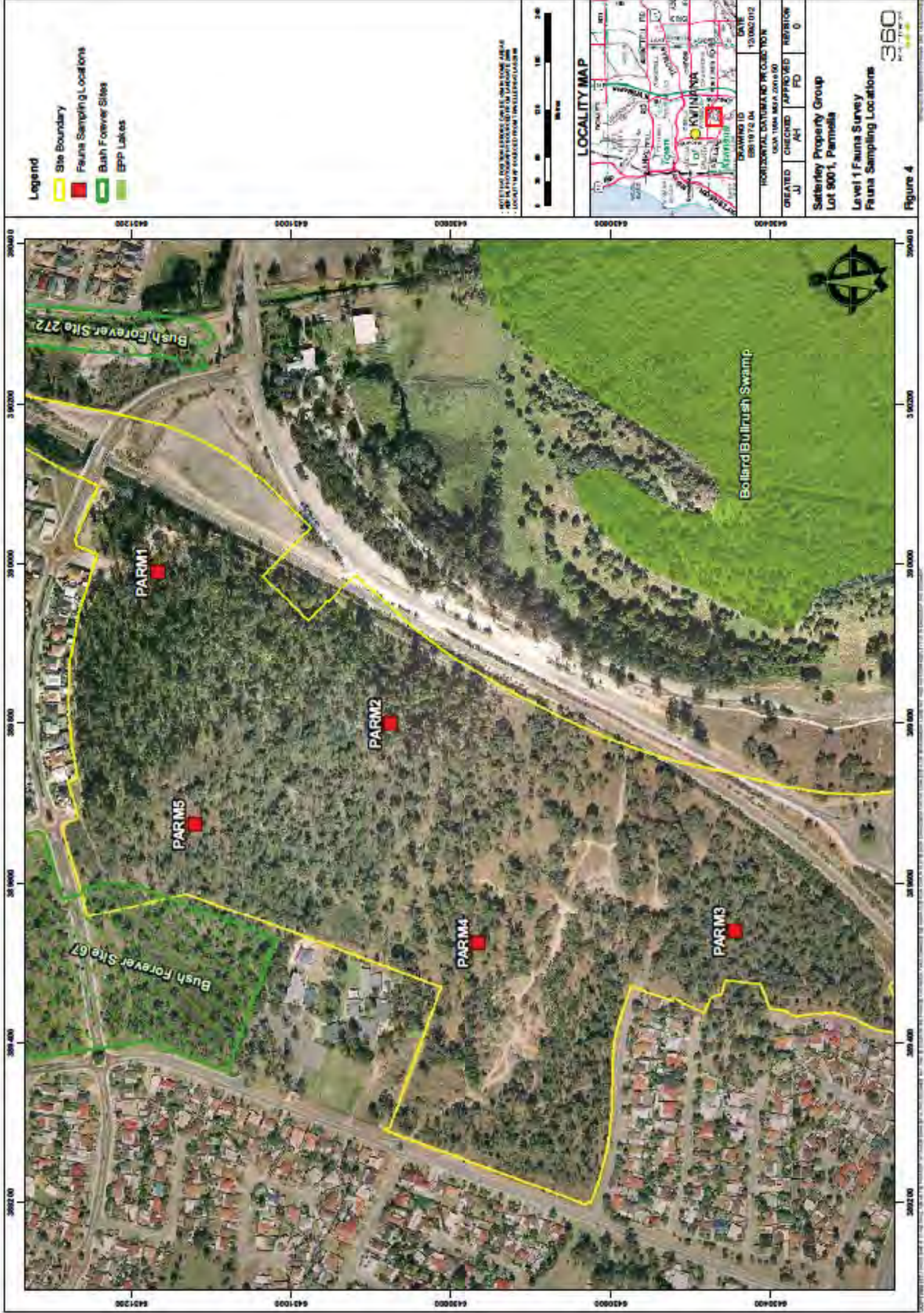
A dedicated bird census was conducted at each sampling location to identify bird species within a two hectare area for a minimum of 30 minutes per session. All individuals detected either visually or audibly between sunrise and 9 am were recorded. Opportunistic sightings of birds were also recorded while traversing the Site.

2.7 Nomenclature

The nomenclature used for each fauna group included:

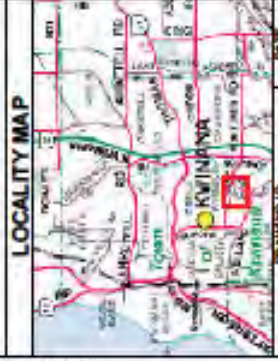
- Birds: Nomenclature for each bird species recorded was checked against Christidis and Boles (Christidis and Boles 2008);
- Mammals: Nomenclature for each mammal species recorded was checked against the *Checklist of the mammals of Western Australia* (How et al. 2009);
- Amphibians: Nomenclature for each amphibian species recorded was checked against the *Checklist of the amphibians of Western Australia* (Doughty and Maryan 2010a); and

- Reptiles: Nomenclature for each reptile species recorded was checked against the *Checklist of the reptiles of Western Australia* (Doughty and Maryan 2010b).



- Legend**
- ▭ Site Boundary
 - ▣ Fauna Sampling Locations
 - ▭ Bush Forever Sites
 - ▭ EPP Lakes

NOTES: FOR THE PURPOSES OF THIS ENVIRONMENTAL ASSESSMENT REPORT, THE LOCATION OF THE BUSH FOREVER SITES IS INDICATED BY THE RED SQUARES.



DATE	15/06/2012
DRAWING NO	0881972_04
HORIZONTAL DATUM AND PROJECTION	
DATE	15/06/2012
CREATED	JJ
CHECKED	AH
APPROVED	FD
REVISION	0

Satterley Property Group
 Lot 8001, Parmelia
 Level 1 Fauna Survey
 Fauna Sampling Locations

2.8 Survey Limitations

Table addresses potential limitations and constraints associated with the Level 1 Fauna Survey with reference to Guidance Statement 56 (EPA 2004).

It should be noted that while Level 1 surveys are limited in nature, the methodology is considered to be adequate for purpose in the context of relatively small bushland remnants in urban areas.

Table 6: Limitations and Constraints

POTENTIAL LIMITATIONS	CONSTRAINT*	COMMENT
Competency and experience of the consultant (s) carrying out the survey	No	The 360 Environmental staff member who completed the field work and prepared this report has appropriate training and experience in conducting Fauna Surveys.
Scope	No	The purpose of a Level 1 Fauna Survey is to conduct a reconnaissance survey to support a desktop study of a particular site in order to compile an inventory of fauna habitats and species and to identify any fauna of elevated Conservation Significance within the proposed Project area.
Proportion of fauna identified, recorded and/or collected	Negligible	As this is a Level 1 Fauna Survey a suitable amount of diversity has been recorded. A higher diversity of fauna species would require fauna trapping and is not within the scope of a Level 1 Fauna Survey.
Sources of Information	Negligible	Vertebrate fauna information was accessed by searching available literature and survey data; web based mapping tools and map-based information.
Proportion of the task achieved	No	The field component fulfils EPA's requirements for a Level 1 Fauna Survey.
Timing/ weather/season/ cycle	No	A dedicated morning fauna survey was conducted throughout during late Winter / early Spring. The weather on the survey day was fine
Disturbances which affected results of the survey	No	Human disturbances are regular throughout the Site. However these are not recent disturbances and therefore would not have affected the survey results.
Intensity of survey effort	Negligible	The intensity of survey effort was sufficient for a Level 1 Fauna Survey.
Completeness	No	The survey was completed over a Site visit during optimal conditions in late Winter / early Spring and the relevant literature and data for the Site was reviewed. Further detail would require a Level 2 Fauna Survey.

POTENTIAL LIMITATIONS	CONSTRAINT*	COMMENT
Resources	No	Adequate resources were available.
Remoteness and/or access problems	No	Access to and within the Site was not an issue.
Availability of contextual information on the region	Negligible	360 Environmental had adequate access to fauna databases to determine which species were likely to be identified within the Site.

*Constraint (yes/no); Significant – greater than 60%; Moderate – 20-60%; Negligible – less than 20%

3 Results

3.1 Desktop Study

3.1.1 Faunal Assemblage

A search of the DEC's Threatened and Priority Fauna Database, Naturemap and the EPBC Protected Matters Database search were undertaken to identify fauna species predicted to occur within a buffer of five kilometres of the Site.

A total of 117 vertebrate fauna species were documented as potentially occurring in the Site (Table 7). Nine of these are species that have been introduced since European settlement. The total inventory included representatives of 50 families, with six families being represented by the introduced species.

Table 7: Fauna Taxa with the Potential to Occur at the Site.

FAUNA GROUP	NUMBER OF FAMILIES	NUMBER OF SPECIES
Avifauna - Native	37	88
Avifauna - Introduced	3	5
Mammals - Native	6	6
Mammals - Introduced	3	4
Bats	0	0
Reptiles	3	11
Amphibians	2	3
Total	54*	117

*Note that four families are represented by both Native and exotic species.

3.1.2 Conservation Significant Fauna

Conservation Significant fauna identified as having the potential to occur in the area included a total of twelve (12) bird species, six (6) terrestrial mammal species and two (2) reptile species (Table 8). One insect of Conservation Significance was also predicted to occur within the Site.

These species will be discussed in further detail in Section 4.3.

Table 8: Desktop Study Results

COMMON NAME	SCIENTIFIC NAME	INTERNATIONAL IUCN	FEDERAL EPBC	STATE	
				DEC	WCA
Birds					
Camaby's Black Cockatoo	<i>Calyptorhynchus latirostris</i>	Endangered	Endangered		Schedule 1
Malleefowl	<i>Leipoa ocellata</i>	Vulnerable	Vulnerable Migratory Terrestrial		Schedule 1
Forest Red-Tailed Black Cockatoo	<i>Calyptorhynchus banksii naso</i>		Vulnerable		Schedule 1
Painted Snipe	<i>Rostratula benghalensis (sensu lato)</i>	Least Concern	Vulnerable Migratory Wetland		Schedule 1
Australian Painted Snipe	<i>Rostratula australis</i>	Endangered	Vulnerable		Schedule 3
Great Egret, White Egret	<i>Ardea alba</i>		Migratory Marine, Migratory Wetland		Schedule 3
Cattle Egret	<i>Ardea ibis</i>		Migratory Marine, Migratory Wetland		Schedule 3
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Least Concern	Migratory Terrestrial		Schedule 3
Rainbow Bee-eater	<i>Merops ornatus</i>	Least Concern	Migratory Terrestrial		Schedule 3
Fork-tailed Swift	<i>Apus pacificus</i>	Least Concern	Migratory Marine		Schedule 3
Peregrine Falcon	<i>Falco peregrinus</i>	Least Concern			Schedule 4
Hooded Plover	<i>Charadrius rubricollis</i>	Vulnerable	Migratory Marine	Priority 4	
Mammals					
Red-tailed Phascogale	<i>Phascogale calura</i>	Near Threatened	Endangered		Schedule 1
Chuditch	<i>Dasyurus geoffroi</i>	Near Threatened	Vulnerable		Schedule 1
Quokka	<i>Setonix brachyurus</i>	Vulnerable	Vulnerable		Schedule 1
Water Rat	<i>Hydromys chrysogaster</i>	Least Concern		Priority 4	
Western Brush Wallaby	<i>Macropus Irma</i>	Least Concern		Priority 4	

COMMON NAME	SCIENTIFIC NAME	INTERNATIONAL IUCN	FEDERAL EPBC	STATE DEC	STATE WCA
Quenda	<i>Isoodon obesulus subsp. fusciventer</i>	Least Concern		Priority 5	
Reptiles					
Lined Skink	<i>Lerista lineata</i>			Priority 3	
Black-striped Snake	<i>Neelaps calonotos</i>	Lower Risk/near threatened		Priority 3	
Insects					
Graceful Sun Moth	<i>Synemon gratiosa</i>		Endangered		Schedule 1

3.2 Fauna Habitats

A single broad fauna habitat type was identified at the Site on the basis of the Vegetation communities identified previously (Appendix E) and the field-based fauna habitat assessment. This predominantly comprised contiguous *Eucalypt* and *Corymbia* woodland of variable density and understorey. It should be noted that portions of this habitat were assessed as being Completely Degraded. A small area of *Dryandra sessilis* scrub was discounted due to its small size (approximately 0.36 ha) and location adjacent to cleared land.

A significant Black Cockatoo habitat tree survey conducted in 2010 identified 633 trees with a trunk diameter at breast height (DBH) (approximately 1.5 m above ground level) of 400 mm or greater (Appendix C). The dominant tree species observed were Tuart, Jarrah and Marri.

3.3 Faunal Assemblage

A total of 28 vertebrate fauna species representing 17 families were recorded during the survey (Table 9). Avifauna species were the most abundant fauna recorded, whilst other groups were represented only by individual animals.

Table 9: Number of Vertebrate Fauna Species recorded at the Site.

FAUNA GROUP	NUMBER OF FAMILIES	NUMBER SPECIES
Birds	14	24
Native Mammals	0	0
Introduced Mammals	2	2
Bats	0	0
Reptiles	1	2
Amphibians	0	0
Total	17	28

3.3.1 Avifauna

A total of 24 avifauna species were recorded either visually or by calls during the survey (Table 10). The most abundant species was the Australian White Ibis with 14.9% (20 records) of the total individuals. Four other species, the Australian Ringneck (12.7%) Rainbow lorikeet and Galah (11.2% each), and the red-capped parrot (9.0%) also represented relatively large proportions of the assemblage. No other species yielded in excess of 6% of the total individuals recorded.

Eight of the 24 avifauna families recorded (33.3%) were represented by single species. The Cacatuidae were relatively diverse with four species while the Acanthizidae and the Psittacidae were each represented by three species.

Of the five sampling locations censused, three could be considered reasonably diverse, with inventories of nine to 15 species across seven to twelve families. The remaining two sampling locations were species poor, with less than six species representing a maximum of four families.

3.3.1.1 Avifauna of Conservation significance

Two avifauna species of conservation significance, Carnaby's Black Cockatoo and the Red-tailed Black Cockatoo, were recorded opportunistically during traverses of the Site. These species will be discussed in greater detail later in this report (see Table 13; Section 4.3.3).

3.3.1.2 Regionally Endemic Avifauna

No regionally endemic avifauna species were recorded during the survey. However, a number of species that were recorded are considered to be restricted to the south west corner of Western Australia. These include the Black Cockatoo species, Golden Whistler and Red-capped Parrot.

3.3.1.3 Avifauna Taxonomy

The taxonomic status of all species recorded is considered to be relatively stable and the species generally accepted under the nomenclature listed in Christidis and Boles (2008).

3.3.2 Mammals

Two species of introduced mammal were recorded during the survey (Table 11). The cat and rabbit were both recorded from secondary signs. Cat tracks (possibly domestic) and a rabbit burrow complex were observed in the north-eastern quarter of the study area.

3.3.2.1 Mammals of Conservation significance

No mammals of conservation significance were recorded during the Site visit.

3.3.2.2 Regionally Endemic Mammals

No regionally endemic mammal species were recorded during the survey.

3.3.2.3 Mammal Taxonomy

The taxonomic status of the two species recorded is considered stable.

3.3.1 Herpetofauna

One reptile species, *Tiliqua rugosa* (Scincidae) was recorded at Site 2 during the survey (Table 12).

3.3.1.1 Herpetofauna of Conservation significance

T. rugosa is not currently listed as a threatened species.

3.3.1.2 Regionally Endemic Herpetofauna

The species recorded is not considered to be endemic to the Bioregion.

3.3.1.3 Herpetofauna Taxonomy

The taxonomy of *T. rugosa* is well defined to the subspecies level.

Table 10: Avifauna Species Recorded at the Site.

COMMON NAME	SCIENTIFIC NAME	CONS SIG	LOCATION					TOTAL	OPP. REC.
			1	2	3	4	5		
Threskiornithidae									
Australian White Ibis	<i>Threskiornis molucca</i>		8 [^]	12 [^]				0	20
Straw-necked Ibis	<i>Threskiornis spinicollis</i>		2					0	2
Cacatuidae									
Caraby's Black Cockatoo	<i>Calyptorhynchus latirostris</i>	Yes						3*	3
Galah	<i>Eolophus roseicapillus</i>		2	2	1 [^]		10	0	15
Little Corella	<i>Cacatua sanguinea</i>		3 [^]					0	3
Red-tailed Black Cockatoo	<i>Calyptorhynchus banksii</i>	Yes						2	2
Psittacidae									
Australian Ringneck	<i>Barnardius zonarius</i>		3	3		1	10	0	17
Rainbow Lorikeet	<i>Trichoglossus haematodus</i>						15	0	15
Red-capped Parrot	<i>Purpurecephalus spurius</i>		4	6			2*	0	12
Halcyonidae									
Laughing Kookaburra	<i>Dacelo novaeguineae</i>			1	2			0	3
Acanthizidae									
Western Gerygone	<i>Gerygone fusca</i>			1				0	1
Western Thornbill	<i>Acanthiza inornata</i>			7				0	7
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>			2	3			0	5
Pardalotidae									
Striated Pardalote	<i>Pardalotus striatus</i>		1	1	3			0	5
Meliphagidae									
Brown Honeyeater	<i>Lichmera indistincta</i>			3	1			0	4
Red Wattlebird	<i>Anthochaera carunculata</i>		2					0	2
Campephagidae									
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>			1				0	1
Pachycephalidae									
Golden Whistler	<i>Pachycephala pectoralis</i>			3				0	3
Artamidae									
Australian Magpie	<i>Cracticus tibicen</i>		1		1		1	0	3
Grey Currawong	<i>Strepera versicolor</i>				2			0	2

COMMON NAME	SCIENTIFIC NAME	CONS SIG	LOCATION					OPP. REC.	TOTAL
			1	2	3	4	5		
Rhipiduridae									
Grey Fantail	<i>Rhipidura albiscapa</i>			1	1		1	0	3
Corvidae									
Australian Raven	<i>Corvus coronoides</i>			5 [^]	1	1		0	7
Monarchidae									
Magpie-lark	<i>Grallina cyanoleuca</i>		1					0	1
Petroicidae									
Scarlet Robin	<i>Petroica boodang</i>			2 [^]				0	2
Total Individuals		-	27	50	15	2	39	5	134
Total Species		-	10	15	9	2	6	2	24

[^] Denotes records of avifauna flying over site. *Denotes avifauna recorded by secondary sign.

Table 11: Mammal Species Recorded at the Site

COMMON NAME	SCIENTIFIC NAME	CONS SIG	LOCATION					OPP. REC.	TOTAL
			1	2	3	4	5		
Felidae									
Cat	<i>Felis catus</i>		1	1				1*	3
Leporidae									
Rabbit	<i>Oryctolagus cuniculus</i>			1				1*	2
Total Individuals			1	2	0	0	0	2	5
Total Species			1	2	0	0	0	2	2

Table 12: Reptile Species Recorded at the Site

COMMON NAME	SCIENTIFIC NAME	CONS SIG	LOC1	LOC2	LOC3	LOC4	LOC5	OPP. RECORD	TOTAL
Bobtail Lizard	<i>Tiliqua rugosa</i>			1					1
Total Individuals			0	1	0	0	0	0	1
Total Species			0	1	0	0	0	0	1

4 Discussion

4.1 Fauna Habitats

The fauna habitats recorded for the Site are typical of a subset of those associated with the Spearwood dune system of the Swan Coastal Plain (How and Dell 1994; 2000). Remnant bushland such as this in the Perth metropolitan area is considered to be of substantial conservation value as habitat for native vertebrate species. It should be noted however, that this value is related at least in part to the size of the remnant and the quality of the vegetation it contains (How and Dell 1994; 2000).

On this basis, it may be expected that development of the Site will impact on the quantity of habitat in the local area. However, these impacts will be limited by the relatively disturbed vegetation and the proximity of urban development. In this context, residual impacts on the habitat of most vertebrate fauna will not greatly exceed those already existing. Additionally, residual impacts are likely to be minimised by the proximity of the Bollard Bulrush Swamp and a number of nature conservation reserves (see Section 1.3.3).

4.2 Fauna Assemblage

The small number of fauna species recorded for the Site is related to the low intensity sampling that is characteristic of Level 1 Fauna surveys (EPA 2004). The species recorded represent a limited subset of those expected to occur on the basis of the desktop study. Research has shown that many of the species that persist in urban bushland remnants do so independently of remnant size (How and Dell 1994; 2000). It can therefore be assumed that a more intensive level of survey would have yielded a greater proportion of the fauna taxa typical of the Swan Coastal Plain. It logically follows, that impacts to these species associated with development of the Site should be expected, although these impacts are unlikely to extend beyond the spatial context of the specific bushland remnant. This assessment is further supported by the proximity of other remnant bushland areas in relatively close proximity to the Site (see Section 1.3.3).

4.3 Fauna of Conservation Significance

4.3.1 Key Statutory Requirements

Native fauna species that are rare, threatened with extinction, or have high conservation value are specially protected by law under the Federal EPBC Act or the State level WC Act. In addition, DEC may list other species that are considered to be of State level significance as Priority species, although this level of recognition is enforced under legislation (Appendix D).

4.3.1.1 Federal Legislation

Fauna species are protected at a Federal level under the EPBC Act. The EPBC Act was developed to provide for the protection of the environment, with specific regard to those aspects of the environment that are matters of national environmental significance (MNES). The EPBC Act promotes the conservation of biodiversity through ecologically sustainable development practices and the ecologically sustainable use of natural resources.

The EPBC Act includes provisions to protect native species (and in particular prevent the extinction and promote the recovery of threatened species) and to ensure the conservation of migratory species protected under international agreements (Japan-Australia Migratory Bird Agreement [JAMBA], China-Australia Migratory Bird Agreement [CAMBA], Republic of Korea-Australia Migratory Bird Agreement [RoKAMBA]).

The significance levels for fauna used in the EPBC Act are those recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN).

4.3.1.2 State Legislation

Western Australia's biodiversity is supported and protected by the following legislation:

- The *Conservation and Land Management Act 1984* (CALM Act);
- The *Environmental Protection Act 1986* (EP Act);
- The WC Act;
- The *Wildlife Conservation Regulations 1970*; and
- The *Wildlife Conservation (Specially Protected Fauna) Notice 2012*.

The *Wildlife Conservation (Specially Protected Fauna) Notice 2012* describes categories for fauna classified as Specially Protected in a series of Schedules. The DEC produces a supplementary list of Priority Fauna, being species that are not considered Threatened under the WC Act but for which the Department feels there is a cause for concern. These species have no special protection, but their presence would normally be considered as potentially significant and the species need further survey and evaluation of their conservation status before consideration can be given to declaration as Threatened Fauna. Levels of Priority are described in Appendix F.

4.3.1.3 International Agreements

The EPBC Act also includes management of migratory species that are recognised under international treaties such as the CAMBA, the JAMBA, RoKAMBA and *The Convention on the Conservation of Migratory Species of Wild Animals* (the Bonn Convention). Species included in these agreements are considered to be significant at the global level.

4.3.2 Threatened Fauna

A total of 20 such vertebrate fauna taxa protected under State and/or Federal legislation were identified as having the potential to occur within the Site on the basis of their known distributions (Table 13). These included fourteen avifauna species, five native mammal species and one reptile. No amphibians of Conservation Significance are predicted to occur within the Site. Additionally, one insect species (the Graceful Sun Moth) of Conservation Significance was identified as having been recorded in the wider area.

An assessment of species likely use of the Site and subsequently for their potential to be significantly impacted by the development was completed on the basis of their habitat preferences. This information yielded six species of conservation significance that have the potential to utilise the habitats available on the Site. These are discussed further in the following subsections.

Table 13: Likelihood of Predicted Conservation Significant Species Occurring at the Site

SPECIES	CONSERVATION STATUS	PREFERRED HABITAT	EXTENT OF HABITAT IN THE STUDY AREA AND REGION	LIKELIHOOD OF OCCURRENCE
Birds				
Australasian Bittern (<i>Botaurus poiciloptilus</i>)	IUCN: Endangered EPBC: Endangered WC: Schedule 1	In the southwest of Western Australia, the Bittern is found in tall rush and short fine sedge beds or open pools. It also occurs around swamps, lakes, pools, rivers and channels fringed with lignum <i>Muehlenbeckia</i> , canegrass <i>Eragrostis</i> or other dense vegetation and may be found in irrigated fields and swamps (Marchant & Higgins 1990).	There are no swamps or water bodies present within the Site.	Unlikely
Australian Painted Snipe (<i>Rostratula australis</i>)	IUCN: Endangered EPBC: Vulnerable WC: Schedule 3	Inhabits shallow terrestrial freshwater wetlands of the Swan Coastal Plain (Johnstone & Storr 1998). (SEWPaC 2012b).	There are no swamps or water bodies present within the Site.	Unlikely
Camaby's Black Cockatoo (<i>Calyptorhynchus latirostris</i>)	IUCN: Endangered EPBC: Endangered WC: Schedule 1	Forests, woodlands, heathlands, farms. It feeds on banksias, hakeas, dryandras (often on ground) and also exploits pine plantations (Morcombe 2003).	Banksia species are common throughout the Site. There is also the potential for breeding habitat with large Jarrah trees throughout the Site.	Confirmed during survey
Cattle Egret (<i>Ardea ibis</i>)	EPBC: Migratory Marine, Migratory Wetland WC: Schedule 3	Inhabits paddocks, pastures, croplands, wetlands, tidal mudflats and drains (Pizzey & Knight 1997). Occurs in tropical and temperate grasslands, woodlands and terrestrial wetlands (SEWPaC 2012b).	The Site does not contain any of the preferred habitats of the species, therefore it is unlikely the species will be present at the Site.	Unlikely
Common Sandpiper (<i>Actitis hypoleucos</i>)	IUCN: Least concern EPBC: Migratory Marine WC: Schedule 3	Utilises a range of coastal wetlands and some inland wetlands with varying levels of salinity, mostly around muddy margins or rocky shores and rarely on mudflats. Has been recorded in estuaries and deltas, on banks farther upstream: around lakes, pools, billabongs, reservoirs, dams and claypans. (Higgins & Davies 1996).	The Site does not contain any of the preferred habitats of the species, therefore it is unlikely the species will be present at the Site.	Unlikely
Fairy Tern (<i>Sterna nereis nereis</i>)	IUCN: Vulnerable EPBC: Vulnerable WC: Schedule 1	Nests on sheltered sandy beaches, spits and banks above the high tide line and below vegetation. The subspecies has been found in embayments of a variety of habitats including offshore, estuarine or lacustrine (lake) islands, wetlands and mainland	There are no water bodies present within the Site.	Unlikely

SPECIES	CONSERVATION STATUS	PREFERRED HABITAT	EXTENT OF HABITAT IN THE STUDY AREA AND REGION	LIKELIHOOD OF OCCURRENCE
Forest Red-Tailed Black Cockatoo (<i>Calyptorhynchus banksii naso</i>)	EPBC: Vulnerable WC: Schedule 1	coastline (Higgins & Davies 1996). Inhabits dense Jarrah, Karri and Marri forests which receive more than 600mm of annual rainfall (SEWPaC 2012b). It feeds on the seeds of Marri and Jarrah fruits (SEWPaC 2012b)	Jarrah is common throughout the Site and there is potential breeding habitat with large trees throughout the Site.	Probable
Fork-Tailed Swift (<i>Apus pacificus</i>)	IUCN: Least concern EPBC: Migratory Marine WC: Schedule 3	This species occurs over open country, from semi-deserts to coasts often in association with passing storm fronts, but typically remains airborne (SEWPaC 2012b).	This species may occur over the Site periodically. However, its biology indicates that it is unlikely to utilise the habitats present.	Unlikely
Glossy Ibis (<i>Plegadis falcinellus</i>)	IUCN: Least concern WC: Schedule 3	The species feeds in very shallow water and nests in freshwater or brackish wetlands with tall dense stands of emergent vegetation (e.g. reeds or rushes) and low trees or bushes (Marchant & Higgins 1990). It shows a preference for marshes at the edges of lakes and rivers, as well as lagoons, flood-plains, wet meadows, swamps sewage ponds, rice-fields and irrigated cultivation (Marchant & Higgins 1990). Swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs (Pizzey and Knight 1997).	There is no water body present within the Site, thus it is unlikely the species will be present at the Site.	Unlikely
Great Egret, White Egret (<i>Ardea alba</i>)	EPBC: Migratory Marine, Migratory Wetland WC: Schedule 3	Swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs (Pizzey and Knight 1997).	As the Site contains no wetlands it is unlikely that the species will be utilising the Site.	Unlikely
Malleefowl (<i>Leipoa ocellaa</i>)	IUCN: Vulnerable EPBC: Vulnerable, Migratory Terrestrial WC: Schedule 1	Malleefowl occur within mallee, Acacia, paperbark, sheoak, and other scrubs; eucalypt woodland; coastal heaths; mostly on sand or gravel soils with abundant litter and low scrub (Pizzey and Knight 1997; Morcombe 2003).	There are no generally accepted records of the species from the Swan Coastal Plain in the vicinity of the study area. Given current knowledge of its distribution it is highly unlikely to occur at the Site.	Unlikely

SPECIES	CONSERVATION STATUS	PREFERRED HABITAT	EXTENT OF HABITAT IN THE STUDY AREA AND REGION	LIKELIHOOD OF OCCURRENCE
Painted Snipe (<i>Rostratula benghalensis s. lat.</i>)	IUCN: Least concern EPBC: Vulnerable Migratory Wetland WC: Schedule 1	Marsh with moderate cover (Simpson & Day 1996). This species inhabits shallow terrestrial freshwater wetlands (SEWPaC 2012b).	As the Site contains no wetlands it is unlikely that the species will be utilising the Site.	Unlikely
Rainbow Bee-Eater (<i>Merops ornatus</i>)	IUCN: Least concern EPBC: Migratory Terrestrial WC: Schedule 3	Occurs in open forests and woodlands, shrublands, sandridges, sandspits, riverbanks, mangroves and in various cleared or semi-cleared habitats, including farmland and areas of human habitation (Higgins 1999). Nests in burrows constructed in sandy substrates.	The study area comprised sand-based habitats. It is probable that that the species will occur in the area periodically, and possible that the area may be used for nesting.	Probable
White-bellied Sea-Eagle (<i>Haliaeetus leucogaster</i>)	IUCN: Least concern EPBC: Migratory Terrestrial WC: Schedule 3	This species occurs mainly around coasts, islands, estuaries, inlets, large rivers, inland lakes and reservoirs (Pizzey and Knight 1997). This species is also found around terrestrial wetlands in tropical and temperate regions (SWEPA 2012b).	Given the distance of the Site from the coast, it is possible that transient individuals will occur over it periodically. However, the species is not expected to utilise the available habitats.	Unlikely
Mammals				
Chuditch (<i>Dasyurus geoffroii</i>)	IUCN: Near Threatened EPBC: Vulnerable WC: Schedule 1	This species is able to exist in a variety of environments from denser eucalypt forests and open woodlands to sparser, semi-arid and low-lying scrub (Van Dyck & Strahan 2008). The only remaining habitat suitable for supporting Chuditch numbers is through the cooler south-west corner of the state, in areas with significant concentrations of prey and sufficient logs and hollows for nests (Van Dyck & Strahan 2008).	The Site contains the species preferred habitat and during pre-European settlement the species would likely have occurred at the Site. The lack of contiguous habitat is likely to make it difficult for the species to persist or to re-establish at the Site. However, the species has been recorded in the vicinity in the past 15 years, and there is a possibility that individuals may occur at the Site periodically.	Possible
Quenda (<i>Isodon obesulus subsp. Fusciventer</i>)	IUCN: Least concern DEC: Priority 5	This species inhabits heathy forest, heath, and coastal scrub (Menkhurst & Knight 2004). The southern brown bandicoot often feeds in forest and woodland that is burnt on a regular basis and also in areas of pasture and cropland adjacent to dense cover.	The Quenda still inhabits remnant vegetation across Perth's suburbs. While the Site does not incorporate preferred habitat due to the relatively open understorey, animals may be resident at the adjacent Bollard Bulrush Swamp and may	Possible

SPECIES	CONSERVATION STATUS	PREFERRED HABITAT	EXTENT OF HABITAT IN THE STUDY AREA AND REGION	LIKELIHOOD OF OCCURRENCE
Quokka (<i>Setonix brachyurus</i>)	IUCN: Vulnerable EPBC: Vulnerable WC: Schedule 1	This species requires wet ground cover in forest or swampy flats (Menkhorst & Knight 2004) and can also be found in heath and shrublands (SEWPaC 2012b).	therefore utilise the Site for foraging. Therefore there is a possibility the species is present at the Site.	Unlikely
Red-Tailed Phascogale (<i>Phascogale calura</i>)	IUCN: Near Threatened EPBC: Endangered WC: Schedule 1	This species is found in woodland habitats in south and central Australia. It is restricted to areas containing mature wandoo or rock oak woodland (Menkhorst & Knight 2004). This species requires hollow-containing eucalyptus trees for breeding (SEWPaC 2012b).	The Site does not contain the preferred habitat for the species and the nearest records are from approximately 20 km to the east in excess of 40 years previously. The species is therefore highly unlikely to be present at the Site.	Unlikely
Western Brush Wallaby (<i>Macropus irma</i>)	IUCN: Least concern DEC: Priority 4	This species inhabits dry sclerophyll forest and woodland in the south-west of Western Australia, including some mallee areas (Menkhorst & Knight 2004). The preferred habitat type for this species is open forest or woodland.	The Site does not contain the species preferred habitat and the Site is well outside the species known distribution. Therefore it is unlikely the species will be present at the Site.	Unlikely
Reptiles				
Lined Skink (<i>Lerista lineata</i>)	DEC: Priority 3	This species is found on the lower west coast of Western Australia. It inhabits areas containing white sands Storr et al. 1999). Its preferred habitat is sandy coastal heath and shrubland (Wilson & Swan 2003).	The Site contains preferred habitat of the species. However due to the nature of the Site (small Site enclosed by residential housing and roads) it is unlikely the species will be present at the Site.	Unlikely
Insects				
Graceful Sun Moth (<i>Syneemon gratioiosa</i>)	EPBC: Endangered WC: Schedule 1	The graceful sun moth is found in coastal heathland and <i>Banksia</i> woodland. This species is dependent on its host plants, <i>Lomandra hermaphrodita</i> and <i>Lomandra maritima</i> for survival (SEWPaC 2012b).	The Site does contain sandy shrublands and it is possible that the species may occur there.	Possible
			<i>Lomandra</i> species were not recorded within the Site during the 2009 Flora and Vegetation Survey. Therefore it is unlikely the species will be present at the Site without its preferred habitat species.	Unlikely

4.3.3 Impacts to Threatened Fauna

4.3.3.1 Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo

A total of 449 significant Jarrah, Marri and Tuart trees (DBH > 500 mm) have been recorded at the Site (Figure 5). Under DSEWPaC (2012) Guidelines, these are considered to provide potential breeding and foraging habitat for both of these Black Cockatoo Species. Additionally, Carnaby's Cockatoo was recorded during the survey, and foraging evidence has previously been recorded at the Site (Figure 6). On this basis, it is probable that at least one of the Black Cockatoo species will utilise the area. Consequently, DSEWPaC is likely to consider the action as significantly impacting Black Cockatoo species and the development should therefore be referred to for assessment.

4.3.3.2 Rainbow Bee-eater

Habitat for the Rainbow Bee-eater is found throughout much of Western Australia, with sandy habitats being used for the construction of nesting burrows (Johnstone and Storr 1998). Impacts to the species habitat are to be expected due to development of the Site. However, the cosmopolitan distribution of the species and its breeding habitat throughout Western Australia indicates that such impacts will not significantly affect the species conservation status.

4.3.3.3 Chuditch

NatureMap indicates that two recent Chuditch records have been documented for the Swan Coastal Plain south of Perth. The first in 2010 was at Keralup, approximately 20 km south of Lot 9001, and the second in May 2012 was from Paganoni Swamp. These records suggest that Chuditch have the potential to utilise the habitat at the Site. However, it should be noted that both of the above-mentioned records were of juvenile males which were likely to be following the breeding season. The nature of these records, in conjunction with the small size of the Site, this indicates that any impacts associated with the development are unlikely to be significant.

4.3.3.4 Quenda

Quenda remain relatively widely distributed through the southwest of Western Australia and are known to persist in pockets of the Perth metropolitan area. It is likely that individuals will forage at the Site periodically. However, their preferred habitat comprises dense undergrowth, typically in swampy to riparian areas and they are prone to predation in open habitats (Van Dyck and Strahan 2008). On this basis, development of the Site is unlikely to impact the species core habitat, and is not expected to significantly impact the species conservation status.

4.3.3.5 Lined Skink

Favouring sandy soils on linear dune systems, this species has been recorded from locations from Bunbury in the South to the Peron Peninsula in the north, with a concentration of records on the Swan Coastal Plain around Perth (How and Dell 1994; 2000). The Priority 3 listing recognizes the wide distribution the species and its preferred habitat. It is therefore considered unlikely that the small scale of the Site development will result in significant impacts to the species conservation status.

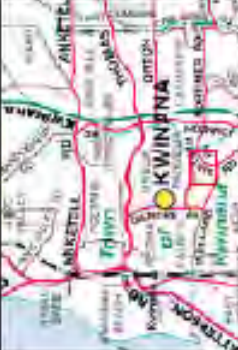
Legend

- Train Station Sites
- Major Roads
- Species**
- Jarrah
- Mann
- Tuart
- Trunk Diameter**
- > 400 - 500mm
- 500 - 800mm
- 800 - 1200mm
- > 1200mm

NOTE: THE FURTHER FROM DRAINAGE AREAS
LOCALITY MAP DERIVED FROM LANDSAT 2008



LOCALITY MAP













DATE	13/02/2012
DRAWN BY	ROBERTA WILSON AND PRODUCTION
SCALE	1:10,000 GDA3 Zone 50
CREATED	01/02/2012
APPROVED	01/02/2012
BY	RT
REVISION	1

Satterley Property Group
 Lot 9001, Parmelia
 Level 1 Fauna Survey
 Black Coasto Habitat Trees

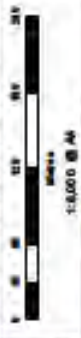


Figure 5

Legend

-  Site Boundary
-  Nesting Hollows
-  Possible Cockatoo Nesting Hollow
-  Hollow Unsuitable for Cockatoos
-  Carnaby's Black Cockatoo
-  Calling Location
-  Foraging Location
-  Red-tailed Black Cockatoo
-  Foraging Location
-  Sighting Location

NOTE: THIS DOCUMENT IS A PRELIMINARY SURVEY REPORT. IT IS NOT TO BE USED FOR ANY OTHER PURPOSES WITHOUT THE WRITTEN PERMISSION OF THE SURVEYOR. LOCALITY MAP IS FOR INFORMATION ONLY.



LOCALITY MAP



DRAWING NO		DATE
SBS 197-2.06		13/01/2012
HORIZONTAL DATUM: AUSTRALIAN NATIONAL GRID		
UOM: 1000 MGA 40/6610	CREATED	APPROVED
UJ	AH	PD
		0
		0

Saiberley Property Group
 Level 1 Fauna Survey
 Black Cockatoo Sighting and Foraging Sites



Figure 6



943000 943100 943200
 300000 300100 300200
 300000 300100 300200
 943000 943100 943200

5 Conclusion and Recommendations

The faunal values of the Site are considered to be representative of those typically associated with urban bushland remnants on the Swan Coastal Plain. In a spatial context, numerous other remnants are located in proximity to the Site, both on and off land reserved for conservation purposes. On this basis, impacts to fauna habitats and assemblages are likely to be restricted to the Site and therefore unlikely to extend beyond the boundaries.

Mitigation of impacts to these broad values might include measures such as:

- Implement a Flora and Fauna Management Plan for the Site for the clearing and construction period;
- Minimising the clearing of remnant native vegetation by utilising previously disturbed areas and retaining native flora species wherever possible;
- Conducting clearing in a staged manner to allow terrestrial fauna time to move away;
- Trapping and removal of individual animals to neighbouring remnant vegetation prior to clearing by a fauna specialist. This will require approval from the Department of Environment and Conservation and liaising with local council to determine an appropriate location for the release of animals; and
- Use of native flora species in landscaping of the Site during development.

Specific impact mitigation measures to be considered relate to protection of habitat for the Black Cockatoo species. Impacts to these species are likely to be considered significant under Federal legislation and typically require stringent measures including:

- Retaining as many trees with a trunk diameter at breast height (DBH) of 500 mm or greater as possible;
- Retain all hollow-bearing trees that may be suitable for breeding of bird species and/or may become suitable for Black Cockatoo species over time. Where clearing of hollow-bearing trees is unavoidable, hollows should be inspected prior to clearing and birds removed to shelter;
- Feral bee control onsite to remove feral bees from the hollows of trees that are retained; and
- Scheduled of clearing operations such that they occur outside Black Cockatoo breeding season.

Where residual impacts to Black Cockatoo habitat remain, it is likely that a scheme to identify and implement an appropriate environmental offset package will be required.

6 References

- 360 Environmental 2009. Bertram Station Precinct. Level 2 Flora and Vegetation Survey.
- 360 Environmental 2012a. Black Cockatoo Survey – Lot 9001 Bertram Road Parmelia.
- 360 Environmental 2012b. Kwinana Town Centre. Level 1 Vertebrate Fauna Survey
- Bennett Environmental Consulting Pty Ltd 2004. Flora Assessment of Proposed Perth Seawater Desalination Plant Kwinana.
- Bureau of Meteorology 2012. Climate Data Online. Accessed 2 October 2012, <http://www.bom.gov.au/climate/data/>
- Cardno 2011. Wellard East – Local Structure Plan. Prepared for Armana Holdings.
- Christidis and Boles 2008. Checklist of Bird species.
- Department of Water 2012a. Hydrogeological Atlas. Available from: <http://www.water.wa.gov.au/idelve/hydroatlas/loiQuery.jsp?ts=1330504521115&d=hydroatlas&bb=115.8079555441048,-32.2578048,115.8227261558952,-32.2462802&k=NONE&w=587&h=458&z=8388.298375546936&x=115.81452305633188&y=-32.25123728777293&i=261&j=197> Accessed 14 August 2012
- Department of Water 2012b. Perth Groundwater Atlas Available from: <http://www.water.wa.gov.au/idelve/gwa/> Accessed 15 August 2012
- Doughty, P. and Maryan, B. 2010a. Checklist of the Amphibians of Western Australia. Department of Terrestrial Zoology, Western Australian Museum, Welshpool, Western Australia.
- Doughty, P. and Maryan, B. 2010b. Checklist of the Reptiles of Western Australia. Department of Terrestrial Zoology, Western Australian Museum, Welshpool, Western Australia.
- Environmental Defender's Office of Western Australia (EDOWA) 2011. Conservation Reserves – Factsheet No 11.
- Environmental Protection Authority 2002. Terrestrial Biological Surveys as an Element of Biodiversity Protection. Government of Western Australia
- Environmental Protection Authority 2004. Guidance for the Assessment of Environmental Factors No 56, Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia. Government of Western Australia
- Environmental Protection Authority 2010. Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment. Government of Western Australia
- GHD 2007. Department for Planning & Infrastructure. Report for Kwinana Intermodal Terminal.

- Government of Western Australia 2012. Wildlife Conservation (Specially Protected Fauna) Notice 2012, in Government Gazette, WA, available online at: <http://www.dec.wa.gov.au/content/view/852/2010/> accessed 15 August 2012
- Harewood, G 2008. Fauna Survey. East Rockingham WWTP Site & Pipeline Corridor
- Higgins, P.J. (ed.) 1999. Handbook of Australian, New Zealand and Antarctic Birds. Volume Four - Parrots to Dollarbird. Melbourne: Oxford University Press.
- Higgins, P.J. & S.J.J.F. Davies, eds (1996). Handbook of Australian, New Zealand and Antarctic Birds. Volume Three - Snipe to Pigeons. Melbourne, Victoria: Oxford University Press.
- How, R. A., Maryan, B. and Stevenson, C. A. 2009. An Assessment of Herpetofauna on Near-Coastal Landforms between Dawesville and Binningup, Southern Swan Coastal Plain. Prepared for Department of Environment and Conservation. Welshpool, Western Australia.
- Johnstone R E & Storr G M 1998, Handbook of Western Australian Birds, Volume 1 Non-Passerines, WA Museum, Perth.
- Marchant, S. & P.J. Higgins, eds. (1990). Handbook of Australian, New Zealand and Antarctic Birds. Volume One - Ratites to Ducks. Melbourne, Victoria: Oxford University Press.
- Menkhorst P and Knight F 2004. A Field Guide to the Mammals of Australia. Second Edition. Oxford University Press, United Kingdom.
- Morcombe 2003. Field guide to Australian birds, Second edition. Steve Parish Publishing.
- Pizzey, G and Knight, F 1997. The Field Guide to the Birds of Australia, Angus and Robertson, NSW.
- SEWPaC (Department of Sustainability, Environment, Water, Population and Communities) 2012. Referral guidelines for three species of Western Australian black cockatoos.
- Simpson K and Day, N (1996). The Claremont Field Guide to the Birds of Australia, Penguin Books Australia Ltd, Castle Hill.
- Storr, GM, Smith, LA and Johnstone, RE 1999 Lizards of Western Australia I: Skinks. The West Australian Museum, Perth.
- Town of Kwinana 2003. Town of Kwinana Rural Strategy. Available online at: <http://www.kwinana.wa.gov.au/Documents/Your-Property/Planning/Appendix-3-Rural-Strategy-Part-1-Chapter-1-Physica.aspx> Accessed 15 August 2012.
- Van Dyck, S and R. Strahan (eds) (2008). The Mammals of Australia, Third Edition. Reed New Holland, NSW.

Wilson, S and Swan, G (2003). A Complete Guide to Reptiles of Australia. Reed New Holland, NSW.

7 Report Limitations

This report is produced strictly in accordance with the scope of services set out in the contract or otherwise agreed in accordance with the contract. 360 Environmental makes no representations or warranties in relation to the nature and quality of environmental aspects discussed in this report other than the visual observation and analytical data in this report.

In the preparation of this report, 360 Environmental has relied upon documents, information, data and analyses (“client’s information”) provided by the client and other individuals and entities. In most cases where client’s information has been relied upon, such reliance has been indicated in this report. Unless expressly set out in this report, 360 Environmental has not verified that the client’s information is accurate, exhaustive or current and the validity and accuracy of any aspect of the report including, or based upon, any part of the client’s information is contingent upon the accuracy, exhaustiveness and currency of the client’s information. 360 Environmental shall not be liable to the client or any other person in connection with any invalid or inaccurate aspect of this report where that invalidity or inaccuracy arose because the client’s information was not accurate, exhaustive and current or arose because of any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to 360 Environmental.

Aspects of this report, including the opinions, conclusions and recommendations it contains, are based on the results of the investigation, sampling and testing set out in the contract and otherwise in accordance with normal practices and standards. The investigation, sampling and testing are designed to produce results that represent a reasonable interpretation of the general conditions of the Site that is the subject of this report. However, due to the characteristics of the Site, including natural variations in Site conditions, the results of the investigation, sampling and testing may not accurately represent the actual state of the whole Site at all points.

It is important to recognise that Site conditions, including the extent and concentration of contaminants, can change with time. This is particularly relevant if this report, including the data, opinions, conclusions and recommendations it contains, are to be used a considerable time after it was prepared. In these circumstances, further investigation of the Site may be necessary.

Subject to the terms of the contract between the Client and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating parts of this report is prohibited (except to the extent required by law) unless the report is produced in its entirety including this page, without the prior written consent of 360 Environmental Pty Ltd.

APPENDIX A: EPBC PROTECTED MATTERS DATABASE SEARCH



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 about the EPBC Act including significance guidelines, forms and application process details can be found at <http://www.environment.gov.au/epbc/assessmentsapprovals/index.html>

Report created: 25/07/12 10:56:12

[Summary](#)

[Details](#)

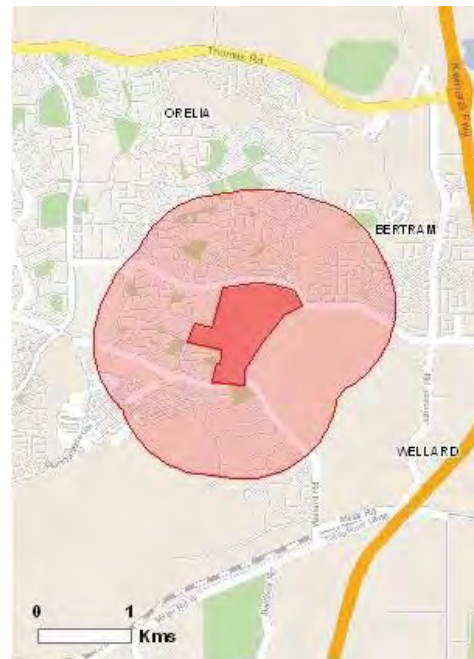
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

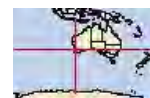
[Caveat](#)

[Acknowledgements](#)



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

[Coordinates](#)
 Buffer: 1.0Km



Summary

Matters of National Environment 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 - see <http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html>

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International	3
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	None
Threatened Species:	13
Migratory Species:	9

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. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage/index.html>

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. Information on EPBC Act permit requirements and application forms can be found at <http://www.environment.gov>.

Commonwealth Lands:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	6
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

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

Place on the RNE:	2
State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	16
Nationally Important Wetlands:	None

Details

Matters of National Environmental Significance

Wetlands of International Significance (RAMSAR)		[Resource Information]
Name		Proximity
Becher point wetlands		Upstream from Ramsar
Forrestdale & thomsons lakes		Within 10km of Ramsar
Peel-yalgorup system		Upstream from Ramsar
Threatened Species		[Resource Information]
Name	Status	Type of Presence
BIRDS		

Name	Status	Type of Presence
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo [67034]	Vulnerable	Species or species habitat may occur within area
Calyptorhynchus latirostris Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Vulnerable	Species or species habitat may occur within area

INSECTS

Synemon gratiosa Graceful Sun Moth [66757]	Endangered	Species or species habitat may occur within area
---	------------	--

MAMMALS

Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Phascogale calura Red-tailed Phascogale [316]	Endangered	Species or species habitat may 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
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
Darwinia foetida Muccha Bell [83190]	Critically Endangered	Species or species habitat may occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area

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 may occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Migratory Terrestrial Species		
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur 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 may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Vulnerable*	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

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 may occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Vulnerable*	Species or species habitat may occur within area

Extra Information

Places on the RNE

[Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Bollard Bulrush Swamp	WA	Indicative Place
Beeliar Regional Park and Adjacent Areas	WA	Interim List

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 Resources Audit,

Name	Status	Type of Presence
Mammals		
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat may occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii		
Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta		
Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla		
Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

Coordinates

-32.25192 115.8348,-32.25264 115.83312,-32.25565 115.83084,-32.25809 115.8292,
-32.25972 115.82916,-32.25934 115.82597,-32.25755 115.82638,-32.25767 115.82673,
-32.25687 115.82684,-32.25615 115.82688,-32.2555 115.82353,-32.25367 115.82437,
-32.25405 115.826,-32.25013 115.82711,-32.2499 115.82913,-32.24963 115.83015,-32.24983
115.83206,-32.25043 115.83404,-32.25184 115.83476,-32.25192 115.8348

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

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

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](#)
- 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](#).

APPENDIX B: NATUREMAP SEARCH

NatureMap Species Report

Created By Guest user on 24/09/2012

Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 115°49' 44" E, 32°15' 12" S
Buffer 5km
Group By Kingdom

Kingdom	Species	Records
Animalia	125	1537
Chromista	1	1
Plantae	228	320
Protozoa	9	9
TOTAL	363	1867

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
Animalia				
1.	24260 <i>Acanthiza apicalis</i> (Broad-tailed Thornbill)			
2.	24261 <i>Acanthiza chrysorrhoa</i> (Yellow-rumped Thornbill)			
3.	24262 <i>Acanthiza inornata</i> (Western Thornbill)			
4.	24560 <i>Acanthorhynchus superciliosus</i> (Western Spinebill)			
5.	25535 <i>Accipiter cirrocephalus</i> (Collared Sparrowhawk)			
6.	24281 <i>Accipiter cirrocephalus</i> subsp. <i>cirrocephalus</i>			
7.	25536 <i>Accipiter fasciatus</i> (Brown Goshawk)			
8.	25011 <i>Acritoscincus trilineatum</i>			
9.	25755 <i>Acrocephalus australis</i> (Australian Reed Warbler)			
10.	41323 <i>Actitis hypoleucos</i> (Common Sandpiper)		IA	
11.	24312 <i>Anas gracilis</i> (Grey Teal)			
12.	24315 <i>Anas rhynchotis</i> (Australasian Shoveler)			
13.	24316 <i>Anas superciliosa</i> (Pacific Black Duck)			
14.	24561 <i>Anthochaera carunculata</i> (Red Wattlebird)			
15.	24562 <i>Anthochaera lunulata</i> (Western Little Wattlebird)			
16.	24286 <i>Aquila morphnoides</i> subsp. <i>morphnoides</i>			
17.	25566 <i>Artamus cinereus</i> (Black-faced Woodswallow)			
18.	24353 <i>Artamus cyanopterus</i> (Dusky Woodswallow)			
19.	24318 <i>Aythya australis</i> (Hardhead)			
20.	24319 <i>Biziura lobata</i> (Musk Duck)			
21.	25716 <i>Cacatua sanguinea</i> (Little Corella)			
22.	25598 <i>Cacomantis flabelliformis</i> (Fan-tailed Cuckoo)			
23.	25717 <i>Calyptorhynchus banksii</i> (Red-tailed Black-Cockatoo)			
24.	24734 <i>Calyptorhynchus latirostris</i> (Carnaby's Cockatoo (short-billed black-cockatoo))		T	
25.	24377 <i>Charadrius ruficapillus</i> (Red-capped Plover)			
26.	24321 <i>Chenonetta jubata</i> (Australian Wood Duck)			
27.	24431 <i>Chrysococcyx basalis</i> (Horsfield's Bronze Cuckoo)			
28.	24833 <i>Cincloramphus cruralis</i> (Brown Songlark)			
29.	24288 <i>Circus approximans</i> (Swamp Harrier)			
30.	25675 <i>Colluricincla harmonica</i> (Grey Shrike-thrush)			
31.	24399 <i>Columba livia</i> (Domestic Pigeon)			
32.	25568 <i>Coracina novaehollandiae</i> (Black-faced Cuckoo-shrike)			
33.	25592 <i>Corvus coronoides</i> (Australian Raven)			
34.	25595 <i>Cracticus tibicen</i> (Australian Magpie)			
35.	24422 <i>Cracticus tibicen</i> subsp. <i>dorsalis</i> (White-backed Magpie)			
36.	25596 <i>Cracticus torquatus</i> (Grey Butcherbird)			
37.	25399 <i>Crinia glauerti</i> (Clicking Frog)			
38.	25040 <i>Ctenotus gemmula</i> (Jewelled South-west Ctenotus, skink (Swan Coastal Plain pop P3))			
39.	24322 <i>Cygnus atratus</i> (Black Swan)			
40.	30901 <i>Dacelo novaeguineae</i> (Laughing Kookaburra)			
41.	25673 <i>Daphoenositta chrysoptera</i> (Varied Sittella)			
42.	25607 <i>Dicaeum hirundinaceum</i> (Mistletoebird)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
43.	25621 <i>Falco berigora</i> (Brown Falcon)			
44.	25622 <i>Falco cenchroides</i> (Australian Kestrel)			
45.	24472 <i>Falco cenchroides</i> subsp. <i>cenchroides</i>			
46.	25623 <i>Falco longipennis</i> (Australian Hobby)			
47.	24041 <i>Felis catus</i> (Cat)			
48.	25727 <i>Fulica atra</i> (Eurasian Coot)			
49.	25729 <i>Gallinula tenebrosa</i> (Dusky Moorhen)			
50.	25530 <i>Gerygone fusca</i> (Western Gerygone)			
51.	24443 <i>Grallina cyanoleuca</i> (Magpie-lark)			
52.	24293 <i>Haliaeetus leucogaster</i> (White-bellied Sea-Eagle)		IA	
53.	24295 <i>Haliastur sphenurus</i> (Whistling Kite)			
54.	25734 <i>Himantopus himantopus</i> (Black-winged Stilt)			
55.	24491 <i>Hirundo neoxena</i> (Welcome Swallow)			
56.	24215 <i>Hydromys chrysogaster</i> (Water-rat)		P4	
57.	25366 <i>Hydrophis elegans</i>			
58.	25478 <i>Isoodon obesulus</i> (Southern Brown Bandicoot)			
59.	24153 <i>Isoodon obesulus</i> subsp. <i>fusciventer</i> (Quenda, Southern Brown Bandicoot)		P5	
60.	25133 <i>Lerista elegans</i>			
61.	25147 <i>Lerista lineata</i> (Perth Slider, Lined Skink)		P3	
62.	24581 <i>Lichenostomus virescens</i> (Singing Honeyeater)			
63.	25661 <i>Lichmera indistincta</i> (Brown Honeyeater)			
64.	25415 <i>Limnodynastes dorsalis</i> (Western Banjo Frog)			
65.	25378 <i>Litoria adelaidensis</i> (Slender Tree Frog)			
66.	24133 <i>Macropus irma</i> (Western Brush Wallaby)		P4	
67.	24326 <i>Malacorhynchus membranaceus</i> (Pink-eared Duck)			
68.	25654 <i>Malurus splendens</i> (Splendid Fairy-wren)			
69.	24583 <i>Manorina flavigula</i> (Yellow-throated Miner)			
70.	25758 <i>Megalurus gramineus</i> (Little Grassbird)			
71.	24598 <i>Merops ornatus</i> (Rainbow Bee-eater)		IA	
72.	24223 <i>Mus musculus</i> (House Mouse)			
73.	24738 <i>Neophema elegans</i> (Elegant Parrot)			
74.	25252 <i>Notechis scutatus</i> (Tiger Snake)			
75.	25564 <i>Nycticorax caledonicus</i> (Rufous Night Heron)			
76.	24407 <i>Ocyphaps lophotes</i> (Crested Pigeon)			
77.	24085 <i>Oryctolagus cuniculus</i> (Rabbit)			
78.	24328 <i>Oxyura australis</i> (Blue-billed Duck)			
79.	25679 <i>Pachycephala pectoralis</i> (Golden Whistler)			
80.	25680 <i>Pachycephala rufiventris</i> (Rufous Whistler)			
81.	25681 <i>Pardalotus punctatus</i> (Spotted Pardalote)			
82.	25682 <i>Pardalotus striatus</i> (Striated Pardalote)			
83.	24630 <i>Pardalotus striatus</i> subsp. <i>westraliensis</i>			
84.	24648 <i>Pelecanus conspicillatus</i> (Australian Pelican)			
85.	24659 <i>Petroica goodenovii</i> (Red-capped Robin)			
86.	25697 <i>Phalacrocorax carbo</i> (Great Cormorant)			
87.	24667 <i>Phalacrocorax sulcirostris</i> (Little Black Cormorant)			
88.	25699 <i>Phalacrocorax varius</i> (Pied Cormorant)			
89.	24409 <i>Phaps chalcoptera</i> (Common Bronzewing)			
90.	24596 <i>Phylidonyris novaehollandiae</i> (New Holland Honeyeater)			
91.	24841 <i>Platalea flavipes</i> (Yellow-billed Spoonbill)			
92.	24750 <i>Platycercus zonarius</i> subsp. <i>semitorquatus</i> (Twenty-eight Parrot)			
93.	24843 <i>Plegadis falcinellus</i> (Glossy Ibis)		IA	
94.	25703 <i>Podargus strigoides</i> (Tawny Frogmouth)			
95.	25704 <i>Podiceps cristatus</i> (Great Crested Grebe)			
96.	24681 <i>Poliocephalus poliocephalus</i> (Hoary-headed Grebe)			
97.	25722 <i>Polytelis anthopeplus</i> (Regent Parrot)			
98.	25731 <i>Porphyrio porphyrio</i> (Purple Swamphen)			
99.	25511 <i>Pseudonaja affinis</i> (Dugite)			
100.	25259 <i>Pseudonaja affinis</i> subsp. <i>affinis</i> (Dugite)			
101.	25264 <i>Pseudonaja nuchalis</i> (Gwardar)			
102.	24245 <i>Rattus rattus</i> (Black Rat)			
103.	24776 <i>Recurvirostra novaehollandiae</i> (Red-necked Avocet)			
104.	25614 <i>Rhipidura leucophrys</i> (Willie Wagtail)			
105.	25534 <i>Sericornis frontalis</i> (White-browed Scrubwren)			
106.	25266 <i>Simoselaps bertholdi</i> (Jan's Banded Snake)			
107.	25267 <i>Simoselaps littoralis</i> (West Coast Banded Snake)			
108.	30948 <i>Smicromis brevirostris</i> (Weebill)			
109.	25597 <i>Strepera versicolor</i> (Grey Currawong)			
110.	25589 <i>Streptopelia chinensis</i> (Spotted Turtle-Dove)			
111.	30951 <i>Streptopelia chinensis</i> subsp. <i>tigrina</i>			
112.	25590 <i>Streptopelia senegalensis</i> (Laughing Turtle-Dove)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
113.	25705 <i>Tachybaptus novaehollandiae</i> (Australasian Grebe)			
114.	24331 <i>Tadorna tadornoides</i> (Australian Shelduck)			
115.	24844 <i>Threskiornis molucca</i> (Australian White Ibis)			
116.	24845 <i>Threskiornis spinicollis</i> (Straw-necked Ibis)			
117.	25207 <i>Tiliqua rugosa</i> subsp. <i>rugosa</i>			
118.	25549 <i>Todiramphus sanctus</i> (Sacred Kingfisher)			
119.	25723 <i>Trichoglossus haematodus</i> (Rainbow Lorikeet)			
120.	25521 <i>Trichosurus vulpecula</i> (Common Brushtail Possum)			
121.	24158 <i>Trichosurus vulpecula</i> subsp. <i>vulpecula</i> (Common Brushtail Possum)			
122.	24849 <i>Turnix varia</i> subsp. <i>varia</i>			
123.	24852 <i>Tyto alba</i> subsp. <i>delicatula</i> (Barn Owl)			
124.	25218 <i>Varanus gouldii</i> (Bungarra or Sand Monitor)			
125.	25765 <i>Zosterops lateralis</i> (Grey-breasted White-eye)			

Chromista

126.	<i>Phytophthora cinnamomi</i>			
------	-------------------------------	--	--	--

Plantae

127.	3374 <i>Acacia huegelii</i>			
128.	3557 <i>Acacia stenoptera</i> (Narrow Winged Wattle)			
129.	1791 <i>Adenanthos obovatus</i> (Basket Flower)			
130.	184 <i>Aira caryophylla</i> (Silvery Hairgrass)	Y		
131.	1728 <i>Allocasuarina fraseriana</i> (Sheoak)			
132.	11434 <i>Anigozanthos humilis</i> subsp. <i>humilis</i>			
133.	11261 <i>Anigozanthos manglesii</i> subsp. <i>manglesii</i>			
134.	3686 <i>Aotus cordifolia</i>			
135.	141 <i>Aponogeton hexatepalus</i> (Stalked Water Ribbons)		P4	
136.	20350 <i>Astartea affinis</i>			
137.	20283 <i>Astartea scoparia</i>			
138.	6334 <i>Astroloma pallidum</i> (Kick Bush)			
139.	17234 <i>Austrostipa compressa</i>			
140.	37421 <i>Austrostipa</i> sp. <i>Marchagee</i> (B.R. Maslin 1407)			
141.	234 <i>Avena fatua</i> (Wild Oat)	Y		
142.	1800 <i>Banksia attenuata</i> (Slender Banksia)			
143.	1819 <i>Banksia grandis</i> (Bull Banksia)			
144.	1822 <i>Banksia ilicifolia</i> (Holly-leaved Banksia)			
145.	1834 <i>Banksia menziesii</i> (Firewood Banksia)			
146.	740 <i>Baumea arthrophylla</i>			
147.	5382 <i>Beaufortia elegans</i>			
148.	4417 <i>Boronia dichotoma</i>			
149.	11381 <i>Boronia ramosa</i> subsp. <i>anethifolia</i>			
150.	3710 <i>Bossiaea eriocarpa</i> (Common Brown Pea)			
151.	244 <i>Briza maxima</i> (Blowfly Grass)	Y		
152.	245 <i>Briza minor</i> (Shivery Grass)	Y		
153.	249 <i>Bromus diandrus</i> (Great Brome)	Y		
154.	250 <i>Bromus hordeaceus</i> (Soft Brome)	Y		
155.	1366 <i>Bulbine semibarbata</i> (Leek Lily)			
156.	12770 <i>Burchardia congesta</i>			
157.	1276 <i>Caesia micrantha</i> (Pale Grass-lily)			
158.	1586 <i>Caladenia discoidea</i> (Dancing Orchid)			
159.	15348 <i>Caladenia flava</i> subsp. <i>flava</i>			
160.	1596 <i>Caladenia huegelii</i> (Grand Spider Orchid)		T	
161.	15361 <i>Caladenia longicauda</i> subsp. <i>calcigena</i>			
162.	17760 <i>Caladenia nobilis</i>			
163.	2854 <i>Calandrinia granulifera</i> (Pygmy Purslane)			
164.	96 <i>Callitris preissii</i> (Rottnest Island Pine)			
165.	5415 <i>Calothamnus lateralis</i>			
166.	35816 <i>Calothamnus quadrifidus</i> subsp. <i>quadrifidus</i>			
167.	1162 <i>Cartonema phylloides</i>			
168.	11242 <i>Cassytha racemosa</i> forma <i>pilosa</i>			
169.	1125 <i>Centrolepis drummondiana</i>			
170.	2889 <i>Cerastium glomeratum</i> (Mouse Ear Chickweed)	Y		
171.	1280 <i>Chamaescilla corymbosa</i> (Blue Squill)			
172.	1885 <i>Conospermum triplinervium</i> (Tree Smokebush)			
173.	6348 <i>Conostephium pendulum</i> (Pearl Flower)			
174.	6349 <i>Conostephium preissii</i>			
175.	1418 <i>Conostylis aculeata</i> (Prickly Conostylis)			
176.	11826 <i>Conostylis aculeata</i> subsp. <i>aculeata</i>			
177.	11438 <i>Conostylis candicans</i> subsp. <i>candicans</i>			
178.	1436 <i>Conostylis juncea</i>			
179.	1455 <i>Conostylis setosa</i> (White Cottonhead)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
180.	3137 <i>Crassula colorata</i> (Dense Stonecrop)			
181.	11345 <i>Crassula thunbergiana</i> subsp. <i>thunbergiana</i>	Y		
182.	768 <i>Cyathochaeta avenacea</i>			
183.	16245 <i>Cyathochaeta teretifolia</i>		P3	
184.	7454 <i>Dampiera linearis</i> (Common Dampiera)			
185.	1218 <i>Dasypogon bromeliifolius</i> (Pineapple Bush)			
186.	16595 <i>Desmocladius flexuosus</i>			
187.	17838 <i>Dielsia stenostachya</i>			
188.	314 <i>Digitaria didactyla</i> (Queensland Blue Couch)	Y		
189.	7054 <i>Dischisma arenarium</i>	Y		
190.	12943 <i>Diuris brumalis</i>			
191.	11049 <i>Diuris corymbosa</i>			
192.	1634 <i>Diuris laxiflora</i> (Bee Orchid)			
193.	12939 <i>Diuris magnifica</i>			
194.	12938 <i>Diuris micrantha</i>		T	
195.	4763 <i>Dodonaea hackettiana</i> (Hackett's Hopbush)		P4	
196.	1639 <i>Drakaea elastica</i> (Glossy-leaved Hammer Orchid)		T	
197.	3095 <i>Drosera erythrorhiza</i> (Red Ink Sundew)			
198.	13216 <i>Drosera menziesii</i> subsp. <i>penicillaris</i>			
199.	3131 <i>Drosera stolonifera</i> (Leafy Sundew)			
200.	11485 <i>Ehrharta brevifolia</i> var. <i>cuspidata</i>	Y		
201.	347 <i>Ehrharta calycina</i> (Perennial Veldt Grass)	Y		
202.	1643 <i>Elythranthera brunonis</i> (Purple Enamel Orchid)			
203.	374 <i>Eragrostis cilianensis</i> (Stinkgrass)	Y		
204.	376 <i>Eragrostis curvula</i> (African Lovegrass)	Y		
205.	5649 <i>Eucalyptus foecunda</i> (Narrow-leaved Red Mallee)			
206.	5659 <i>Eucalyptus gomphocephala</i> (Tuart)			
207.	5708 <i>Eucalyptus marginata</i> (Jarrah)			
208.	5763 <i>Eucalyptus rudis</i> (Flooded Gum)			
209.	3872 <i>Euchilopsis linearis</i> (Swamp Pea)			
210.	29940 <i>Euphorbia maculata</i>	Y		
211.	894 <i>Fimbristylis velata</i>			
212.	8365 <i>Fumaria bastardii</i>	Y		
213.	3957 <i>Gompholobium tomentosum</i> (Hairy Yellow Pea)			
214.	37500 <i>Grammatotheca bergiana</i> var. <i>bergiana</i>	Y		
215.	14282 <i>Gratiola pubescens</i>			
216.	3961 <i>Hardenbergia comptoniana</i> (Native Wisteria)			
217.	3016 <i>Heliophila pusilla</i>	Y		
218.	6710 <i>Heliotropium europaeum</i> (Common Heliotrope)	Y		
219.	6839 <i>Hemiantra pungens</i> (Snakebush)			
220.	5135 <i>Hibbertia hypericoides</i> (Yellow Buttercups)			
221.	5154 <i>Hibbertia perfoliata</i>			
222.	5162 <i>Hibbertia racemosa</i> (Stalked Guinea Flower)			
223.	445 <i>Holcus setiger</i> (Annual Fog)	Y		
224.	6222 <i>Homalosciadium homalocarpum</i>			
225.	3968 <i>Hovea trisperma</i> (Common Hovea)			
226.	5216 <i>Hybanthus calycinus</i> (Wild Violet)			
227.	6224 <i>Hydrocotyle blepharocarpa</i>			
228.	6240 <i>Hydrocotyle scutellifera</i>			
229.	35070 <i>Hypocalymma angustifolium</i> subsp. <i>Swan Coastal Plain</i> (G.J. Keighery 16777)			
230.	8086 <i>Hypochoeris glabra</i> (Smooth Catsear)	Y		
231.	1070 <i>Hypolaena exsulca</i>			
232.	910 <i>Isolepis cernua</i> (Nodding Club-rush)			
233.	7396 <i>Isotoma hypocrateriformis</i> (Woodbridge Poison)			
234.	3992 <i>Isotropis cuneifolia</i> (Granny Bonnets)			
235.	19700 <i>Isotropis cuneifolia</i> subsp. <i>cuneifolia</i>			
236.	8092 <i>Ixiolaena viscosa</i> (Sticky Ixiolaena)			
237.	4012 <i>Jacksonia furcellata</i> (Grey Stinkwood)			
238.	1189 <i>Juncus pauciflorus</i> (Loose Flower Rush)			
239.	4044 <i>Kennedia prostrata</i> (Scarlet Runner)			
240.	5832 <i>Kunzea ericifolia</i> (Spearwood)			
241.	15498 <i>Kunzea glabrescens</i> (Spearwood)			
242.	20019 <i>Lachnagrostis filiformis</i>			
243.	19955 <i>Lachnagrostis plebeia</i>			
244.	19956 <i>Lachnagrostis preissii</i>			
245.	18585 <i>Lagenophora huegelii</i>			
246.	28342 <i>Landoltia punctata</i> (Thin Duckweed)			
247.	1309 <i>Laxmannia squarrosa</i>			
248.	7574 <i>Lechenaultia floribunda</i> (Free-flowering Leschenaultia)			
249.	925 <i>Lepidosperma angustatum</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
250.	19833 <i>Leptocarpus laxus</i>			
251.	15418 <i>Leptoceras menziesii</i>			
252.	6374 <i>Leucopogon conostephioides</i>			
253.	7677 <i>Levenhookia stipitata</i> (Common Stylewort)			
254.	36160 <i>Liparophyllum capitatum</i>			
255.	7407 <i>Lobelia rhytidosperra</i> (Wrinkled-seeded Lobelia)			
256.	7408 <i>Lobelia tenuior</i> (Slender Lobelia)			
257.	1223 <i>Lomandra caespitosa</i> (Tufted Mat Rush)			
258.	1232 <i>Lomandra micrantha</i> (Small-flower Mat-rush)			
259.	1234 <i>Lomandra nigricans</i>			
260.	1239 <i>Lomandra preissii</i>			
261.	1243 <i>Lomandra sericea</i> (Silky Mat Rush)			
262.	1246 <i>Lomandra suaveolens</i>			
263.	1097 <i>Lyginia barbata</i>			
264.	85 <i>Macrozamia riedlei</i> (Zamia)			
265.	13271 <i>Melaleuca huegelii</i> subsp. <i>huegelii</i>			
266.	5978 <i>Melaleuca teretifolia</i> (Banbar)			
267.	5980 <i>Melaleuca thymoides</i>			
268.	13280 <i>Melaleuca viminea</i> subsp. <i>viminea</i>			
269.	6883 <i>Mentha pulegium</i> (Pennyroyal)	Y		
270.	955 <i>Mesomelaena pseudostygia</i>			
271.	485 <i>Microlaena stipoides</i> (Weeping Grass)			
272.	15419 <i>Microtis media</i> subsp. <i>media</i>			
273.	4662 <i>Monotaxis grandiflora</i> (Diamond of the Desert)			
274.	4666 <i>Monotaxis occidentalis</i>			
275.	2412 <i>Muehlenbeckia adpressa</i> (Climbing Lignum)			
276.	6140 <i>Oenothera mollissima</i>	Y		
277.	14292 <i>Oenothera stricta</i> subsp. <i>stricta</i>	Y		
278.	8149 <i>Olearia rudis</i> (Rough Daisybush)			
279.	12782 <i>Ophioglossum gramineum</i>			
280.	36177 <i>Ornduffia albiflora</i>			
281.	7122 <i>Orobanche minor</i> (Lesser Broomrape)	Y		
282.	4358 <i>Oxalis purpurea</i> (Largeflower Wood Sorrel)	Y		
283.	1667 <i>Paracaleana nigrita</i> (Flying Duck Orchid)			
284.	516 <i>Parapholis incurva</i> (Coast Barbgrass)	Y		
285.	527 <i>Paspalum dilatatum</i>	Y		
286.	528 <i>Paspalum distichum</i> (Water Couch)	Y		
287.	1550 <i>Patersonia occidentalis</i> (Purple Flag)			
288.	30471 <i>Patersonia occidentalis</i> var. <i>angustifolia</i>			
289.	16477 <i>Pericalymma ellipticum</i> var. <i>ellipticum</i>			
290.	2273 <i>Persoonia saccata</i> (Snottygobble)			
291.	2299 <i>Petrophile linearis</i> (Pixie Mops)			
292.	18529 <i>Philothea spicata</i> (Pepper and Salt)			
293.	1478 <i>Phlebocarya ciliata</i>			
294.	2793 <i>Phytolacca octandra</i> (Red Ink Plant)	Y		
295.	5254 <i>Pimelea leucantha</i>			
296.	18117 <i>Pimelea rosea</i> subsp. <i>rosea</i>			
297.	8175 <i>Podolepis gracilis</i> (Slender Podolepis)			
298.	8182 <i>Podotheca angustifolia</i> (Sticky Longheads)			
299.	8184 <i>Podotheca gnaphalioides</i> (Golden Long-heads)			
300.	582 <i>Polypogon monspeliensis</i> (Annual Beardgrass)	Y		
301.	583 <i>Polypogon tenellus</i>			
302.	4691 <i>Poranthera microphylla</i> (Small Poranthera)			
303.	1670 <i>Prasophyllum drummondii</i> (Swamp Leek Orchid)			
304.	1676 <i>Prasophyllum hians</i> (Yawning Leek Orchid)			
305.	10853 <i>Prasophyllum plumiforme</i>			
306.	11260 <i>Ptilotus drummondii</i> var. <i>drummondii</i> (Pussytail)			
307.	2751 <i>Ptilotus polystachyus</i> (Prince of Wales Feather)			
308.	4181 <i>Pultenaea reticulata</i>			
309.	40431 <i>Rytidosperma acerosum</i>			
310.	30434 <i>Salsola australis</i>			
311.	7595 <i>Scaevola anchusifolia</i>			
312.	7603 <i>Scaevola canescens</i> (Grey Scaevola)			
313.	982 <i>Schoenus clandestinus</i>			
314.	986 <i>Schoenus efoliatus</i>			
315.	25878 <i>Senecio condylus</i>			
316.	2909 <i>Silene gallica</i> (French Catchfly)	Y		
317.	8225 <i>Siloxerus humifusus</i> (Procumbent Siloxerus)			
318.	7022 <i>Solanum nigrum</i> (Black Berry Nightshade)	Y		
319.	7037 <i>Solanum symonii</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
320.	8231 <i>Sonchus oleraceus</i> (Common Sowthistle)	Y		
321.	1312 <i>Sowerbaea laxiflora</i> (Purple Tassels)			
322.	19403 <i>Stenopetalum gracile</i>			
323.	2316 <i>Stirlingia latifolia</i> (Blueboy)			
324.	7693 <i>Stylidium brunonianum</i> (Pink Fountain Triggerplant)			
325.	17850 <i>Stylidium ireneae</i>		P4	
326.	7774 <i>Stylidium piliferum</i> (Common Butterfly Triggerplant)			
327.	25830 <i>Stylidium</i> sp. Darling Range (H. Bowler 371)			
328.	2326 <i>Synaphea polymorpha</i> (Albany Synaphea)			
329.	2329 <i>Synaphea spinulosa</i>			
330.	15532 <i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>			
331.	2791 <i>Tersonia cyathiflora</i> (Button Creeper)			
332.	20731 <i>Thelymitra vulgaris</i>			
333.	20728 <i>Thelymitra xanthotricha</i>			
334.	1319 <i>Thysanotus arenarius</i>			
335.	1339 <i>Thysanotus multiflorus</i> (Many-flowered Fringe Lily)			
336.	1351 <i>Thysanotus sparteus</i>			
337.	6280 <i>Trachymene pilosa</i> (Native Parsnip)			
338.	1481 <i>Tribonanthes australis</i>			
339.	4383 <i>Tribulus terrestris</i> (Caltrop)	Y		
340.	1361 <i>Tricoryne elatior</i> (Yellow Autumn Lily)			
341.	4292 <i>Trifolium campestre</i> (Hop Clover)	Y		
342.	8255 <i>Ursinia anthemoides</i> (Ursinia)	Y		
343.	7111 <i>Veronica persica</i> (Creeping Speedwell)	Y		
344.	722 <i>Vulpia bromoides</i> (Squirrel Tail Fescue)	Y		
345.	724 <i>Vulpia myuros</i> (Rat's Tail Fescue)	Y		
346.	12052 <i>Vulpia myuros</i> forma <i>megalura</i>	Y		
347.	33101 <i>Vulpia myuros</i> forma <i>myuros</i>	Y		
348.	1394 <i>Wurmbea dioica</i> (Early Nancy)			
349.	12072 <i>Wurmbea dioica</i> subsp. <i>alba</i>			
350.	1398 <i>Wurmbea monantha</i>			
351.	1256 <i>Xanthorrhoea preissii</i> (Grass tree)			
352.	6289 <i>Xanthosia huegelii</i>			
353.	2331 <i>Xylomelum occidentale</i> (Woody Pear)			
354.	1049 <i>Zantedeschia aethiopica</i> (Arum Lily)	Y		

Protozoa

355.	38964 <i>Arcyria cinerea</i>			
356.	38967 <i>Arcyria incarnata</i>			
357.	38979 <i>Badhamia utricularis</i>			
358.	39019 <i>Didymium clavus</i>			Y
359.	39048 <i>Lycogala epidendrum</i>			
360.	39071 <i>Physarum luteolum</i>			Y
361.	39079 <i>Physarum viride</i>			
362.	39085 <i>Stemonitis lignicola</i>			
363.	39087 <i>Stemonitis splendens</i>			

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 wholly 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 Species Report

Created By Guest user on 24/09/2012

Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 115°49' 44" E,32°15' 12" S
Buffer 5km
Group By Family

Family	Species	Records
Acanthizidae	6	144
Accipitridae	7	51
Amaranthaceae	2	2
Anarthriaceae	1	1
Anatidae	10	144
Apiaceae	2	3
Aponogetonaceae	1	1
Araceae	2	2
Araliaceae	3	5
Arcyriaceae	2	2
Ardeidae	1	2
Artamidae	2	7
Asparagaceae	12	22
Asphodelaceae	1	1
Asteraceae	11	15
Boraginaceae	1	1
Brassicaceae	2	4
Campanulaceae	4	5
Campephagidae	1	24
Caryophyllaceae	2	2
Casuarinaceae	1	2
Centrolepidaceae	1	1
Charadriidae	1	3
Chenopodiaceae	1	1
Colchicaceae	4	8
Columbidae	6	45
Commelinaceae	1	1
Corvidae	1	60
Cracticidae	4	126
Crassulaceae	2	3
Cuculidae	2	12
Cupressaceae	1	1
Cyperaceae	9	11
Dasyopogonaceae	1	2
Dicaeidae	1	1
Dicruridae	2	63
Didymiaceae	1	1
Dilleniaceae	3	5
Droseraceae	3	4
Elapidae	7	12
Ericaceae	4	6
Euphorbiaceae	3	3
Fabaceae	14	21
Falconidae	4	16
Felidae	1	1
Goodeniaceae	4	5
Gyrostemonaceae	1	1
Haemodoraceae	9	15
Halcyonidae	2	38
Hemerocallidaceae	2	4
Hirundinidae	1	19
Hylidae	1	1
Iridaceae	2	2
Juncaceae	1	1
Lamiaceae	2	3
Lauraceae	1	1
Leporidae	1	1
Limnodynastidae	1	1
Lycogalaceae	1	1
Macropodidae	1	1
Maluridae	1	35
Meliphagidae	7	186
Menyanthaceae	2	2
Meropidae	1	13
Muridae	3	29
Myobatrachidae	1	1
Myrtaceae	17	20
Neositidae	1	5
Onagraceae	2	2
Ophioglossaceae	1	1
Orchidaceae	20	31
Orobanchaceae	1	2
Oxalidaceae	1	1
Pachycephalidae	3	60
Papaveraceae	1	1
Pardalotidae	3	50
Pelecanidae	1	15

Peramelidae	2	55
Petroicidae	1	2
Phalacrocoracidae	3	28
Phalangeridae	2	15
Phyllanthaceae	1	1
Physaraceae	3	3
Phytolaccaceae	1	1
Plantaginaceae	2	2
Poaceae	28	39
Podargidae	1	2
Podicipedidae	3	43
Polygonaceae	1	1
Portulacaceae	1	2
Proteaceae	13	19
Psittacidae	7	30
Pythiaceae	1	1
Rallidae	3	37
Recurvirostridae	2	7
Restionaceae	4	6
Rutaceae	3	5
Sapindaceae	1	4
Scincidae	5	21
Scolopacidae	1	1
Scrophulariaceae	1	1
Solanaceae	2	2
Stemonitidaceae	2	2
Stylidiaceae	5	5
Sylviidae	3	10
Threskiornithidae	4	75
Thymelaeaceae	2	2
Turnicidae	1	1
Tytonidae	1	1
Varanidae	1	1
Violaceae	1	1
Xanthorrhoeaceae	1	1
Zamiaceae	1	2
Zosteropidae	1	42
Zygophyllaceae	1	1
TOTAL	363	1867

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
Acanthizidae				
1.	24260 <i>Acanthiza apicalis</i> (Broad-tailed Thornbill)			
2.	24261 <i>Acanthiza chrysorrhoa</i> (Yellow-rumped Thornbill)			
3.	24262 <i>Acanthiza inornata</i> (Western Thornbill)			
4.	25530 <i>Gerygone fusca</i> (Western Gerygone)			
5.	25534 <i>Sericornis frontalis</i> (White-browed Scrubwren)			
6.	30948 <i>Smicronis brevirostris</i> (Weebill)			
Accipitridae				
7.	25535 <i>Accipiter cirrocephalus</i> (Collared Sparrowhawk)			
8.	24281 <i>Accipiter cirrocephalus</i> subsp. <i>cirrocephalus</i>			
9.	25536 <i>Accipiter fasciatus</i> (Brown Goshawk)			
10.	24286 <i>Aquila morphnoides</i> subsp. <i>morphnoides</i>			
11.	24288 <i>Circus approximans</i> (Swamp Harrier)			
12.	24293 <i>Haliaeetus leucogaster</i> (White-bellied Sea-Eagle)		IA	
13.	24295 <i>Haliastur sphenurus</i> (Whistling Kite)			
Amaranthaceae				
14.	11260 <i>Ptilotus drummondii</i> var. <i>drummondii</i> (Pussytail)			
15.	2751 <i>Ptilotus polystachyus</i> (Prince of Wales Feather)			
Anarthriaceae				
16.	1097 <i>Lyginia barbata</i>			
Anatidae				
17.	24312 <i>Anas gracilis</i> (Grey Teal)			
18.	24315 <i>Anas rhynchotis</i> (Australasian Shoveler)			
19.	24316 <i>Anas superciliosa</i> (Pacific Black Duck)			
20.	24318 <i>Aythya australis</i> (Hardhead)			
21.	24319 <i>Biziura lobata</i> (Musk Duck)			
22.	24321 <i>Chenonetta jubata</i> (Australian Wood Duck)			
23.	24322 <i>Cygnus atratus</i> (Black Swan)			
24.	24326 <i>Malacorhynchus membranaceus</i> (Pink-eared Duck)			
25.	24328 <i>Oxyura australis</i> (Blue-billed Duck)			
26.	24331 <i>Tadorna tadornoides</i> (Australian Shelduck)			
Apiaceae				
27.	6222 <i>Homalosciadium homalocarpum</i>			
28.	6289 <i>Xanthosia huegelii</i>			
Aponogetonaceae				
29.	141 <i>Aponogeton hexatepalus</i> (Stalked Water Ribbons)		P4	
Araceae				
30.	28342 <i>Landoltia punctata</i> (Thin Duckweed)			
31.	1049 <i>Zantedeschia aethiopica</i> (Arum Lily)	Y		
Araliaceae				
32.	6224 <i>Hydrocotyle blepharocarpa</i>			
33.	6240 <i>Hydrocotyle scutellifera</i>			
34.	6280 <i>Trachymene pilosa</i> (Native Parsnip)			
Arcyriaceae				
35.	38964 <i>Arcyria cinerea</i>			
36.	38967 <i>Arcyria incarnata</i>			
Ardeidae				
37.	25564 <i>Nycticorax caledonicus</i> (Rufous Night Heron)			
Artamidae				
38.	25566 <i>Artamus cinereus</i> (Black-faced Woodswallow)			
39.	24353 <i>Artamus cyanopterus</i> (Dusky Woodswallow)			
Asparagaceae				
40.	1280 <i>Chamaescilla corymbosa</i> (Blue Squill)			
41.	1309 <i>Laxmannia squarrosa</i>			
42.	1223 <i>Lomandra caespitosa</i> (Tufted Mat Rush)			
43.	1232 <i>Lomandra micrantha</i> (Small-flower Mat-rush)			
44.	1234 <i>Lomandra nigricans</i>			
45.	1239 <i>Lomandra preissii</i>			
46.	1243 <i>Lomandra sericea</i> (Silky Mat Rush)			
47.	1246 <i>Lomandra suaveolens</i>			
48.	1312 <i>Sowerbaea laxiflora</i> (Purple Tassels)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
49.	1319 <i>Thysanotus arenarius</i>			
50.	1339 <i>Thysanotus multiflorus</i> (<i>Many-flowered Fringe Lily</i>)			
51.	1351 <i>Thysanotus sparteus</i>			
Asphodelaceae				
52.	1366 <i>Bulbine semibarbata</i> (<i>Leek Lily</i>)			
Asteraceae				
53.	8086 <i>Hypochaeris glabra</i> (<i>Smooth Catsear</i>)	Y		
54.	8092 <i>Ixiolaena viscosa</i> (<i>Sticky Ixiolaena</i>)			
55.	18585 <i>Lagenophora huegelii</i>			
56.	8149 <i>Olearia rudis</i> (<i>Rough Daisybush</i>)			
57.	8175 <i>Podolepis gracilis</i> (<i>Slender Podolepis</i>)			
58.	8182 <i>Podotheca angustifolia</i> (<i>Sticky Longheads</i>)			
59.	8184 <i>Podotheca gnaphalioides</i> (<i>Golden Long-heads</i>)			
60.	25878 <i>Senecio condylus</i>			
61.	8225 <i>Siloxerus humifusus</i> (<i>Procumbent Siloxerus</i>)			
62.	8231 <i>Sonchus oleraceus</i> (<i>Common Sowthistle</i>)	Y		
63.	8255 <i>Ursinia anthemoides</i> (<i>Ursinia</i>)	Y		
Boraginaceae				
64.	6710 <i>Heliotropium europaeum</i> (<i>Common Heliotrope</i>)	Y		
Brassicaceae				
65.	3016 <i>Heliophila pusilla</i>	Y		
66.	19403 <i>Stenopetalum gracile</i>			
Campanulaceae				
67.	37500 <i>Grammatotheca bergiana</i> var. <i>bergiana</i>	Y		
68.	7396 <i>Isotoma hypocrateriformis</i> (<i>Woodbridge Poison</i>)			
69.	7407 <i>Lobelia rhytidosperra</i> (<i>Wrinkled-seeded Lobelia</i>)			
70.	7408 <i>Lobelia tenuior</i> (<i>Slender Lobelia</i>)			
Campephagidae				
71.	25568 <i>Coracina novaehollandiae</i> (<i>Black-faced Cuckoo-shrike</i>)			
Caryophyllaceae				
72.	2889 <i>Cerastium glomeratum</i> (<i>Mouse Ear Chickweed</i>)	Y		
73.	2909 <i>Silene gallica</i> (<i>French Catchfly</i>)	Y		
Casuarinaceae				
74.	1728 <i>Allocasuarina fraseriana</i> (<i>Sheoak</i>)			
Centrolepidaceae				
75.	1125 <i>Centrolepis drummondiana</i>			
Charadriidae				
76.	24377 <i>Charadrius ruficapillus</i> (<i>Red-capped Plover</i>)			
Chenopodiaceae				
77.	30434 <i>Salsola australis</i>			
Colchicaceae				
78.	12770 <i>Burchardia congesta</i>			
79.	1394 <i>Wurmbea dioica</i> (<i>Early Nancy</i>)			
80.	12072 <i>Wurmbea dioica</i> subsp. <i>alba</i>			
81.	1398 <i>Wurmbea monantha</i>			
Columbidae				
82.	24399 <i>Columba livia</i> (<i>Domestic Pigeon</i>)			
83.	24407 <i>Ocyphaps lophotes</i> (<i>Crested Pigeon</i>)			
84.	24409 <i>Phaps chalcoptera</i> (<i>Common Bronzewing</i>)			
85.	25589 <i>Streptopelia chinensis</i> (<i>Spotted Turtle-Dove</i>)			
86.	30951 <i>Streptopelia chinensis</i> subsp. <i>tigrina</i>			
87.	25590 <i>Streptopelia senegalensis</i> (<i>Laughing Turtle-Dove</i>)			
Commelinaceae				
88.	1162 <i>Cartonema philyroides</i>			
Corvidae				
89.	25592 <i>Corvus coronoides</i> (<i>Australian Raven</i>)			
Cracticidae				
90.	25595 <i>Cracticus tibicen</i> (<i>Australian Magpie</i>)			
91.	24422 <i>Cracticus tibicen</i> subsp. <i>dorsalis</i> (<i>White-backed Magpie</i>)			
92.	25596 <i>Cracticus torquatus</i> (<i>Grey Butcherbird</i>)			
93.	25597 <i>Strepera versicolor</i> (<i>Grey Currawong</i>)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
Crassulaceae				
94.	3137 <i>Crassula colorata</i> (Dense Stonecrop)			
95.	11345 <i>Crassula thunbergiana</i> subsp. <i>thunbergiana</i>	Y		
Cuculidae				
96.	25598 <i>Cacomantis flabelliformis</i> (Fan-tailed Cuckoo)			
97.	24431 <i>Chrysococcyx basalis</i> (Horsfield's Bronze Cuckoo)			
Cupressaceae				
98.	96 <i>Callitris preissii</i> (Rottnest Island Pine)			
Cyperaceae				
99.	740 <i>Baumea arthropphylla</i>			
100.	768 <i>Cyathochaeta avenacea</i>			
101.	16245 <i>Cyathochaeta teretifolia</i>		P3	
102.	894 <i>Fimbristylis velata</i>			
103.	910 <i>Isolepis cernua</i> (Nodding Club-rush)			
104.	925 <i>Lepidosperma angustatum</i>			
105.	955 <i>Mesomelaena pseudostygia</i>			
106.	982 <i>Schoenus clandestinus</i>			
107.	986 <i>Schoenus efoliatus</i>			
Dasypogonaceae				
108.	1218 <i>Dasypogon bromeliifolius</i> (Pineapple Bush)			
Dicaeidae				
109.	25607 <i>Dicaeum hirundinaceum</i> (Mistletoebird)			
Dicruridae				
110.	24443 <i>Grallina cyanoleuca</i> (Magpie-lark)			
111.	25614 <i>Rhipidura leucophrys</i> (Willie Wagtail)			
Didymiaceae				
112.	39019 <i>Didymium clavus</i>			Y
Dilleniaceae				
113.	5135 <i>Hibbertia hypericoides</i> (Yellow Buttercups)			
114.	5154 <i>Hibbertia perfoliata</i>			
115.	5162 <i>Hibbertia racemosa</i> (Stalked Guinea Flower)			
Droseraceae				
116.	3095 <i>Drosera erythrorhiza</i> (Red Ink Sundew)			
117.	13216 <i>Drosera menziesii</i> subsp. <i>penicillaris</i>			
118.	3131 <i>Drosera stolonifera</i> (Leafy Sundew)			
Elapidae				
119.	25366 <i>Hydrophis elegans</i>			
120.	25252 <i>Notechis scutatus</i> (Tiger Snake)			
121.	25511 <i>Pseudonaja affinis</i> (Dugite)			
122.	25259 <i>Pseudonaja affinis</i> subsp. <i>affinis</i> (Dugite)			
123.	25264 <i>Pseudonaja nuchalis</i> (Gwardar)			
124.	25266 <i>Simoselaps bertholdi</i> (Jan's Banded Snake)			
125.	25267 <i>Simoselaps littoralis</i> (West Coast Banded Snake)			
Ericaceae				
126.	6334 <i>Astroloma pallidum</i> (Kick Bush)			
127.	6348 <i>Conostephium pendulum</i> (Pearl Flower)			
128.	6349 <i>Conostephium preissii</i>			
129.	6374 <i>Leucopogon conostephioides</i>			
Euphorbiaceae				
130.	29940 <i>Euphorbia maculata</i>	Y		
131.	4662 <i>Monotaxis grandiflora</i> (Diamond of the Desert)			
132.	4666 <i>Monotaxis occidentalis</i>			
Fabaceae				
133.	3374 <i>Acacia huegelii</i>			
134.	3557 <i>Acacia stenoptera</i> (Narrow Winged Wattle)			
135.	3686 <i>Aotus cordifolia</i>			
136.	3710 <i>Bossiaea eriocarpa</i> (Common Brown Pea)			
137.	3872 <i>Euchilopsis linearis</i> (Swamp Pea)			
138.	3957 <i>Gompholobium tomentosum</i> (Hairy Yellow Pea)			
139.	3961 <i>Hardenbergia comptoniana</i> (Native Wisteria)			
140.	3968 <i>Hovea trisperma</i> (Common Hovea)			
141.	3992 <i>Isotropis cuneifolia</i> (Granny Bonnets)			
142.	19700 <i>Isotropis cuneifolia</i> subsp. <i>cuneifolia</i>			
143.	4012 <i>Jacksonia furcellata</i> (Grey Stinkwood)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
144.	4044 <i>Kennedia prostrata</i> (Scarlet Runner)			
145.	4181 <i>Pultenaea reticulata</i>			
146.	4292 <i>Trifolium campestre</i> (Hop Clover)	Y		
Falconidae				
147.	25621 <i>Falco berigora</i> (Brown Falcon)			
148.	25622 <i>Falco cenchroides</i> (Australian Kestrel)			
149.	24472 <i>Falco cenchroides</i> subsp. <i>cenchroides</i>			
150.	25623 <i>Falco longipennis</i> (Australian Hobby)			
Felidae				
151.	24041 <i>Felis catus</i> (Cat)			
Goodeniaceae				
152.	7454 <i>Dampiera linearis</i> (Common Dampiera)			
153.	7574 <i>Lechenaultia floribunda</i> (Free-flowering Leschenaultia)			
154.	7595 <i>Scaevola anchusifolia</i>			
155.	7603 <i>Scaevola canescens</i> (Grey Scaevola)			
Gyrostemonaceae				
156.	2791 <i>Tersonia cyathiflora</i> (Button Creeper)			
Haemodoraceae				
157.	11434 <i>Anigozanthos humilis</i> subsp. <i>humilis</i>			
158.	11261 <i>Anigozanthos manglesii</i> subsp. <i>manglesii</i>			
159.	1418 <i>Conostylis aculeata</i> (Prickly Conostylis)			
160.	11826 <i>Conostylis aculeata</i> subsp. <i>aculeata</i>			
161.	11438 <i>Conostylis candicans</i> subsp. <i>candicans</i>			
162.	1436 <i>Conostylis juncea</i>			
163.	1455 <i>Conostylis setosa</i> (White Cottonhead)			
164.	1478 <i>Phlebocarya ciliata</i>			
165.	1481 <i>Tribonanthes australis</i>			
Halcyonidae				
166.	30901 <i>Dacelo novaeguineae</i> (Laughing Kookaburra)			
167.	25549 <i>Todiramphus sanctus</i> (Sacred Kingfisher)			
Hemerocallidaceae				
168.	1276 <i>Caesia micrantha</i> (Pale Grass-lily)			
169.	1361 <i>Tricoryne elatior</i> (Yellow Autumn Lily)			
Hirundinidae				
170.	24491 <i>Hirundo neoxena</i> (Welcome Swallow)			
Hylidae				
171.	25378 <i>Litoria adelaidensis</i> (Slender Tree Frog)			
Iridaceae				
172.	1550 <i>Patersonia occidentalis</i> (Purple Flag)			
173.	30471 <i>Patersonia occidentalis</i> var. <i>angustifolia</i>			
Juncaceae				
174.	1189 <i>Juncus pauciflorus</i> (Loose Flower Rush)			
Lamiaceae				
175.	6839 <i>Hemiandra pungens</i> (Snakebush)			
176.	6883 <i>Mentha pulegium</i> (Pennyroyal)	Y		
Lauraceae				
177.	11242 <i>Cassytha racemosa</i> forma <i>pilosa</i>			
Leporidae				
178.	24085 <i>Oryctolagus cuniculus</i> (Rabbit)			
Limnodynastidae				
179.	25415 <i>Limnodynastes dorsalis</i> (Western Banjo Frog)			
Lycogalaceae				
180.	39048 <i>Lycogala epidendrum</i>			
Macropodidae				
181.	24133 <i>Macropus irma</i> (Western Brush Wallaby)		P4	
Maluridae				
182.	25654 <i>Malurus splendens</i> (Splendid Fairy-wren)			
Meliphagidae				
183.	24560 <i>Acanthorhynchus superciliosus</i> (Western Spinebill)			
184.	24561 <i>Anthochaera carunculata</i> (Red Wattlebird)			
185.	24562 <i>Anthochaera lunulata</i> (Western Little Wattlebird)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
186.	24581 <i>Lichenostomus virescens</i> (Singing Honeyeater)			
187.	25661 <i>Lichmera indistincta</i> (Brown Honeyeater)			
188.	24583 <i>Manorina flavigula</i> (Yellow-throated Miner)			
189.	24596 <i>Phylidonyris novaehollandiae</i> (New Holland Honeyeater)			
Menyanthaceae				
190.	36160 <i>Liparophyllum capitatum</i>			
191.	36177 <i>Ornduffia albiflora</i>			
Meropidae				
192.	24598 <i>Merops ornatus</i> (Rainbow Bee-eater)		IA	
Muridae				
193.	24215 <i>Hydromys chrysogaster</i> (Water-rat)		P4	
194.	24223 <i>Mus musculus</i> (House Mouse)			
195.	24245 <i>Rattus rattus</i> (Black Rat)			
Myobatrachidae				
196.	25399 <i>Crinia glauerti</i> (Clicking Frog)			
Myrtaceae				
197.	20350 <i>Astartea affinis</i>			
198.	20283 <i>Astartea scoparia</i>			
199.	5382 <i>Beaufortia elegans</i>			
200.	5415 <i>Calothamnus lateralis</i>			
201.	35816 <i>Calothamnus quadrifidus</i> subsp. <i>quadrifidus</i>			
202.	5649 <i>Eucalyptus foecunda</i> (Narrow-leaved Red Mallee)			
203.	5659 <i>Eucalyptus gomphocephala</i> (Tuart)			
204.	5708 <i>Eucalyptus marginata</i> (Jarrah)			
205.	5763 <i>Eucalyptus rudis</i> (Flooded Gum)			
206.	35070 <i>Hypocalymma angustifolium</i> subsp. <i>Swan Coastal Plain</i> (G.J. Keighery 16777)			
207.	5832 <i>Kunzea ericifolia</i> (Spearwood)			
208.	15498 <i>Kunzea glabrescens</i> (Spearwood)			
209.	13271 <i>Melaleuca huegellii</i> subsp. <i>huegellii</i>			
210.	5978 <i>Melaleuca teretifolia</i> (Banbar)			
211.	5980 <i>Melaleuca thymoides</i>			
212.	13280 <i>Melaleuca viminea</i> subsp. <i>viminea</i>			
213.	16477 <i>Pericalymma ellipticum</i> var. <i>ellipticum</i>			
Neositidae				
214.	25673 <i>Daphoenositta chrysoptera</i> (Varied Sittella)			
Onagraceae				
215.	6140 <i>Oenothera mollissima</i>	Y		
216.	14292 <i>Oenothera stricta</i> subsp. <i>stricta</i>	Y		
Ophioglossaceae				
217.	12782 <i>Ophioglossum gramineum</i>			
Orchidaceae				
218.	1586 <i>Caladenia discoidea</i> (Dancing Orchid)			
219.	15348 <i>Caladenia flava</i> subsp. <i>flava</i>			
220.	1596 <i>Caladenia huegellii</i> (Grand Spider Orchid)		T	
221.	15361 <i>Caladenia longicauda</i> subsp. <i>calcigena</i>			
222.	17760 <i>Caladenia nobilis</i>			
223.	12943 <i>Diuris brumalis</i>			
224.	11049 <i>Diuris corymbosa</i>			
225.	1634 <i>Diuris laxiflora</i> (Bee Orchid)			
226.	12939 <i>Diuris magnifica</i>			
227.	12938 <i>Diuris micrantha</i>		T	
228.	1639 <i>Drakaea elastica</i> (Glossy-leaved Hammer Orchid)		T	
229.	1643 <i>Elythranthera brunonis</i> (Purple Enamel Orchid)			
230.	15418 <i>Leptoceras menziesii</i>			
231.	15419 <i>Microtis media</i> subsp. <i>media</i>			
232.	1667 <i>Paracaleana nigrita</i> (Flying Duck Orchid)			
233.	1670 <i>Prasophyllum drummondii</i> (Swamp Leek Orchid)			
234.	1676 <i>Prasophyllum hians</i> (Yawning Leek Orchid)			
235.	10853 <i>Prasophyllum plumiforme</i>			
236.	20731 <i>Thelymitra vulgaris</i>			
237.	20728 <i>Thelymitra xanthotricha</i>			
Orobanchaceae				
238.	7122 <i>Orobanche minor</i> (Lesser Broomrape)	Y		
Oxalidaceae				
239.	4358 <i>Oxalis purpurea</i> (Largeflower Wood Sorrel)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
		Y		
Pachycephalidae				
240.	25675 <i>Colluricincla harmonica</i> (Grey Shrike-thrush)			
241.	25679 <i>Pachycephala pectoralis</i> (Golden Whistler)			
242.	25680 <i>Pachycephala rufiventris</i> (Rufous Whistler)			
Papaveraceae				
243.	8365 <i>Fumaria bastardii</i>	Y		
Pardalotidae				
244.	25681 <i>Pardalotus punctatus</i> (Spotted Pardalote)			
245.	25682 <i>Pardalotus striatus</i> (Striated Pardalote)			
246.	24630 <i>Pardalotus striatus</i> subsp. <i>westraliensis</i>			
Pelecanidae				
247.	24648 <i>Pelecanus conspicillatus</i> (Australian Pelican)			
Peramelidae				
248.	25478 <i>Isoodon obesulus</i> (Southern Brown Bandicoot)			
249.	24153 <i>Isoodon obesulus</i> subsp. <i>fusciventer</i> (Quenda, Southern Brown Bandicoot)		P5	
Petroicidae				
250.	24659 <i>Petroica goodenovii</i> (Red-capped Robin)			
Phalacrocoracidae				
251.	25697 <i>Phalacrocorax carbo</i> (Great Cormorant)			
252.	24667 <i>Phalacrocorax sulcirostris</i> (Little Black Cormorant)			
253.	25699 <i>Phalacrocorax varius</i> (Pied Cormorant)			
Phalangeridae				
254.	25521 <i>Trichosurus vulpecula</i> (Common Brushtail Possum)			
255.	24158 <i>Trichosurus vulpecula</i> subsp. <i>vulpecula</i> (Common Brushtail Possum)			
Phyllanthaceae				
256.	4691 <i>Poranthera microphylla</i> (Small Poranthera)			
Physaraceae				
257.	38979 <i>Badhamia utricularis</i>			
258.	39071 <i>Physarum luteolum</i>			Y
259.	39079 <i>Physarum viride</i>			
Phytolaccaceae				
260.	2793 <i>Phytolacca octandra</i> (Red Ink Plant)	Y		
Plantaginaceae				
261.	14282 <i>Gratiola pubescens</i>			
262.	7111 <i>Veronica persica</i> (Creeping Speedwell)	Y		
Poaceae				
263.	184 <i>Aira caryophyllea</i> (Silvery Hairgrass)	Y		
264.	17234 <i>Austrostipa compressa</i>			
265.	37421 <i>Austrostipa</i> sp. <i>Marchagee</i> (B.R. Maslin 1407)			
266.	234 <i>Avena fatua</i> (Wild Oat)	Y		
267.	244 <i>Briza maxima</i> (Blowfly Grass)	Y		
268.	245 <i>Briza minor</i> (Shivery Grass)	Y		
269.	249 <i>Bromus diandrus</i> (Great Brome)	Y		
270.	250 <i>Bromus hordeaceus</i> (Soft Brome)	Y		
271.	314 <i>Digitaria didactyla</i> (Queensland Blue Couch)	Y		
272.	11485 <i>Ehrharta brevifolia</i> var. <i>cuspidata</i>	Y		
273.	347 <i>Ehrharta calycina</i> (Perennial Veldt Grass)	Y		
274.	374 <i>Eragrostis cilianensis</i> (Stinkgrass)	Y		
275.	376 <i>Eragrostis curvula</i> (African Lovegrass)	Y		
276.	445 <i>Holcus setiger</i> (Annual Fog)	Y		
277.	20019 <i>Lachnagrostis filiformis</i>			
278.	19955 <i>Lachnagrostis plebeia</i>			
279.	19956 <i>Lachnagrostis preissii</i>			
280.	485 <i>Microlaena stipoides</i> (Weeping Grass)			
281.	516 <i>Parapholis incurva</i> (Coast Barbgrass)	Y		
282.	527 <i>Paspalum dilatatum</i>	Y		
283.	528 <i>Paspalum distichum</i> (Water Couch)	Y		
284.	582 <i>Polypogon monspeliensis</i> (Annual Beardgrass)	Y		
285.	583 <i>Polypogon tenellus</i>			
286.	40431 <i>Rytidosperma acerosum</i>			
287.	722 <i>Vulpia bromoides</i> (Squirrel Tail Fescue)	Y		
288.	724 <i>Vulpia myuros</i> (Rat's Tail Fescue)	Y		
289.	12052 <i>Vulpia myuros</i> forma <i>megalura</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
290.	33101 <i>Vulpia myuros forma myuros</i>	Y		
		Y		
Podargidae				
291.	25703 <i>Podargus strigoides</i> (Tawny Frogmouth)			
Podicipedidae				
292.	25704 <i>Podiceps cristatus</i> (Great Crested Grebe)			
293.	24681 <i>Poliiocephalus poliocephalus</i> (Hoary-headed Grebe)			
294.	25705 <i>Tachybaptus novaehollandiae</i> (Australasian Grebe)			
Polygonaceae				
295.	2412 <i>Muehlenbeckia adpressa</i> (Climbing Lignum)			
Portulacaceae				
296.	2854 <i>Calandrinia granulifera</i> (Pygmy Purslane)			
Proteaceae				
297.	1791 <i>Adenanthos obovatus</i> (Basket Flower)			
298.	1800 <i>Banksia attenuata</i> (Slender Banksia)			
299.	1819 <i>Banksia grandis</i> (Bull Banksia)			
300.	1822 <i>Banksia ilicifolia</i> (Holly-leaved Banksia)			
301.	1834 <i>Banksia menziesii</i> (Firewood Banksia)			
302.	1885 <i>Conospermum triplinervium</i> (Tree Smokebush)			
303.	2273 <i>Persoonia saccata</i> (Snottygobble)			
304.	2299 <i>Petrophile linearis</i> (Pixie Mops)			
305.	2316 <i>Stirlingia latifolia</i> (Blueboy)			
306.	2326 <i>Synaphea polymorpha</i> (Albany Synaphea)			
307.	2329 <i>Synaphea spinulosa</i>			
308.	15532 <i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>			
309.	2331 <i>Xylomelum occidentale</i> (Woody Pear)			
Psittacidae				
310.	25716 <i>Cacatua sanguinea</i> (Little Corella)			
311.	25717 <i>Calyptorhynchus banksii</i> (Red-tailed Black-Cockatoo)			
312.	24734 <i>Calyptorhynchus latirostris</i> (Carnaby's Cockatoo (short-billed black-cockatoo))		T	
313.	24738 <i>Neophema elegans</i> (Elegant Parrot)			
314.	24750 <i>Platycercus zonarius</i> subsp. <i>semitorquatus</i> (Twenty-eight Parrot)			
315.	25722 <i>Polytelis anthopeplus</i> (Regent Parrot)			
316.	25723 <i>Trichoglossus haematodus</i> (Rainbow Lorikeet)			
Pythiaceae				
317.	<i>Phytophthora cinnamomi</i>			
Rallidae				
318.	25727 <i>Fulica atra</i> (Eurasian Coot)			
319.	25729 <i>Gallinula tenebrosa</i> (Dusky Moorhen)			
320.	25731 <i>Porphyrio porphyrio</i> (Purple Swamphen)			
Recurvirostridae				
321.	25734 <i>Himantopus himantopus</i> (Black-winged Stilt)			
322.	24776 <i>Recurvirostra novaehollandiae</i> (Red-necked Avocet)			
Restionaceae				
323.	16595 <i>Desmocladus flexuosus</i>			
324.	17838 <i>Dielsia stenostachya</i>			
325.	1070 <i>Hypolaena exsulca</i>			
326.	19833 <i>Leptocarpus laxus</i>			
Rutaceae				
327.	4417 <i>Boronia dichotoma</i>			
328.	11381 <i>Boronia ramosa</i> subsp. <i>anethifolia</i>			
329.	18529 <i>Philotheca spicata</i> (Pepper and Salt)			
Sapindaceae				
330.	4763 <i>Dodonaea hackettiana</i> (Hackett's Hopbush)		P4	
Scincidae				
331.	25011 <i>Acritoscincus trilineatum</i>			
332.	25040 <i>Ctenotus gemmula</i> (Jewelled South-west Ctenotus, skink (Swan Coastal Plain pop P3))			
333.	25133 <i>Lerista elegans</i>			
334.	25147 <i>Lerista lineata</i> (Perth Slider, Lined Skink)		P3	
335.	25207 <i>Tiliqua rugosa</i> subsp. <i>rugosa</i>			
Scolopacidae				
336.	41323 <i>Actitis hypoleucos</i> (Common Sandpiper)		IA	

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
Scrophulariaceae				
337.	7054 <i>Dischisma arenarium</i>	Y		
Solanaceae				
338.	7022 <i>Solanum nigrum</i> (Black Berry Nightshade)	Y		
339.	7037 <i>Solanum symonii</i>			
Stemonitidaceae				
340.	39085 <i>Stemonitis lignicola</i>			
341.	39087 <i>Stemonitis splendens</i>			
Stylidiaceae				
342.	7677 <i>Levenhookia stipitata</i> (Common Stylewort)			
343.	7693 <i>Stylidium brunonianum</i> (Pink Fountain Triggerplant)			
344.	17850 <i>Stylidium ireneae</i>		P4	
345.	7774 <i>Stylidium piliferum</i> (Common Butterfly Triggerplant)			
346.	25830 <i>Stylidium</i> sp. Darling Range (H. Bowler 371)			
Sylviidae				
347.	25755 <i>Acrocephalus australis</i> (Australian Reed Warbler)			
348.	24833 <i>Cincloramphus cruralis</i> (Brown Songlark)			
349.	25758 <i>Megalurus gramineus</i> (Little Grassbird)			
Threskiornithidae				
350.	24841 <i>Platalea flavipes</i> (Yellow-billed Spoonbill)			
351.	24843 <i>Plegadis falcinellus</i> (Glossy Ibis)		IA	
352.	24844 <i>Threskiornis molucca</i> (Australian White Ibis)			
353.	24845 <i>Threskiornis spinicollis</i> (Straw-necked Ibis)			
Thymelaeaceae				
354.	5254 <i>Pimelea leucantha</i>			
355.	18117 <i>Pimelea rosea</i> subsp. <i>rosea</i>			
Turnicidae				
356.	24849 <i>Turnix varia</i> subsp. <i>varia</i>			
Tytonidae				
357.	24852 <i>Tyto alba</i> subsp. <i>delicatula</i> (Barn Owl)			
Varanidae				
358.	25218 <i>Varanus gouldii</i> (Bungarra or Sand Monitor)			
Violaceae				
359.	5216 <i>Hybanthus calycinus</i> (Wild Violet)			
Xanthorrhoeaceae				
360.	1256 <i>Xanthorrhoea preissii</i> (Grass tree)			
Zamiaceae				
361.	85 <i>Macrozamia riedlei</i> (<i>Zamia</i>)			
Zosteropidae				
362.	25765 <i>Zosterops lateralis</i> (Grey-breasted White-eye)			
Zygophyllaceae				
363.	4383 <i>Tribulus terrestris</i> (Caltrop)	Y		

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 wholly 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 C: DEPARTMENT OF ENVIRONMENT AND CONSERVATION THREATENED FAUNA SEARCH

NAME	SOURCE_CODE	FAMILY	GENUS	SPECIES	INFANAME	AUTHOR	VERNACULAR	KINGDOM	CONS_CODE	CLASS	DAY	MONTH	YEAR	LOCALITY_NAME	SITE_NAME
Calyptorhynchus latirostris	FAUNA SURVEY	Psittacidae	Calyptorhynchus	latirostris		Carnaby	Carnaby's Cockatoos	Animalia	T	BIRD	07	03	2009	EAST ROCKINGHAM	East Rockingham WWTP
Calyptorhynchus latirostris	BIRD ATLAS2	Psittacidae	Calyptorhynchus	latirostris		Carnaby	Carnaby's Cockatoos	Animalia	T	BIRD	20	07	2000	MEDINA	Thomas Oval, Medina
Calyptorhynchus latirostris	BIRD ATLAS2	Psittacidae	Calyptorhynchus	latirostris		Carnaby	Carnaby's Cockatoos	Animalia	T	BIRD	19	09	2002	POSTANS	The Spectacles
Tiliqua rugosa subsp. konowi	FAUNA SURVEY	Scincidae	Tiliqua	rugosa	subsp. konowi	(Mertens)		Animalia	T	REPTILE	11	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 6.3
Tiliqua rugosa subsp. konowi	FAUNA SURVEY	Scincidae	Tiliqua	rugosa	subsp. konowi	(Mertens)		Animalia	T	REPTILE	09	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 6.5
Falco peregrinus	FAUNA SURVEY	Falconidae	Falco	peregrinus		Tunstall	Peregrine Falcon	Animalia	S	BIRD	07	03	2009	EAST ROCKINGHAM	East Rockingham WWTP
Isodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAMMAL	05	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 6.7
Isodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAMMAL	11	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.3
Isodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAMMAL	06	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 5.5
Isodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAMMAL	05	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.7
Isodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAMMAL	07	03	2009	EAST	East Rockingham

NAME	SOURCE_CODE	FAMILY	GENUS	SPECIES	INFANAM	AUTHOR	VERNACULAR	KINGDOM	CONS CODE	CLASS	DAY	MONTH	YEAR	LOCALITY_NAME	SITE_NAME
subsp. fusciventer	SURVEY				subsp. fusciventer					MAL				ROCKINGHAM	WWTP TS 3.5
Isoodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	08	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 5.5
Isoodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	05	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.5
Isoodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	10	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.3
Isoodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	07	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 6.7
Isoodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	05	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.7
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	01	11	2001	COOLOONGUP	N end of Lake Cooloongup, Cooloongup (Site 3)
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	01	12	1974	CASUARINA	Mortimer Road, Wellard.
Isoodon obesulus subsp. fusciventer	FAUNA SURVEY	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	25	05	2010	LEDA	Leda Wetlands
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	01	11	2001	LEDA	Leda Reserve, Leda (Site 2)
Isoodon obesulus subsp. fusciventer	WAM	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	22	06	1961	MEDINA	

NAME	SOURCE_CODE	FAMILY	GENUS	SPECIES	INFANAM	AUTHOR	VERNACULAR	KINGDOM	CONS CODE	CLASS	DAY	MONTH	YEAR	LOCALITY_NAME	SITE_NAME
subsp. fusciventer	SPECIMENS				fusciventer					MAL					
Isodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	01	11	2001	PARMELIA	Bushland opposite Sicklemore Road, Parmelia/Bertram (Site 1)
Isodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	06	11	2007	HOPE VALLEY	north of Anketall Road, across from the Spectales
Isodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	03	11	2007	HOPE VALLEY	north of Anketall Road, across from the Spectales
Isodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	04	11	2007	HOPE VALLEY	north of Anketall Road, across from the Spectales
Isodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	09	07	2004	HOPE VALLEY	Alcoa development site on Anketall Road, E of Abercombe Road
Isodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	02	11	2007	HOPE VALLEY	north of Anketall Road, across from the Spectales
Isodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM	05	11	2007	HOPE VALLEY	north of Anketall Road, across from the Spectales

NAME	SOURCE_CODE	FAMILY	GENUS	SPECIES	INFANAM	AUTHOR	VERNACULAR	KINGDOM	CONS CODE	CLASS	DAY	MONTH	YEAR	LOCALITY_NAME	SITE_NAME
fusciventer					nter										from the Spectacles
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM MAL	02 11	2007		KWINANA BEACH	roadside south of Anketell Road, adjacent to the Spectacles
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM MAL	06 11	2007		KWINANA BEACH	roadside south of Anketell Road, adjacent to the Spectacles
Isoodon obesulus subsp. fusciventer	TFAUNA	Peramelidae	Isoodon	obesulus	subsp. fusciventer	(Gray)	Quenda	Animalia	5	MAM MAL	04 11	2007		KWINANA BEACH	roadside south of Anketell Road, adjacent to the Spectacles
Charadrius rubricollis	TFAUNA	Charadriidae	Charadrius	rubricollis		(Gmelin)	Hooded Plover	Animalia	4	BIRD	10 01	1998		COOLOONGUP	Cooloongup Lake, City of Rockingham
Hydromys chrysogaster	TFAUNA	Muridae	Hydromys	chrysogaster		Geoffroy	Water-rat	Animalia	4	MAM MAL	10 06	1973		MEDINA	Medina
Macropus irma	TFAUNA	Macropodidae	Macropus	irma		(Jourdan)	Western Brush Wallaby	Animalia	4	MAM MAL	01 01	1989		WELLARD	Leda Nature Reserve, Town of Kwinana
Notoscincus butleri	FAUNA SURVEY	Scincidae	Notoscincus	butleri		Storr		Animalia	4	REPTI LE	08 03	2009		EAST ROCKINGHAM	East Rockingham WWTP TS 1.9
Notoscincus butleri	FAUNA SURVEY	Scincidae	Notoscincus	butleri		Storr		Animalia	4	REPTI LE	07 03	2009		EAST ROCKINGHAM	East Rockingham WWTP TS 3.2
Lerista lineata	WAM SPECIMENS	Scincidae	Lerista	lineata		Bell		Animalia	3	REPTI LE	05 01	1979		MEDINA	Spectacle Swamp, near Medina
Lerista lineata	TFAUNA	Scincidae	Lerista	lineata		Bell		Animalia	3	REPTI LE	13 11	2007		THE SPECTACLES	roadside south of Anketell Road,

NAME	SOURCE_CODE	FAMILY	GENUS	SPECIES	INFRAORDER	AUTHOR	VERNACULAR	KINGDOM	CONS CODE	CLASS	DAY	MONTH	YEAR	LOCALITY_NAME	SITE_NAME
Lerista lineata	TFAUNA	Scincidae	Lerista	lineata		Bell (A.M.C. DumØril, Bibron & A. DumØril)		Animalia	3	REPTI LE	05	01	1979	THE SPECTACLES	adjacent to the Spectacles Spectacle Swamp, near Medina
Neelaps calonotos	TFAUNA	Elapidae	Neelaps	calonotos		(A.M.C. DumØril, Bibron & A. DumØril)	Black- striped Snake	Animalia	3	REPTI LE				COOLOONGUP	East Rockingham
Neelaps calonotos	WAM SPECIMEN S	Elapidae	Neelaps	calonotos		(A.M.C. DumØril, Bibron & A. DumØril)	Black- striped Snake	Animalia	3	REPTI LE				COOLOONGUP	East Rockingham
Pletholax gracilis subsp. edelensis	FAUNA SURVEY	Pygopodidae	Pletholax	gracilis	subsp. edelen sis	Storr		Animalia	3	REPTI LE	08	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 4.3

APPENDIX D: SITE HABITAT PLATES

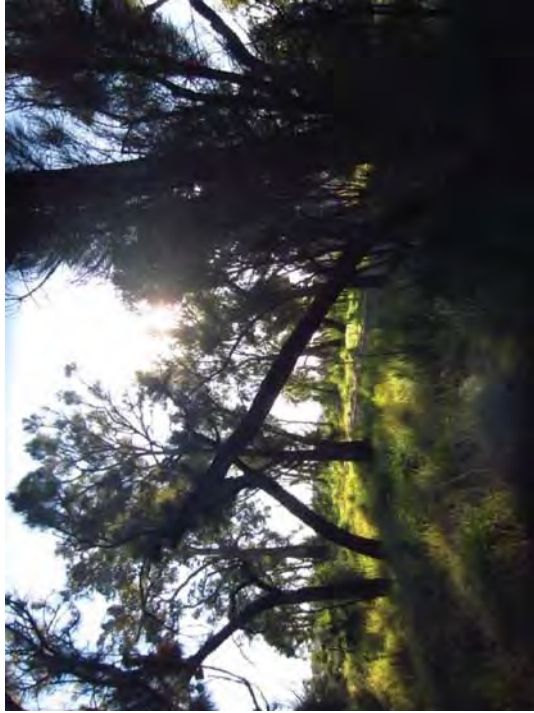
Plate 1: Sampling Location 1



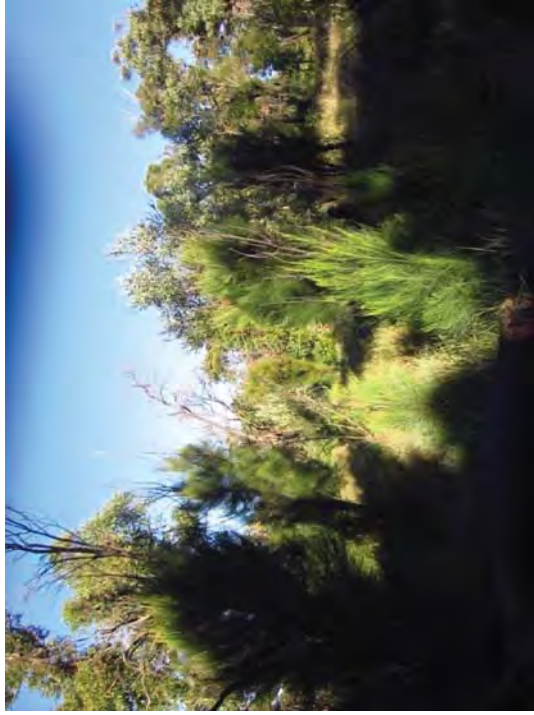
North



South



East



West

Plate 2: Sampling Location 2



North



South



East



West

Plate 3: Sampling Location 3



North



South



East



West

Plate 4: Sampling Location 4



North



South



East



West

Plate 5: Sampling Location 5



North



South



East



West

APPENDIX E: VEGETATION TYPES OF THE SITE

***Eucalyptus gomphocephala* (Tuart) woodlands**

Eucalyptus gomphocephala (Tuart) woodland over *Banksia sessilis* var. *cygnorum*, *Jacksonia furcellata*, *Hakea prostrata* high open shrubland to high shrubland over *Grevillea vestita*, *Acacia pulchella* var. *glaberrima* open shrubland over **Ehrharta calycina*, **Euphorbia terracina*, *Conostylis candicans* subsp. *candicans*, **Lupinus cosentinii* closed grassland/herbland.

***Eucalyptus gomphocephala* (Tuart) mixed woodlands**

Eucalyptus gomphocephala (Tuart) scattered tall trees over *Corymbia calophylla* (Marri) open woodland over *Allocasuarina fraseriana*, *Banksia grandis* scattered low trees over *Jacksonia furcellata* high open shrubland over *Acacia pulchella* var. *glaberrima* open shrubland over *Macrozamia riedlei* scattered shrubs over **Ehrharta calycina* grassland and **Lupin cosentinii*, **Euphorbia terracina* open herbland.

Eucalyptus gomphocephala (Tuart) open woodland over *Allocasuarina fraseriana*, *Corymbia calophylla* (patches) open woodland over *Banksia grandis* scattered low trees over *Jacksonia furcellata* scattered tall shrubs to high open shrubland over *Acacia pulchella* var. *glaberrima*, *Macrozamia riedlei* open shrubland over **Ehrharta calycina*, **Briza maxima* closed grassland with *Conostylis aculeata* subsp. *Aculeata* very open herbland.

Eucalyptus gomphocephala (Tuart) scattered trees over *Eucalyptus marginata* subsp. *marginata* (Jarrah) woodland over *Banksia grandis*, *Banksia attenuata* low open woodland over *Jacksonia furcellata* scattered tall shrubs to high open shrubland over *Acacia pulchella* var. *glaberrima*, *Macrozamia riedlei* open shrubland over **Ehrharta calycina* closed grassland and **Lupin cosentinii*, **Euphorbia terracina* open herbland.

***Eucalyptus marginata* (Jarrah) - *Corymbia calophylla* (Marri) – *Banksia* spp. woodlands**

Eucalyptus marginata subsp. *marginata* (Jarrah), *Corymbia calophylla* (Marri) open woodland over *Banksia attenuata*, *Banksia grandis* low open woodland over *Macrozamia riedlei*, *Acacia pulchella* var. *glaberrima* open shrubland over *Pimelea rosea*, *Gompholobium tomentosum* low open shrubland over *Desmocladius flexuosus*, *Lepidosperma pubisquameum* very open sedgeland and **Ehrharta calycina*, **Briza maxima* grassland.

Eucalyptus marginata subsp. *marginata* (Jarrah), *Corymbia calophylla* (Marri) woodland over *Banksia attenuata*, *Banksia menziesii*, *Banksia grandis* low open woodland to low woodland (much of it regrowth (?after fire)) over *Jacksonia sternbergiana* scattered tall shrubs over *Acacia pulchella* var. *glaberrima* open

shrubland over *Leucopogon propinquus* scattered low shrubs over *Tetraria octandra*, open sedgeland and **Ehrharta calycina*, (**Briza maxima*) grassland with *Conostylis aculeata subsp. aculeata* very open herbland.

***Eucalyptus marginata* (Jarrah) - *Banksia* spp. woodland**

Eucalyptus marginata subsp. marginata (Jarrah), *Allocasuarina fraseriana* low woodland over *Banksia attenuata* low open woodland to low woodland over *Acacia pulchella var. glaberrima* open shrubland to shrubland over *Gompholobium tomentosum*, *Petrophile linearis* low open woodland over *Lepidosperma pubisquameum*, *Luzula meridionalis*, *Desmocladius flexuosus* scattered sedges and **Ehrharta calycina* grassland with *Conostylis aculeata subsp. aculeata* very open herbland.

Eucalyptus marginata subsp. marginata (Jarrah) open woodland over *Banksia attenuata* (*Banksia menziesii*, *Banksia grandis*) low woodland over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei*, *Acacia pulchella var. glaberrima* open shrubland over *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina* open to closed grassland.

***Corymbia calophylla* (Marri) woodland**

Corymbia calophylla (Marri), (*Eucalyptus marginata subsp. marginata* (Jarrah)) open forest over *Banksia grandis* scattered low trees over *Jacksonia furcellata* scattered tall shrubs over *Macrozamia riedlei*, *Acacia pulchella var. glaberrima* open shrubland over *Pimelea rosea*, *Gompholobium tomentosum* low open shrubland over **Ehrharta calycina*, **Lagurus ovatus*, **Briza maxima* closed grassland.

Corymbia calophylla (Marri), *Eucalyptus marginata subsp. marginata* (Jarrah) open forest over *Banksia attenuata*, *Banksia grandis* scattered low trees over *Macrozamia riedlei* scattered shrubs over **Ehrharta calycina*, **Briza maxima* grassland.

***Dryandra sessilis* scrub**

(Regrowth after fire) *Banksia sessilis var. cygnorum*, *Jacksonia furcellata* open to closed scrub over *Acacia pulchella var. glaberrima*, *Olearia axillaris*, *Macrozamia riedlei* open shrubland over **Ehrharta calycina* closed grassland.

APPENDIX F: STATE AND FEDERAL LEVEL CONSERVATION CODES

WC Act Codes for Threatened Fauna

CONSERVATION CODE	CATEGORY
Schedule 1	Fauna that is rare or likely to become extinct are declared to be fauna that is in need of special protection.
Schedule 2	Fauna that is presumed to be extinct are declared to be fauna that is in need of special protection.
Schedule 3	Birds that are identified in the agreement between the governments of Australia and Japan relating to the protection of migratory birds, and birds in danger of extinction, are declared to be fauna that is in need of special protection.
Schedule 4	Fauna that is in need of special protection, otherwise than for the reasons mentioned (in Schedule 1 – 3).

DEC Priority Fauna Conservation Codes (DEC 2010)

CONSERVATION CODE	CATEGORY
P1	Priority One Taxa with few, poorly known populations on threatened lands.
P2	Priority Two Taxa with few, poorly known populations on conservation lands. Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown Land, water reserves, etc.
P3	Priority Three Taxa which are known from few specimens or sight records, some of which are on lands not under immediate threat of habitat destruction or degradation.
P4	Priority Four Rare taxa. 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.
P5	Priority Five Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

EPBC Act Categories of Threatened Fauna Species

CONSERVATION CODE	CATEGORY
Ex	Extinct - Taxa not defiantly located in the wild during the past 50 years.
ExW	Extinct in the Wild - Taxa known to survive only in captivity.
CE	Critically Endangered - Taxa facing an extremely high risk of extinction in the wild in the immediate future.
E	Endangered - Taxa facing a very high risk of extinction in the wild in the near future.
V	Vulnerable - Taxa facing a high risk of extinction in the wild in the medium-term.
CD	Conservation Dependent - Taxa whose survival depends upon ongoing conservation measures. Without these measures. A conservation dependent taxon would be classified as Vulnerable or more severely Threatened.

ATTACHMENT 2H

The logo for 360 environmental, featuring the number '360' in a large, bold, black sans-serif font, with the word 'environmental' in a smaller, black sans-serif font directly below it.

environmental



Level 1 Vertebrate Fauna Survey – Kwinana Train Station Precinct

Prepared for:

Department of Housing/
Satterley Property Group

October 2012

● people ● planet ● professional

Document Reference	Revision	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
EBS197-3AD	INTERNAL DRAFT	AH	FD	-	5/10/2012
EBS197-3AD	CLIENT REPORT	AH	Client	1 Electronic copy	16/10/2012

Disclaimer

This report is issued in accordance with, and is subject to, the terms of the contract between the Client and 360 Environmental Pty Ltd, including, without limitation, the agreed scope of the report. To the extent permitted by law, 360 Environmental Pty Ltd shall not be liable in contract, tort (including, without limitation, negligence) or otherwise for any use of, or reliance on, parts of this report without taking into account the report in its entirety and all previous and subsequent reports. 360 Environmental Pty Ltd considers the contents of this report to be current as at the date it was produced. This report, including each opinion, conclusion and recommendation it contains, should be considered in the context of the report as a whole. The opinions, conclusions and recommendations in this report are limited by its agreed scope. More extensive, or different, investigation, sampling and testing may have produced different results and therefore different opinions, conclusions and recommendations. Subject to the terms of the contract between the Client and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating parts of this report is prohibited (except to the extent required by law) unless the report is produced in its entirety including this cover page, without the prior written consent of 360 Environmental Pty Ltd.

© Copyright 2012 360 Environmental Pty Ltd ACN 109 499 041

Table of Contents

Executive Summary	1
1 Introduction	4
1.1 Project Background and Study Area Location	4
1.2 Study Objectives and Scope	4
1.3 Existing Environment.....	5
1.4 Previous Fauna Surveys	9
1.5 Report Format	10
2 Methods	13
2.1 Desktop Study	13
2.2 Survey Timing and Weather	13
2.3 Fauna Survey Team.....	14
2.4 Fauna Habitat Assessment	14
2.5 Sampling Locations	14
2.6 Survey Effort	15
2.7 Nomenclature.....	15
2.8 Survey Limitations.....	17
3 Results	20
3.1 Desktop Study	20
3.2 Broad Fauna Habitat and Sampling Locations	23
3.3 Fauna Survey and Fauna Assemblage	23
4 Conservation Significant Fauna Discussion	30
4.1 Threatened Fauna Statutory Framework	30
4.2 Threatened Fauna	31
5 Conclusion and Recommendations	41
5.1 Fauna Assemblage Discussion	41
5.2 Significant Fauna Discussion	41
5.3 Recommendations	42
6 References	44
7 Report Limitations	47

List of Figures

Figure 1: Mean Rainfall and Temperature for Medina Research Station Recorded Between 1983 and 2012 (Bureau of Meteorology, 2012).....	6
Figure 2: Site Location Overview	11
Figure 3: Site Regional Context	12
Figure 4: Fauna Sampling Locations	19
Figure 5: Previous Significant Tree Survey	39
Figure 6: Previous Black Cockatoo Survey	40
Figure 7: IBRA Bioregions.....	49

List of Tables

Table 1: Nature Reserves in the Vicinity of the Parmelia Site.....	8
Table 2: Other Fauna Surveys Undertaken in the Area	10
Table 3: Database Sources	13
Table 4: Weather at Time of Survey.....	14
Table 5: Last Six Months of Rainfall (mm) Compared to Rainfall Average (Medina weather station)	14
Table 6: Sampling Location, Including GPS Location (GDA 1994) and Broad Habitat Type	15
Table 7: Limitations and Constraints.....	17
Table 8: Total Fauna Potentially Occurring within the Site	20
Table 9: Desktop Study of Predicted Threatened Fauna	21
Table 10: Number of Vertebrate Fauna Species Recorded at the Train Station Site.	23
Table 11: Avifauna Species Recorded at the Site	27
Table 12: Mammal Species Recorded at the Site	29
Table 13: Reptile Species Recorded at the Site.....	29
Table 14: Likelihood of Predicted Conservation Significant Species Occurring in the Project Area	32
Table 15: EPBC Act Categories of Threatened Fauna Species	77
Table 16: WC Act Codes for Threatened Fauna	78
Table 17: DEC Priority Fauna Conservation Codes (DEC 2010).....	78

List of Appendices

- Appendix A IBRA Map
- Appendix B Sampling Location Plates
- Appendix C EPBC Search
- Appendix D Naturemap Search
- Appendix E Department of Environment and Conservation Search
- Appendix F Vegetation Types of the Site
- Appendix G Threatened Fauna Statutory Framework

Executive Summary

Background

360 Environmental Pty Ltd (360 Environmental) was commissioned by Satterley Property Group on behalf of the Department of Housing to undertake a baseline Level 1 Vertebrate Fauna Survey for areas surrounding the Kwinana Train Station, known as the Kwinana Train Station Precinct (the Site). The Site is located in the Town of Kwinana, approximately 32 km south of Perth.

The Site consists of six discrete sub-site areas adjacent to the Kwinana Train Station. The baseline survey included a Level 1 Vertebrate Fauna Survey within the sub-site areas A, C, D, E, F and G (Figure 2). The areas are all located along Sulphur Road and range in size from 0.26 hectares (ha) to 4.9 ha. The total area surveyed was approximately 11.81 ha of which the majority is uncleared bushland.

Methods

The entire Site was traversed on foot with a total of four sampling locations being used to assess the fauna habitat types. Passive detection methods were used to identify vertebrate fauna species across the Site. Emphasis was placed on detecting fauna species of Conservation Significance that may occur within the Site.

Results

One broad fauna habitat type was identified within the Site:

- Jarrah-Banksia Woodland over variable understorey

This was composed of *Banksia attenuata* woodland variably interspersed with other tree species such as Jarrah *Eucalyptus marginata*, Sheoak *Allocasuarina fraseriana*, with occasional stands of *Jacksonia furcellata*, *Kunzea glabrescens*, *Banksia menziessii* over an understorey of *Hibbertia*, *Acacia* and *Xanthorrhoea*. Floristically each site differed subtly, but generally, for the purpose of the fauna survey the habitat was considered as the same broad fauna habitat type.

The desktop survey indicated that a total assemblage of 127 vertebrate fauna species representing 47 families have the potential to occur at the Site. Of these, 21 taxa are listed either at Federal or State level as species of elevated conservation significance.

A total of 28 vertebrate fauna species representing 19 families were recorded across the Site during the field survey. These comprised 23 avifauna species, one native mammal species, three introduced mammal species and one reptile species.

On the basis of the known distributions, habitat preferences and the habitats available, six vertebrate fauna species of elevated conservation significance might reasonably be expected to occur at the Site. These include:

- Two species of Black Cockatoo: Carnaby's (*Calyptorhynchus latisrostris*) and Forest Red-tailed (*Calyptorhynchus banksii naso*);
- Rainbow Bee-eater (*Merops ornatus*);
- Chuditch (*Dasyurus geoffroii*);
- Quenda (*Isoodon obesulus*); and
- Lined Skink (*Lerista lineata*).

Two species of Conservation Significance were recorded at the Site:

- Carnaby's Black Cockatoo listed as Endangered (under both the *EPBC Act* and *WC Act*); and
- Quenda listed as a Priority 5 species (under DEC rating).

Discussion

The faunal values of the Kwinana Train Station Precinct development Site are considered to be representative of those typically associated with urban bushland remnants on the Swan Coastal Plain. In a spatial context, numerous other remnants are located in proximity to the Site, both on and off land reserved for conservation purposes. On this basis, impacts to fauna habitats and assemblages are likely to be restricted to the Site and therefore unlikely to extend beyond the boundaries.

Generally, the fauna habitat at the Site is in good condition and provides fauna value with intact *Banksia* woodland vegetation containing several large older growth habitat trees such as Jarrah. Levels of annual weeds within the Site were relatively low with the exception of disturbance areas where weeds were encroaching. The fragmented nature of the Site does limit some of the fauna value, with all sub-site areas being surrounded to some extent by roads and rail. These have a particular impact on ground dwelling species such as mammals and reptiles, as it is difficult for some species to persist within a Site of this size and furthermore it makes it difficult for new migrants to move into the area.

That being said Quenda persist within the Site. It is likely the species is present within the Spectacles Wetlands which are in close proximity to the Site. As the Quenda is listed as Priority 5 it is only a species of concern at a State level; it is not listed as protected under Federal legislation. Quenda are known to occur within other populations throughout the area. Development at the Site is unlikely to impact any conservation management program for the species.

The Carnaby's Black Cockatoo was recorded at the Site. The species appears to be utilising the Site for feeding particularly with the high levels of *Banksia* throughout the Site. Evidence of feeding was recorded during the Black Cockatoo Survey previously undertaken at the Site (360 Environmental 2012a). Carnaby's Black Cockatoo were heard and sighted on two separate occasions while undertaking the fauna survey. The Carnaby's Black Cockatoo is listed as Endangered under Federal legislation and

Schedule 1 at a State level. Therefore significant effort should be implemented to avoid, minimise or mitigate the habitat clearing at the Site, particularly of the large habitat trees considered by the Department of Sustainability, Environment, Water, Population and Communities (DSEWPAC) as potentially significant for the Black Cockatoo species.

Recommendations

In summary, the recommendations arising from this fauna survey at the Kwinana Train Station Precinct include:

- Minimise the clearing of remnant native vegetation wherever possible. For example, previously disturbed areas should be used in preference to clearing remnant vegetation wherever possible;
- It is recommended that a fauna removal specialist be engaged to trap Quenda at the site to relocate any individuals within the Site immediately prior to vegetation clearing. Trapping at the Site and translocation of animals will require approval from the Department of Environment and Conservation (DEC). Prior to the translocation taking place it will also be necessary to liaise with the local council to determine an appropriate location for the animals to be released. The Spectacles Wetlands would appear to be an appropriate location;
- Implementation of a Flora and Fauna Management Plan, including staged habitat clearing to allow for fauna dispersal away from the Site, for the duration of the clearing and construction period;
- Retention of hollow-bearing trees where possible. These trees may be suitable for breeding of bird species and may become suitable for Black Cockatoo species over time (as the trees grow and the hollows increase in size). If clearing of trees with hollows is unavoidable, it is recommended that clearing is undertaken outside of breeding season for significant species or that hollows are inspected prior to clearing to ensure that they are unoccupied or not in use;
- Following the implementation of measures to avoid, minimise and otherwise mitigate impacts, environmental offset of residual impacts of habitat clearing will be required if there is a significant residual impact to conservation significant species. Offsets might include the purchase of land containing appropriate habitat (including suitable Black Cockatoo habitat), or reinstatement of habitat elsewhere; and
- It is suggested that no further fauna survey work will be required at the Site (with the exception of Quenda trapping and relocation and potentially hollow inspections if clearing must be conducted during breeding season). A Level 1 Vertebrate Fauna Survey and Black Cockatoo Survey should be sufficient for the Site.

1 Introduction

1.1 Project Background and Study Area Location

360 Environmental Pty Ltd (360 Environmental) was commissioned to undertake a Level 1 Vertebrate Fauna Survey within six areas surrounding the Kwinana Train Station, referred to as the Kwinana Train Station Precinct (the Site). The Department of Housing and Satterley Property Group propose to develop the Site for residential development. This report is required as part of the approvals process and will be included as an Appendix within the Federal Referral document.

The Site comprises a total survey area of approximately 11.81 hectares (ha). It is located in the suburbs of Parmelia and Bertram, approximately 33 kilometres (km) south of Perth. The Site mostly comprises remnant bushland and is composed of sub-site areas A, C, D, E, F and G (Figure 2). All surveyed areas adjoin Sulphur Road and all are within close proximity to the Kwinana Train Station. Area B has already been referred federally in 2010 and is therefore not part of this scope of work.

1.2 Study Objectives and Scope

1.2.1 Objective

The broad objectives of the survey were to provide Site-specific descriptions of fauna habitats and establish the likelihood of fauna species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and *Wildlife Conservation Act 1950* (WC Act) occurring within the Site.

Specifically, the objectives of the Level 1 Vertebrate Fauna Survey were to:

- Provide an inventory of the fauna habitats and assemblages of the Site;
- To identify significant opportunities and constraints associated with the faunal values within the Site;
- To assist the client with the evaluation of potential impacts on habitat and/or vertebrate fauna of Conservation Significance; and
- Provide recommendations to minimise and mitigate fauna impacts.

1.2.2 Scope

In order to achieve the objective, 360 Environmental undertook a Level 1 Vertebrate Fauna Survey for the Site. The scope of works for the fauna survey included a desktop study followed by a Site visit and habitat assessment.

The purpose of the desktop study was to gather background information relevant to the Site by searching literature, data sources and map based information. The reconnaissance survey aimed to verify the accuracy of the desktop study, to delineate and characterise fauna and faunal assemblages present within the Site and identify potential impacts.

The Level 1 Vertebrate Fauna Survey was planned and implemented in accordance with the Environmental Protection Authority (EPA) *Position Statement No. 3 Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002) and *Guidance Statement No. 56 Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004). To ensure adequate data of a high standard the survey was conducted with reference to the *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA 2010) to meet the EPA and DEC's expectations for undertaking a Level 1 Vertebrate Fauna Survey.

1.3 Existing Environment

1.3.1 Physical Environment

1.3.1.1 Climate

The closest official Bureau of Meteorology (BoM) weather station currently operating is Medina Research Station where climate data is available between 1983 and 2012 (BoM 2012). The climate is classified as Warm Mediterranean, with mean minima ranging approximately from 10°C to 18°C and maxima from approximately 19°C to 33°C (Figure 1). Rainfall totals approximately 762.2 mm per annum (BoM 2012).

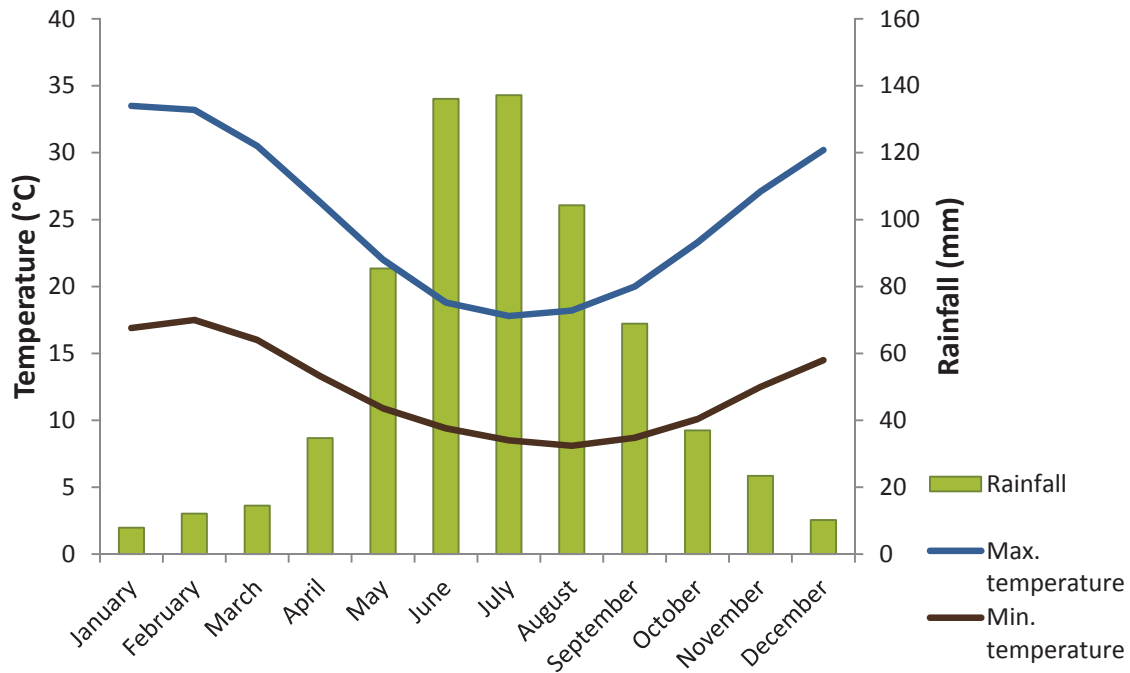


Figure 1: Mean Rainfall and Temperature for Medina Research Station Recorded Between 1983 and 2012 (Bureau of Meteorology, 2012).

1.3.1.2 Geology

The Site is located on the Spearwood Dune System. This consists primarily of coastal limestone (Town of Kwinana 2003). The sediment is composed of Quaternary deposits which are unconsolidated or unlithified. The Spearwood dune system occurs within the Cottesloe and Karrakatta sands soil unit, which consists of calcareous sands (Bennett Environmental Consulting 2004). The predominant geology of the Site is limestone and calcarenite (Department of Water 2012a).

1.3.1.3 Hydrology

The Site is located in the Serpentine River Catchment, and forms part of the Peel-Harvey Drainage Catchment (Cardno 2011). The highly permeable, sandy nature of the soils of this area result in good drainage of surface waters into the groundwater table (GHD 2007). The Perth Groundwater Atlas indicates that the ground water below the Site ranges between approximately 15 and 20 m below the ground surface (Department of Water 2012b). The major aquifers in the area which may have influences on the Site are Yarragadee North, Leederville, Superficial Swan and Rockingham Sand. These aquifers all have marginal salinity except Yarragadee which has brackish salinity (Department of Water 2012a).

1.3.1.4 Soils and Landforms

The Kwinana area is located on the Spearwood Dune System (Town of Kwinana 2003). This system comprises red/brown, yellow and pale yellow/grey sands. Regional geological mapping identifies the Site as comprised of sand derived from Tamala Limestone. This features pale yellow brown, fine-to-coarse grained, sub-angular to well-rounded quartz, with high-to-medium permeability and contribute to groundwater infiltration. The Site topography rises from a low point at the east of the Site at approximately 20 m Australian Height Datum (AHD) to approximately 35 m AHD at the west of the Site (Department of Water 2012b).

1.3.2 Biological Environment

1.3.2.1 IBRA Bioregions

The Site lies within the Swan Coastal Plain Bioregion and Perth subregion of the Interim Biogeographic Regionalisation of Australia (IBRA) (Appendix A). The Perth subregion (SWA2) is a low lying coastal plain composed of colluvial and Aeolian sands, alluvial river flats and coastal limestone rising to duricrusted Mesozoic sediments in the east. Outwash plains are extensive only in the south, while a complex series of seasonal wetlands and swamps extends from north to south. Vegetation comprises heath and/or Tuart woodlands on limestone, Banksia and Jarrah- Banksia woodlands on Quaternary marine dunes of various ages, Marri on colluvial and alluvial soils, *Casuarina obesa* on out-wash plains, and paperbark (*Melaleuca* spp.) in wetland areas.

1.3.2.2 Flora and Vegetation

The predominant vegetation of the Spearwood Dune System is “*Eucalyptus gomphocephala* (Tuart) forest woodland. *E. marginata* and *E. calophylla* (now *Corymbia calophylla*) occur scattered throughout, but it is only in the transition Zone from this system to the Bassendean Dunes that *E. marginata* becomes dominant. Associations with *E. marginata* and following a similar trend in their occurrence are *Banksia attenuata*, *B. menziesli* and *Allocasuarina fraseriana*. The ground cover generally comprise proteaceous and leguminous woody perennials, *Dryandra* spp *Hakea* spp and *Leucopogon* spp” (Town of Kwinana 2003).

A Site specific flora and vegetation survey was completed in 2009 (360 Environmental 2009). Detailed vegetation descriptions within each sub-site area are presented in Appendix F.

1.3.2.3 Fauna Habitats and Assemblages

The vertebrate fauna of the Swan Coastal Plain is recognized as being particularly diverse, although it is experiencing dramatic decline. Approximately 14% of avifauna species on the Swan Coastal Plain had declined sharply or become locally extinct within

150 years of European settlement (How and Dell 2000). Over half of the small terrestrial mammals had disappeared in the same period, and studies of urban remnants in the late 20th century yielded records of only three species (How and Dell 2000). Reptiles have fared better, but have still declined by conservative estimates of about 30% (How and Dell 2000). The primary threats that have led to, and are exacerbating this decline include the clearing of native bushland, the associated encroachment of urban and industrial areas and the influence of feral predators.

Given the threats listed above, it is unsurprising that the results of the decline in native fauna on the Swan Coastal Plain is most keenly observed in the greater metropolitan area, although those in surrounding agricultural zones are also significant. Larger pockets of remnant bushland may harbour the greatest number of species, although the value of smaller such areas as corridors through which animals are able to migrate are also important (How and Dell 1994).

Fauna surveys in the Perth area often yield reasonable numbers of avifauna due to commonly diurnal activity patterns. Herpetofauna and mammals are less commonly recorded, and establishing their potential to occur often relies on the veracity of habitat assessments. Where habitat assessments are considered to be insufficient, and often where fauna species of elevated Conservation Significance (protected under State or Federal legislation) are considered likely to occur, multiple phase Level 2 surveys may be required.

1.3.3 Conservation Reserves in the Locality

There are four gazetted Nature Reserves in the vicinity of the Train Station Precinct Site (Figure 3; Table 1). These are established for wildlife and landscape conservation, scientific study and preservation of features of archaeological, historic or scientific interest by the Conservation Commission of Western Australia (Environmental Defender's Office WA (EDOWA) 2011).

Table 1: Nature Reserves in the Vicinity of the Parmelia Site.

RESERVE NAME	LOCATION RELATIVE TO KWINANA TRAIN STATION SITE	AREA (HA)
Leda Nature Reserve	7.5 km south	442.8
Banksia Nature Reserve	6 km south-east	32.5
Modong Nature Reserve	4.5 km east-southeast	155.2
Wandi Nature Reserve	2.5 km east	30.3

In addition to these, there are six Bush Forever sites within similar distances. The aim of the Bush Forever programme is to ensure the long-term protection of biodiversity and associated environmental values inherent in remnant bushland across the Perth metropolitan area. The policy recognises the protection and management of significant

bushland areas as a fundamental consideration in the planning process, while also seeking to integrate and balance wider environmental, social and economic considerations. This includes the Rotary Wildflower Reserve adjacent to sub-site areas A and C and a long strip of remnant vegetation along Sicklemore Road (Bush Forever Site 272).

Less than one kilometre to the north across Thomas Road are two regional parks. This includes Jandakot Regional Park and the southern extent of Beeliar Regional Park which is composed of the Spectacles Wetlands. While regional parks have no specific legal status, they generally comprise areas of land that have been identified as having regionally significant conservation, landscape and recreation values. As such these parks therefore provide the opportunity to develop a management approach that incorporates and coordinates these values.

Another wetland under private ownership known as Bollard Bullrush Swamp occurs two kilometres south of the Site.

1.4 Previous Fauna Surveys

Several surveys have been completed in the vicinity of the Kwinana Train Station Site recently. These include:

- A targeted Black Cockatoo Survey at the Site in July 2012 (360 Environmental 2012a);
- Kwinana Town Centre Level 1 Vertebrate Fauna Survey 2012 (360 Environmental 2012b);
- Lot 9001, Parmelia Level 1 Vertebrate Fauna Survey 2012 (360 Environmental in publication); and
- Level 1 Vertebrate Fauna Survey in the East Rockingham area (Harewood 2008).

Details of these surveys are provided in Table 2.

Table 2: Other Fauna Surveys Undertaken in the Area

	EAST ROCKINGHAM WWTP FAUNA ASSESSMENT	BLACK COCKATOO SURVEY AT THE SITE	LEVEL 1 FAUNA SURVEY KWINANA TOWN CENTRE	LEVEL 1 FAUNA SURVEY LOT 9001, PARMELIA
Consultant	Greg Harewood	360 Environmental	360 Environmental	360 Environmental
Timing	July 2008	July 2012	Autumn	Late winter
Type	Level 1 Fauna Survey	Black Cockatoo Survey	Level 1 Fauna Survey	Level 1 Fauna Survey
Approx. Distance from Current Survey	10 km	At Site	3 km	2.3 km
Total Trap Nights	N/A (reconnaissance survey)	N/A (reconnaissance survey)	N/A (reconnaissance survey)	N/A (reconnaissance survey)
Amphibians	0	-	0	0
Reptiles	3	-	2	2
Mammals	3	-	6	2
Birds	30	Carnaby's Black Cockatoo	28	24
Total species	36	-	36	28
Conservation Significant species recorded	Quenda (Southern Brown Bandicoot)	Carnaby's Black Cockatoo	Carnaby's and Red-tailed Black Cockatoo and Quenda	Carnaby's and Forest Red-tailed Black Cockatoo
No. Conservation Significant species	1	1	3	2
Duration	31 July 2008	July 2012	3 Days from March – May 2012	27 July 2012

1.5 Report Format

This Report has been structured in the following format:

- Section 1: Introduction;
- Section 2: Methods;
- Section 3: Results;
- Section 4: Conservation Significant Fauna;
- Section 5: Conclusion and Recommendations;
- Section 6: References; and
- Section 7: Report Limitations.

- Legend**
-  Site Boundary
 -  Major Roads
 -  Bush Forever Sites
 -  EPP Lanes

NOT TO SCALE
 DATUM: GDA 1984
 PROJECTION: UTM
 ZONE: 56S
 LOCAL MAP DERIVED FROM INTELLIGENT PLATFORM



LOCALITY MAP



DATE	13/10/2012
DRAWING ID	EB 197-3 02
VICEROYAL DATUM AND PROJECTION	
GDA 1984 MGA Zone 56S	

CREATED	JJ	APPROVED	PD	REVISION	0
---------	----	----------	----	----------	---

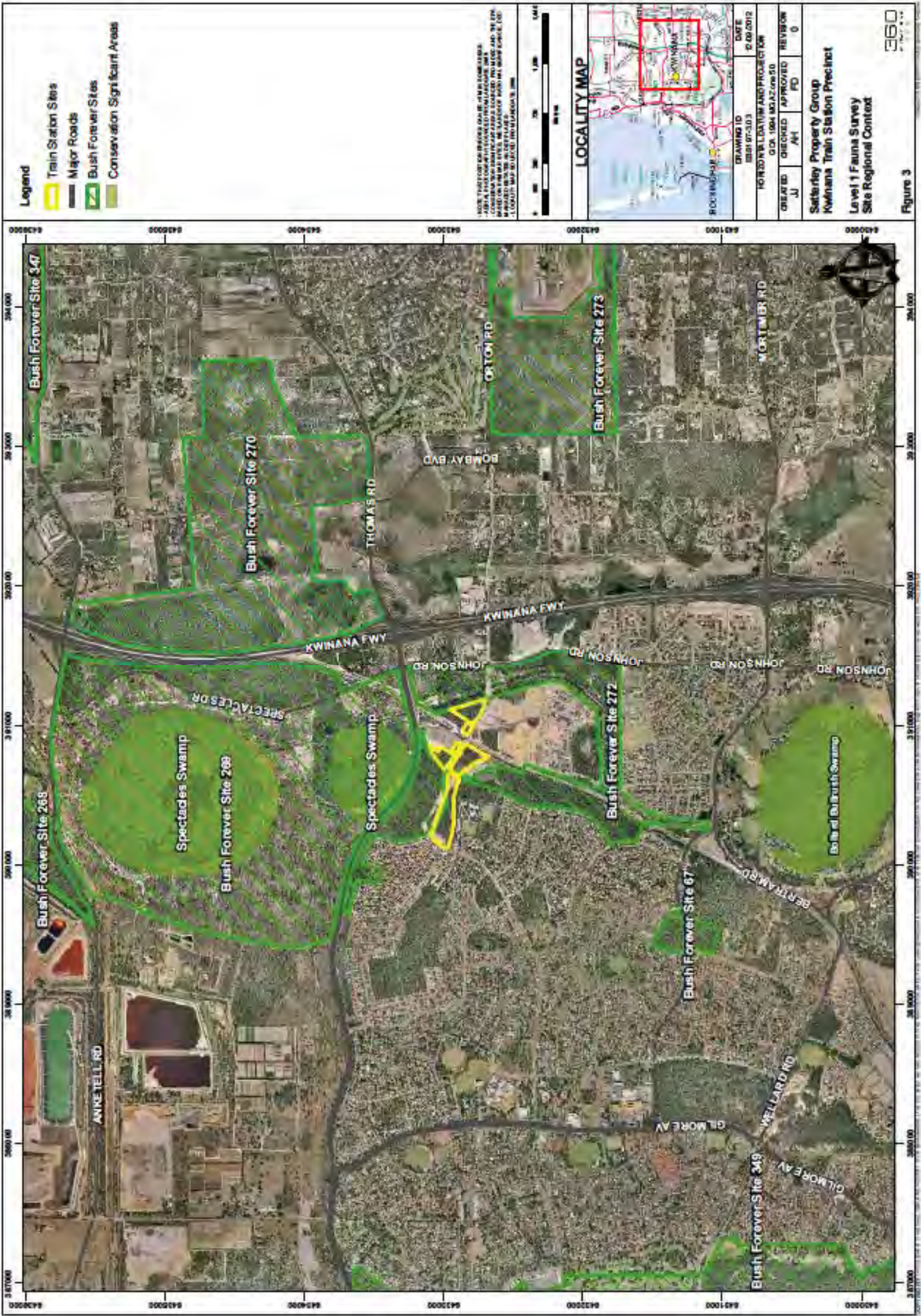
Sattlerley Property Group
 Kwinana Train Station Precinct
 Level 1 Fauna Survey
 Site Location Overview



Figure 2



9432000 9432100 9432200 9432300 9432400 9432500 9432600 9432700 9432800 9432900 9433000
 9431700 9431800 9431900 9432000 9432100 9432200 9432300 9432400 9432500 9432600 9432700 9432800 9432900 9433000



- Legend**
- Train Station Sites
 - Major Roads
 - Bush Forever Sites
 - Conservation Significant Areas

NOTE: THESE COORDINATES ARE IN UTM ZONE 56S
 - AREA HAS BEEN VERIFIED FROM AIRPHOTOGRAPHY
 - COORDINATE SYSTEM IS GDA 1984 MGA 2000
 - MAP WAS MADE USING GIS SOFTWARE
 - LOCALITY MAP SHOWS THE LOCATION OF THIS MAP



DRAWING ID	DATE		
2007-07-30-3	08/09/2012		
FOR REVIEW, DATA AND PROJECTION			
CREATED	CHECKED	APPROVED	REVISION
JJ	AH	PD	0
GDA 1984 MGA 2000			

Sattley Property Group
 Kwinana Train Station Precinct
 Level 1 Fauna Survey
 Site Regional Context

Figure 3

2 Methods

2.1 Desktop Study

A desktop review was undertaken to collect current data relevant to the Site and its surrounds. This involved a search of available literature and survey data, web based mapping tools and map-based information (Table 3). A desktop survey of species potentially occurring within the Site was performed using data from:

- Searches of the Department of Environment and Conservation (DEC) databases;
- Search of the EPBC Protected Matters database;
- Search of the International Union for Conservation of Nature (IUCN) Red-list;
- Search of Birds Australia *Birdata* database;
- Various reference books (Wilson and Swan [2003]; Pizzey and Knight [1997]; Morcombe [2003]; Simpson and Day [1996]; Van Dyke and Strahan [2008]; Menkhorst and Knight [2004]); and
- Previous fauna survey's in the area.

All species of elevated Conservation Significance recorded or expected to occur on the Site were cross-checked against the Federal EPBC Threatened Matters Database (SEWPaC 2012a) and the Government Gazette Number 12 (Government of Western Australia 2010) for their status under the EPBC Act and WC Act respectively.

Table 3: Database Sources

PROVIDER	DATABASE	PARAMETERS
Department of Sustainability, Environment, Water, Population and Communities	Protected Matters Database Search Tool. Accessed 14 August 2012 (Appendix C)	Buffer of five kilometres centred around -32.23612 115.84042
Department of Environment and Conservation	Naturemap (Appendix D)	Buffer of five kilometres centred around -32.23612 115.84042
Department of Environment and Conservation	Fauna Search (Appendix E)	Buffer of five kilometres centred around -32.23612 115.84042

2.2 Survey Timing and Weather

A reconnaissance survey was undertaken during the mornings of 20 July and the 7 September 2012 in accordance with the EPA's Guidance Statement 56 (EPA 2004). Weather conditions during all survey days were warm and fine (Table 4). The survey was undertaken over two mornings in late winter / early spring in an attempt to record as much of the fauna assemblage within the Site as practicable, particularly after the winter rain and the onset of spring. The Site had received a reasonable amount of rainfall during the winter months prior to the survey (Table 5). With the exception of July which was

very dry compared to previous years all months received close to average rainfall for the area.

Table 4: Weather at Time of Survey

DATE	MINIMUM TEMPERATURE (°C)	MAXIMUM TEMPERATURE (°C)	RAINFALL 24HRS TO 9AM (MM)	WEATHER
20/07/12	2.4	21.5	0.0	Fine, no cloud
7/09/12	6.0	19.2	0.0	Fine, no cloud

Table 5: Last Six Months of Rainfall (mm) Compared to Rainfall Average (Medina weather station)

	APRIL	MAY	JUNE	JULY	AUGUST	SEPT
Average (1983 - 2012)	40.3	97.5	148.3	147.9	114.2	76.6
Rainfall 2012	57	92	153.2	39.4	94.2	69

2.3 Fauna Survey Team

360 Environmental's Senior Environmental Scientist Andrew Hide coordinated and implemented the field survey. He was responsible for fauna identification and documentation and managed the data analysis and report production. Andrew has a Degree in Natural Resource Management and seven years of relevant field experience.

2.4 Fauna Habitat Assessment

Fauna habitats are typically identified on the basis of landforms in combination with soil types and associated vegetation complexes. Habitats were initially identified on the basis of flora and vegetation survey results (360 Environmental 2009). The fauna habitat present at each sampling location was subsequently verified during the Site reconnaissance survey.

Habitat descriptions were compiled at each sampling location, providing a description of the landform, soil and vegetation type. Photographic records of the habitat at each sampling location included a view to the North, East, South and West (Appendix B).

2.5 Sampling Locations

The Site reconnaissance survey incorporated the verification of potential habitats identified from the flora and vegetation survey (360 Environmental 2009). Sampling locations were selected so as to ensure that all major habitats were sampled and such that the spatial distribution of sampling locations incorporated the entire Site. Each sampling location was recorded using a Differential Global Positioning System (DGPS). Transects were completed throughout the length of the Site to ensure all habitats were identified and to increase the chance of opportunistically sighting fauna.

2.6 Survey Effort

2.6.1 Fauna Sampling

The principal component of the survey comprised four non-systematic sampling locations (Figure 4). Sampling at each location involved a detailed fauna search, comprising raking of leaf litter, and searching rock crevices, potential burrows and nests, for a minimum of 30 minutes. Sampling was conducted in the early morning and involved searching an approximate area of two hectares around the Site to identify and document fauna species (sightings) or secondary signs, such as scats, tracks and diggings.

Transects were walked through all sub-site areas, as the broad fauna habitat was the same throughout each it was not necessary to sub-sample every sub-site area.

Photographic images for each fauna sampling location are displayed in Appendix B and GPS coordinates and habitat type are displayed in Table 6.

Table 6: Sampling Location, Including GPS Location (GDA 1994) and Broad Habitat Type

SURVEY LOCATION	ZONE	GPS LOCATION		PLATE NO	BROAD FAUNA HABITAT
		EASTING	NORTHING		
Location 1	50H	390738	6432830	Plate 1	Jarrah-Banksia Woodland
Location 2	50H	390345	6432985	Plate 2	Jarrah-Banksia Woodland
Location 3	50H	390758	6433011	Plate 3	Jarrah-Banksia Woodland
Location 4	50H	391096	6432800	Plate 4	Jarrah-Banksia Woodland

2.6.1.1 Ornithological Census

A dedicated bird census was conducted at each sampling location to identify bird species within a two hectare area for a minimum of 30 minutes per session. All individuals detected either visually or audibly between sunrise and 9 am were recorded. Opportunistic sightings of birds were also recorded while traversing the Site.

2.7 Nomenclature

The nomenclature used for each fauna group included:

- Birds: Nomenclature for each bird species recorded was checked against Christidis and Boles (Christidis and Boles 2008);
- Mammals: Nomenclature for each mammal species recorded was checked against the *Checklist of the mammals of Western Australia* (How et al. 2009);

- Amphibians: Nomenclature for each amphibian species recorded was checked against the *Checklist of the amphibians of Western Australia* (Doughty and Maryan 2010a); and
- Reptiles: Nomenclature for each reptile species recorded was checked against the *Checklist of the reptiles of Western Australia* (Doughty and Maryan 2010b).

2.8 Survey Limitations

Table 7 addresses potential limitations and constraints associated with the Level 1 Fauna Survey with reference to Guidance Statement 56 (EPA 2004).

It should be noted that while Level 1 surveys are limited in nature, the methodology is considered to be adequate for purpose in the context of relatively small bushland remnants in urban areas.

Table 7: Limitations and Constraints

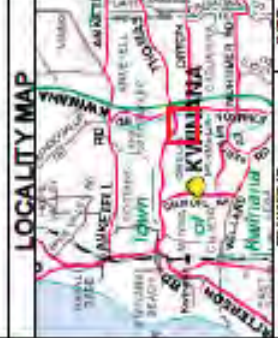
POTENTIAL LIMITATIONS	CONSTRAINT*	COMMENT
Competency and experience of the consultant (s) carrying out the survey	No	The 360 Environmental staff member who completed the field work and prepared this report has appropriate training and experience in conducting fauna surveys.
Scope	No	The purpose of a Level 1 Vertebrate Fauna Survey is to conduct a reconnaissance survey to support a desktop study of a particular site in order to compile an inventory of fauna habitats and species and to identify any fauna of elevated Conservation Significance within the proposed Project area.
Proportion of fauna identified, recorded and/ or collected	Negligible	As this is a Level 1 Vertebrate Fauna Survey a suitable amount of diversity has been recorded. A higher diversity of fauna species would require fauna trapping and is not within the scope of a Level 1 Vertebrate Fauna Survey.
Sources of Information	Negligible	Vertebrate fauna information was accessed by searching available literature and survey data; web based mapping tools and map-based information.
Proportion of the task achieved	No	The field component fulfils EPA's requirements for a Level 1 Vertebrate Fauna Survey.
Timing/ weather/season/ cycle	No	A total of two dedicated morning fauna survey visits were conducted throughout spring. The weather on all survey days was fine.
Disturbances which affected results of the survey	No	Human disturbances are present throughout the Site and regularly present within the surrounds of each area. However these are not recent disturbances and therefore would not have affected the survey results.
Intensity of survey effort	Negligible	The intensity of survey effort was sufficient for a Level 1 Vertebrate Fauna Survey.
Completeness	No	The survey was completed in detail over two morning site visits and the relevant literature and data for the Site was reviewed. Further detail would require a Level 2 Fauna Survey.

POTENTIAL LIMITATIONS	CONSTRAINT*	COMMENT
Resources	No	Adequate resources were available.
Remoteness and/or access problems	No	Access to and within the Site was not an issue.
Availability of contextual information on the region	Negligible	360 Environmental had adequate access to fauna databases to determine which species were likely to be identified within the Survey area.

*Constraint (yes/ no); Significant – greater than 60%; Moderate – 20-60%; Negligible – less than 20%

- Legend**
-  Train Station Sites
 -  Fauna Sampling Locations
 -  Major Roads
 -  Minor Roads

NOTE THAT POSITIONING COULD BE IN SOME AREAS
 - Aerial photography obtained from LANDSAT 300
 - LOCALITY MAP OBTAINED FROM LANDSAT 300



DRAWING ID	DATE
2021-07-30-A	06/09/2012
NORWAL LOCALITY MAP AND PROJECTION	
OGDA 1984 MOA Zone 50	
CREATED	CHECKED
JJ	AH
APPROVED	PD
REVISION	0

Sattlerley Property Group
 Kwinana Train Station Precinct
 Level 1 Fauna Survey
 Fauna Sampling Locations

360
 CONSULTANTS

Figure 4



3 Results

3.1 Desktop Study

A search of the DEC's Threatened and Priority Fauna Database, Naturemap and the EPBC Protected Matters Database search were undertaken to identify fauna species predicted to occur within a buffer of five kilometers of the Site.

A total of 99 bird species, eight native terrestrial mammal species, 13 reptile species, three amphibian species and four invasive mammal species were identified as potentially occurring within the Site (Table 8).

Table 8: Total Fauna Potentially Occurring within the Site

FAUNA GROUP	NUMBER OF FAMILIES	NUMBER SPECIES
Avifauna	34	99
Mammals - Native	6	8
Mammals - Introduced	3	4
Bats	0	0
Reptiles	3	13
Amphibians	2	3
Total		127

3.1.1 Conservation Significant Fauna

A list of all predicted threatened fauna potentially present within the site is displayed in Table 9. Conservation Significant fauna identified as having the potential to occur in the area included a total of fourteen (14) bird species, five (5) terrestrial mammal species and one (1) reptile species (Table 9). One insect of Conservation Significance was also predicted to occur within the Site.

These species will be discussed in further detail in Section 5.2.

Table 9: Desktop Study of Predicted Threatened Fauna

COMMON NAME	SCIENTIFIC NAME	INTERNATIONAL		FEDERAL		STATE	
		IUCN	EPBC ACT	DEC	WC ACT		
Birds							
Australasian Bittern	<i>Botaurus poiciloptilus</i>	Endangered	Endangered	Endangered	Schedule 1		Schedule 1
Australian Painted Snipe	<i>Rostratula australis</i>	Endangered	Endangered	Vulnerable	Schedule 3		Schedule 3
Carnaby's Black Cockatoo	<i>Calyptorhynchus latirostris</i>	Endangered	Endangered	Endangered	Schedule 1		Schedule 1
Cattle Egret	<i>Ardea ibis</i>			Migratory Marine, Migratory Wetland	Schedule 3		Schedule 3
Common Sandpiper	<i>Actitis hypoleucos</i>	Least concern		Migratory Marine	Schedule 3		Schedule 3
Fairy Tern (Australian)	<i>Sternula nereis nereis</i>	Vulnerable		Vulnerable	Schedule 1		Schedule 1
Forest Red-Tailed Black Cockatoo	<i>Calyptorhynchus banksii naso</i>			Vulnerable	Schedule 1		Schedule 1
Fork-Tailed Swift	<i>Apus pacificus</i>	Least Concern		Migratory Marine	Schedule 3		Schedule 3
Glossy Ibis	<i>Plegadis falcinellus</i>	Least concern			Schedule 3		Schedule 3
Great Egret, White Egret	<i>Ardea alba</i>			Migratory Marine, Migratory Wetland	Schedule 3		Schedule 3
Malleefowl	<i>Leipoa ocellata</i>	Vulnerable		Vulnerable, Migratory Terrestrial	Schedule 1		Schedule 1
Painted Snipe	<i>Rostratula benghalensis s. lat.</i>	Least Concern		Vulnerable Migratory Wetland	Schedule 1		Schedule 1
Rainbow Bee-Eater	<i>Merops ornatus</i>	Least Concern		Migratory Terrestrial	Schedule 3		Schedule 3
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Least Concern		Migratory Terrestrial	Schedule 3		Schedule 3
Mammals							
Chuditch	<i>Dasyurus geoffroii</i>	Near Threatened		Vulnerable	Schedule 1		Schedule 1
Quenda	<i>Isodon obesulus subsp. fusciventer</i>	Least concern			Priority 5		
Quokka	<i>Setonix brachyurus</i>	Vulnerable		Vulnerable	Schedule 1		Schedule 1

COMMON NAME	SCIENTIFIC NAME	INTERNATIONAL		FEDERAL		STATE	
		IUCN		EPBC ACT	DEC	WC ACT	
Red-Tailed Phascogale	<i>Phascogale calura</i>	Near Threatened		Endangered		Schedule 1	
Western Brush Wallaby	<i>Macropus Irma</i>	Least concern			Priority 4		
Reptiles							
Lined Skink	<i>Lerista lineata</i>				Priority 3		
Insects							
Graceful Sun Moth	<i>Synemon gratiosa</i>			Endangered		Schedule 1	

3.2 Broad Fauna Habitat and Sampling Locations

All sub-site areas within the Site contained the same broad fauna habitat type. This was composed of *Banksia* Woodland with Jarrah and Sheoak scattered throughout. As all areas contained the same general fauna habitat type four fauna sampling locations were established throughout the site, each within the four larger areas (Figure 4). Most sub-site areas provided value and were in good condition from a fauna perspective. Isolated areas of clearing and weed invasion were the only negative impacts throughout the Site. Fragmentation between sub-sites was an issue with road and rail separating each sub-site from one another. This would not be an issue for avifauna species but would be an issue for arboreal and ground-dwelling mammals and herpetofauna.

3.3 Fauna Survey and Fauna Assemblage

The following section summarises the mammals, birds and herpetofauna recorded during the survey. Table 10 summarises the total species recorded during the survey. A more intensive survey including trapping (Level 2 Vertebrate Fauna Survey) would need to be implemented to complete a more comprehensive list for the Site.

Avifauna was recorded the most, as the species are much more active during the day and trapping techniques are usually required to survey the remaining fauna assemblages. Species abundance and diversity at the Site did not differ greatly between sub-sites and therefore did not have a significant impact on the fauna distribution at each survey location.

Table 10: Number of Vertebrate Fauna Species Recorded at the Train Station Site.

FAUNA GROUP	NUMBER OF FAMILIES	NUMBER SPECIES
Birds	14	23
Native Mammals	1	1
Introduced Mammals	3	3
Bats	0	0
Reptiles	1	1
Amphibians	0	0
Total	19	28

3.3.1 Avifauna

A total of 23 bird species were recorded either visually or by calls during the survey (Table 11).

3.3.1.1 Avifauna Assemblage

The most abundant species was the Brown Honeyeater with 10.1% (12 records) of the total individuals. Three other species, the New Holland Honeyeater (5.8%; seven records), the Australian Raven (5%; six records) and Australian Ringneck (4.2%; five records) were also represented most commonly throughout the Site. Several species were only recorded three times or less, and one of these was identified by a call in the distance.

The majority of avifauna families recorded with 57.1% (eight families) were represented by single species. The *Meliphagidae* family were relatively diverse with four species while the *Psittacidae* family were represented by three species.

What appeared to be a Swamp Harrier (*Circus approximans*) was observed on one occasion, however as the sighting was so brief it was difficult to confidently identify the species.

Sampling location 1, 3 and 4 recorded the most bird species. Habitat within these areas was denser and as a result it appeared bird species had a higher preference for these locations.

3.3.1.2 Avifauna of Conservation significance

Fauna sightings were recorded in conjunction with a Black Cockatoo survey conducted in July 2012 (360 Environmental 2012a). During this time, feeding evidence of Carnaby's Black Cockatoo were observed on Site by Tony Kirkby. This suggests that although not extensively utilised, Carnaby's Black Cockatoos do at least occasionally utilise the survey area for foraging and feeding, but there was no evidence of breeding. While undertaking the fauna survey a Carnaby's Black Cockatoo was heard flying overhead to the east by a single call from Location 1. Another single Carnaby's Black Cockatoo was observed flying overhead while within Location 2.

The suggestion that Black Cockatoo's occasionally utilise the site is supported by two callings of Carnaby's Black Cockatoos to the east of the site.

3.3.1.3 Regionally Endemic Species

No regionally endemic avifauna species were recorded during the survey. However, a number of species that were recorded are considered to be restricted to the south west corner of Western Australia. These include Carnaby's Black Cockatoo and Red-capped Parrot.

3.3.1.4 Taxonomic Certainty

The taxonomic status of all species recorded is considered to be relatively stable and the species generally accepted under the nomenclature listed in Christidis and Boles (2008).

3.3.2 Mammals

A total of six individual mammal observations were recorded within the Site (Table 12). All of these records were through tracks, scats and diggings at the Site. One native mammal species was observed during the survey of a potential eight predicted to occur in the area. Three introduced mammal species were recorded out of a predicted four.

What appeared to be Quenda (*Isoodon obesulus*) diggings were observed at Location 1. These diggings differ from that of Rabbit (*Oryctolagus cuniculus*) in that the digging ends in more of a point compared to the Rabbit which is usually more rounded. Rabbit diggings also usually have scat clusters within close proximity to diggings. Presence of Quenda was confirmed with track observations made within sandy soil within sub-site areas D and F. In order to gain an estimate of Quenda abundance trapping would be required.

Signs of introduced mammal species were obvious throughout the Site. Red Fox (*Vulpes vulpes*) prints were observed at Location 1 and 4. Prints from Cat (*Felis catus*) were sighted at location 4. Additionally, Rabbit diggings and a warren system at Location 4 were recorded at the Site.

3.3.2.1 Mammals of Conservation Significance

Although no direct observations of the species were made (only diggings and tracks), the Quenda is listed as a Priority 5 species by the DEC and is present at the Site.

3.3.2.2 Regionally Endemic Species

As mentioned above, the Quenda represents a regionally endemic species and is present at the Site due to the observation of diggings and tracks.

3.3.2.3 Taxonomic Certainty

The taxonomic status of all species recorded is considered to be relatively stable and the species generally accepted under the nomenclature listed in How *et al.* 2009.

3.3.3 Herpetofauna

One species of reptile was observed during the survey (Table 13) of a potential 13 predicted to occur in the area. No amphibian species were recorded of a total three predicted to occur in the area. Fauna trapping techniques would be required to gain a more representative sample of the herpetofauna assemblage present within the Site.

A Bobtail Lizard (*Tiliqua rugosa*) was observed within the Site at Location 4. Observation of only a single species would be expected for the Site without implementing more intensive methods such as pit and funnel trapping.

3.3.3.1 Herpetofauna of Conservation Significance

No species found on the Site were of Conservation Significance based on the protected lists under State or Federal legislation or under the DEC's Priority list at the time of reporting.

3.3.3.2 Regionally Endemic Species

No regionally endemic herpetofauna species were recorded during the survey.

3.3.3.3 Taxonomic Certainty

The taxonomic status of all species recorded is considered to be relatively stable and the species generally accepted under the nomenclature listed in Doughty and Maryan 2010a for amphibians and Doughty and Maryan 2010b for reptiles.

Table 11: Avifauna Species Recorded at the Site

COMMON NAME	SCIENTIFIC NAME	CONS SIG	LOC1	LOC2	LOC3	LOC4	OPP. RECORD	TOTAL
Acanthizidae								
Western Gerygone	<i>Gerygone fusca</i>		1					1
Accipitridae								
Swamp Harrier	<i>Circus approximans</i>				1#			1
Artamidae								
Australian Magpie	<i>Cracticus tibicen</i>				2	1		3
Grey Currawong	<i>Strepera versicolor</i>		2		1			3
Cacatuidae								
Carnaby's Black Cockatoo	<i>Calyptorhynchus latirostris</i>	Yes	1 ^ *	1 ^				2
Galah	<i>Eolophus roseicapillus</i>		1 ^			2 ^		3
Campephagidae								
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>				1			1
Corvidae								
Australian Raven	<i>Corvus coronoides</i>		2	2		2		6
Meliphagidae								
Brown Honeyeater	<i>Lichmera indistincta</i>		5		3	4		12
New Holland Honeyeater	<i>Phylidonyris novaehollandiae</i>				3	4		7
Red Wattlebird	<i>Anthochaera carunculata</i>			3				3
Western Spinebill	<i>Acanthorhynchus superciliosus</i>		2					2
Pachycephalidae								
Grey Shrike-Thrush	<i>Colluricincla harmonica</i>				1			1
Rufous Whistler	<i>Pachycephala rufiventris</i>					2		2
Pardalotidae								
Striated Pardalote	<i>Pardalotus striatus</i>		1*		1*	1*		3
Petroicidae								
Scarlet Robin	<i>Petroica multicolor</i>		2			1		3
Psittacidae								
Australian Ringneck	<i>Barnardius zonarius</i>		1	2	2			5
Elegant Parrot	<i>Neophema elegans</i>				1			1
Red-capped Parrot	<i>Purpureicephalus spurius</i>				1	3		4
Rhipiduridae								

COMMON NAME	SCIENTIFIC NAME	CONS SIG	LOC1	LOC2	LOC3	LOC4	OPP. RECORD	TOTAL
Grey Fantail	<i>Rhipidura albiscapa</i>		1					1
Threskiornithidae								
Australian White Ibis	<i>Threskiornis molucca</i>		8 [^]	4 [^]	16 [^]	7 [^]		35
Straw-necked Ibis	<i>Threskiornis spinicollis</i>		4 [^]		7 [^]	6 [^]		17
Timaliidae								
Grey-breasted White-eye (Silvereye)	<i>Zosterops lateralis</i>		3					3
Total Individuals			34	12	40	33	0	119
Total Species								23

* Indicates that the species was heard but not sighted

Indicates that the species was observed briefly and therefore identification is tentative

^ Species observed overhead (not utilising Site)

Table 12: Mammal Species Recorded at the Site

COMMON NAME	SCIENTIFIC NAME	CONS SIG	LOC1	LOC2	LOC3	LOC4	OPP. RECORD	TOTAL
Canidae								
Red Fox	<i>Vulpes Vulpes</i>		1*			1*		2
Felidae								
Cat	<i>Felis catus</i>					1*		1
Leporidae								
Rabbit	<i>Onyctolagus cuniculus</i>					1*		1
Peramelidae								
Quenda	<i>Isoodon obesulus</i>	Yes	1*				2*	2
Total Individuals			2	0	0	3	0	6
Total Species								4

* Indicates that only evidence of the species was observed (scats, tracks, diggings)

Table 13: Reptile Species Recorded at the Site

COMMON NAME	SCIENTIFIC NAME	CONS SIG	LOC1	LOC2	LOC3	LOC4	OPP. RECORD	TOTAL
Scincidae								
Bobtail Lizard	<i>Tiliqua rugosa</i>					1		1
Total Individuals			0	0	0	1	0	1
Total Species								1

4 Conservation Significant Fauna Discussion

The desktop fauna list was used to determine specially protected fauna under State and/or Federal legislation that may occur within the Site (Table 9). A total of fourteen bird species, five native mammal species and one reptile species, listed under State and/or Federal legislation, are predicted to occur within the Site. No amphibians of Conservation Significance are predicted to occur within the Site. One insect species (the Graceful Sun Moth) of Conservation Significance was recorded in the wider area during the desktop survey.

4.1 Threatened Fauna Statutory Framework

Native fauna species that are rare, threatened with extinction, or have high conservation value are specially protected by law under the Federal *EPBC Act* or the State level *WC Act*. In addition, DEC may list other species that are considered to be of State level significance as Priority species, although this level of recognition is enforced under legislation (Appendix G).

4.1.1 Federal Legislation

Fauna species are protected at a Federal level under the *EPBC Act*. The *EPBC Act* was developed to provide for the protection of the environment, with specific regard to those aspects of the environment that are matters of national environmental significance (MNES). The *EPBC Act* promotes the conservation of biodiversity through ecologically sustainable development practices and the ecologically sustainable use of natural resources.

The *EPBC Act* includes provisions to protect native species (and in particular prevent the extinction and promote the recovery of threatened species) and to ensure the conservation of migratory species protected under international agreements (Japan-Australia Migratory Bird Agreement [JAMBA], China-Australia Migratory Bird Agreement [CAMBA], Republic of Korea-Australia Migratory Bird Agreement [RoKAMBA]).

The significance levels for fauna used in the *EPBC Act* are those recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN).

4.1.2 State Legislation

Western Australia's biodiversity is supported and protected by the following legislation:

- The *Conservation and Land Management Act 1984* (CALM Act);
- The *Environmental Protection Act 1986* (EP Act);

- The WC Act;
- The *Wildlife Conservation Regulations 1970*; and
- The *Wildlife Conservation (Specially Protected Fauna) Notice 2012*.

The *Wildlife Conservation (Specially Protected Fauna) Notice 2012* describes categories for fauna classified as Specially Protected in a series of Schedules. The DEC produces a supplementary list of Priority Fauna, being species that are not considered Threatened under the *WC Act* but for which the Department feels there is a cause for concern. These species have no special protection, but their presence would normally be considered as potentially significant and the species need further survey and evaluation of their conservation status before consideration can be given to declaration as Threatened Fauna. Levels of Priority are described in Appendix G.

4.1.3 International Agreements

The *EPBC Act* also includes management of migratory species that are recognised under international treaties such as the CAMBA, the JAMBA, RoKAMBA and *The Convention on the Conservation of Migratory Species of Wild Animals* (the Bonn Convention). Species included in these agreements are considered to be significant at the global level.

4.2 Threatened Fauna

4.2.1 Predicted Significant Fauna

An assessment was conducted to determine the likelihood of each of the predicted Conservation Significant species listed in Table 9 occurring within the Site. This involved determining background and habitat preference for each of the fauna species, along with the likelihood of each occurring within the Site (Table 14). Based on this information and the habitat preferences of each of the species it was determined that there was a total of six species of conservation significance that were predicted to potentially occur within the site. This included both Carnaby's Black Cockatoo and Forest Red-tailed Black Cockatoo, Quenda, Rainbow Bee-Eater and Lined Skink which were predicted as having a 'probable' possibility of occurring within the Site (Carnaby's Black Cockatoo and Quenda were recorded during the survey). The Chuditch was predicted as having a 'possible' occurrence within the Site.

Table 14: Likelihood of Predicted Conservation Significant Species Occurring in the Project Area

SPECIES	CONSERVATION STATUS	PREFERRED HABITAT	EXTENT OF HABITAT IN THE STUDY AREA AND REGION	EXPECTED LIKELIHOOD OF OCCURRENCE
Birds				
Australasian Bittern (<i>Botaurus poiciloptilus</i>)	IUCN: Endangered EPBC: Endangered WC: Schedule 1	In the southwest of Western Australia, the Bittern is found in beds of tall rush mixed with or near short fine sedge or open pools. It also occurs around swamps, lakes, pools, rivers and channels fringed with <i>lignum Muehlenbeckia</i> , <i>canegrass Eragrostis</i> or other dense vegetation and may be found in ricefields and swamps sustained by irrigation (Marchant & Higgins 1990).	There are no swamps or water bodies present within the Site.	Unlikely
Australian Painted Snipe (<i>Rostratula australis</i>)	IUCN: Endangered EPBC: Vulnerable WC: Schedule 3	Common in the south-west in swamps of the Swan Coastal Plain (Johnstone & Storr 1998). Inhabits shallow terrestrial freshwater wetlands (SEWPaC 2012b).	There are no swamps or water bodies present within the Site.	Unlikely
Carnaby's Black Cockatoo (<i>Calyptorhynchus latirostris</i>)	IUCN: Endangered EPBC: Endangered WC: Schedule 1	Forests, woodlands, heathlands, farms. It feeds on banksias, hakeas, dryandras (often on ground) and also exploits pine plantations (Morcombe 2003).	Banksia species are common throughout the Site. There is also the potential for breeding habitat with large Jarrah trees throughout the Site.	Probable, Confirmed during survey
Cattle Egret (<i>Ardea ibis</i>)	EPBC: Migratory Marine, Migratory Wetland WC: Schedule 3	Inhabits paddocks, pastures, croplands, wetlands, tidal mudflats and drains (Pizzev & Knight 1997). Occurs in tropical and temperate grasslands, woodlands and terrestrial wetlands (SEWPaC 2012b).	The Site does not contain any of the preferred habitats of the species, therefore it is unlikely the species will be present at the Site.	Unlikely
Common Sandpiper (<i>Actitis hypoleucos</i>)	IUCN: Least concern EPBC: Migratory Marine WC: Schedule 3	Utilises a range of coastal wetlands and some inland wetlands with varying levels of salinity, mostly around muddy margins or rocky shores and rarely on mudflats. Has been recorded in estuaries and deltas, on banks farther upstream; around lakes, pools, billabongs, reservoirs, dams and claypans. (Higgins & Davies 1996).	The Site does not contain any of the preferred habitats of the species, therefore it is unlikely the species will be present at the Site.	Unlikely
Fairy Tern (<i>Sterna nereis nereis</i>)	IUCN: Vulnerable EPBC: Vulnerable WC: Schedule 1	Nests on sheltered sandy beaches, spits and banks above the high tide line and below vegetation. The subspecies has been found in embayments of a variety of habitats including offshore,	There is no water bodies present within the Site.	Unlikely

SPECIES	CONSERVATION STATUS	PREFERRED HABITAT	EXTENT OF HABITAT IN THE STUDY AREA AND REGION	EXPECTED LIKELIHOOD OF OCCURRENCE
Forest Red-Tailed Black Cockatoo (<i>Calyptorhynchus banksii naso</i>)	EPBC: Vulnerable WC: Schedule 1	estuarine or lacustrine (lake) islands, wetlands and mainland coastline (Higgins & Davies 1996). Inhabits dense Jarrah, Karri and Marri forests which receive more than 600mm of annual rainfall (SEWPaC 2012b). It feeds on the seeds of Marri and Jarrah fruits (SEWPaC 2012b)	Jarrah is common throughout the Site. There is also the potential for breeding habitat with large Jarrah trees throughout the Site.	Probable
Fork-Tailed Swift (<i>Apus pacificus</i>)	IUCN: Least concern EPBC: Migratory Marine WC: Schedule 3	This species occurs over open country, from semi-deserts to coasts. It sometimes occurs over forests (Pizzey & Knight 1997). This species most commonly occurs over inland plains (SEWPaC 2012b).	This species may occur over the Site periodically. However, its biology indicates that it is unlikely to utilise the habitats present.	Unlikely
Glossy Ibis (<i>Plegadis falcinellus</i>)	IUCN: Least concern WC: Schedule 3	The species feeds in very shallow water and nests in freshwater or brackish wetlands with tall dense stands of emergent vegetation (e.g. reeds or rushes) and low trees or bushes (Marchant & Higgins 1990). It shows a preference for marshes at the edges of lakes and rivers, as well as lagoons, flood-plains, wet meadows, swamps sewage ponds, rice-fields and irrigated cultivation (Marchant & Higgins 1990).	There is no water body present within the Site, thus it is unlikely the species will be present at the Site.	Unlikely
Great Egret, White Egret (<i>Ardea alba</i>)	EPBC: Migratory Marine, Migratory Wetland WC: Schedule 3	Swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs (Pizzey and Knight 1997).	As the Site contains no wetlands it is unlikely that the species will be utilising the Site.	Unlikely
Malleefowl (<i>Leipoa ocellaa</i>)	IUCN: Vulnerable EPBC: Vulnerable, Migratory Terrestrial WC: Schedule 1	Malleefowl occur within mallee, Acacia, paperbark, sheoak, and other scrubs; eucalypt woodland; coastal heaths; mostly on sand or gravel soils with abundant litter and low scrub (Pizzey and Knight 1997; Morcombe 2003).	There are no generally accepted records of the species from the Swan Coastal Plain in the vicinity of the study area. Given current knowledge of its distribution it is highly unlikely to occur at the Site.	Unlikely

SPECIES	CONSERVATION STATUS	PREFERRED HABITAT	EXTENT OF HABITAT IN THE STUDY AREA AND REGION	EXPECTED LIKELIHOOD OF OCCURRENCE
Painted Snipe (<i>Rostratula benghalensis s. lat.</i>)	IUCN: Least concern EPBC: Vulnerable Migratory Wetland WC: Schedule 1	Marsh with moderate cover (Simpson & Day 1996). This species inhabits shallow terrestrial freshwater wetlands (SEWPac 2012b).	As the Site contains no wetlands it is unlikely that the species will be utilising the Site.	Unlikely
Rainbow Bee-Eater (<i>Merops ornatus</i>)	IUCN: Least concern EPBC: Migratory Terrestrial WC: Schedule 3	Occurs in open forests and woodlands, shrublands, sandridges, sandspits, riverbanks, mangroves and in various cleared or semi-cleared habitats, including farmland and areas of human habitation (Higgins 1999).	The study area comprised sand-based habitats. It is probable that that the species will occur in the area periodically, and possible that the area may be used for nesting.	Probable
White-bellied Sea-Eagle (<i>Haliaeetus leucogaster</i>)	IUCN: Least concern EPBC: Migratory Terrestrial WC: Schedule 3	This species occurs mainly around coasts, islands, estuaries, inlets, large rivers, inland lakes and reservoirs (Pizzey and Knight 1997). This species is also found around terrestrial wetlands in tropical and temperate regions (SWEPA 2012b).	Given the distance of the Site from the coast, it is possible that transient individuals will occur over it periodically. However, the species is not expected to utilise the available habitats.	Unlikely
Mammals				
Chuditch (<i>Dasyurus geoffroi</i>)	IUCN: Near Threatened EPBC: Vulnerable WC: Schedule 1	This species is able to exist in a variety of environments from denser eucalypt forests and open woodlands to sparser, semi-arid and low-lying scrub (Van Dyck & Strahan 2008). The only remaining habitat suitable for supporting Chuditch numbers is through the cooler south-west corner of the state, in areas with significant concentrations of prey and sufficient logs and hollows for nests (Van Dyck & Strahan 2008).	The Site contains the species preferred habitat and during pre-European settlement the species would likely have occurred at the Site. The lack of contiguous habitat is likely to make it difficult for the species to persist or to re-establish at the Site. However, the species has been recorded in the vicinity in the past 15 years, and there is a possibility that individuals may occur at the Site periodically.	Possible
Quenda (<i>Isodon obesulus subsp. Fusciventer</i>)	IUCN: Least concern DEC: Priority 5	This species inhabits heathy forest, heath, and coastal scrub (Menkhorst & Knight 2004). The southern brown bandicoot often feeds in forest and woodland that is burnt on a regular basis and also in areas of pasture and cropland adjacent to dense cover.	The Quenda still inhabits remnant vegetation across Perth's suburbs. While the Site does not incorporate preferred habitat due to the relatively open understorey, animals may be resident at the adjacent Spectacles Swamps and may	Probable, confirmed during survey

SPECIES	CONSERVATION STATUS	PREFERRED HABITAT	EXTENT OF HABITAT IN THE STUDY AREA AND REGION	EXPECTED LIKELIHOOD OF OCCURRENCE
Quokka (<i>Setonix brachyurus</i>)	IUCN: Vulnerable EPBC: Vulnerable WC: Schedule 1	This species requires wet ground cover in forest or swampy flats (Menkhorst & Knight 2004). The Quokka is also found in heaths and shrublands (SEWPaC 2012b).	Therefore utilise the Site for foraging. Therefore there is a possibility the species is present at the Site. The Site does not contain the preferred habitat for the species. In addition the lack of contiguous habitat at the Site is likely to inhibit the species survival at the Site. Therefore it is unlikely the species will be present at the Site.	Unlikely
Red-Tailed Phascogale (<i>Phascogale calura</i>)	IUCN: Near Threatened EPBC: Endangered WC: Schedule 1	This species is found in woodland habitats in south and central Australia. It is restricted to areas containing mature wandoo or rock oak woodland (Menkhorst & Knight 2004). This species requires hollow-containing eucalyptus trees for breeding (SEWPaC 2012b).	The Site does not contain the species preferred habitat. In addition the Site is well outside the species known distribution. Therefore it is unlikely the species will be present at the Site.	Unlikely
Western Brush Wallaby (<i>Macropus irma</i>)	IUCN: Least concern DEC: Priority 4	This species inhabits dry sclerophyll forest and woodland in the south-west of Western Australia, including some mallee areas (Menkhorst & Knight 2004). The preferred habitat type for this species is open forest or woodland.	The Site contains preferred habitat of the species. However due to the nature of the site (small Site enclosed by residential housing and roads) it is unlikely the species will be present at the Site.	Unlikely
Reptiles				
Lined Skink (<i>Lerista lineata</i>)	DEC: Priority 3	This species is found on the lower west coast of Western Australia. It inhabits areas containing white sands Storr et al. 1999). Its preferred habitat is sandy coastal heath and shrubland (Wilson & Swan 2003).	The Site does contain sandy shrublands and it is possible that the species may occur there.	Possible
Insects				
Graceful Sun Moth (<i>Synemon gratioosa</i>)	EPBC: Endangered WC: Schedule 1	The graceful sun moth is found in coastal heathland and <i>Banksia</i> woodland. This species is dependent on its host plants, <i>Lomandra hermaphrodita</i> and <i>Lomandra maritima</i> for survival (SEWPaC 2012b).	<i>Lomandra</i> species were not recorded within the site during the 2009 Flora and Vegetation Survey. Therefore it is unlikely the species will be present at the site without its preferred habitat species.	Unlikely

4.2.2 Impacts to Threatened Fauna

4.2.2.1 Carnaby's Cockatoo and Forest Red-tailed Black Cockatoo

A total of 37 significant Jarrah trees (DBH > 500 mm) have been recorded at the Train Station Precinct Site (Figure 5). Under DSEWPaC (2012) Guidelines, these are considered to provide potential breeding and foraging habitat for both of these Black Cockatoo Species. Additionally, Carnaby's Cockatoo was recorded during the survey, and foraging evidence has previously been recorded at the Site (Figure 6). On this basis, it is probable that at least one of the Black Cockatoo species will utilise the area. Consequently, DSEWPaC is likely to consider the action as significantly impacting Black Cockatoo species and the development should therefore be referred to for assessment.

4.2.2.2 Rainbow Bee-eater

Habitat for the Rainbow Bee-eater is found throughout much of Western Australia, with sandy habitats being used for the construction of nesting burrows (Johnstone and Storr 1998). Impacts to the species habitat are to be expected due to development of the Kwinana train Station Precinct Site. However, the cosmopolitan distribution of the species and its breeding habitat throughout Western Australia indicates that such impacts will not significantly affect the species conservation status.

4.2.2.3 Chuditch

NatureMap indicates that two recent Chuditch records have been documented for the Swan Coastal Plain south of Perth. The first in 2010 was at Keralup, approximately 22 km south of the Site, and the second in May 2012 was from Paganoni Swamp. These records suggest that Chuditch have the potential to utilise the habitat surrounding the Kwinana Train Station Precinct. However, it should be noted that both of the above-mentioned records were of juvenile males which were likely to be following the breeding season. The nature of these records, in conjunction with the small size of the Kwinana train Station Precinct Site, this indicates that any impacts associated with the development are unlikely to be significant.

4.2.2.4 Quenda

Quenda remain relatively widely distributed through the southwest of Western Australia and are known to persist in pockets of the Perth metropolitan area. It is likely that individuals will forage at the Site periodically. However, their preferred habitat comprises dense undergrowth, typically in swampy to riparian areas and they are prone to predation in open habitats (Van Dyck and Strahan 2008). On this basis, development of the Kwinana Train Station Site is unlikely to impact the species core habitat, and is not expected to significantly impact the species conservation status.

4.2.2.5 Lined Skink

Favouring sandy soils on linear dune systems, this species has been recorded from locations from Bunbury in the South to the Peron Peninsula in the north, with a concentration of records on the Swan Coastal Plain around Perth (How and Dell 1994; 2000). The Priority 3 listing recognizes the wide distribution the species and its preferred habitat. It is therefore considered unlikely that the small scale of the Kwinana Train Station Precinct development will result in significant impacts to the species conservation status.

4.2.3 Recorded Significant Fauna

Of the 21 fauna species of conservation significance that may be expected to occur within the site on the basis of DEC, EPBC and other database searches only four were predicted to have a 'probable' likelihood of occurring at the site and another species with a 'possible' likelihood of occurring within the Site. Of conservation significant species predicted to potentially occur within the Site two were recorded during the survey. This included the Carnaby's Black Cockatoo and Quenda.

Feeding evidence and sightings of Carnaby's Black Cockatoo (Listed as Endangered/Schedule 1) were made at the Site. Carnaby's Black Cockatoo sightings were made during the Level 1 Vertebrate Fauna Survey and during a specific Black Cockatoo Survey. Detailed findings of the Black Cockatoo Survey are presented within the Black Cockatoo Report for the Site (360 Environmental 2012a).

Evidence of Quenda (Listed as Priority 5 by the DEC) being present at the Site was observed through diggings and tracks at set locations throughout the Site. Diggings can be similar to rabbit and therefore their presence based on this cannot always be confirmed. However their tracks are very distinctive and when present in good substrate are unmistakable for any other species.

There was no evidence of the Forest Red-tailed Black Cockatoo being present on Site at the time of the survey (predicted as 'probable' to occur within the Site). The species preference for the Site may be low due to the lack of their preferred foraging species such as Marri.

There was no evidence of the Rainbow Bee-eater being present on Site at the time of the survey (predicted as 'probable' to occur within the Site).

4.2.4 Migratory Species

The Cattle Egret (*Ardea ibis*), Common Sandpiper (*Actitis hypoleucos*), Fork-tailed Swift (*Apus pacificus*), the Great Egret (*Ardea alba*), Painted Snipe (*Rostratula benghalensis*), the Rainbow Bee-eater (*Merops ornatus*) and White-bellied Sea-eagle (*Haliaeetus leucogaster*) are listed as Migratory species under the EPBC Act. The EPBC Database search suggested that these species or their habitat are potentially present at the Site,

however inspection of the Site during the reconnaissance survey suggested there was a lack of preferred habitat making their presence at the site unlikely).

The Cattle Egret inhabits moist pastures with tall grass; shallow open wetlands and margins, mudflats (Morcombe 2003).

The Common Sandpiper utilises a wide range of coastal wetlands and some inland wetlands, with varying levels of salinity, and is mostly found around muddy margins or rocky shores and rarely on mudflats. It is often associated with mangroves, and sometimes found in areas of mud littered with rocks or snags (Higgins & Davies 1996).

The Fork-tailed Swift is found over open country, from semi desert to coasts, islands, occasionally over forests and cities (Pizzey and Knight 1997).

The Great Egret has been recorded in a wide range of wetland habitats. These include swamps and marshes; margins of rivers and lakes; damp or flooded grasslands, pastures or agricultural lands; reservoirs; sewage treatment ponds; drainage channels; salt pans and salt lakes; salt marshes; estuarine mudflats, tidal streams; mangrove swamps; coastal lagoons; and offshore reefs (Pizzey and Knight 1997).

The Painted Snipe inhabits marshes with moderate cover (Simpson & Day 1996) and shallow terrestrial freshwater wetlands (DSEWPaC 2012b).

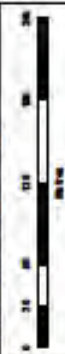
The Rainbow Bee-eater has been recorded in open woodlands with sandy loamy soil; sand ridges, sandpits, riverbanks, road cuttings, beaches dunes, cliffs mangroves, rainforests, woodlands and golf courses (Pizzey and Knight 1997).

White-bellied Sea Eagle usually occurs within coastal areas, over islands, reefs, headlands, beaches, bays, estuaries, mangroves, seasonally flooded inland swamps, lagoons and floodplains. It is often found far inland on large pools of major rivers (Morcombe 2003).

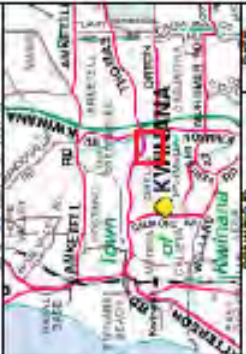
Based on these species' widespread distributions and aerial behaviour over a wide variety of habitats, there is potential for these species to be recorded within the Project area. Conversely, as a result of their wide distribution and indifference to a wide variety of habitats it is considered that clearing on the Site is unlikely to have a significant impact on the species. The proposed area to be cleared is small and therefore is unlikely to impact the conservation status of these migratory species.

- Legend**
- Train Station Sites
 - Major Roads
 - Minor Roads
 - Species
 - Jambh
- Trunk Diameter (mm)**
- 400 - 500
 - 500 - 800
 - 800 - 1200
 - >1200

HOW THE FOREST REGENERATION AND MANAGEMENT
 - FROM PHOTOGRAPHY TO FIELD AND REMOTE SENSING
 - LOCALITY MAPS FOR THE PROJECT



LOCALITY MAP

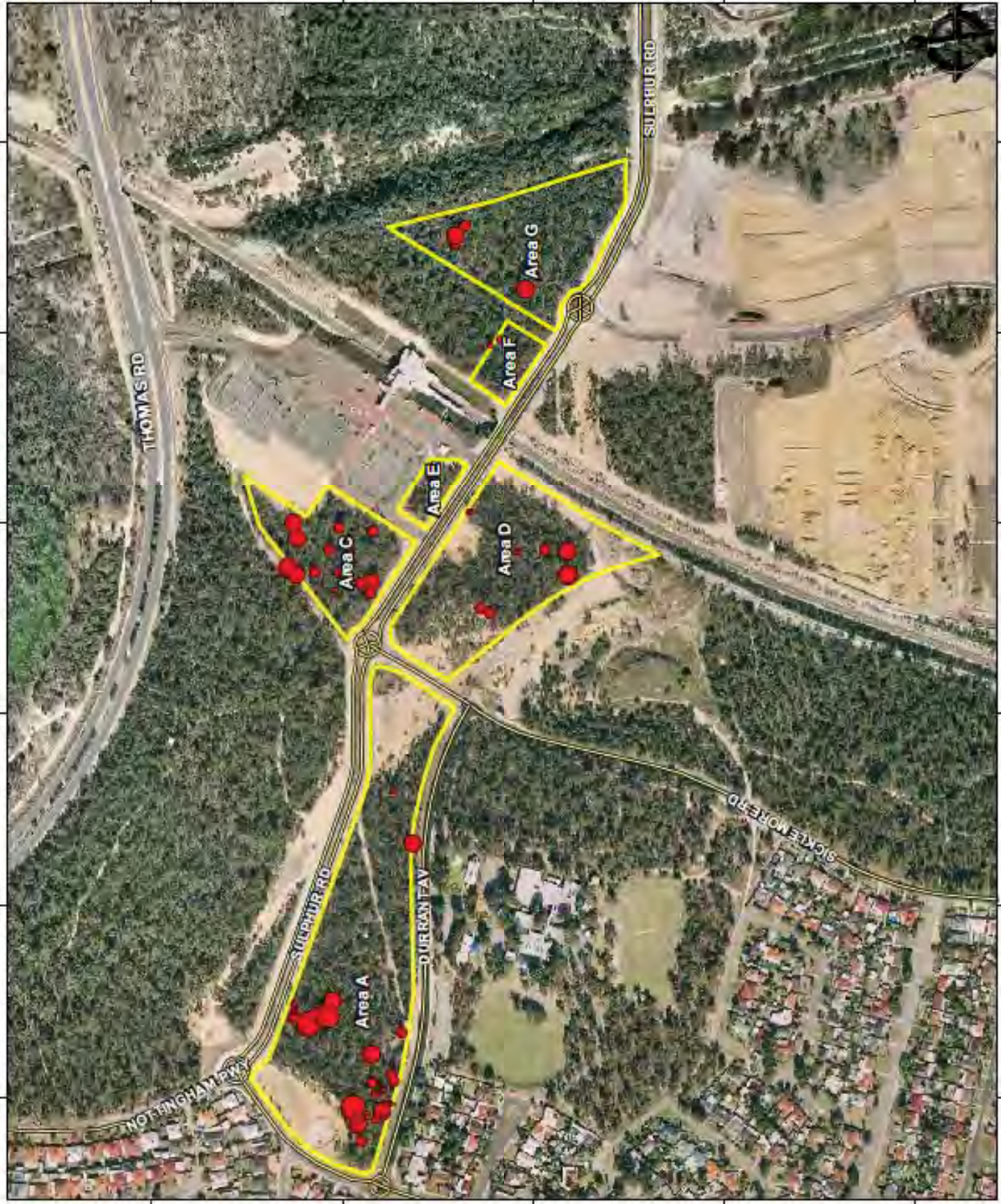


DATE	10/09/2012
PROJECT	HORIZONTAL CONTROL AND PROJECTION
CLIENT	GDK 104 MGA Zone 50
CREATED	JJ
CHECKED	AH
APPROVED	RD
REVISION	0

Satterley Property Group
 Kwinana Train Station Precinct
 Level 1 Fauna Survey
 Previous Significant Tree Survey



Figure 5



Legend

- Train Station Sites
- Major Roads
- Minor Roads
- Nesting Hollows
- Possible Cockatoo Nesting Hollow
- Hollow Unsuitable for Cockatoos
- Carmaby's Black Cockatoo
- Calling Location
- Feeding Location

NOTE: THIS POSITION INFORMATION IS IN NEW ZEALAND'S NZ MAP COORDINATE SYSTEM (NZMS2001) LOCALITY MAP COORDINATE SYSTEM (NZMS2001)

LOCALITY MAP COORDINATE SYSTEM (NZMS2001)

DATE: 12/01/2012
DRAWING NO: 053 197-3.00

HORIZONTAL DATUM: NZMS2001 PROJECTIONS: UTM 18M NZMS2001

CREATED	CHECKED	APPROVED	REVISION
JJ	AH	PD	0

Saiterley Property Group
Kwinana Train Station Precinct
Level 1 Fauna Survey
Previous Black Cockatoo Survey

360
ENVIRONMENTAL CONSULTANTS



Figure 6

5 Conclusion and Recommendations

5.1 Fauna Assemblage Discussion

Generally, the fauna habitat at the Site is in good condition and provides significant fauna value with large older growth habitat trees such as Jarrah, Banksia and Sheoak being present throughout. The Site contained one major broad fauna habitat type composed of Jarrah-Banksia Woodland. Levels of annual weeds within the Site were generally low and an intact understorey of native species was present throughout further increasing the value of the Site to fauna species. However, isolated disturbances were present throughout the Site. This includes clearing of areas of vegetation and weed invasion within some areas. The isolated and fragmented nature of the Site does limit some of the fauna value, with all areas being surrounded to some extent by roads and rail. This has a particular impact on ground dwelling species such as mammals and reptiles, as it is difficult for some species to persist within a Site of this size and furthermore it makes it difficult for new migrants to move into the area.

The fauna and fauna assemblage recorded at the Site was expected and generally representative for the area. No unexpected species were recorded. The current species list for this Site is not exhaustive and there are likely to be many more species present at the Site, particularly reptiles and bats. However a much higher survey intensity involving trapping techniques would need to be implemented at the Site to record many of these species. However it is felt that the current level of survey is suitable for the proposed action and provides sufficient information regarding the fauna assemblage present within the Site.

5.2 Significant Fauna Discussion

Database searches for the Site revealed that a total of 21 species of Conservation Significance are predicted to occur within the Site. This was composed of 14 bird species, five native mammal species and one reptile species, listed under State and/or Federal legislation. No amphibians of Conservation Significance are predicted to occur within the area. One insect species of Conservation Significance, the Graceful Sun Moth, was predicted to occur within the Site.

The expected likelihood of each of these predicted Threatened species being present within the Site was determined based on the fauna habitat present within the Site. This analysis revealed that there is a possibility that four of these Threatened species may occur within the Site. This included Carnaby's Black Cockatoo, Forest Red-tail Black Cockatoo, Rainbow Bee-Eater, Chuditch, Quenda and Lined Skink. A reconnaissance Site visit confirmed the presence of Carnaby's Black Cockatoo and Quenda. The Carnaby's Black Cockatoo is of high Conservation Significance being listed as Endangered under Federal legislation and Schedule 1 at a State level. Therefore significant effort should be implemented to avoid, minimise or mitigate the habitat

clearing at the Site, particularly of the large habitat trees considered significant for the Black Cockatoo species. If significant impacts remain after avoidance, minimisation and mitigation then offsets should be considered.

The Quenda presence at the site was confirmed during the reconnaissance survey through the observation of diggings and prints throughout the Site. As the Quenda is listed as Priority 5 it is only of conservation concern at a State level; it is not listed as protected under Federal legislation. That being said considerations should be made to mitigate any impact to the species. It is recommended trapping be undertaken to remove any Quenda utilising the Site prior to habitat clearing. Any removed Quenda can potentially be released into the adjoining Spectacles Wetlands (consultation with DEC and the council will be required).

Efforts should be made by the proponent to avoid, mitigate or minimise the impacts to Fauna Habitat within the Site, particularly of habitat utilised by the Carnaby's Black Cockatoo. This includes the large Jarrah trees present on Site that may provide Black Cockatoo breeding habitat in the future and the Banksia Habitat throughout the Site that currently provides foraging habitat. In regards to Quenda potential mitigation methods include the removal of any animals present on the Site prior to impacting particular areas or progressive clearing of habitat to allow the species time to move out of the area. If it is not possible to mitigate or minimise the impacts then offset strategies may be put in place to account for the potential impact to the species.

5.3 Recommendations

In summary, the recommendations arising from this fauna survey at the Kwinana Train Station Precinct include:

- Minimise the clearing of remnant native vegetation wherever possible. For example, previously disturbed areas should be used in preference to clearing remnant vegetation wherever possible;
- It is recommended that a fauna removal specialist be engaged to trap Quenda at the site to relocate any individuals within the Site immediately prior to vegetation clearing. Trapping at the Site and translocation of animals will require approval from the Department of Environment and Conservation (DEC). Prior to the translocation taking place it will also be necessary to liaise with the local council to determine an appropriate location for the animals to be released. The Spectacles Wetlands would appear to be an appropriate location;
- Implementation of a Flora and Fauna Management Plan, including staged habitat clearing to allow for fauna dispersal away from the Site, for the duration of the clearing and construction period;
- Retention of hollow-bearing trees where possible. These trees may be suitable for breeding of bird species and may become suitable for Black Cockatoo species over time (as the trees grow and the hollows increase in size). If clearing

of trees with hollows is unavoidable, it is recommended that clearing is undertaken outside of breeding season for significant species or that hollows are inspected prior to clearing to ensure that they are unoccupied or not in use;

- Following the implementation of measures to avoid, minimise and otherwise mitigate impacts, environmental offset of residual impacts of habitat clearing will be required if there is a significant residual impact to conservation significant species. Offsets might include the purchase of land containing appropriate habitat (including suitable Black Cockatoo habitat), or reinstatement of habitat elsewhere; and
- It is suggested that no further fauna survey work will be required at the Site (with the exception of Quenda trapping and relocation and potentially hollow inspections if clearing must be conducted during breeding season). A Level 1 Vertebrate Fauna Survey and Black Cockatoo Survey should be sufficient for the Site.

6 References

- 360 Environmental 2009. Bertram Station Precinct. Level 2 Flora and Vegetation Survey.
- 360 Environmental 2012a. Kwinana Train Station Precinct. Black Cockatoo Survey.
- 360 Environmental 2012b. Kwinana Town Centre. Level 1 Vertebrate Fauna Survey
- Bennett Environmental Consulting Pty Ltd 2004. Flora Assessment of Proposed Perth Seawater Desalination Plant Kwinana.
- Bureau of Meteorology 2012. Climate Data Online. Accessed 2 October 2012, <http://www.bom.gov.au/climate/data/>
- Cardno 2011. Wellard East – Local Structure Plan. Prepared for Armana Holdings.
- Christidis and Boles 2008. Checklist of Bird species.
- Department of Water 2012a. Hydrogeological Atlas. Available from: <http://www.water.wa.gov.au/idelve/hydroatlas/loiQuery.jsp?ts=1330504521115&d=hydroatlas&bb=115.8079555441048,-32.2578048,115.8227261558952,-32.2462802&k=NONE&w=587&h=458&z=8388.298375546936&x=115.81452305633188&y=-32.25123728777293&i=261&j=197> Accessed 14 August 2012
- Department of Water 2012b. Perth Groundwater Atlas Available from: <http://www.water.wa.gov.au/idelve/gwa/> Accessed 15 August 2012
- Doughty, P. and Maryan, B. 2010a. Checklist of the Amphibians of Western Australia. Department of Terrestrial Zoology, Western Australian Museum, Welshpool, Western Australia.
- Doughty, P. and Maryan, B. 2010b. Checklist of the Reptiles of Western Australia. Department of Terrestrial Zoology, Western Australian Museum, Welshpool, Western Australia.
- Environmental Protection Authority 2002. Terrestrial Biological Surveys as an Element of Biodiversity Protection. Government of Western Australia
- Environmental Protection Authority 2004. Guidance for the Assessment of Environmental Factors No 56, Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia. Government of Western Australia
- Environmental Protection Authority 2010. Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment. Government of Western Australia
- GHD 2007. Department for Planning & Infrastructure. Report for Kwinana Intermodal Terminal.

- Government of Western Australia 2012. Wildlife Conservation (Specially Protected Fauna) Notice 2012, in Government Gazette, WA, available online at: <http://www.dec.wa.gov.au/content/view/852/2010/> accessed 15 August 2012
- Harewood, G 2008. Fauna Survey. East Rockingham WWTP Site & Pipeline Corridor
- Higgins, P.J. (ed.) 1999. Handbook of Australian, New Zealand and Antarctic Birds. Volume Four - Parrots to Dollarbird. Melbourne: Oxford University Press.
- Higgins, P.J. & S.J.J.F. Davies, eds (1996). Handbook of Australian, New Zealand and Antarctic Birds. Volume Three - Snipe to Pigeons. Melbourne, Victoria: Oxford University Press.
- How, R. A., Maryan, B. and Stevenson, C. A. 2009. An Assessment of Herpetofauna on Near-Coastal Landforms between Dawesville and Binningup, Southern Swan Coastal Plain. Prepared for Department of Environment and Conservation. Welshpool, Western Australia.
- Johnstone R E & Storr G M 1998, Handbook of Western Australian Birds, Volume 1 Non-Passerines, WA Museum, Perth.
- Marchant, S. & P.J. Higgins, eds. (1990). Handbook of Australian, New Zealand and Antarctic Birds. Volume One - Ratites to Ducks. Melbourne, Victoria: Oxford University Press.
- Menkhorst P and Knight F 2004. A Field Guide to the Mammals of Australia. Second Edition. Oxford University Press, United Kingdom.
- Morcombe 2003. Field guide to Australian birds, Second edition. Steve Parish Publishing.
- Pizzey, G and Knight, F 1997. The Field Guide to the Birds of Australia, Angus and Robertson, NSW.
- SEWPaC (Department of Sustainability, Environment, Water, Population and Communities) 2012a. EPBC Act Protected Matters Report.
- SEWPaC (Department of Sustainability, Environment, Water, Population and Communities) (2012b). Species Profile and Threats Database (SPRAT) <http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl>. Accessed 19 March 2012
- Simpson K and Day, N (1996). The Claremont Field Guide to the Birds of Australia, Penguin Books Australia Ltd, Castle Hill.
- Storr, GM, Smith, LA and Johnstone, RE 1999 Lizards of Western Australia I: Skinks. The West Australian Museum, Perth.
- Town of Kwinana 2003. Town of Kwinana Rural Strategy. Available online at: <http://www.kwinana.wa.gov.au/Documents/Your-Property/Planning/Appendix-3-Rural-Strategy-Part-1-Chapter-1-Physica.aspx> Accessed 15 August 2012.

Van Dyke, S and R. Strahan (eds) (2008). The Mammals of Australia, Third Edition. Reed New Holland, NSW.

Wilson, S and Swan, G (2003). A Complete Guide to Reptiles of Australia. Reed New Holland, NSW.

7 Report Limitations

This report is produced strictly in accordance with the scope of services set out in the contract or otherwise agreed in accordance with the contract. 360 Environmental makes no representations or warranties in relation to the nature and quality of environmental aspects discussed in this report other than the visual observation and analytical data in this report.

In the preparation of this report, 360 Environmental has relied upon documents, information, data and analyses (“client’s information”) provided by the client and other individuals and entities. In most cases where client’s information has been relied upon, such reliance has been indicated in this report. Unless expressly set out in this report, 360 Environmental has not verified that the client’s information is accurate, exhaustive or current and the validity and accuracy of any aspect of the report including, or based upon, any part of the client’s information is contingent upon the accuracy, exhaustiveness and currency of the client’s information. 360 Environmental shall not be liable to the client or any other person in connection with any invalid or inaccurate aspect of this report where that invalidity or inaccuracy arose because the client’s information was not accurate, exhaustive and current or arose because of any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to 360 Environmental.

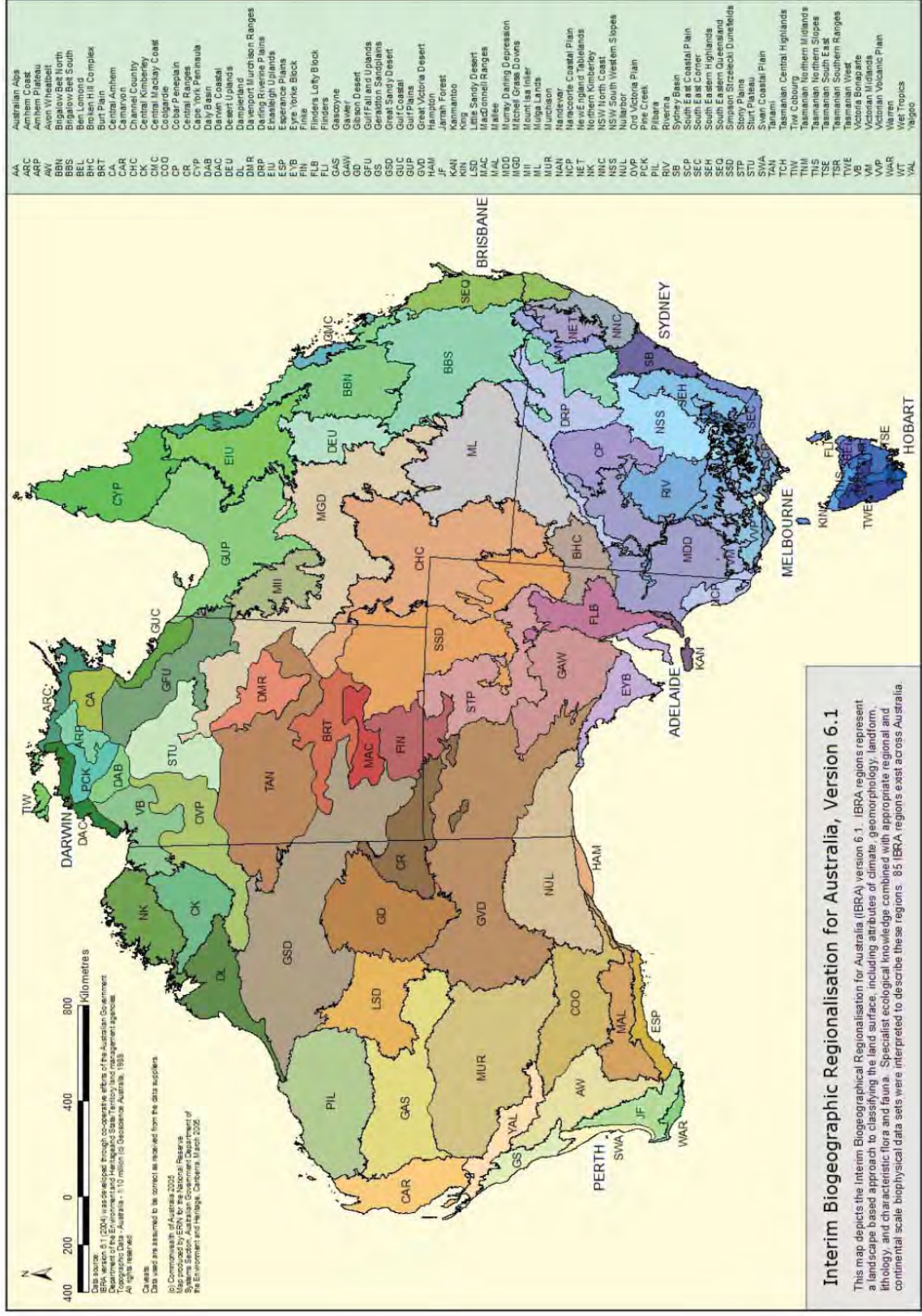
Aspects of this report, including the opinions, conclusions and recommendations it contains, are based on the results of the investigation, sampling and testing set out in the contract and otherwise in accordance with normal practices and standards. The investigation, sampling and testing are designed to produce results that represent a reasonable interpretation of the general conditions of the site that is the subject of this report. However, due to the characteristics of the site, including natural variations in site conditions, the results of the investigation, sampling and testing may not accurately represent the actual state of the whole site at all points.

It is important to recognise that site conditions, including the extent and concentration of contaminants, can change with time. This is particularly relevant if this report, including the data, opinions, conclusions and recommendations it contains, are to be used a considerable time after it was prepared. In these circumstances, further investigation of the site may be necessary.

Subject to the terms of the contract between the Client and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating parts of this report is prohibited (except to the extent required by law) unless the report is produced in its entirety including this page, without the prior written consent of 360 Environmental Pty Ltd.

APPENDIX A: IBRA MAP

Figure 7: IBRA Bioregions



APPENDIX B: SAMPLING LOCATION PLATES

Plate 1: Sampling Location 1

North



West



East

South



Plate 2: Sampling Location 2

North



West



East



South

Plate 3: Sampling Location 3

North



West



East



South



Plate 4: Sampling Location 4

North



South



West



East

APPENDIX C: EPBC SEARCH



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 about the EPBC Act including significance guidelines, forms and application process details can be found at <http://www.environment.gov.au/epbc/assessmentsapprovals/index.html>

Report created: 14/08/12 17:50:07

[Summary](#)

[Details](#)

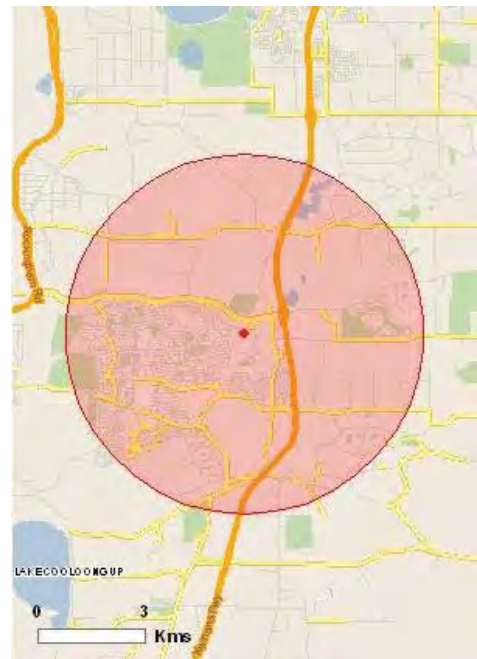
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

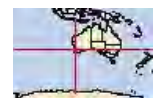
[Caveat](#)

[Acknowledgements](#)



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

[Coordinates](#)
 Buffer: 5.0Km



Summary

Matters of National Environment 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 - see <http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html>

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International	3
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	None
Threatened Species:	19
Migratory Species:	9

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. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage/index.html>

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. Information on EPBC Act permit requirements and application forms can be found at <http://www.environment.gov>.

Commonwealth Lands:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	7
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

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

Place on the RNE:	6
State and Territory Reserves:	2
Regional Forest Agreements:	None
Invasive Species:	16
Nationally Important Wetlands:	1

Details

Matters of National Environmental Significance

Wetlands of International Significance (RAMSAR)		[Resource Information]
Name		Proximity
Becher point wetlands		Upstream from Ramsar
Forrestdale & thomsons lakes		Within 10km of Ramsar
Peel-yalgorup system		Upstream from Ramsar
Threatened Species		[Resource Information]
Name	Status	Type of Presence
BIRDS		

Name	Status	Type of Presence
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo [67034]	Vulnerable	Species or species habitat may occur within area
Calyptorhynchus latirostris Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Vulnerable	Species or species habitat may occur within area
Sternula nereis nereis Fairy Tern (Australian) [82950]	Vulnerable	Species or species habitat may occur within area
INSECTS		
Synemon gratiosa Graceful Sun Moth [66757]	Endangered	Species or species habitat may occur within area
MAMMALS		
Dasyurus geoffroi Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Phascogale calura Red-tailed Phascogale [316]	Endangered	Species or species habitat may 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
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
Darwinia foetida Muceha Bell [83190]	Critically Endangered	Species or species habitat likely to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area
Drakaea elastica Glossy-leaved Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat likely to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat likely to occur within area
Eucalyptus balanites Cadda Road Mallee, Cadda Mallee [24264]	Endangered	Species or species

Name	Status	Type of Presence
Lepidosperma rostratum		habitat likely to occur within area
Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area

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 may occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area

Migratory Terrestrial Species

Haliaeetus leucogaster		
White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Leipoa ocellata		
Malleefowl [934]	Vulnerable	Species or species habitat may occur 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 may occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato)		
Painted Snipe [889]	Vulnerable*	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [[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 may occur within area

Name	Threatened	Type of Presence
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Vulnerable*	Species or species habitat may occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area

Extra Information

Places on the RNE [\[Resource Information \]](#)

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Bollard Bulrush Swamp	WA	Indicative Place
Leda Area	WA	Indicative Place
Beeliar Regional Park and Adjacent Areas	WA	Interim List
Wandi Nature Reserve	WA	Registered
Historic		
Woodlands Cottage and Reserve 25132	WA	Indicative Place
Smirks Cottage	WA	Registered

State and Territory Reserves [\[Resource Information \]](#)

Name	State
Leda	WA
Wandi	WA

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 Resources Audit,

Name	Status	Type of Presence
Mammals		
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur

Name	Status	Type of Presence within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat may occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area

Nationally Important Wetlands		[Resource Information]
Name		State
Spectacles Swamp		WA

Coordinates

-32.23612 115.84042

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

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

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](#)
- 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.

[© Commonwealth of Australia](#)

Department of Sustainability, Environment, Water, Population and Communities

GPO Box 787

Canberra ACT 2601 Australia

+61 2 6274 1111

APPENDIX D: NATUREMAP SEARCH

NatureMap Species Report

Created By Guest user on 14/08/2012

Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 115°50' 38" E,32°14' 11" S
Buffer 5km

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
1.	3374 <i>Acacia huegelii</i>			
2.	3557 <i>Acacia stenoptera</i> (Narrow Winged Wattle)			
3.	24260 <i>Acanthiza apicalis</i> (Broad-tailed Thornbill)			
4.	24261 <i>Acanthiza chrysorrhoa</i> (Yellow-rumped Thornbill)			
5.	24262 <i>Acanthiza inornata</i> (Western Thornbill)			
6.	24560 <i>Acanthorhynchus superciliosus</i> (Western Spinebill)			
7.	25535 <i>Accipiter cirrocephalus</i> (Collared Sparrowhawk)			
8.	24281 <i>Accipiter cirrocephalus</i> subsp. <i>cirrocephalus</i>			
9.	25536 <i>Accipiter fasciatus</i> (Brown Goshawk)			
10.	25011 <i>Acritoscincus trilineatum</i>			
11.	25755 <i>Acrocephalus australis</i> (Australian Reed Warbler)			
12.	6203 <i>Actinotus glomeratus</i>			
13.	41323 <i>Actitis hypoleucos</i> (Common Sandpiper)		IA	
14.	1791 <i>Adenanthos obovatus</i> (Basket Flower)			
15.	184 <i>Aira caryophyllea</i> (Silvery Hairgrass)	Y		
16.	1728 <i>Allocasuarina fraseriana</i> (Sheoak)			
17.	20184 <i>Amphipogon laguroides</i> subsp. <i>laguroides</i>			
18.	24312 <i>Anas gracilis</i> (Grey Teal)			
19.	24315 <i>Anas rhynchotis</i> (Australasian Shoveler)			
20.	24316 <i>Anas superciliosa</i> (Pacific Black Duck)			
21.	11434 <i>Anigozanthos humilis</i> subsp. <i>humilis</i>			
22.	11261 <i>Anigozanthos manglesii</i> subsp. <i>manglesii</i>			
23.	24561 <i>Anthochaera carunculata</i> (Red Wattlebird)			
24.	24562 <i>Anthochaera lunulata</i> (Western Little Wattlebird)			
25.	3686 <i>Aotus cordifolia</i>			
26.	1117 <i>Aphelia cyperoides</i>			
27.	141 <i>Aponogeton hexatepalus</i> (Stalked Water Ribbons)		P4	
28.	24286 <i>Aquila morphnoides</i> subsp. <i>morphnoides</i>			
29.	38964 <i>Arcyria cinerea</i>			
30.	38967 <i>Arcyria incarnata</i>			
31.	25566 <i>Artamus cinereus</i> (Black-faced Woodswallow)			
32.	24353 <i>Artamus cyanopterus</i> (Dusky Woodswallow)			
33.	20350 <i>Astartea affinis</i>			
34.	20283 <i>Astartea scoparia</i>			
35.	6334 <i>Astroloma pallidum</i> (Kick Bush)			
36.	17234 <i>Austrostipa compressa</i>			
37.	37421 <i>Austrostipa</i> sp. <i>Marchagee</i> (B.R. Maslin 1407)			
38.	234 <i>Avena fatua</i> (Wild Oat)	Y		
39.	24318 <i>Aythya australis</i> (Hardhead)			
40.	38979 <i>Badhamia utricularis</i>			
41.	1800 <i>Banksia attenuata</i> (Slender Banksia)			
42.	1822 <i>Banksia ilicifolia</i> (Holly-leaved Banksia)			
43.	1834 <i>Banksia menziesii</i> (Firewood Banksia)			
44.	5382 <i>Beaufortia elegans</i>			
45.	24319 <i>Biziura lobata</i> (Musk Duck)			
46.	16636 <i>Boronia crenulata</i> subsp. <i>viminea</i>			
47.	4417 <i>Boronia dichotoma</i>			
48.	16633 <i>Boronia juncea</i> subsp. <i>juncea</i>		P1	
49.	11381 <i>Boronia ramosa</i> subsp. <i>anethifolia</i>			
50.	3710 <i>Bossiaea eriocarpa</i> (Common Brown Pea)			
51.	7878 <i>Brachyscome iberidifolia</i>			
52.	244 <i>Briza maxima</i> (Blowfly Grass)	Y		
53.	245 <i>Briza minor</i> (Shivery Grass)	Y		

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
54.	249 <i>Bromus diandrus</i> (Great Brome)	Y		
55.	250 <i>Bromus hordeaceus</i> (Soft Brome)	Y		
56.	1366 <i>Bulbine semibarbata</i> (Leek Lily)			
57.	12770 <i>Burchardia congesta</i>			
58.	25716 <i>Cacatua sanguinea</i> (Little Corella)			
59.	25598 <i>Cacomantis flabelliformis</i> (Fan-tailed Cuckoo)			
60.	1586 <i>Caladenia discoidea</i> (Dancing Orchid)			
61.	15348 <i>Caladenia flava</i> subsp. <i>flava</i>			
62.	1596 <i>Caladenia huegelii</i> (Grand Spider Orchid)		T	
63.	15361 <i>Caladenia longicauda</i> subsp. <i>calcigena</i>			
64.	17760 <i>Caladenia nobilis</i>			
65.	5415 <i>Calothamnus lateralis</i>			
66.	25717 <i>Calyptorhynchus banksii</i> (Red-tailed Black-Cockatoo)			
67.	24731 <i>Calyptorhynchus banksii</i> subsp. <i>naso</i> (Forest Red-tailed Black-Cockatoo)		T	
68.	24734 <i>Calyptorhynchus latirostris</i> (Carnaby's Cockatoo (short-billed black-cockatoo))		T	
69.	5460 <i>Calytrix fraseri</i> (Pink Summer Calytrix)			
70.	5476 <i>Calytrix sapphirina</i>			
71.	1162 <i>Cartonema philydroides</i>			
72.	11242 <i>Cassytha racemosa</i> forma <i>pilosa</i>			
73.	11799 <i>Cassytha racemosa</i> forma <i>racemosa</i>			
74.	6214 <i>Centella asiatica</i>			
75.	1132 <i>Centrolepis mutica</i>			
76.	1280 <i>Chamaescilla corymbosa</i> (Blue Squill)			
77.	24377 <i>Charadrius ruficapillus</i> (Red-capped Plover)			
78.	24321 <i>Chenonetta jubata</i> (Australian Wood Duck)			
79.	24431 <i>Chrysococcyx basalis</i> (Horsfield's Bronze Cuckoo)			
80.	24288 <i>Circus approximans</i> (Swamp Harrier)			
81.	25675 <i>Colluricincla harmonica</i> (Grey Shrike-thrush)			
82.	24399 <i>Columba livia</i> (Domestic Pigeon)			
83.	4564 <i>Comesperma virgatum</i> (Milkwort)			
84.	15611 <i>Conospermum stoechadis</i> subsp. <i>stoechadis</i> (Common Smokebush)			
85.	6348 <i>Conostephium pendulum</i> (Pearl Flower)			
86.	6349 <i>Conostephium preissii</i>			
87.	1418 <i>Conostylis aculeata</i> (Prickly Conostylis)			
88.	11826 <i>Conostylis aculeata</i> subsp. <i>aculeata</i>			
89.	1436 <i>Conostylis juncea</i>			
90.	1455 <i>Conostylis setosa</i> (White Cottonhead)			
91.	25568 <i>Coracina novaehollandiae</i> (Black-faced Cuckoo-shrike)			
92.	25592 <i>Corvus coronoides</i> (Australian Raven)			
93.	24671 <i>Coturnix pectoralis</i> (Stubble Quail)			
94.	25595 <i>Cracticus tibicen</i> (Australian Magpie)			
95.	24422 <i>Cracticus tibicen</i> subsp. <i>dorsalis</i> (White-backed Magpie)			
96.	25596 <i>Cracticus torquatus</i> (Grey Butcherbird)			
97.	11563 <i>Crassula colorata</i> var. <i>colorata</i>			
98.	11345 <i>Crassula thunbergiana</i> subsp. <i>thunbergiana</i>	Y		
99.	25399 <i>Crinia glauerti</i> (Clicking Frog)			
100.	25040 <i>Ctenotus gemmula</i> (Jewelled South-west Ctenotus, skink (Swan Coastal Plain pop P3))			
101.	768 <i>Cyathochaeta avenacea</i>			
102.	16245 <i>Cyathochaeta teretifolia</i>		P3	
103.	24322 <i>Cygnus atratus</i> (Black Swan)			
104.	30901 <i>Dacelo novaeguineae</i> (Laughing Kookaburra)			
105.	7454 <i>Dampiera linearis</i> (Common Dampiera)			
106.	25673 <i>Daphoenositta chrysoptera</i> (Varied Sittella)			
107.	1218 <i>Dasypogon bromeliifolius</i> (Pineapple Bush)			
108.	16595 <i>Desmocladius flexuosus</i>			
109.	299 <i>Deyeuxia quadriseta</i> (Reed Bentgrass)			
110.	1259 <i>Dianella revoluta</i> (Blueberry Lily)			
111.	25607 <i>Dicaeum hirundinaceum</i> (Mistletoebird)			
112.	39019 <i>Didymium clavus</i>			Y
113.	17838 <i>Dielsia stenostachya</i>			
114.	314 <i>Digitaria didactyla</i> (Queensland Blue Couch)	Y		
115.	9027 <i>Diplolaena drummondii</i>			
116.	7054 <i>Dischisma arenarium</i>	Y		
117.	12943 <i>Diuris brumalis</i>			
118.	10791 <i>Diuris carinata</i> (Bee Orchid)			
119.	11049 <i>Diuris corymbosa</i>			
120.	1634 <i>Diuris laxiflora</i> (Bee Orchid)			
121.	12939 <i>Diuris magnifica</i>			
122.	12938 <i>Diuris micrantha</i>		T	

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
123.	4763 <i>Dodonaea hackettiana</i> (Hackett's Hopbush)		P4	
124.	1639 <i>Drakaea elastica</i> (Glossy-leaved Hammer Orchid)		T	
125.	3095 <i>Drosera erythrorhiza</i> (Red Ink Sundew)			
126.	14298 <i>Drosera macrantha</i> subsp. <i>macrantha</i>			
127.	13216 <i>Drosera menziesii</i> subsp. <i>penicillaris</i>			
128.	3124 <i>Drosera pulchella</i> (Pretty Sundew)			
129.	11485 <i>Ehrharta brevifolia</i> var. <i>cuspidata</i>	Y		
130.	347 <i>Ehrharta calycina</i> (Perennial Veldt Grass)	Y		
131.	1643 <i>Elythranthera brunonis</i> (Purple Enamel Orchid)			
132.	374 <i>Eragrostis cilianensis</i> (Stinkgrass)	Y		
133.	376 <i>Eragrostis curvula</i> (African Lovegrass)	Y		
134.	379 <i>Eragrostis elongata</i> (Clustered Lovegrass)			
135.	5708 <i>Eucalyptus marginata</i> (Jarrah)			
136.	3872 <i>Euchilopsis linearis</i> (Swamp Pea)			
137.	29940 <i>Euphorbia maculata</i>	Y		
138.	3880 <i>Eutaxia virgata</i>			
139.	25622 <i>Falco cenchroides</i> (Australian Kestrel)			
140.	24472 <i>Falco cenchroides</i> subsp. <i>cenchroides</i>			
141.	25623 <i>Falco longipennis</i> (Australian Hobby)			
142.	24041 <i>Felis catus</i> (Cat)			
143.	894 <i>Fimbristylis velata</i>			
144.	25727 <i>Fulica atra</i> (Eurasian Coot)			
145.	8365 <i>Fumaria bastardii</i>	Y		
146.	25729 <i>Gallinula tenebrosa</i> (Dusky Moorhen)			
147.	20473 <i>Gastrobium ebracteolatum</i>			
148.	25530 <i>Gerygone fusca</i> (Western Gerygone)			
149.	3957 <i>Gompholobium tomentosum</i> (Hairy Yellow Pea)			
150.	7538 <i>Goodenia pulchella</i>			
151.	24443 <i>Grallina cyanoleuca</i> (Magpie-lark)			
152.	37500 <i>Grammatotheca bergiana</i> var. <i>bergiana</i>	Y		
153.	14282 <i>Gnaphalium pubescens</i>			
154.	24293 <i>Haliaeetus leucogaster</i> (White-bellied Sea-Eagle)		IA	
155.	24295 <i>Haliastur spheonurus</i> (Whistling Kite)			
156.	3961 <i>Hardenbergia comptoniana</i> (Native Wisteria)			
157.	3016 <i>Heliophila pusilla</i>	Y		
158.	6710 <i>Heliotropium europaeum</i> (Common Heliotrope)	Y		
159.	6839 <i>Hemiantra pungens</i> (Snakebush)			
160.	5135 <i>Hibbertia hypericoides</i> (Yellow Buttercups)			
161.	5154 <i>Hibbertia perfoliata</i>			
162.	5162 <i>Hibbertia racemosa</i> (Stalked Guinea Flower)			
163.	25734 <i>Himantopus himantopus</i> (Black-winged Stilt)			
164.	24491 <i>Hirundo neoxena</i> (Welcome Swallow)			
165.	445 <i>Holcus setiger</i> (Annual Fog)	Y		
166.	6222 <i>Homalosciadium homalocarpum</i>			
167.	3968 <i>Hovea trisperma</i> (Common Hovea)			
168.	5216 <i>Hybanthus calycinus</i> (Wild Violet)			
169.	6224 <i>Hydrocotyle blepharocarpa</i>			
170.	6240 <i>Hydrocotyle scutellifera</i>			
171.	25366 <i>Hydrophis elegans</i>			
172.	35070 <i>Hypocalymma angustifolium</i> subsp. <i>Swan Coastal Plain</i> (G.J. Keighery 16777)			
173.	8086 <i>Hypochoeris glabra</i> (Smooth Catsear)	Y		
174.	1070 <i>Hypolaena exsulca</i>			
175.	912 <i>Isolepis cyperoides</i>			
176.	25478 <i>Isoodon obesulus</i> (Southern Brown Bandicoot)			
177.	24153 <i>Isoodon obesulus</i> subsp. <i>fusciventer</i> (Quenda, Southern Brown Bandicoot)		P5	
178.	7396 <i>Isotoma hypocrateriformis</i> (Woodbridge Poison)			
179.	3992 <i>Isotropis cuneifolia</i> (Granny Bonnets)			
180.	19700 <i>Isotropis cuneifolia</i> subsp. <i>cuneifolia</i>			
181.	4012 <i>Jacksonia furcellata</i> (Grey Stinkwood)			
182.	4029 <i>Jacksonia sternbergiana</i> (Stinkwood)			
183.	4044 <i>Kennedia prostrata</i> (Scarlet Runner)			
184.	5832 <i>Kunzea ericifolia</i> (Spearwood)			
185.	15498 <i>Kunzea glabrescens</i> (Spearwood)			
186.	20019 <i>Lachnagrostis filiformis</i>			
187.	19955 <i>Lachnagrostis plebeia</i>			
188.	19956 <i>Lachnagrostis preissii</i>			
189.	18585 <i>Lagenophora huegelii</i>			
190.	4052 <i>Latrobea tenella</i>			
191.	1309 <i>Laxmannia squarrosa</i>			
192.	7574 <i>Lechenaultia floribunda</i> (Free-flowering Leschenaultia)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
193.	925 <i>Lepidosperma angustatum</i>			
194.	940 <i>Lepidosperma pubisquamum</i>			
195.	19833 <i>Leptocarpus laxus</i>			
196.	15418 <i>Leptoceras menziesii</i>			
197.	1090 <i>Lepyrodia muirii</i>			
198.	25133 <i>Lerista elegans</i>			
199.	25147 <i>Lerista lineata</i> (Perth Slider, Lined Skink)		P3	
200.	6360 <i>Leucopogon australis</i> (Spiked Beard-heath)			
201.	6374 <i>Leucopogon conostephioides</i>			
202.	7677 <i>Levenhookia stipitata</i> (Common Stylewort)			
203.	24581 <i>Lichenostomus virescens</i> (Singing Honeyeater)			
204.	25661 <i>Lichmera indistincta</i> (Brown Honeyeater)			
205.	25415 <i>Limnodynastes dorsalis</i> (Western Banjo Frog)			
206.	36160 <i>Liparophyllum capitatum</i>			
207.	25378 <i>Litoria adelaidensis</i> (Slender Tree Frog)			
208.	9289 <i>Lobelia anceps</i> (Angled Lobelia)			
209.	7407 <i>Lobelia rhytidisperma</i> (Wrinkled-seeded Lobelia)			
210.	7408 <i>Lobelia tenuior</i> (Slender Lobelia)			
211.	1223 <i>Lomandra caespitosa</i> (Tufted Mat Rush)			
212.	1232 <i>Lomandra micrantha</i> (Small-flower Mat-rush)			
213.	1234 <i>Lomandra nigricans</i>			
214.	1239 <i>Lomandra preissii</i>			
215.	1243 <i>Lomandra sericea</i> (Silky Mat Rush)			
216.	1246 <i>Lomandra suaveolens</i>			
217.	39048 <i>Lycogala epidendrum</i>			
218.	18049 <i>Lyginia imberbis</i>			
219.	1656 <i>Lyperanthus serratus</i> (Rattle Beak Orchid)			
220.	2839 <i>Macarthuria australis</i>			
221.	24133 <i>Macropus irma</i> (Western Brush Wallaby)		P4	
222.	85 <i>Macrozamia riedlei</i> (Zamia)			
223.	24326 <i>Malacorhynchus membranaceus</i> (Pink-eared Duck)			
224.	25654 <i>Malurus splendens</i> (Splendid Fairy-wren)			
225.	24583 <i>Manorina flavigula</i> (Yellow-throated Miner)			
226.	17694 <i>Meeboldina scariosa</i>			
227.	25758 <i>Megalurus gramineus</i> (Little Grassbird)			
228.	5926 <i>Melaleuca lateritia</i> (Robin Redbreast Bush)			
229.	5978 <i>Melaleuca teretifolia</i> (Banbar)			
230.	5980 <i>Melaleuca thymoides</i>			
231.	6883 <i>Mentha pulegium</i> (Pennyroyal)	Y		
232.	24598 <i>Merops ornatus</i> (Rainbow Bee-eater)		IA	
233.	955 <i>Mesomelaena pseudostygia</i>			
234.	957 <i>Mesomelaena tetragona</i> (Semaphore Sedge)			
235.	1658 <i>Microtis atrata</i> (Swamp Mignonette Orchid)			
236.	15419 <i>Microtis media</i> subsp. <i>media</i>			
237.	37440 <i>Monopsis debilis</i> var. <i>depressa</i>	Y		
238.	4662 <i>Monotaxis grandiflora</i> (Diamond of the Desert)			
239.	4666 <i>Monotaxis occidentalis</i>			
240.	24223 <i>Mus musculus</i> (House Mouse)			
241.	24738 <i>Neophema elegans</i> (Elegant Parrot)			
242.	25252 <i>Notechis scutatus</i> (Tiger Snake)			
243.	25564 <i>Nycticorax caledonicus</i> (Rufous Night Heron)			
244.	24407 <i>Ocyphaps lophotes</i> (Crested Pigeon)			
245.	6140 <i>Oenothera mollissima</i>	Y		
246.	14292 <i>Oenothera stricta</i> subsp. <i>stricta</i>	Y		
247.	8149 <i>Olearia rudis</i> (Rough Daisybush)			
248.	12782 <i>Ophioglossum gramineum</i>			
249.	36177 <i>Ornduffia albiflora</i>			
250.	7122 <i>Orobanche minor</i> (Lesser Broomrape)	Y		
251.	24085 <i>Oryctolagus cuniculus</i> (Rabbit)			
252.	4358 <i>Oxalis purpurea</i> (Largeflower Wood Sorrel)	Y		
253.	24328 <i>Oxyura australis</i> (Blue-billed Duck)			
254.	25679 <i>Pachycephala pectoralis</i> (Golden Whistler)			
255.	25680 <i>Pachycephala rufiventris</i> (Rufous Whistler)			
256.	1667 <i>Paracaleana nigrita</i> (Flying Duck Orchid)			
257.	516 <i>Parapholis incurva</i> (Coast Barbgrass)	Y		
258.	25681 <i>Pardalotus punctatus</i> (Spotted Pardalote)			
259.	25682 <i>Pardalotus striatus</i> (Striated Pardalote)			
260.	527 <i>Paspalum dilatatum</i>	Y		
261.	1550 <i>Patersonia occidentalis</i> (Purple Flag)			
262.	30471 <i>Patersonia occidentalis</i> var. <i>angustifolia</i>			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
263.	24648 <i>Pelecanus conspicillatus</i> (Australian Pelican)			
264.	6006 <i>Pericalymma ellipticum</i> (Swamp Teatree)			
265.	16477 <i>Pericalymma ellipticum</i> var. <i>ellipticum</i>			
266.	2273 <i>Persoonia saccata</i> (Snottygobble)			
267.	24659 <i>Petroica goodenovii</i> (Red-capped Robin)			
268.	2299 <i>Petrophile linearis</i> (Pixie Mops)			
269.	2301 <i>Petrophile macrostachya</i>			
270.	2312 <i>Petrophile striata</i>			
271.	25697 <i>Phalacrocorax carbo</i> (Great Cormorant)			
272.	24667 <i>Phalacrocorax sulcirostris</i> (Little Black Cormorant)			
273.	25699 <i>Phalacrocorax varius</i> (Pied Cormorant)			
274.	24409 <i>Phaps chalcoptera</i> (Common Bronzewing)			
275.	24099 <i>Phascogale tapoatafa</i> subsp. <i>tapoatafa</i> (Southern Brush-tailed Phascogale, Wambenger)		T	
276.	18529 <i>Philothea spicata</i> (Pepper and Salt)			
277.	1478 <i>Phlebocarya ciliata</i>			
278.	24596 <i>Phylidonyris novaehollandiae</i> (New Holland Honeyeater)			
279.	39071 <i>Physarum luteolum</i>			Y
280.	39079 <i>Physarum viride</i>			
281.	2793 <i>Phytolacca octandra</i> (Red Ink Plant)	Y		
282.	<i>Phytophthora cinnamomi</i>			
283.	5252 <i>Pimelea lanata</i>			
284.	18117 <i>Pimelea rosea</i> subsp. <i>rosea</i>			
285.	24841 <i>Platalea flavipes</i> (Yellow-billed Spoonbill)			
286.	24750 <i>Platycercus zonarius</i> subsp. <i>semitorquatus</i> (Twenty-eight Parrot)			
287.	24843 <i>Plegadis falcinellus</i> (Glossy Ibis)		IA	
288.	25703 <i>Podargus strigoides</i> (Tawny Frogmouth)			
289.	25704 <i>Podiceps cristatus</i> (Great Crested Grebe)			
290.	8175 <i>Podolepis gracilis</i> (Slender Podolepis)			
291.	8182 <i>Podotheca angustifolia</i> (Sticky Longheads)			
292.	8184 <i>Podotheca gnaphalioides</i> (Golden Long-heads)			
293.	24681 <i>Poliocephalus poliocephalus</i> (Hoary-headed Grebe)			
294.	582 <i>Polypogon monspeliensis</i> (Annual Beardgrass)	Y		
295.	583 <i>Polypogon tenellus</i>			
296.	25722 <i>Polytelis anthopeplus</i> (Regent Parrot)			
297.	4691 <i>Poranthera microphylla</i> (Small Poranthera)			
298.	25731 <i>Porphyrio porphyrio</i> (Purple Swamphen)			
299.	1670 <i>Prasophyllum drummondii</i> (Swamp Leek Orchid)			
300.	1676 <i>Prasophyllum hians</i> (Yawning Leek Orchid)			
301.	10853 <i>Prasophyllum plumiforme</i>			
302.	25511 <i>Pseudonaja affinis</i> (Dugite)			
303.	25259 <i>Pseudonaja affinis</i> subsp. <i>affinis</i> (Dugite)			
304.	25264 <i>Pseudonaja nuchalis</i> (Gwardar)			
305.	11260 <i>Ptilotus drummondii</i> var. <i>drummondii</i> (Pussytail)			
306.	4181 <i>Pultenaea reticulata</i>			
307.	24245 <i>Rattus rattus</i> (Black Rat)			
308.	24776 <i>Recurvirostra novaehollandiae</i> (Red-necked Avocet)			
309.	25614 <i>Rhipidura leucophrys</i> (Willie Wagtail)			
310.	40431 <i>Rytidosperma acerosum</i>			
311.	30434 <i>Salsola australis</i>			
312.	7603 <i>Scaevola canescens</i> (Grey Scaevola)			
313.	982 <i>Schoenus clandestinus</i>			
314.	986 <i>Schoenus efoliatus</i>			
315.	25878 <i>Senecio condylus</i>			
316.	25534 <i>Sericornis frontalis</i> (White-browed Scrubwren)			
317.	2909 <i>Silene gallica</i> (French Catchfly)	Y		
318.	8225 <i>Siloxerus humifusus</i> (Procumbent Siloxerus)			
319.	25266 <i>Simoselaps bertholdi</i> (Jan's Banded Snake)			
320.	25267 <i>Simoselaps littoralis</i> (West Coast Banded Snake)			
321.	30948 <i>Smicromis brevirostris</i> (Weebill)			
322.	7037 <i>Solanum symonii</i>			
323.	1312 <i>Sowerbaea laxiflora</i> (Purple Tassels)			
324.	39085 <i>Stemonitis lignicola</i>			
325.	39087 <i>Stemonitis splendens</i>			
326.	19403 <i>Stenopetalum gracile</i>			
327.	2316 <i>Stirlingia latifolia</i> (Blueboy)			
328.	25597 <i>Strepera versicolor</i> (Grey Currawong)			
329.	25589 <i>Streptopelia chinensis</i> (Spotted Turtle-Dove)			
330.	30951 <i>Streptopelia chinensis</i> subsp. <i>tigrina</i>			
331.	25590 <i>Streptopelia senegalensis</i> (Laughing Turtle-Dove)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
332.	7693 <i>Stylidium brunonianum</i> (Pink Fountain Triggerplant)			
333.	7696 <i>Stylidium calcaratum</i> (Book Triggerplant)			
334.	7734 <i>Stylidium guttatum</i> (Dotted Triggerplant)			
335.	17850 <i>Stylidium ireneae</i>		P4	
336.	7756 <i>Stylidium longitubum</i> (Jumping Jacks)		P3	
337.	25800 <i>Stylidium paludicola</i>			
338.	7774 <i>Stylidium piliferum</i> (Common Butterfly Triggerplant)			
339.	7785 <i>Stylidium repens</i> (Matted Triggerplant)			
340.	7798 <i>Stylidium schoenoides</i> (Cow Kicks)			
341.	25830 <i>Stylidium</i> sp. Darling Range (H. Bowler 371)			
342.	7806 <i>Stylidium utricularioides</i> (Pink Fan Triggerplant)			
343.	2326 <i>Synaphea polymorpha</i> (Albany Synaphea)			
344.	2329 <i>Synaphea spinulosa</i>			
345.	15532 <i>Synaphea spinulosa</i> subsp. <i>spinulosa</i>			
346.	33992 <i>Synemon gratiosa</i> (Graceful Sunmoth)		T	
347.	25705 <i>Tachybaptus novaehollandiae</i> (Australasian Grebe)			
348.	24331 <i>Tadorna tadornoides</i> (Australian Shelduck)			
349.	24167 <i>Tarsipes rostratus</i> (Honey Possum)			
350.	20135 <i>Taxandria linearifolia</i>			
351.	2791 <i>Tersonia cyathiflora</i> (Button Creeper)			
352.	1710 <i>Thelymitra mucida</i> (Plum Orchid)			
353.	20731 <i>Thelymitra vulgaris</i>			
354.	20728 <i>Thelymitra xanthotricha</i>			
355.	24844 <i>Threskiornis molucca</i> (Australian White Ibis)			
356.	24845 <i>Threskiornis spinicollis</i> (Straw-necked Ibis)			
357.	1319 <i>Thysanotus arenarius</i>			
358.	1339 <i>Thysanotus multiflorus</i> (Many-flowered Fringe Lily)			
359.	1351 <i>Thysanotus sparteus</i>			
360.	1357 <i>Thysanotus thyrsoideus</i>			
361.	25207 <i>Tiliqua rugosa</i> subsp. <i>rugosa</i>			
362.	25549 <i>Todiramphus sanctus</i> (Sacred Kingfisher)			
363.	6280 <i>Trachymene pilosa</i> (Native Parsnip)			
364.	1481 <i>Tribonanthes australis</i>			
365.	25723 <i>Trichoglossus haematodus</i> (Rainbow Lorikeet)			
366.	25521 <i>Trichosurus vulpecula</i> (Common Brushtail Possum)			
367.	24158 <i>Trichosurus vulpecula</i> subsp. <i>vulpecula</i> (Common Brushtail Possum)			
368.	1361 <i>Tricoryne elatior</i> (Yellow Autumn Lily)			
369.	24849 <i>Turnix varia</i> subsp. <i>varia</i>			
370.	24852 <i>Tyto alba</i> subsp. <i>delicatula</i> (Barn Owl)			
371.	8255 <i>Ursinia anthemoides</i> (Ursinia)	Y		
372.	25218 <i>Varanus gouldii</i> (Bungarra or Sand Monitor)			
373.	7111 <i>Veronica persica</i> (Creeping Speedwell)	Y		
374.	722 <i>Vulpia bromoides</i> (Squirrel Tail Fescue)	Y		
375.	724 <i>Vulpia myuros</i> (Rat's Tail Fescue)	Y		
376.	12052 <i>Vulpia myuros</i> forma <i>megalura</i>	Y		
377.	33101 <i>Vulpia myuros</i> forma <i>myuros</i>	Y		
378.	12072 <i>Wurmbea dioica</i> subsp. <i>alba</i>			
379.	1398 <i>Wurmbea monantha</i>			
380.	1256 <i>Xanthorrhoea preissii</i> (Grass tree)			
381.	6289 <i>Xanthosia huegelii</i>			
382.	2331 <i>Xylomelum occidentale</i> (Woody Pear)			
383.	25765 <i>Zosterops lateralis</i> (Grey-breasted White-eye)			

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 wholly 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 E: DEC SEARCH

NAME	SOURCE_CODE	FAMILY	GENUS	SPECIES	INFRASPECIFIC ANK	INFRASPECIFIC NAME	AUTHOR	VERNACULAR	CONS_CODE	CLASS	DAY	MONTH	YEAR	LOCALITY_NAME	SITE_NAME
<i>Calyptorhynchus latirostris</i>	FAUNASURVEY	Psittacidae	Calyptorhynchus	latirostris			Carnaby	Carnaby's Cockatoo	T	BIRD	07	03	2009	EAST ROCKINGHAM	East Rockingham WWTP
<i>Calyptorhynchus latirostris</i>	BIRDATLAS2	Psittacidae	Calyptorhynchus	latirostris			Carnaby	Carnaby's Cockatoo	T	BIRD	20	07	2000	MEDINA	Thomas Oval, Medina
<i>Calyptorhynchus latirostris</i>	BIRDATLAS2	Psittacidae	Calyptorhynchus	latirostris			Carnaby	Carnaby's Cockatoo	T	BIRD	19	09	2002	POSTANS	The Spectacles
<i>Charadrius rubricollis</i>	TFAUNA	Charadriidae	Charadrius	rubricollis	subsp.	konowi	(Gmelin)	Hooded Plover	4	BIRD	10	01	1998	COOLOONGUP	Coooloong Lake, City of Rockingham
<i>Tiliqua rugosa</i> subsp. <i>konowi</i>	FAUNASURVEY	Scincidae	Tiliqua	rugosa	subsp.		(Martens)		T	REPTILE	09	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 6.5
<i>Falco peregrinus</i>	FAUNASURVEY	Falconidae	Falco	peregrinus			Tunstall	Peregrine Falcon	S	BIRD	07	03	2009	EAST ROCKINGHAM	East Rockingham WWTP
<i>Hydromys chrysogaster</i>	TFAUNA	Muridae	Hydromys	chrysogaster			Geoffroy	Water-rat	4	MAMMAL	10	06	1973	MEDINA	Medina
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	FAUNASURVEY	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	11	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.3
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	FAUNASURVEY	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	06	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 5.5
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	FAUNASURVEY	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	05	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.7
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	FAUNASURVEY	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	07	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 3.5
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	FAUNASURVEY	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	08	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 5.5
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	FAUNASURVEY	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	05	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.5
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	FAUNASURVEY	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	10	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.3
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	FAUNASURVEY	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	07	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 6.7
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	FAUNASURVEY	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	05	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 2.7
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	TFAUNA	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	01	11	2001	COOLOONGUP	N end of Lake Coooloongup, Coooloongup (S)
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	TFAUNA	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	01	12	1974	CASUARINA	Mortimer Rd, Wellard.
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	FAUNASURVEY	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	25	05	2010	LEDA	Leda Wetlands
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	TFAUNA	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	01	11	2001	LEDA	Leda Reserve, Leda (Site 2)
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	WAMSPECIMEN S	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	22	06	1961	MEDINA	
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	TFAUNA	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	01	11	2001	PARMELIA	Bushland opposite Sicklemore Rd, Parmelia/Bertram (Site 1)
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	TFAUNA	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	06	11	2007	HOPE VALLEY	north of Anketell Rd, across from the Spec
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	TFAUNA	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	03	11	2007	HOPE VALLEY	north of Anketell Rd, across from the Spec
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	TFAUNA	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	04	11	2007	HOPE VALLEY	north of Anketell Rd, across from the Spec
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	TFAUNA	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	09	07	2004	HOPE VALLEY	Alcoa development site on Anketell Rd, E Abercombe Rd
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	TFAUNA	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	02	11	2007	HOPE VALLEY	north of Anketell Rd, across from the Spec
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	TFAUNA	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	05	11	2007	HOPE VALLEY	north of Anketell Rd, across from the Spec
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	TFAUNA	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	02	11	2007	KWINANA BEACH	roadside south of Anketell Rd, adjacent to Spectacles
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	TFAUNA	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	06	11	2007	KWINANA BEACH	roadside south of Anketell Rd, adjacent to Spectacles
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	TFAUNA	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	04	11	2007	KWINANA BEACH	roadside south of Anketell Rd, adjacent to Spectacles
<i>Isoodon obesulus</i> subsp. <i>fusciventer</i>	FAUNASURVEY	Peramelidae	Isoodon	obesulus	subsp.	fusciventer	(Gray)	Quenda	5	MAMMAL	05	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 6.7

NAME	SOURCE_CODE	FAMILY	GENUS	SPECIES	INFRARANK	INFRANAME	AUTHOR	VERNACULAR	CONS_CODE	CLASS	DAY	MONTH	YEAR	LOCALITY_NAME	SITE_NAME
<i>Lerista lineata</i>	WAMSPECIMENS	Scincidae	Lerista	lineata			Bell		3	REPTILE	05	01	1979	MEDINA	Spectacle Swamp, near Medina
<i>Macropus irma</i>	TFAUNA	Macropodidae	Macropus	irma			(Jourdan)	Western Brush Wallaby	4	MAMMAL	01	01	1989	WELLARD	Leda Nature Reserve, Town of Kwinana
<i>Neelaps calonotos</i>	TFAUNA	Elapidae	Neelaps	calonotos			(A.M.C. DumOril, Bibron & A. DumOril)	Black-striped Snake	3	REPTILE	07	03	2009	COOLOONGUP	East Rockingham
<i>Notoscincus butleri</i>	FAUNASURVEY	Scincidae	Notoscincus	butleri			Storr		4	REPTILE	08	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 3.2
<i>Notoscincus butleri</i>	FAUNASURVEY	Scincidae	Notoscincus	butleri			Storr		4	REPTILE	08	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 1.9
<i>Lerista lineata</i>	TFAUNA	Scincidae	Lerista	lineata			Bell		3	REPTILE	13	11	2007	THE SPECTACLES	roadside south of Anketell Rd, adjacent to Spectacles
<i>Lerista lineata</i>	TFAUNA	Scincidae	Lerista	lineata			Bell		3	REPTILE	05	01	1979	THE SPECTACLES	Spectacle Swamp, near Medina
<i>Pletholax gracilis</i> subsp. <i>edelensis</i>	FAUNASURVEY	Pygopodidae	Pletholax	gracilis	subsp.	edelensis	Storr		3	REPTILE	08	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 4.3
<i>Neelaps calonotos</i>	WAMSPECIMENS	Elapidae	Neelaps	calonotos			(A.M.C. DumOril, Bibron & A. DumOril)	Black-striped Snake	3	REPTILE				COOLOONGUP	East Rockingham
<i>Tiliqua rugosa</i> subsp. <i>konowi</i>	FAUNASURVEY	Scincidae	Tiliqua	rugosa	subsp.	konowi	(Vertens)		T	REPTILE	11	03	2009	EAST ROCKINGHAM	East Rockingham WWTP TS 6.3

APPENDIX F: VEGETATION TYPES OF THE SITE

- Sub-site Area A: *Banksia attenuata* - *Allocasuarina fraseriana* woodland with occasional stands of *Jacksonia furcellata* and *Kunzea glabrescens* above a generally low, multi-species understorey with *Acacia pulchella*, *Hibbertia rhadinopoda*, *Petrophile linearis* and *Xanthorrhoea preissii* common low shrubs. Weeds occur throughout;
- Sub-site Area B (not included in this survey): *Banksia attenuata*- *Allocasuarina fraseriana*- *Xylomelum occidentale* woodland above a generally degraded low, understorey commonly of *Hibbertia rhadinopoda*, *Petrophile linearis* and *Patersonia occidentalis* low shrubs. Weeds occur throughout;
- Sub-site Area C: Variable *Banksia attenuata*- to tall woodland of *Corymbia calophylla*. Understorey density and height varies with open areas of low shrubs and herbs below tall trees and taller more dense shrubs occurring below *B. attenuata*. *Hibbertia rhadinopoda*, *Macrozamia riedlei*, *Petrophile linearis* and *Xanthorrhoea preissii* are common shrubs. Weeds occur throughout;
- Sub-site Area D: *Banksia attenuata*- *Allocasuarina fraseriana* woodland above a generally low, multi-species understorey with *Hibbertia rhadinopoda*, *Patersonia occidentalis* and *Xanthorrhoea preissii* common shrubs. Weeds occur throughout;
- Sub-site Area E: *Banksia attenuata* – *Corymbia calophylla* -*Allocasuarina fraseriana* woodland above a generally low, weed dominated understorey; and
- Sub-site Area F and Area G: *Banksia attenuata* – *Banksia menziesii* – *Allocasuarina fraseriana* woodland with occasional stands of *Jacksonia furcellata* and *Kunzea glabrescens* above a generally low, multi-species understorey with *Acacia pulchella*, *Hibbertia rhadinopoda*, *Petrophile linearis* and *Xanthorrhoea preissii* common shrubs.

APPENDIX G: THREATENED FAUNA STATUTORY FRAMEWORK

7.1.1 Federal Legislation

Fauna species are protected at a Federal level under the EPBC Act. The EPBC Act was developed to provide for the protection of the environment, with specific regard to those aspects of the environment that are matters of national environmental significance (MNES). The EPBC Act promotes the conservation of biodiversity through ecologically sustainable development practices and the ecologically sustainable use of natural resources.

The EPBC Act includes provisions to protect native species (and in particular prevent the extinction and promote the recovery of threatened species) and to ensure the conservation of migratory species protected under international agreements (Japan-Australia Migratory Bird Agreement [JAMBA], China-Australia Migratory Bird Agreement [CAMBA], Republic of Korea-Australia Migratory Bird Agreement [RoKAMBA]).

The significance levels for fauna used in the EPBC Act are those recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN). Table 15 outlines the categories of significance levels.

Table 15: EPBC Act Categories of Threatened Fauna Species

CONSERVATION CODE	CATEGORY
Ex	Extinct - Taxa not defiantly located in the wild during the past 50 years.
ExW	Extinct in the Wild - Taxa known to survive only in captivity.
CE	Critically Endangered - Taxa facing an extremely high risk of extinction in the wild in the immediate future.
E	Endangered - Taxa facing a very high risk of extinction in the wild in the near future.
V	Vulnerable - Taxa facing a high risk of extinction in the wild in the medium-term.
CD	Conservation Dependent - Taxa whose survival depends upon ongoing conservation measures. Without these measures. A conservation dependent taxon would be classified as Vulnerable or more severely Threatened.

7.1.2 State Legislation

Western Australia's biodiversity is supported and protected by the following legislation:

- The *Conservation and Land Management Act 1984* (CALM Act);
- The *Environmental Protection Act 1986* (EP Act);
- The WC Act;
- The *Wildlife Conservation Regulations 1970*; and
- The *Wildlife Conservation (Specially Protected Fauna) Notice 2012*.

The *Wildlife Conservation (Specially Protected Fauna) Notice 2012* describes

categories for fauna classified as Specially Protected in a series of Schedules (Table 16). The DEC produces a supplementary list of Priority Fauna, being species that are not considered Threatened under the *WC Act* but for which the Department feels there is a cause for concern. These species have no special protection, but their presence would normally be considered as potentially significant and the species need further survey and evaluation of their conservation status before consideration can be given to declaration as Threatened Fauna. Levels of Priority are described in Table 17 and Table 17.

Table 16: WC Act Codes for Threatened Fauna

CONSERVATION CODE	CATEGORY
Schedule 1	Fauna that is rare or likely to become extinct are declared to be fauna that is in need of special protection.
Schedule 2	Fauna that is presumed to be extinct are declared to be fauna that is in need of special protection.
Schedule 3	Birds that are identified in the agreement between the governments of Australia and Japan relating to the protection of migratory birds, and birds in danger of extinction, are declared to be fauna that is in need of special protection.
Schedule 4	Fauna that is in need of special protection, otherwise than for the reasons mentioned (in Schedule 1 – 3).

Table 17: DEC Priority Fauna Conservation Codes (DEC 2010)

CONSERVATION CODE	CATEGORY
P1	Priority One Taxa with few, poorly known populations on threatened lands.
P2	Priority Two Taxa with few, poorly known populations on conservation lands. Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown Land, water reserves, etc.
P3	Priority Three Taxa which are known from few specimens or sight records, some of which are on lands not under immediate threat of habitat destruction or degradation.
P4	Priority Four Rare taxa. 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.
P5	Priority Five Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

7.1.3 International Agreements

The EPBC Act also includes management of migratory species that are recognised under international treaties such as the CAMBA, the JAMBA, RoKAMBA and *The Convention on the Conservation of Migratory Species of Wild Animals* (the Bonn Convention).

Species included in these agreements are considered to be significant at the global level.

ATTACHMENT 2I



360
environmental



Black Cockatoo Survey - Kwinana Town Centre

Prepared for:

Department of Housing/
Satterley Property Group

May 2012

● people ● planet ● professional

Document Reference	Revision	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
EBS165_1AB	A INTERNAL DRAFT	AH	TS/FD	-	11/05/12
EBS165_1AB	B CLIENT DRAFT	AH	Client	1 Electronic (email)	11/05/12

Disclaimer

This report is issued in accordance with, and is subject to, the terms of the contract between the Client and 360 Environmental Pty Ltd, including, without limitation, the agreed scope of the report. To the extent permitted by law, 360 Environmental Pty Ltd shall not be liable in contract, tort (including, without limitation, negligence) or otherwise for any use of, or reliance on, parts of this report without taking into account the report in its entirety and all previous and subsequent reports. 360 Environmental Pty Ltd considers the contents of this report to be current as at the date it was produced. This report, including each opinion, conclusion and recommendation it contains, should be considered in the context of the report as a whole. The opinions, conclusions and recommendations in this report are limited by its agreed scope. More extensive, or different, investigation, sampling and testing may have produced different results and therefore different opinions, conclusions and recommendations. Subject to the terms of the contract between the Client and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating parts of this report is prohibited (except to the extent required by law) unless the report is produced in its entirety including this cover page, without the prior written consent of 360 Environmental Pty Ltd.

© Copyright 2012 360 Environmental Pty Ltd ACN 109 499 041

Executive Summary

360 Environmental Pty Ltd (360 Environmental) was commissioned by Satterley Property Group on behalf of the Department of Housing (DoH) to undertake a Black Cockatoo Survey at Lot 26 Meares Avenue, Kwinana (the site), known as Kwinana Town Centre (Figure 1). The survey involved a Black Cockatoo Foraging Assessment, Black Cockatoo Breeding Assessment and Black Cockatoo Significant Tree Survey (the survey). The DoH has proposed the area be utilised for residential development. The site comprises an area of approximately 36 hectares (ha) and is located in the Town of Kwinana, approximately 33 kilometres (km) south of Perth. The site is composed of uncleared bushland with Tuart, Jarrah, Marri and Banksia species present throughout.

A search of the Environment Protection and Biodiversity Conservation (EPBC) database and past site assessments revealed that the Vulnerable Forest Red-tailed Black Cockatoo and Baudin's Black Cockatoo, and the Endangered Carnaby's Black Cockatoo are likely to occur within the area. A survey conducted in 2009 at the site found evidence of Black Cockatoo foraging (360 Environmental, 2009). This consisted of feeding debris from Carnaby's Black Cockatoo and Red-tailed Black Cockatoo. Three potential breeding hollows were also identified. No evidence of Black Cockatoo breeding was recorded on site at the time of the survey (360 Environmental, 2009).

The current survey identified only one potentially suitable nesting hollow for Black Cockatoo within the Kwinana Town Centre. No evidence of Black Cockatoo breeding was recorded. Suitable feeding species (Banksia and Jarrah) and sparse evidence of feeding debris were recorded at the site. The majority of the feeding evidence was old foraging evidence on seeds. There were three locations which showed evidence of Carnaby's Black Cockatoo feeding and ten locations which showed evidence of Forest Red-Tailed Black Cockatoo feeding. Of these, only one location showed recent evidence of Black Cockatoo feeding (Forest Red-tailed Black Cockatoo). Tail feathers and scats were recorded, which indicates the presence of a small roost site within the study area. This suggests that although not extensively utilised, both Carnaby's Black Cockatoo and Red-tailed Black Cockatoo do at least occasionally utilise the survey area for foraging, feeding, to some extent roosting but there was no evidence of breeding.

The suggestion that Black Cockatoo's occasionally utilise the site is supported by a sighting of at least three Red-tailed Black Cockatoos flying over the site, thirty Carnaby's Black Cockatoo's observed within the garden just outside the site on Meares Avenue and seven Carnaby's Black Cockatoo observed on *Banksia attenuata* trees along Meares Avenue.

From the outcomes of this report the following are recommended:

- Retain as many trees with a trunk diameter at breast height (DBH) of 500 mm or greater. The Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) considers that trees over 500 mm could provide

breeding and foraging habitat for Black Cockatoo species. Trees with DBH less than 500 mm are considered foraging habitat for the Black Cockatoo species. SEWPaC places higher value on potential breeding trees over foraging trees. It is recommended that emphasis be placed on retaining potential breeding and foraging trees to minimise impacts. Should offsets be required for vegetation clearing they are likely to be greater for the clearing of breeding habitat; and

- Retain trees that display hollows. These trees may be suitable for breeding of bird species and may become suitable for Black Cockatoo species over time (as the trees grow and the hollows increase in size). If clearing of trees with hollows is unavoidable, it is recommended that hollows are inspected prior to clearing to ensure that hollows are not currently occupied or in use.
- Consider offset of the impacts of clearing of habitat as a last resort after consideration of minimising and otherwise mitigating impacts. Offset could include the purchase of land containing appropriate habitat (including suitable Black Cockatoo habitat);
- Clear habitat in stages to allow fauna to disperse away from the site;
- Feral bee control could be implemented on site to remove feral bees from the hollows of trees that remain on site; and
- Conduct clearing operations outside the breeding season for Black Cockatoos. Carnaby's Black Cockatoo and Baudin's Black Cockatoo breed in late winter to spring (although Carnaby's primarily breed in the wheatbelt) and Red-tailed Black Cockatoos breed within a period from September to April. This will reduce the likelihood of Black Cockatoos using the site during clearing.

Table of Contents

1	Introduction	1
1.1	Background	1
1.2	Objectives	1
1.3	Scope of the Study	1
2	Site Description.....	2
2.1	Site Location	2
2.2	Broad Habitat Assessment	2
3	Black Cockatoo Species.....	3
3.1	Carnaby's Black Cockatoo.....	3
3.2	Forest Red-tailed Black Cockatoo	4
3.3	Baudin's Black Cockatoo	4
4	Methods.....	5
4.1	Background Research	5
4.2	Black Cockatoo Foraging and Breeding Assessment Methodology.....	5
4.3	Black Cockatoo Significant Tree Survey Methodology	6
5	Results	8
5.1	Black Cockatoo Breeding Assessment	8
5.2	Black Cockatoo Foraging Assessment.....	8
5.3	Black Cockatoo Opportunistic Observations	9
5.4	Black Cockatoo Significant Tree Assessment.....	9
6	Discussion.....	11
7	Summary and Recommendations.....	12
8	Limitations.....	13
9	References	14

List of Tables

Table 1: Black Cockatoo Significant Tree Survey Results	10
---	----

List of Figures

Figure 1: Site Location	16
Figure 2: Location of Breeding, Foraging and Sighting Records	17
Figure 3: Black Cockatoo Significant Tree Survey	18
Figure 4: Recent Fire Records	19

List of Appendices

Appendix A: Figures	15
Appendix B: Black Cockatoo, Breeding, Foraging and Sighting Data	20
Appendix C: Black Cockatoo Significant Tree Data	26

1 Introduction

1.1 Background

360 Environmental Pty Ltd (360 Environmental) was commissioned to undertake a Black Cockatoo Breeding and Foraging Survey and Black Cockatoo Significant Tree Survey at Lot 26 Meares Avenue, Kwinana (the site), known as Kwinana Town Centre (Figure 1). The site is approximately 36 hectares in size and is bounded by Gilmore, Challenger, Meares Avenues and Wellard Road. The site is composed of uncleared bushland. The vegetation within the survey area can be classified into four broad vegetation groups (360 Environmental, 2006). These groups are Jarrah-Banksia woodlands; Tuart woodlands; Marri woodlands; and finally shallow limestone shrublands.

The Department of Housing/ Satterley Property Group has proposed the area be utilised for residential development.

1.2 Objectives

The objectives of the Black Cockatoo Survey were to:

- Identify significant habitat trees (breeding and feeding) suitable for Black Cockatoo and evidence of Black Cockatoo breeding and feeding at the site with reference to SEWPaC's (2011) draft referral guidelines for Black Cockatoos; and
- Determine the extent of the use of the site by Black Cockatoos.

1.3 Scope of the Study

In order to determine what areas of the survey area would be considered foraging or breeding habitat for Black Cockatoos, a survey of suitable trees within the proposed development area was undertaken. The Black Cockatoo Survey included:

- Background Research;
- On site Black Cockatoo Breeding Assessment;
- On site Black Cockatoo Foraging Assessment; and
- On site Black Cockatoo Significant Tree Assessment.

2 Site Description

2.1 Site Location

The survey site is approximately 36 ha and is bounded by Gilmore, Challenger, Meares Avenues and Wellard Road. The majority of the site is uncleared bushland.

2.2 Broad Habitat Assessment

In 2006, 360 Environmental conducted a site assessment of the area. The vegetation consists of Tuart (*Eucalyptus gomphocephalla*) and Jarrah (*Eucalyptus marginata*) with sections of Marri (*Corymbia calophylla*) and *Banksia* species (360 Environmental, 2006). The vegetation within the survey area can be classified into four broad vegetation groups. These groups are Tuart woodlands, Jarrah-Banksia woodlands, Marri woodlands and shallow limestone shrublands (360 Environmental, 2006). The Jarrah-Banksia vegetation units covered the largest part of the study area. The condition of the vegetation in the survey area was mostly in the range of 'Good' to 'Very Poor'. Some physical disturbance has occurred in various places in the survey area.

3 Black Cockatoo Species

Three species of Black Cockatoo occur in the south-west of Western Australia. All three species are protected under the following State and Federal legislation:

- The *Wildlife Conservation Act 1950* (WC Act), Western Australia; and
- The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) is listed as Endangered under the EPBC Act. The Red-tailed Black Cockatoo (*Calyptorhynchus banksii*) and Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) are classified as Vulnerable.

Under the WC Act both Carnaby's Black Cockatoo and Baudin's Black Cockatoo are listed as Endangered. The Forest Red-tailed Black Cockatoo is listed as Vulnerable.

3.1 Carnaby's Black Cockatoo

Carnaby's Black Cockatoo is a large, Black cockatoo with a white patch on its cheek, white bands on its tail, and a strong curved bill. Carnaby's Black Cockatoo is also known as the Short-billed Cockatoo. In males, the bill is black and the eye-ring dark-pink. Females have a light grey bill, grey eye-ring, and the cheek patch is less distinctive.

Carnaby's Black Cockatoo is endemic to the southwest of Western Australia, extending from the Murchison River to Esperance, and inland to Coorow, Kellerberrin and Lake Cronin (DEC, 2009). There is evidence the species is currently expanding its breeding range westward and south into the Jarrah-Marri forests of the Darling Range and into the Tuart forests of the Swan Coastal Plain (Johnstone and Kirkby, 2006).

Carnaby's Black Cockatoos are believed to breed mostly in the wheatbelt region of Western Australia (DEC, 2009). After breeding, Carnaby's Cockatoo disperse to the higher rainfall coastal areas of the south-west of Western Australia to feed in late December to July (DEC, 2009).

Carnaby's Black Cockatoo display strong pair bonds. They occur in uncleared or remnant areas of Eucalypt woodland, principally Salmon gum (*Eucalyptus salmonophloia*) or Wandoo (*E. wandoo*), and shrubland or kwongan heath dominated by Hakea and Banksia species. Carnaby's Black Cockatoo nest in the hollows of live or dead smooth-barked Eucalypts (Salmon Gum and Wandoo) but also in Red Morrell (*E. longicornis*), York Gum (*E. loxophleba*), Marri and Tuart (Johnstone and Storr, 1998). Nest hollows range from 2.5-12 m above ground, size of entrance from 23-30 cm and depth of hollows from 1-2.5 m (Johnstone and Storr, 1998). Eggs are laid between July to mid-October and incubation is 29 days (Johnstone and Storr, 1998).

On the Swan Coastal Plain, the birds feed on a large variety of plants including the *Proteaceae* (Banksia and Grevillea), Marri nuts and introduced species – notably Pines (DEC, 2009).

Carnaby's Black Cockatoo has undergone a dramatic decline in recent years, declining by 50 percent in the past 45 years, one of the main contributing factors being land clearing (DEC, 2009). The long-term survival and recovery of this species is linked to the survival of its habitat – both in breeding areas in the Wheatbelt and non-breeding areas such as the Swan Coastal Plain (DEC, 2009). In addition, clearing of heathland near breeding sites has reduced the availability of food for breeding pairs and their young (DEC, 2009).

3.2 Forest Red-tailed Black Cockatoo

The Forest Red-tailed Black Cockatoo is a large Black Cockatoo with a pair of black central tail feathers and a bright red, orange or yellow barring on the tail (SEWPaC, 2012). This species is endemic to the south-west humid and semi-humid zones of Western Australia. It inhabits dense Jarrah, Karri and Marri forests which receive more than 600mm average annual rainfall (SEWPaC, 2012). Forest Red-tailed Black Cockatoos feed predominantly on the seeds of Jarrah and Marri fruits.

3.3 Baudin's Black Cockatoo

Baudin's Black Cockatoo is a large black cockatoo with rectangular white patches in the tail. This species is only found in the extreme south-west of Western Australia. It occurs in areas of high rainfall and usually in heavily forested locations dominated by Marri, Karri or Jarrah. The diet of Baudin's Black Cockatoo consists mostly of *Eucalyptus* seeds (e.g. Marri and Jarrah) and occasionally insect larvae (SEWPaC, 2012).

4 Methods

4.1 Background Research

The background research is designed to gather existing data on known locations of breeding and feeding for Black Cockatoo. The background research and desktop study included review of the following websites and documents:

- DEC's website on Black Cockatoos;
- SEWPaC's EPBC Act draft referral guidelines; and
- Reports of previous studies undertaken in the area.

4.2 Black Cockatoo Foraging and Breeding Assessment Methodology

4.2.1 Survey Personnel

The Black Cockatoo Foraging and Breeding Survey was undertaken by Black Cockatoo specialist Tony Kirkby. Tony Kirkby was a technical officer at the WA Museum and has had significant field experience with Black Cockatoos in Western Australia. He is considered an expert in the area of protected Black Cockatoos and has authored a number of papers on the subject. Over the last seven years Tony has collected, recorded and photographed most of the food taken by the three south-west Black Cockatoos and has to date a database of over 20,000 records and an image library of over 3,000 cockatoo and cockatoo food related photographs.

4.2.2 Black Cockatoo Breeding Site Assessment

Tony Kirkby undertook a one day site visit during the 21 March 2012 to assess trees considered to be suitable for breeding. The trees were assessed based on the following criteria:

- Native trees (Jarrah, Tuart, Marri etc.);
- Diameter at breast height > 500 millimetres (mm); and
- Hollows > 12 centimetres (cm) diameter.

The survey area was walked and all trees meeting the criteria for potential breeding habitat (species, girth and hollow diameter) were recorded and electronically logged using a hand held Differential Global Positioning System (DGPS) unit (Appendix B).

4.2.3 Black Cockatoo Foraging Site Assessment

Tony Kirkby undertook a one day site visit to conduct an observational site survey and feeding assessment to determine the extent of foraging habitat for Black Cockatoos at

the same time as the breeding assessment was undertaken. The observational and foraging assessment included:

- Analysis of dentition marks in seed and nut material; and
- Opportunistic observations of Carnaby's Black Cockatoos within the proposed development area.

Feeding trees and opportunistic observations were recorded and located using a hand held DGPS unit (Appendix B).

4.3 Black Cockatoo Significant Tree Survey Methodology

4.3.1 Survey Personnel

The Black Cockatoo Significant Tree Survey was conducted by two Environmental Scientists from 360 Environmental. The survey was conducted over a period of four days during April and early May.

4.3.2 Site Survey

The survey comprised of recording the location, species, tree diameter at breast height and any other important descriptive information about each tree located within the site boundary.

Roughly 40 m wide walking transects were designed across the site. Every tree within a survey transect was assessed based on the Black Cockatoo significant tree criteria (below). Each transect ran parallel or perpendicular to another transect to ensure all trees within the site were included within a transect line. Tree details were individually recorded electronically using a DGPS.

4.3.3 Black Cockatoo Significant Tree Criteria

Trees exceeding 400 mm trunk diameter at breast height (DBH) (~1.5 m above ground level) were considered environmentally significant for the purposes of this survey based on criteria used by the Town of Kwinana (Town of Kwinana, pers. comm., 9 February 2010). This is a more conservative measure of tree significance than the standard 500 mm used by SEWPaC. Trees with a trunk DBH less than 400 mm were not recorded for the purposes of this survey.

4.3.3.1 Tree Location (using DGPS)

Each significant tree was individually recorded using a DGPS to get the Universal Transverse Mercator (UTM GDA 94 Zone 50) coordinates.

4.3.3.2 Tree Species

Each significant tree was individually recorded according to its species, as either:

- Jarrah (*Eucalyptus marginata*);
- Marri (*Corymbia calophylla*);
- Tuart (*Eucalyptus gomphocephala*);
- Sheoak (*Allocasuarina fraseriana*);
- Banksia (*Banksia attenuata* or *Banksia grandis*); or
- Stag (standing dead tree).

4.3.3.3 Trunk Diameter at Breast Height

Each significant tree was individually recorded according to its trunk DBH, as either:

- Small: 400 mm to 500 mm;
- Medium: 500 mm to 800 mm;
- Large: 800 mm to 1,200 mm; and
- Very Large: 1,200 mm+.

5 Results

The breeding and foraging survey was undertaken on 21 March 2012 by Tony Kirkby. The Significant Tree Survey was undertaken throughout April and early May by Environmental Scientists at 360 Environmental. The following summarises the results of the Black Cockatoo breeding, foraging and significant tree assessments.

5.1 Black Cockatoo Breeding Assessment

Tree hollows were assessed by Tony Kirkby to determine if they were being utilised by Black Cockatoos, and if not to determine if they were suitable or have the potential to be suitable for use by Black Cockatoos.

- One Tuart tree was found to contain a hollow of suitable size for Black Cockatoos, however, it contained feral bees which would preclude current use by Black Cockatoos – 388213E 6431257N;
- Tail feathers and scats were observed in one Marri tree which indicate a small roost site located - 388583E 6431216N;
- A slightly chewed hollow in a Marri tree was observed, however, this was too low and slightly small to be a Black Cockatoo hollow – 388486E 6431012N; and
- A hollow in Marri which showed no signs of use – 388238E 6431118N.

Feral bees were observed in 8 locations within the site.

Figure 2 provides a map illustrating the locations where possible suitable hollows were located. Appendix B provides a summary of data results for the foraging assessment. Data from the 2009 Breeding Assessment (360 Environmental, 2009) was included in Figure 2 and Appendix B.

5.2 Black Cockatoo Foraging Assessment

There was a relatively large amount of old feeding evidence on the seeds of Marri and *Banksia attenuata*. Recent feeding evidence was also observed on Marri seeds. The following provides a summary of feeding evidence observed during the foraging assessment.

- Old evidence of feeding on seeds from *Banksia attenuata* – 388435E 6430749N;
- Old evidence of feeding on seeds from *Banksia attenuata* – 388427E 6430945N;
- Old evidence of feeding on seeds from *Banksia attenuata* – 388473E 6430927N;
- Old evidence of feeding on seeds from Marri – 388319E 6430725N;
- Recent evidence of feeding on seeds from Marri – 388275E 6430680N;

- Old evidence of feeding on seeds from Marri – 388131E 6430839N;
- Old evidence of feeding on seeds from Marri – 388486E 6431012N;
- Old evidence of feeding on seeds from Marri – 388507E 6431043N;
- Old evidence of feeding on seeds from Marri – 388552E 6431110N;
- Old evidence of feeding on seeds from Marri – 388481E 6431118N;
- Old evidence of feeding on seeds from Marri – 388422E 6431125N;
- Old evidence of feeding on seeds from Marri – 388583E 6431447N; and
- Old evidence of feeding on seeds from Marri – 388608E 6431251N.

Figure 2 provides a map illustrating the locations where feeding evidence was found. Appendix B provides a summary of data results for the foraging assessment. Data from the 2009 Foraging Assessment (360 Environmental, 2009) was included in Figure 2 and Appendix B.

5.3 Black Cockatoo Opportunistic Observations

Thirty Carnaby's Black Cockatoos were seen milling around in gardens along Meares Avenue on the 21 March 2012. In early May at least three Red-tailed Black Cockatoos were sighted flying overhead while within the site. These birds did not utilise any trees within the site at the time of the observation. On 7 May 2012 five birds were sighted within a *Banksia attenuata* on the edge of the site along Meares Avenue. The location of these observations is displayed in Figure 2.

5.4 Black Cockatoo Significant Tree Assessment

A summary of the results of the Black Cockatoo significant Tree Survey are presented in Table 1 and Figure 3. The raw survey data is located in Appendix C.

In total, 1,063 trees were recorded on site with a trunk DBH greater than 400 mm. A total of 574 (54%) of these trees were recorded with a trunk DBH >500 mm. A total of 35 (3.3%) extra large trees were recorded within the site. These included primarily Marri, Jarrah and Tuart. An example of an extra large tree is displayed in Plate 1. The most commonly recorded tree species were Jarrah, Marri, Tuart and to a lesser extent Banksia. Sheoak and dead Stags were recorded less frequently. Jarrah and Tuart trees were located throughout the site. Marri occurs in clumps throughout the site usually replacing Tuart and to a lesser extent Jarrah (Figure 3).

Table 1: Black Cockatoo Significant Tree Survey Results

TRUNK SIZE (DBH)	JARRAH	MARRI	TUART	SHEOAK	BANKSIA	STAG	TOTAL
Small: 400mm – 500mm	194	114	72	20	89	0	489
Medium: 500mm – 800mm	135	97	165	8	17	5	427
Large: 800mm – 1200mm	38	13	50	1	1	9	112
Extra Large: >1200mm	12	10	10	0	0	3	35
TOTAL	379	234	297	29	107	17	1,063



Plate 1: An example of an extra large tree (>1,200mm DBH)

It is evident that fires have recently occurred at the site and the majority of significant trees displayed various degrees of fire scarring. Recent fire damage was recorded while conducting the tree survey (Figure 4; Appendix C). In general most trees survived the recent fire events, giving the impression it was a cool burn. The fire appears to have caused little to no permanent damage.

6 Discussion

Potential nesting hollows were identified in a Tuart tree (388213E 6431257N) and two Marri trees (338486E 6431012N and 388238E 6431118N). One of the hollows located in the Marri trees was too low and small for use by Black Cockatoos. The other hollow in Marri showed no signs of use. The hollow located in the Tuart tree was occupied with feral bees and therefore not suitable for Black Cockatoos. Invasion of tree hollows by feral bees leads to a reduction in the number of suitable hollows left for Black Cockatoos (WAM, 2011). A number of Black Cockatoo chicks have been found dead in such hollows as a result of being stung by feral bees (WAM, 2011). Based on this, it is considered unlikely that a Black Cockatoo would utilise or pursue the invaded tree hollow/s as a nest hollow suitable for breeding. Consequently, only one suitable nesting hollow for Black Cockatoos was identified within the site area during this survey.

The occurrence of suitable feeding species (Banksia and Jarrah) and the sparse evidence of feeding debris recorded during the field survey suggests that although not extensively utilised, Carnaby's Black Cockatoo do at least occasionally utilise the survey area for foraging and feeding. The majority of the feeding evidence was old feeding evidence on seeds. There were three locations which showed evidence of Carnaby's Black Cockatoo feeding and ten locations which showed evidence of Forest Red-Tailed Black Cockatoo feeding. Of these, only one location showed recent evidence of Black Cockatoo feeding. This suggests that the survey area is used to some extent by Carnaby's and Forest Red-Tailed Black Cockatoos. Tail feathers and scats were recorded, which indicates the presence of a small roost site within the study area. The evidence recorded during this survey suggests that the study area is used by Carnaby's and Forest Red-Tailed Black Cockatoos for feeding and to some extent roosting but not currently for breeding.

The Black Cockatoo Significant Tree Survey revealed that a large proportion of the site contains old trees, many of which have reached a size that SEWPaC would consider a potential breeding tree. In total 574 trees were recorded which met SEWPaC's criteria of >500 mm DBH. This suggests that the site has the potential to be of significance to Black Cockatoo species in the future.

7 Summary and Recommendations

The evidence recorded during this survey suggests that the study area is used by Carnaby's and Forest Red-Tailed Black Cockatoos for feeding and to some extent roosting, but not breeding. Therefore in order to reduce the impacts of the proposed development on Black Cockatoos, the following are recommended:

- Retain as many trees with a trunk diameter at breast height (DBH) of 500 mm or greater. The Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) considers that trees over 500 mm could provide breeding and foraging habitat for Black Cockatoo species. Trees with DBH less than 500 mm are considered foraging habitat for the Black Cockatoo species. SEWPaC places higher value on potential breeding trees over foraging trees. It is recommended that emphasis be placed on retaining potential breeding and foraging trees to minimise impacts. Should offsets be required for vegetation clearing they are likely to be greater for the clearing of breeding habitat; and
- Retain trees that display hollows. These trees may be suitable for breeding of bird species and may become suitable for Black Cockatoo species over time (as the trees grow and the hollows increase in size). If clearing of trees with hollows is unavoidable, it is recommended that hollows are inspected prior to clearing to ensure that hollows are not currently occupied or in use.
- Consider offset of the impacts of clearing of habitat as a last resort after consideration of minimising and otherwise mitigating impacts. Offset could include the purchase of land containing appropriate habitat (including suitable Black Cockatoo habitat);
- Clear habitat in stages to allow fauna to disperse away from the site;
- Feral bee control could be implemented on site to remove feral bees from the hollows of trees that remain on site; and
- Conduct clearing operations outside the breeding season for Black Cockatoos. Carnaby's Black Cockatoo and Baudin's Black Cockatoo breed in late winter to spring (although Carnaby's primarily breed in the wheatbelt) and Red-tailed Black Cockatoos breed within a period from September to April. This will reduce the likelihood of Black Cockatoos using the site during clearing.

8 Limitations

This report is produced strictly in accordance with the scope of services set out in the contract or otherwise agreed in accordance with the contract. 360 Environmental makes no representations or warranties in relation to the nature and quality of biological results other than the visual observation and analytical data in this report.

In the preparation of this report, 360 Environmental has relied upon documents, information, data and analyses (“client’s information”) provided by the client and other individuals and entities. In most cases where client’s information has been relied upon, such reliance has been indicated in this report. Unless expressly set out in this report, 360 Environmental has not verified that the client’s information is accurate, exhaustive or current and the validity and accuracy of any aspect of the report including, or based upon, any part of the client’s information is contingent upon the accuracy, exhaustiveness and currency of the client’s information. 360 Environmental shall not be liable to the client or any other person in connection with any invalid or inaccurate aspect of this report where that invalidity or inaccuracy arose because the client’s information was not accurate, exhaustive and current or arose because of any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to 360 Environmental.

Aspects of this report, including the opinions, conclusions and recommendations it contains, are based on the results of the investigation, sampling and testing set out in the contract and otherwise in accordance with normal practices and standards. The investigation, sampling and testing are designed to produce results that represent a reasonable interpretation of the general conditions of the site that is the subject of this report. However, due to the characteristics of the site, including natural variations in site conditions, the results of the investigation, sampling and testing may not accurately represent the actual state of the whole site at all points.

It is important to recognise that site conditions, including the extent and concentration of contaminants, can change with time. This is particularly relevant if this report, including the data, opinions, conclusions and recommendations it contains, are to be used a considerable time after it was prepared. In these circumstances, further investigation of the site may be necessary.

Subject to the terms of the contract between the Client and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating parts of this report is prohibited (except to the extent required by law) unless the report is produced in its entirety including this page, without the prior written consent of 360 Environmental Pty Ltd.

9 References

- 360 Environmental 2006. Kwinana Town Centre. Spring Flora Survey.
- 360 Environmental 2009. Kwinana Town Centre. Black Cockatoo Survey Results.
- 360 Environmental 2011. Lots E 26, 303 and 9014 Gilmore Avenue Kwinana. Environmental Assessment.
- Department of Environment and Conservation (DEC) 2009. Carnaby's Black-cockatoo *Calyptorhynchus latirostris* (Carnaby 1948)
www.dec.wa.gov.au/component/option,com_docman/Itemid,117/task,doc_download/ Accessed on 2/3/2012.
- Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) 2011. Environment Protection and Biodiversity Conservation Act 1999 draft referral guidelines for three threatened black cockatoo species
<http://www.environment.gov.au/epbc/publications/pubs/referral-guidelines-wa-black-cockatoo.pdf> Accessed on 2/3/2012.
- Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) 2012. Species Profiles and Threats Database. Available from
<http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl> Accessed on 2/3/2012
- Johnstone, R.E. and Kirkby, T. 2006. Cockatoos in Crisis. *Landscape*. 21 (2)
- Johnstone, RE and Storr, GM 1998. Handbook of Western Australian Birds Volume 1 – Nonpasserines (Emu to Dollarbird), Western Australian Museum.
- Western Australian Museum 2011. Feral Bees
<http://www.museum.wa.gov.au/explore/online-exhibitions/cockatoo-care/feral-bees> Accessed 1/12/11.

APPENDIX A

Figures



COPYRIGHT: THIS DOCUMENT IS AND SHALL REMAIN THE PROPERTY OF 360 ENVIRONMENTAL. THIS DOCUMENT IS TO BE USED ONLY FOR THE PURPOSES FOR WHICH IT HAS BEEN ISSUED AND NOT FOR ANY OTHER PURPOSE. ANY REPRODUCTION OF THIS DOCUMENT WITHOUT THE WRITTEN PERMISSION OF 360 ENVIRONMENTAL IS STRICTLY PROHIBITED.

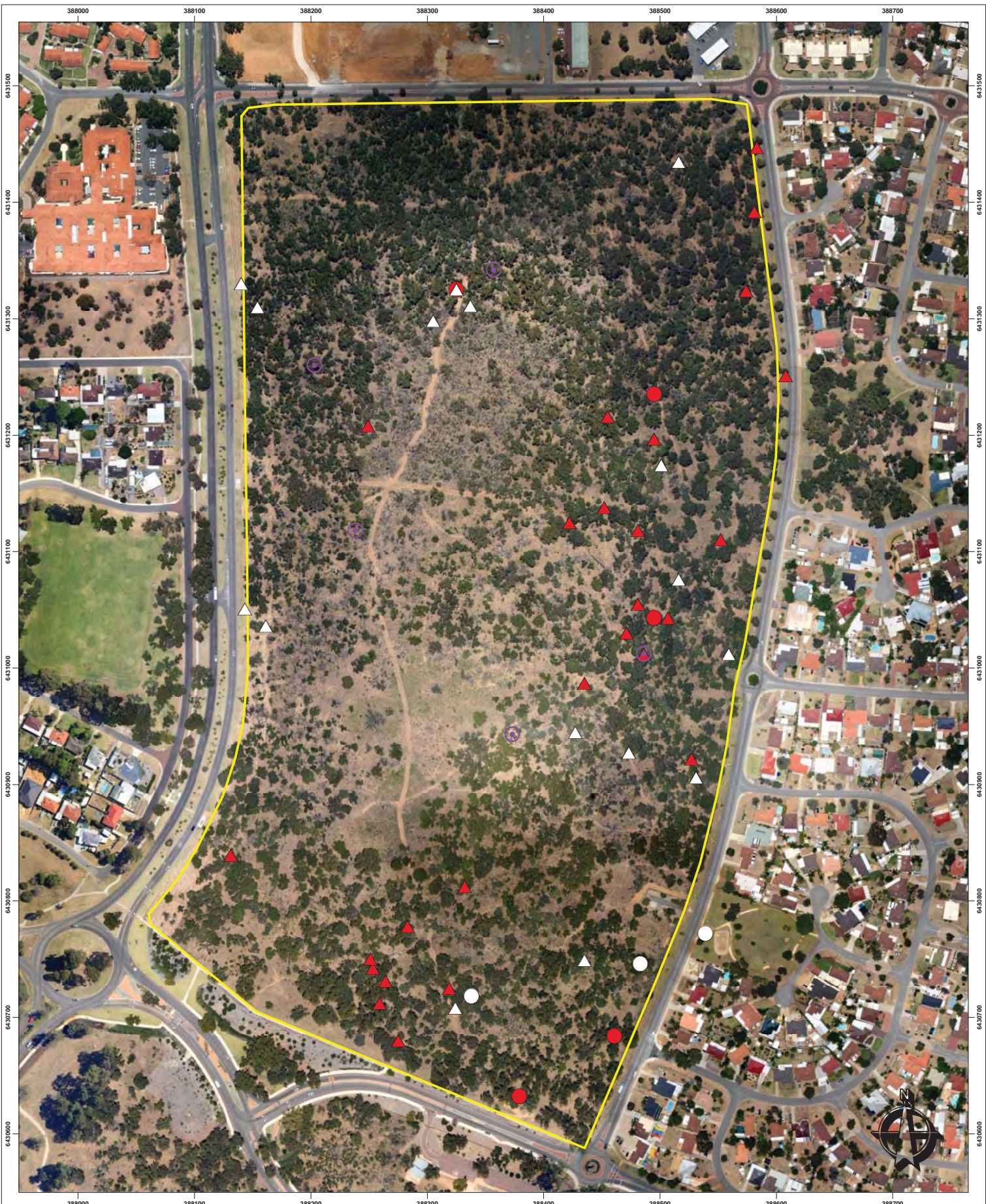
Legend

Site Boundary



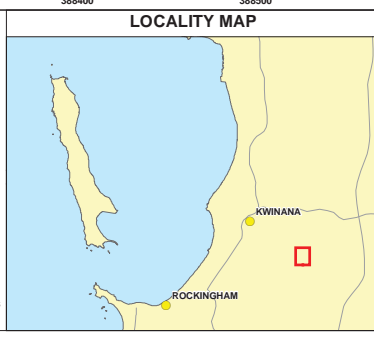
1:3,000 @ A3			
DRAWING ID		DATE	
EBS165-1.01		18/04/2012	
HORIZONTAL DATUM AND PROJECTION			
GDA 1994 MGA Zone 50			
CREATED	CHECKED	APPROVED	REVISION
TD	AH	AH	0
Satterley Property Group			
Black Cockatoo Survey			
Kwinana Town Centre			
Site Location			
Figure 1			

- NOTE THAT POSITION ERRORS CAN BE $\pm 5\text{M}$ IN SOME AREAS
 - AERIAL PHOTOGRAPHY SOURCED FROM NEARMAP 2012
 - LOCALITY MAP SOURCED FROM LANDGATE 2006



Legend

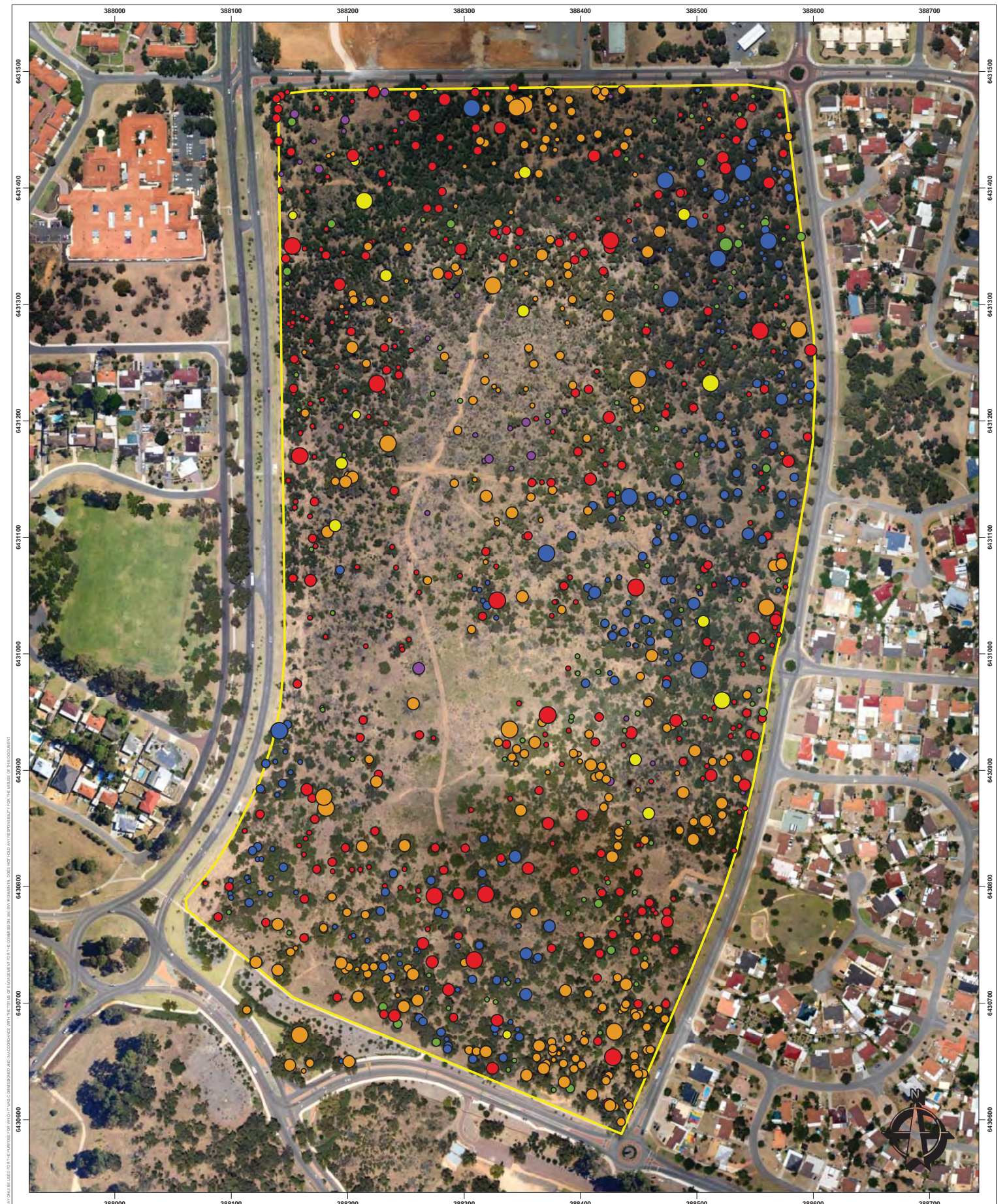
- Site Boundary
- Possible Cockatoo Nesting Hollow
- Carnaby's Black Cockatoo Sighting Location
- Carnaby's Black Cockatoo Feeding Location
- Red-tailed Black Cockatoo Sighting Location
- ▲ Red-tailed Black Cockatoo Feeding Location



DRAWING ID EBS165-1.02		DATE 10/05/2012	
HORIZONTAL DATUM AND PROJECTION GDA 1994 MGA Zone 50			
CREATED JJ	CHECKED AH	APPROVED AH	REVISION 0
Satterley Property Group			
Black Cockatoo Survey Kwinana Town Centre Black Cockatoo Sighting and Feeding Sites			
Figure 2			

- NOTE THAT POSITION ERRORS CAN BE $\pm 5\text{M}$ IN SOME AREAS
 - AERIAL PHOTOGRAPHY SOURCED FROM NEARMAP 2012
 - LOCALITY MAP SOURCED FROM LANDSAT 2006

COPYRIGHT: THIS DOCUMENT IS AND SHALL REMAIN THE PROPERTY OF SATTERLEY PROPERTY GROUP. IT IS TO BE USED ONLY FOR THE PURPOSES FOR WHICH IT WAS COMMISSIONED AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT THE WRITTEN PERMISSION OF SATTERLEY PROPERTY GROUP.



<p>Legend</p> <p> Site Boundary</p> <p>Trunk Diameter (mm)</p> <ul style="list-style-type: none"> 400 - 500 500 - 800 800 - 1200 >1200 		<p>Species</p> <ul style="list-style-type: none"> ● Banksia ● Jarrah ● Marri ● Sheoak ● Stag ● Tuart 	<p>LOCALITY MAP</p>	<p>1:3,000 @ A3</p> <p>0 15 30 60 90 120 Metres</p> <table border="1"> <tr> <td colspan="2">DRAWING ID</td> <td colspan="2">DATE</td> </tr> <tr> <td colspan="2">EBS165-1.03</td> <td colspan="2">10/05/2012</td> </tr> <tr> <td colspan="4">HORIZONTAL DATUM AND PROJECTION</td> </tr> <tr> <td colspan="4">GDA 1994 MGA Zone 50</td> </tr> <tr> <td>CREATED</td> <td>CHECKED</td> <td>APPROVED</td> <td>REVISION</td> </tr> <tr> <td>JJ</td> <td>AH</td> <td>AH</td> <td>0</td> </tr> </table> <p>Satterley Property Group</p> <p>Black Cockatoo Survey Kwinana Town Centre Black Cockatoo Significant Tree Survey</p> <p>Figure 3</p>	DRAWING ID		DATE		EBS165-1.03		10/05/2012		HORIZONTAL DATUM AND PROJECTION				GDA 1994 MGA Zone 50				CREATED	CHECKED	APPROVED	REVISION	JJ	AH	AH	0
DRAWING ID		DATE																										
EBS165-1.03		10/05/2012																										
HORIZONTAL DATUM AND PROJECTION																												
GDA 1994 MGA Zone 50																												
CREATED	CHECKED	APPROVED	REVISION																									
JJ	AH	AH	0																									



- Legend**
- Site Boundary
 - Trunk Diameter (mm)**
 - 400 - 500
 - 500 - 800
 - 800 - 1200
 - >1200

- Evidence of Fire**
- Evidence of Fire
 - No Evidence of Fire



1:3,000 @ A3

DRAWING ID		DATE	
EBS165-1.04		10/05/2012	
HORIZONTAL DATUM AND PROJECTION			
GDA 1994 MGA Zone 50			
CREATED	CHECKED	APPROVED	REVISION
JJ	AH	AH	0

Satterley Property Group

**Black Cockatoo Survey
Kwinana Town Centre
Significant Trees with Evidence of Fire
Figure 4**

- NOTE THAT POSITION ERRORS CAN BE $\pm 5\text{M}$ IN SOME AREAS
- AERIAL PHOTOGRAPHY SOURCED FROM NEARMAP 2012
- LOCALITY MAP SOURCED FROM LANDGATE 2006

APPENDIX B

Black Cockatoo Breeding, Foraging and Sighting Data

DATE	SPECIES	EASTINGS (UTM GDA 94 ZONE 50)	NORTHINGS (UTM GDA 94 ZONE 50)	COMMENTS
19/03/2009	Red-tailed Black Cockatoo <i>Calyptorhynchus banksii naso</i> (Evidence of feeding on Marri was at all stages from grey to fairly recent (up to a month old). Generally fairly extensive and well used area)	388379	6430632	Two calling
		388461	6430684	16 heading west at 08:00
		388527	6430922	Recent evidence of feeding on Jarrah
		388574	6431324	Evidence of feeding on the seeds of Marri
		388554	6431760	Evidence of feeding on the seeds of Marri
		388581	6431392	Evidence of feeding on the seeds of Marri
		388495	6431197	Evidence of feeding on the seeds of Marri
		388452	6431138	Recent evidence of feeding on the seeds of Marri
		388495	6431043	Evidence of feeding on the seeds of Marri
		388495	6431043	Two heading east at 12:15
		388435	6430987	Evidence of feeding on the seeds of Marri
		388338	6430718	Evidence of feeding on the seeds of Marri
		388471	6431030	Evidence of feeding on the seeds of Marri
		388481	6431055	Evidence of feeding on the seeds of Marri
		388455	6431216	Evidence of feeding on the seeds of Marri
		388332	6430812	Old grey evidence of feeding on the seeds of Marri
		388283	6430778	Evidence of feeding on the seeds of Marri
		388253	6430742	Evidence of feeding on the seeds of Marri
		388325	6431325	Three heading east at 13:30
		388249	6431208	Recent evidence of feeding on the seeds of Sheoak
388251	6430750	Evidence of feeding on the seeds of Marri		

DATE	SPECIES	EASTINGS (UTM GDA 94 ZONE 50)	NORTHINGS (UTM GDA 94 ZONE 50)	COMMENTS
		388264	6430731	Evidence of feeding on the seeds of Marri
		388259	6430712	Recent evidence of feeding on the seeds of Jarrah, several trees
	Carnaby's Cockatoo <i>Calyptorhynchus latirostris</i> (Evidence of feeding was old and fairly recent. Most were small amounts only)	388531	6430906	Clippings from <i>Banksia attenuata</i>
		388559	6431012	Evidence of feeding on the seeds of <i>Banksia attenuata</i> , several trees
		388516	6431076	Evidence of feeding on the seeds of <i>Banksia attenuata</i>
		388585	6431748	Evidence of feeding on the seeds of <i>Banksia attenuata</i>
		388516	6431435	Clippings from <i>Banksia attenuata</i>
		388501	6431174	Evidence of feeding on the seeds of <i>Banksia attenuata</i>
		388324	6430708	Evidence of feeding on the seeds of <i>Banksia attenuata</i>
		388338	6430718	Three calling from west at 11:30
		388337	6431311	Evidence of feeding on the seeds of <i>Banksia attenuata</i>
		388325	6431325	Clippings from <i>Banksia attenuata</i>
		388305	6431298	Evidence of feeding from nectar of <i>Banksia attenuata</i>
		388143	6431051	Evidence of feeding on the seeds of <i>Banksia attenuata</i>
		388154	6431310	- Carnaby's Cockatoo feeding debris from <i>Banksia attenuata</i> nectar. Small amount
		388140	6431330	- Carnaby's Cockatoo feeding debris from <i>Banksia attenuata</i> seeds. Small amount
		388161	6431036	- Carnaby's Cockatoo feeding debris from <i>Banksia attenuata</i>
	Possible Cockatoo	388357	6431342	Chewed hollow in Tuart

DATE	SPECIES	EASTINGS (UTM GDA 94 ZONE 50)	NORTHINGS (UTM GDA 94 ZONE 50)	COMMENTS
	nest hollows	388373	6430943	Well Chewed hollow in Jarrah
		388203	6431260	Chewed hollow in Tuart
3/21/2012	Carnaby's Cockatoo <i>Calyptorhynchus latirostris</i>	388539	6430772	07:00. 30 birds milling around in gardens along Meares Ave.
		388435	6430749	Old evidence of feeding on seeds from <i>Banksia attenuata</i> .
		388427	6430945	Old evidence of feeding on seeds from <i>Banksia attenuata</i> .
		388473	6430927	Old evidence of feeding on seeds from <i>Banksia attenuata</i> .
	Forest Red-tailed Black Cockatoo <i>Calyptorhynchus banksii naso</i>	388319	6430725	Old evidence of feeding on seeds from Marri <i>Corymbia calophyla</i> .
		388275	6430680	Redent evidence of feeding on seeds from Marri <i>Corymbia calophyla</i> .
		388131	6430839	Old evidence of feeding on seeds from Marri <i>Corymbia calophyla</i> .
		388486	6431012	Old evidence of feeding on seeds from Marri <i>Corymbia calophyla</i> .
		388507	6431043	Old evidence of feeding on seeds from Marri <i>Corymbia calophyla</i> .
		388552	6431110	Old evidence of feeding on seeds from Marri <i>Corymbia calophyla</i> .
		388481	6431118	Old evidence of feeding on seeds from Marri <i>Corymbia calophyla</i> .
		388422	6431125	Old evidence of feeding on seeds from Marri <i>Corymbia calophyla</i> .
		388583	6431447	Old evidence of feeding on seeds from Marri <i>Corymbia calophyla</i> .
		388608	6431251	Old evidence of feeding on

DATE	SPECIES	EASTINGS (UTM GDA 94 ZONE 50)	NORTHINGS (UTM GDA 94 ZONE 50)	COMMENTS
				seeds from Marri <i>Corymbia calophyla</i> .
		388583	6431216	Tail feather and scats located indicating small roost site in Marri <i>Corymbia calophyla</i> .
	Possible Cockatoo nest hollows	388486	6431012	Slightly chewed hollow in Marri <i>Corymbia calophyla</i> . Too low and slightly small to be a black cockatoo hollow.
		388238	6431118	Hollow in Marri <i>Corymbia calophyla</i> , shows no signs of use.
	Feral honey bees <i>Apis mellifera</i>	388460	6430815	Hive in Tuart <i>Eucalyptus gomphocephala</i> .
		388434	6430677	Hive in Tuart <i>Eucalyptus gomphocephala</i> .
		388451	6430904	Hive in Jarrah <i>Eucalyptus marginata</i> .
		388486	6431012	Hive in Marri <i>Corymbia calophyla</i> .
		388507	6431043	2 hives in Marri <i>Corymbia calophyla</i> .
		388238	6431118	2 hives in Marri <i>Corymbia calophyla</i> .
		388213	6431257	Hollow in Tuart <i>Eucalyptus gomphocephala</i> which looks a suitable size for Black Cockatoos but contains feral honey bees <i>Apis mellifera</i> .
		388503	6431365	Hive in Tuart <i>Eucalyptus gomphocephala</i> .
4/5/2012	Forest Red-tailed Black Cockatoo <i>Calyptorhynchus banksii naso</i>	388495	6431235	At least three Red-tailed Black Cockatoo flew overhead
7/5/2012	Carnaby's Cockatoo <i>Calyptorhynchus</i>	388483	6430746	Carnaby foraging in tree. <i>Banksia attenuata</i>

DATE	SPECIES	EASTINGS (UTM GDA 94 ZONE 50)	NORTHINGS (UTM GDA 94 ZONE 50)	COMMENTS
	<i>latirostris</i>			

APPENDIX C

Black Cockatoo Significant Tree Data

TREE NUMBER	EASTINGS	NORTHINGS	DGPS	SPECIES	DBH	SIZE	
	(UTM GDA 94 ZONE 50)	(UTM GDA 94 ZONE 50)	REFERENCE NUMBER			CATEGORY	FIRE
1	388479.83909	6430789.49889	358	Jarrah	401.070457	2	Y
2	388474.40584	6430778.13016	359	Jarrah	509.295818	3	Y
3	388429.46980	6430675.30079	360	Tuart	1823.915648	5	
4	388428.10813	6430653.55511	361	Jarrah	1209.577567	5	Y
5	388410.18664	6430621.31570	362	Tuart	1031.324031	4	
6	388424.69605	6430612.71704	363	Jarrah	974.028252	4	Y
7	388425.55365	6430611.83954	364	Tuart	1117.267701	4	
8	388429.52355	6430610.66376	365	Tuart	741.662035	3	
9	388434.94192	6430597.75168	366	Tuart	792.591617	3	
10	388441.47240	6430612.12606	367	Tuart	550.676103	3	
11	388440.99651	6430612.56429	368	Tuart	474.28173	2	
12	388438.51181	6430615.75212	369	Tuart	445.633841	2	
13	388422.02051	6430633.19859	370	Tuart	798.957814	3	
14	388421.72567	6430634.30405	371	Tuart	630.253575	3	
15	388424.51623	6430637.55009	372	Tuart	544.309905	3	
16	388450.03255	6430638.94034	373	Tuart	776.676122	3	
17	388454.55055	6430639.32279	374	Tuart	773.811333	3	
18	388451.99488	6430640.40331	375	Tuart	550.676103	3	
19	388451.41255	6430641.94907	376	Tuart	416.985951	2	
20	388446.96430	6430643.78480	377	Tuart	665.267662	3	
21	388447.03893	6430645.55955	378	Tuart	592.056388	3	
22	388446.46763	6430654.64465	379	Tuart	537.943708	3	
23	388457.34119	6430659.64292	380	Tuart	588.873289	3	
24	388460.07181	6430659.78391	381	Tuart	611.154981	3	
25	388457.12718	6430679.04293	382	Tuart	751.211331	3	
26	388472.78182	6430686.20046	383	Tuart	735.295837	3	
27	388467.23008	6430694.12191	384	Tuart	630.253575	3	
28	388460.51729	6430696.26528	385	Tuart	458.366236	2	
29	388473.48535	6430699.29096	386	Jarrah	582.507092	3	Y
30	388449.64984	6430699.24977	387	Jarrah	588.873289	3	

TREE NUMBER	EASTINGS	NORTHINGS	DGPS	SPECIES	DBH	SIZE	
	(UTM GDA 94 ZONE 50)	(UTM GDA 94 ZONE 50)	REFERENCE NUMBER			CATEGORY	FIRE
31	388446.62557	6430691.56633	388	Tuart	531.57751	3	
32	388451.35400	6430689.95544	389	Tuart	690.732453	3	
33	388447.97741	6430688.58774	390	Tuart	757.577529	3	
34	388480.89825	6430744.71883	391	Jarrah	541.126807	3	
35	388482.45934	6430748.39478	392	Jarrah	490.197225	2	
36	388415.05083	6430667.15899	393	Jarrah	665.267662	3	
37	388417.04375	6430674.38758	394	Banksia	426.535247	2	
38	388434.83811	6430692.54498	395	Tuart	436.084544	2	
39	388437.81465	6430696.01482	396	Tuart	512.478917	3	
40	388439.38428	6430698.91477	397	Tuart	541.126807	3	
41	388439.19592	6430715.98678	398	Tuart	904.000077	4	
42	388441.15092	6430718.11489	399	Tuart	452.000038	2	
43	388448.14267	6430716.30723	400	Banksia	429.718346	2	
44	388455.31310	6430732.46258	401	Tuart	537.943708	3	
45	388455.81350	6430738.34425	402	Banksia	442.450742	2	
46	388446.98298	6430744.56646	403	Jarrah	623.887377	3	
47	388465.32435	6430755.85586	404	Jarrah	623.887377	3	
48	388474.87313	6430769.93089	405	Jarrah	958.431067	4	Y
49	388462.79569	6430780.10864	406	Jarrah	439.267643	2	
50	388459.33714	6430786.16838	407	Jarrah	525.211312	3	
51	388446.99295	6430794.90186	408	Banksia	432.901445	2	
52	388377.07430	6430625.27416	409	Banksia	401.070457	2	
53	388386.13839	6430632.02647	410	Tuart	846.704297	4	
54	388391.19102	6430626.64958	411	Banksia	525.211312	3	
55	388394.68255	6430643.20785	412	Tuart	732.112738	3	
56	388401.14696	6430646.49446	413	Tuart	681.183156	3	
57	388395.99645	6430652.20288	414	Tuart	754.39443	3	
58	388386.34021	6430647.88321	415	Tuart	474.28173	2	
59	388385.39942	6430647.76195	416	Tuart	636.619772	3	
60	388381.62521	6430656.81169	417	Tuart	445.633841	2	

TREE NUMBER	EASTINGS	NORTHINGS	DGPS	SPECIES	DBH	SIZE	
	(UTM GDA 94 ZONE 50)	(UTM GDA 94 ZONE 50)	REFERENCE NUMBER			CATEGORY	FIRE
61	388382.56600	6430656.93294	418	Tuart	436.084544	2	
62	388377.24789	6430660.75471	419	Tuart	423.352149	2	
63	388385.81900	6430660.96020	420	Tuart	426.535247	2	
64	388389.39864	6430669.53676	421	Tuart	646.169069	3	
65	388403.55335	6430667.47558	422	Tuart	655.718366	3	
66	388403.19856	6430674.01304	423	Tuart	436.084544	2	
67	388416.46509	6430692.67486	424	Jarrah	401.070457	2	
68	388418.97184	6430696.02864	425	Tuart	544.309905	3	
69	388406.78186	6430707.86815	426	Tuart	655.718366	3	
70	388414.64223	6430721.25938	427	Jarrah	754.39443	3	
71	388431.88121	6430721.44961	428	Tuart	738.478936	3	
72	388416.57644	6430742.34616	429	Jarrah	630.253575	3	
73	388426.71970	6430745.22985	430	Banksia	547.493004	3	
74	388427.79632	6430758.65709	431	Jarrah	585.690191	3	Y
75	388432.35599	6430772.34449	432	Banksia	442.450742	2	
76	388439.10555	6430775.41247	433	Jarrah	490.197225	2	Y
77	388453.10627	6430778.78218	434	Jarrah	732.112738	3	Y
78	388460.57156	6430785.29503	435	Jarrah	506.112719	3	Y
79	388464.80574	6430777.24818	436	Jarrah	436.084544	2	Y
80	388449.29037	6430757.45291	437	Tuart	674.816959	3	
81	388440.95411	6430770.11107	438	Jarrah	407.436654	2	Y
82	388360.47267	6430661.23473	439	Tuart	477.464829	2	Y
83	388354.04019	6430637.99172	440	Tuart	846.704297	4	
84	388368.39425	6430643.47200	441	Tuart	932.647967	4	
85	388370.98660	6430647.60284	442	Tuart	709.831046	3	
86	388377.07053	6430651.21787	443	Tuart	420.16905	2	
87	388376.42944	6430658.08478	444	Tuart	592.056388	3	
88	388376.40007	6430660.74535	445	Tuart	722.563442	3	
89	388364.50253	6430663.16403	446	Tuart	888.084582	4	
90	388362.53903	6430653.27485	447	Tuart	763.943727	3	

TREE NUMBER	EASTINGS	NORTHINGS	DGPS	SPECIES	DBH	SIZE	
	(UTM GDA 94 ZONE 50)	(UTM GDA 94 ZONE 50)	REFERENCE NUMBER			CATEGORY	FIRE
91	388375.20601	6430666.49745	448	Tuart	709.831046	3	
92	388387.15482	6430710.64503	449	Tuart	868.985989	4	
93	388407.33727	6430751.44646	450	Tuart	993.126845	4	
94	388400.94863	6430758.36081	451	Jarrah	432.901445	2	
95	388415.63199	6430785.24269	452	Banksia	569.774696	3	Y
96	388417.49281	6430795.90681	453	Banksia	522.028213	3	Y
97	388418.54616	6430794.36625	454	Jarrah	620.704278	3	Y
98	388423.72366	6430803.29303	455	Banksia	467.915533	2	Y
99	388422.74371	6430806.71921	456	Jarrah	407.436654	2	Y
100	388434.08106	6430795.31376	457	Jarrah	502.92962	3	Y
101	388449.44107	6430812.11382	458	Jarrah	627.070476	3	Y
102	388427.24836	6430825.39519	459	Tuart	1177.746579	4	
103	388432.23013	6430834.98503	460	Tuart	623.887377	3	Y
104	388432.88591	6430843.86192	461	Tuart	636.619772	3	Y
105	388432.85533	6430846.63335	462	Tuart	722.563442	3	
106	388433.13671	6430846.74733	463	Tuart	776.676122	3	
107	388435.45999	6430849.65560	464	Tuart	496.563422	2	
108	388452.75785	6430835.98760	465	Jarrah	477.464829	2	Y
109	388420.18074	6430868.22415	466	Tuart	770.309925	3	
110	388401.79027	6430861.36897	467	Jarrah	1040.873328	4	
111	388337.90303	6430717.19697	468	Banksia	429.718346	2	
112	388327.34520	6430700.67151	470	Banksia	401.070457	2	
113	388328.55527	6430684.94122	471	Jarrah	881.718385	4	
114	388333.80881	6430652.84673	473	Marri	728.929639	3	
115	388324.48661	6430643.87411	474	Jarrah	1200.028271	4	
116	388338.25715	6430642.47401	475	Banksia	452.000038	2	
117	388343.25711	6430650.40105	476	Banksia	436.084544	2	
118	388347.55599	6430670.62699	477	Marri	518.845114	3	
119	388337.26230	6430672.84160	478	Stag	528.394411	3	
120	388346.07196	6430677.04111	479	Marri	477.464829	2	

TREE NUMBER	EASTINGS	NORTHINGS	DGPS	SPECIES	DBH	SIZE	
	(UTM GDA 94 ZONE 50)	(UTM GDA 94 ZONE 50)	REFERENCE NUMBER			CATEGORY	FIRE
121	388339.87417	6430683.73578	480	Marri	490.197225	2	
122	388353.18095	6430707.27644	481	Marri	824.422605	4	
123	388346.26743	6430719.06327	482	Marri	464.732434	2	
124	388359.55105	6430736.17316	483	Marri	420.16905	2	
125	388360.96653	6430735.96705	484	Marri	445.633841	2	
126	388353.36059	6430742.20270	485	Marri	818.056407	4	
127	388363.57237	6430738.87846	486	Marri	588.873289	3	
128	388375.25954	6430746.99018	487	Jarrah	537.943708	3	
129	388374.27952	6430767.49044	488	Marri	598.422586	3	
130	388389.62473	6430777.08384	489	Banksia	452.000038	2	
131	388403.15808	6430788.65289	490	Banksia	416.985951	2	Y
132	388394.97098	6430813.39757	491	Jarrah	725.74654	3	Y
133	388417.89045	6430828.17457	492	Jarrah	572.957795	3	Y
134	388531.95570	6430830.76307	128	Jarrah	429.718346	2	
135	388513.30611	6430847.40980	129	Tuart	690.732453	3	
136	388510.70029	6430853.03548	130	Tuart	569.774696	3	
137	388507.65034	6430856.21710	131	Tuart	878.535286	4	
138	388510.16694	6430858.68400	132	Tuart	588.873289	3	
139	388521.91180	6430861.58525	133	Tuart	553.859202	3	
140	388521.61340	6430871.56032	134	Tuart	993.126845	4	
141	388536.77394	6430863.74476	135	Jarrah	464.732434	2	
142	388541.44745	6430867.12239	136	Jarrah	407.436654	2	
143	388539.88654	6430880.52053	137	Sheoak	458.366236	2	
144	388541.13085	6430887.29735	138	Jarrah	821.239506	4	
145	388534.76056	6430892.54893	139	Tuart	576.140894	3	
146	388543.67959	6430912.49308	140	Jarrah	907.183176	4	
147	388527.59029	6430910.54180	141	Tuart	674.816959	3	
148	388523.11250	6430906.50109	142	Tuart	709.831046	3	
149	388513.86831	6430907.50788	143	Tuart	639.802871	3	
150	388508.82653	6430903.35008	144	Jarrah	452.000038	2	

TREE NUMBER	EASTINGS	NORTHINGS	DGPS	SPECIES	DBH	SIZE	
	(UTM GDA 94 ZONE 50)	(UTM GDA 94 ZONE 50)	REFERENCE NUMBER			CATEGORY	FIRE
151	388512.39763	6430895.62851	145	Jarrah	1002.676141	4	
152	388505.45833	6430892.66936	146	Jarrah	432.901445	2	
153	388488.71468	6430907.34140	147	Jarrah	588.873289	3	
154	388498.41286	6430916.42886	148	Tuart	849.887396	4	
155	388511.68244	6430943.40586	149	Jarrah	464.732434	2	
156	388529.17608	6430929.07467	150	Jarrah	442.450742	2	
157	388550.27900	6430929.19641	151	Jarrah	585.690191	3	
158	388545.82820	6430931.25389	152	Jarrah	512.478917	3	
159	388536.80550	6430937.80668	153	Jarrah	464.732434	2	
160	388531.45542	6430935.97377	154	Jarrah	404.253555	2	
161	388542.90200	6430948.85007	155	Jarrah	636.619772	3	
162	388557.30791	6430949.67406	156	Banksia	572.957795	3	
163	388556.51505	6430944.67615	157	Jarrah	515.662016	3	
164	388548.09069	6430956.77907	158	Banksia	432.901445	2	
165	388543.93360	6430966.37899	159	Banksia	490.197225	2	
166	388543.10531	6430964.59593	160	Tuart	531.57751	3	
167	388553.89727	6430968.48448	161	Banksia	429.718346	2	
168	388557.17270	6430987.59032	162	Jarrah	426.535247	2	
169	388555.66067	6430996.55417	163	Jarrah	467.915533	2	
170	388549.07149	6431013.11214	164	Jarrah	1050.422624	4	
171	388557.20242	6431010.54086	165	Banksia	455.183137	2	
172	388565.15471	6431007.08063	166	Jarrah	477.464829	2	
173	388570.61262	6431016.23216	167	Jarrah	436.084544	2	
174	388567.33880	6431022.62658	168	Jarrah	413.802852	2	
175	388568.11702	6431028.95478	169	Jarrah	837.155001	4	
176	388567.83074	6431029.28424	170	Jarrah	493.380324	2	
178	388569.01143	6431033.28859	172	Jarrah	604.788784	3	
179	388560.27250	6431039.73365	173	Tuart	1356.000115	5	
180	388540.64755	6431059.36320	174	Jarrah	490.197225	2	
181	388533.08303	6431061.82985	175	Marri	732.112738	3	

TREE NUMBER	EASTINGS	NORTHINGS	DGPS	SPECIES	DBH	SIZE	
	(UTM GDA 94 ZONE 50)	(UTM GDA 94 ZONE 50)	REFERENCE NUMBER			CATEGORY	FIRE
182	388527.87119	6431064.54416	176	Marri	487.014126	2	
183	388537.02108	6431046.46224	177	Banksia	471.098632	2	
184	388538.76383	6430999.47232	178	Jarrah	401.070457	2	
185	388539.79996	6430990.94670	179	Jarrah	413.802852	2	
186	388532.24238	6430958.60005	180	Jarrah	439.267643	2	
187	388521.77104	6430959.81507	181	Stag	1276.422644	5	
188	388514.96379	6430953.42040	182	Jarrah	413.802852	2	
189	388506.94901	6430945.46022	183	Jarrah	416.985951	2	
190	388490.23813	6430940.06504	184	Banksia	442.450742	2	
191	388482.20144	6430942.63731	185	Jarrah	1034.50713	4	
192	388479.04862	6430938.05684	186	Tuart	649.352168	3	
193	388474.35676	6430936.34204	187	Tuart	728.929639	3	
194	388484.91855	6430926.92364	188	Jarrah	410.619753	2	
195	388497.17773	6430840.46886	189	Tuart	837.155001	4	
196	388497.48249	6430855.55063	190	Tuart	553.859202	3	
197	388485.50149	6430848.43366	191	Tuart	783.04232	3	
198	388460.84587	6430837.29640	192	Banksia	439.267643	2	
199	388449.74702	6430835.62177	193	Jarrah	487.014126	2	Y
200	388455.53992	6430840.00963	194	Tuart	598.422586	3	
201	388441.24189	6430855.04118	195	Banksia	404.253555	2	
202	388458.77476	6430862.77380	196	Stag	1196.845172	4	
203	388449.79127	6430882.85316	197	Tuart	448.81694	2	
204	388460.82781	6430890.18150	198	Jarrah	397.887358	2	
205	388447.52438	6430908.99363	199	Stag	1005.85924	4	
206	388462.53947	6430905.83314	200	Sheoak	416.985951	2	
207	388483.35966	6430897.41486	201	Tuart	407.436654	2	
208	388488.35110	6430880.50670	202	Tuart	989.943746	4	
209	388474.12947	6430974.03554	203	Marri	658.901464	3	
210	388474.37663	6430977.25352	204	Jarrah	579.323993	3	
211	388475.91337	6430991.68365	205	Marri	496.563422	2	

TREE NUMBER	EASTINGS	NORTHINGS	DGPS	SPECIES	DBH	SIZE	
	(UTM GDA 94 ZONE 50)	(UTM GDA 94 ZONE 50)	REFERENCE NUMBER			CATEGORY	FIRE
212	388473.26471	6431001.18931	206	Marri	499.746521	2	
213	388475.91357	6431017.29476	207	Marri	576.140894	3	
214	388483.95751	6430996.98328	208	Marri	509.295818	3	
215	388502.07160	6430986.20683	209	Marri	1604.281826	5	
216	388505.85491	6431027.60328	210	Stag	967.980364	4	
217	388508.87294	6431010.22987	211	Jarrah	738.478936	3	
218	388513.07417	6431005.17614	212	Jarrah	407.436654	2	
219	388500.47423	6431028.54179	213	Marri	404.253555	2	
220	388503.23333	6431051.74417	214	Marri	436.084544	2	
221	388515.02374	6431059.08075	215	Jarrah	445.633841	2	
222	388570.47136	6431054.70270	216	Marri	420.16905	2	
223	388515.20359	6431059.85882	216	Banksia	416.985951	2	
224	388576.56904	6431057.09817	217	Jarrah	436.084544	2	
225	388570.47395	6431063.01802	218	Banksia	429.718346	2	
226	388566.47472	6431075.39145	219	Tuart	849.887396	4	Y
227	388573.52424	6431076.91045	220	Tuart	1088.619811	4	
228	388572.67517	6431077.01196	221	Tuart	827.605704	4	
229	388572.79640	6431083.11118	222	Jarrah	537.943708	3	
230	388556.32905	6431098.34073	223	Marri	725.74654	3	
231	388544.31363	6431102.86488	224	Marri	954.929659	4	
232	388506.86352	6431072.84961	225	Jarrah	531.57751	3	Y
233	388507.53189	6431106.22903	226	Marri	525.211312	3	
234	388560.81916	6431101.27285	227	Jarrah	579.323993	3	
235	388571.64211	6431119.46401	228	Marri	703.464848	3	
236	388583.11827	6431129.67967	229	Marri	557.042301	3	
237	388573.15337	6431136.22212	230	Marri	563.408499	3	
238	388583.82217	6431151.30719	231	Marri	786.225419	3	Y
239	388578.76834	6431165.33207	232	Jarrah	1107.718404	4	
240	388573.60670	6431172.03830	233	Tuart	442.450742	2	
241	388565.99813	6431178.49583	234	Marri	725.74654	3	

ATTACHMENT 2J



360
environmental



Black Cockatoo
Survey - Lot 9001
Bertram Road,
Parmelia

Prepared for:

Department of Housing/
Satterley Property Group

September 2012

● people ● planet ● professional

Document Reference	Revision	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
EBS197_2AB	A INTERNAL DRAFT	AH	FD/TS	-	13/09/12
EBS197_2AB	B CLIENT DRAFT	AH	Client	1 Electronic (email)	26/09/12

Disclaimer

This report is issued in accordance with, and is subject to, the terms of the contract between the Client and 360 Environmental Pty Ltd, including, without limitation, the agreed scope of the report. To the extent permitted by law, 360 Environmental Pty Ltd shall not be liable in contract, tort (including, without limitation, negligence) or otherwise for any use of, or reliance on, parts of this report without taking into account the report in its entirety and all previous and subsequent reports. 360 Environmental Pty Ltd considers the contents of this report to be current as at the date it was produced. This report, including each opinion, conclusion and recommendation it contains, should be considered in the context of the report as a whole. The opinions, conclusions and recommendations in this report are limited by its agreed scope. More extensive, or different, investigation, sampling and testing may have produced different results and therefore different opinions, conclusions and recommendations. Subject to the terms of the contract between the Client and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating parts of this report is prohibited (except to the extent required by law) unless the report is produced in its entirety including this cover page, without the prior written consent of 360 Environmental Pty Ltd.

© Copyright 2012 360 Environmental Pty Ltd ACN 109 499 041

Executive Summary

360 Environmental Pty Ltd (360 Environmental) was commissioned by Satterley Property Group on behalf of the Department of Housing (DoH) to undertake a Black Cockatoo Foraging Activity Survey (the survey) at Lot 9001 Parmelia Avenue, Parmelia (the site) (Figure 1). The site is proposed to be utilised for residential development, comprises an area of approximately 50 hectares (ha) and is located in the Town of Kwinana.

The site is composed of mostly uncleared bushland with Tuart (*Eucalyptus gomphocephala*), Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) with occasional Banksia (*Banksia* species) throughout and a stand of Sheoak (*Allocasuarina fraseriana*) present along the northern border of the site.

A search of the Environment Protection and Biodiversity Conservation (EPBC) database revealed that the Vulnerable Forest Red-tailed Black Cockatoo and the Endangered Carnaby's Black Cockatoo are likely to occur within the area.

The current survey identified only one potentially suitable nesting hollow for Black Cockatoo within the site. However, no evidence of Black Cockatoo breeding was recorded. Suitable feeding species (Marri, Jarrah and Banksia) and sparse evidence of feeding debris were recorded at the site. The majority of the feeding evidence was recent foraging evidence on seeds. There were eight locations which showed evidence of Carnaby's Black Cockatoo feeding and one location which showed evidence of Forest Red-tailed Black Cockatoo feeding. Of these, only one location showed old evidence of Black Cockatoo feeding (Carnaby's Black Cockatoo), while the rest was recent evidence. This suggests that although not extensively utilised, both Carnaby's Black Cockatoo and Forest Red-tailed Black Cockatoo do at least occasionally utilise the survey area for foraging and potentially for breeding.

The suggestion that Black Cockatoo's occasionally utilise the site is supported by the sighting of one Forest Red-tailed Black Cockatoo in the eastern part of the site. Furthermore, one Forest Red-tailed Black Cockatoo calling and four Carnaby's Black Cockatoo's callings were recorded onsite.

From the outcomes of this report the following are recommended:

- Retain as many trees with a trunk diameter at breast height (DBH) of 500 mm or greater. The Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) considers that trees over 500 mm could provide breeding and foraging habitat for Black Cockatoo species. Trees with DBH less than 500 mm are considered foraging habitat for the Black Cockatoo species. SEWPaC places higher value on potential breeding trees over foraging trees;
- Retain trees that display hollows. These trees may be suitable for breeding of bird species and may become suitable for Black Cockatoo species over time (as the trees grow and the hollows increase in size). If clearing of trees with hollows

is unavoidable, it is recommended that hollows are inspected prior to clearing to ensure that hollows are not currently occupied or in use;

- Consider offset of the impacts of clearing of habitat as a last resort after consideration of avoiding, minimising and otherwise mitigating impacts. Offset could include the purchase of land containing appropriate habitat (including suitable Black Cockatoo habitat);
- Clear habitat in stages to allow fauna to disperse away from the site;
- Feral bee control could be implemented on site to remove feral bees from the hollows of trees that remain on site; and
- Conduct clearing operations outside the breeding season for Black Cockatoos. Carnaby's Black Cocktoos breed in late winter to spring (although Carnaby's primarily breed in the wheatbelt) and Forest Red-tailed Black Cockatoos breed within a period from September to April. This will reduce the likelihood of impact to Black Cockatoos during clearing.

Table of Contents

1	Introduction	5
1.1	Background	5
1.2	Objectives	5
1.3	Scope of the Study	5
2	Site Description.....	6
2.1	Site Location	6
2.2	Broad Habitat Assessment	6
3	Methods.....	7
3.1	Background Research	7
3.2	Black Cockatoo Breeding and Foraging Assessment Methodology.....	7
3.3	Significant Tree Survey Methodology	8
4	Results	10
4.1	Background Research Results	10
4.2	Black Cockatoo Breeding Assessment	12
4.3	Black Cockatoo Foraging Assessment.....	14
4.4	Black Cockatoo Opportunistic Observations	15
4.5	Black Cockatoo Significant Tree Assessment.....	15
5	Discussion.....	17
6	Summary and Recommendations.....	18
7	Limitations.....	19
8	References	20

List of Tables

Table 1: Evidence of Foraging Activity	15
Table 2: Summary of Significant Tree Survey Results	16

List of Figures

Figure 1: Site Location	22
Figure 2: Location of Breeding, Foraging and Sighting Records	23
Figure 3: Black Cockatoo Significant Tree Survey	24
Figure 4: Black Cockatoo Sightings and Feeding Sites	25

List of Appendices

Appendix A: Figures	21
Appendix B: Black Cockatoo Breeding, Foraging and Sighting Data.....	26
Appendix C: Black Cockatoo Significant Tree Data.....	28

1 Introduction

1.1 Background

Three species of Black Cockatoo occur in the south-west of Western Australia. All three species are protected under the following State and Federal legislation:

- The *Wildlife Conservation Act 1950* (WC Act), Western Australia; and
- The Environment Protection and Biodiversity Conservation Act (EPBC Act), Commonwealth.

The Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) is listed as Endangered under the EPBC Act. The Red-tailed Black Cockatoo (*Calyptorhynchus banksii*) and Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) are classified as Vulnerable. Both Carnaby's Black Cockatoo and Baudin's Black Cockatoo are listed as Endangered under the WC Act. The Forest Red-tailed Black Cockatoo is listed as Vulnerable.

360 Environmental Pty Ltd (360 Environmental) was commissioned to undertake a Black Cockatoo Breeding and Foraging Survey at Lot 9001 Parmelia Avenue, Parmelia (the site) (Figure 1). The Department of Housing and Satterley Property Group has proposed the area be utilised for residential development.

1.2 Objectives

The objectives of the Black Cockatoo Foraging Activity Survey were to:

- Identify significant feeding and breeding habitat suitable for Black Cockatoos and evidence of feeding and opportunistic observations at the site with reference to the Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) (2011) draft referral guidelines for Black Cockatoos; and
- Determine the extent of the use of the site by Black Cockatoos.

1.3 Scope of the Study

In order to determine what areas of the survey site would be considered foraging or breeding habitat for Black Cockatoos, a Black Cockatoo Foraging Activity Assessment was undertaken. The Black Cockatoo Survey included:

- Background Research;
- On site Black Cockatoo Breeding Assessment;
- On site Black Cockatoo Foraging Assessment; and
- On site Black Cockatoo Opportunistic Observations.

2 Site Description

2.1 Site Location

The site is approximately 50 hectares in size and is bounded by Parmelia Avenue (in parts), St Vincent's Primary School and Bush Forever Site 67 on the west side, Challenger Avenue to the north, the Perth to Mandurah rail line and Bollard Bullrush Swamp to the east and Tuart and Wellard Roads on the southern side.

2.2 Broad Habitat Assessment

The majority of the site is uncleared bushland. In 2010, 360 Environmental conducted a site assessment of the area. The vegetation consists of Tuart (*Eucalyptus gomphocephala*) and Jarrah (*Eucalyptus marginata*) with sections of Marri (*Corymbia calophylla*) and *Banksia* species (360 Environmental, 2010a). The vegetation within the survey area can be classified into six broad vegetation groups. These groups are Tuart woodlands, Tuart mixed woodlands, Jarrah-Marri woodlands, Jarrah-Banksia woodlands, Marri woodlands and shallow limestone shrublands (360 Environmental, 2010a).

The condition of the vegetation in the survey area was mostly in the range of Good to Good to Degraded. Some physical disturbance has occurred in various places in the survey area; especially Jarrah trees appear to be in poor health, believed to be caused by damage by the larvae of leafminer (*Perthida glyphopa*) (360 Environmental, 2010a).

Cleared areas around the Mandurah-Perth railway line corridor were Completely Degraded. A former limestone quarry covered a large area in the central-southern part of the survey area (Figure 1). The old quarry area included large cleared and excavated areas, widespread remnant or regrowth *Eucalyptus gomphocephala* (Tuart) trees and small patches of regrowth vegetation or remnant vegetation (mostly Degraded, some Good condition) (360 Environmental, 2010a).

3 Methods

3.1 Background Research

The background research is designed to gather existing data on known locations of feeding for Black Cockatoo. The background research and desktop study included review of the following websites and documents:

- DEC's website on Black Cockatoos;
- SEWPaC's EPBC Act draft referral guidelines; and
- Reports of previous studies undertaken in the area.

3.2 Black Cockatoo Breeding and Foraging Assessment Methodology

3.2.1 Survey Personnel

The Black Cockatoo Breeding Survey was undertaken by Black Cockatoo specialist Tony Kirkby on 14 July 2012. Tony Kirkby was a technical officer at the WA Museum and has had significant field experience with Black Cockatoos in Western Australia. He is considered an expert in the area of protected Black Cockatoos and has authored a number of papers on the subject. Over the last seven years Tony has collected, recorded and photographed most of the food taken by the three south-west Black Cockatoos and has to date a database of over 20,000 records and an image library of over 3,000 Black Cockatoos and Black Cockatoo food related photographs.

3.2.2 Black Cockatoo Breeding Site Assessment

This assessment involved observation of suitably sized trees with the potential for hollows to be present. Each tree was assessed to determine if hollows were present. If hollows were present each was assessed with the use of binoculars to determine its suitability for use by Black Cockatoo species as a breeding hollow. Any suitable hollows that were located were assessed to determine if they were being utilised by Black Cockatoo species as a breeding hollow. The assessment method takes into consideration the size and shape of the hollow, chew marks around the entrance, feathers nearby or any other signs that indicate that Black Cockatoo may potentially utilise the hollow.

3.2.3 Black Cockatoo Foraging Site Assessment

Tony Kirkby undertook a one day site visit to conduct an observational site survey and feeding assessment across all survey areas to determine the extent of foraging habitat for Black Cockatoos at the same time as the breeding assessment was undertaken. The observational and foraging assessment included:

- General habitat suitability of the sites;

- Analysis of dentition marks in seed and nut material;
- Opportunistic observations of Black Cockatoos within the proposed development area; and
- Casual opportunistic observations of potential breeding habitat.

Feeding trees and opportunistic observations were recorded and located using a hand held Differential Global Positioning System (DGPS) unit (Appendix B).

3.3 Significant Tree Survey Methodology

3.3.1 Site Survey

The Black Cockatoo Significant Tree Survey conducted on 15 to the 18 February 2010. The survey was undertaken to determine number of trees in within the areas that are of a certain size, as outlined by SEWPaC, and have the potential in the future to develop hollows suitable for Black Cockatoo breeding. The 2010 survey comprised of recording the location, species, tree trunk diameter at breast height (DBH) and any other important descriptive information about each tree located within the site boundary.

In 2010, 25 m x 25 m grids were designed across the site. Each consecutive grid was surveyed to ensure all trees were included. Tree details were individually recorded electronically using a DGPS.

3.3.2 Black Cockatoo Significant Tree Criteria

Trees exceeding 500 mm trunk (DBH) (~1.5 m above ground level) were considered environmentally significant for the purposes of this survey

3.3.2.1 Tree Location (using DGPS)

Each significant tree was individually recorded using a DGPS to obtain Universal Transverse Mercator (UTM GDA 94 Zone 50) coordinates.

3.3.2.2 Tree Species

Each significant tree was individually recorded according to its species, as either:

- Jarrah (*Eucalyptus marginata*);
- Marri (*Corymbia calophylla*);
- Tuart (*Eucalyptus gomphocephala*);
- Sheoak (*Allocasuarina fraseriana*);
- Hakea (*Hakea sp.*);
- Banksia (*Banksia attenuata* or *Banksia menziesii*); or
- Stag (standing dead tree).

The species with the potential to develop hollows were then mapped to visually represent the tree species with the potential to be of breeding significance to Black Cockatoos.

3.3.2.3 Trunk Diameter at Breast Height

Each significant tree was individually recorded according to its trunk DBH, as either:

- Small: 400 mm to 500 mm;
- Medium: 500 mm to 800 mm;
- Large: 800 mm to 1,200 mm; and
- Very Large: 1,200 mm+.

4 Results

The Black Cockatoo Foraging and Breeding Assessment and Black Cockatoo Significant Tree Survey results have been included within this report and discussed in detail below.

4.1 Background Research Results

4.1.1 Black Cockatoo Species

A search of the EPBC database revealed that the Vulnerable Forest Red-tailed Black Cockatoo and the Endangered Carnaby's Black Cockatoo are likely to occur within the site. There is a possibility that Baudin's Black Cockatoo may also occur occasionally within the site. Only three species of Black Cockatoo occur within the south west of Western Australia. Each is described below in detail

4.1.1.1 Carnaby's Black Cockatoo

Carnaby's Black Cockatoo is a large, Black Cockatoo with a white patch on its cheek, white bands on its tail, and a strong curved bill. Carnaby's Black Cockatoo is also known as the Short-billed Cockatoo. In males, the bill is black and the eye-ring dark-pink. Females have a light grey bill, grey eye-ring, and the cheek patch is less distinctive.

Carnaby's Black Cockatoo is endemic to the southwest of Western Australia, extending from the Murchison River to Esperance, and inland to Coorow, Kellerberrin and Lake Cronin (DEC, 2009). There is evidence the species is currently expanding its breeding range westward and south into the Jarrah-Marri forests of the Darling Range and into the Tuart forests of the Swan Coastal Plain (Johnstone and Kirkby, 2006).

Carnaby's Black Cockatoos are believed to breed mostly in the wheatbelt region of Western Australia (DEC, 2009). After breeding, Carnaby's Cockatoo disperse to the higher rainfall coastal areas of the south-west of Western Australia to feed in late December to July (DEC, 2009).

Carnaby's Black Cockatoo display strong pair bonds. They occur in uncleared or remnant areas of Eucalypt woodland, principally Salmon gum (*Eucalyptus salmonophloia*) or Wandoo (*E. wandoo*), and shrubland or kwongan heath dominated by *Hakea* and *Banksia* species. Carnaby's Black Cockatoo nest in the hollows of live or dead smooth-barked Eucalypts (Salmon Gum and Wandoo) but also in Red Morrell (*E. longicornis*), York Gum (*E. loxophleba*), Marri and Tuart (Johnstone and Storr, 1998).

On the Swan Coastal Plain, the birds feed on a large variety of plants including the Proteaceae (*Banksia* and *Grevillea*), Marri nuts and introduced species – notably Pines (DEC, 2009).

Carnaby's Black Cockatoo has undergone a dramatic decline in recent years, declining by 50 percent in the past 45 years, one of the main contributing factors being land

clearing (DEC, 2009). The long-term survival and recovery of this species is linked to the survival of its habitat – both in breeding areas in the Wheatbelt and non-breeding areas such as the Swan Coastal Plain (DEC, 2009). In addition, clearing of heathland near breeding sites has reduced the availability of food for breeding pairs and their young (DEC, 2009).

4.1.1.2 Forest Red-tailed Black Cockatoo

The Forest Red-tailed Black Cockatoo is 55–60 cm in length and weighs between 570 and 870 g (Higgins 1999). Males can be distinguished by broad red tail panels that are only visible when taking off or alighting (Higgins 1999). Females on the other hand can be distinguished by yellow or whitish spots on the feathers of the head and upper wing coverts. Their tail feathers are bright red and orange, grading to yellow on the inner margins, and have variable black horizontal barring.

This species is endemic to the south-west humid and semi-humid zones of Western Australia. It inhabits dense Jarrah, Karri and Marri forests which receive more than 600mm average annual rainfall (SEWPaC, 2012). Although most records are in Jarrah-Marri forests, the Forest Red-tailed Black Cockatoo has been observed in a range of other forest and woodland types, including Blackbutt (*E. patens*), Wandoo (*E. wandoo*), Tuart (*E. gomphocephala*), Albany Blackbutt, Yate (*E. cornuta*), and Flooded Gum (*E. rudis*) (Abbott 1998a,b).

Forest Red-tailed Black Cockatoos feed predominantly on the seeds of Jarrah and Marri fruits. The other species used for feeding include Blackbutt, Albany Blackbutt (*E. staeri*), Forest Sheoak, Snottygobble and the non-indigenous native Spotted Gum (*E. maculata*) and Cape Lilac (Johnstone & Kirkby 1999).

The Forest Red-tailed Black Cockatoo has declined in range by 25–30% as a result of clearing of the margins of the forests for agriculture in the early 1900s (Mawson & Johnstone 1997) and is projected to further decline by 30% or more between 2005 and 2015 (Chapman 2005).

Key threats to the Forest Red-tailed Black Cockatoo are habitat loss, nest hollow shortage and competition for available nest hollows from other species, and injury or death from the European Honeybee (*Apis mellifera*), illegal shooting (Chapman 2005) and fire (WA CALM 2006).

4.1.1.3 Baudin's Black Cockatoo

Baudin's Black Cockatoo is a large black cockatoo which measures 50–57 cm in length, with a wingspan of approximately 110 cm, and a mass of 560–770 g. It is mostly dull black in colour, with pale whitish margins on the feathers, large, rounded patches on the ear coverts, and rectangular white panels in the tail. It has a large bill that is coloured black in the male and whitish-grey with a black tip in the female. It also features a dark

brown iris that is surrounded by a reddish-pink eye-ring in the male and a grey eye-ring in the female. (Higgins 1999; Johnstone & Storr 1998)

This species is only found in the extreme south-west of Western Australia. It occurs in areas of high rainfall and usually in heavily forested locations dominated by Marri, Karri or Jarrah. However, it also occurs in woodlands of Wandoo (*E. wandoo*), Blackbutt (*E. patens*), Flooded Gum (*E. rudis*), Yate (*E. cornuta*) and in orchards, and is occasionally recorded in farmland and grasslands (Johnstone & Kirkby 2008).

The diet of Baudin's Black Cockatoo consists mostly of Eucalyptus seeds (e.g. Marri and Jarrah) and occasionally insect larvae and the seeds of other plants such as *Banksia*, *Dryandra*, *Erodium*, *Hakea*, *Malus sylvestris* (apple) and *Pyrus communis* (pear), and occasionally with nectar from Marri or other plants (Higgins 1999).

Baudin's Black-Cockatoo is gregarious. It is usually seen in groups of three (comprising the adult pair and a single dependent young) or in small parties, but will occasionally gather in large flocks of up to 300 birds during the non-breeding season, usually at sites where food is abundant (Higgins 1999). During the breeding season, adults nest in solitary pairs

4.2 Black Cockatoo Breeding Assessment

A breeding assessment was undertaken alongside the foraging activity assessment. This assessment identified three trees with hollows that may be suitable to support breeding by Black Cockatoos throughout the site. Two large Tuart trees were observed to support hollows, but their hollows were occupied by feral bees and Galah nests and none of the hollows were suitable in shape or size for breeding by Black Cockatoo. One Marri featured a potential Black Cockatoo nesting hollow. This hollow was chewed which signified past use but currently held two bee hives that were observed within the same trunk as the suitable hollow (Plate 2 and 3). This suggests that feral bee activity may be negatively impacting the larger hollow.



Plate 1: Marri tree with a hollow suitable for Black Cockatoo



Plate 2: Marri tree with a hollow suitable for Black Cockatoo

4.3 Black Cockatoo Foraging Assessment

The site contained a mixture of habitat, most of which was dominated by large tree species and *Banksia*. These species are all suitable foraging species for Black Cockatoo (Figure 2). There was a relatively large amount of evidence of recent feeding on seeds of Marri by Forest Red-tailed Black Cockatoo within one area of the site (Plate 1). Feeding by Carnaby's Black Cockatoo on *Banksia attenuata* seeds was recorded on several occasions, most of this was new feeding evidence, while only one old indication of feeding on seeds of *Banksia attenuata* was recorded. Feeding on the nectar of *Banksia menziesii* was also recorded on two occasions by Carnaby's Black Cockatoo (Figure 4). The site contained a high level's of weeds throughout the site, which significantly hampered the ability to identify more feeding evidence throughout the site.



Plate 1: Feeding on *Corymbia calophylla* by Forest Red-tailed Black Cockatoo

The following table provides a summary of feeding evidence observed during the foraging assessment.

Table 1: Evidence of Foraging Activity

EVIDENCE	EASTING	NORTHING
Recent evidence of feeding on seeds from Marri <i>Corymbia calophylla</i> by Forest Red-tailed Black Cockatoo.	389759	6430717
Recent evidence of feeding on nectar from <i>Banksia menziesii</i> from two trees	389588	6430399
Recent evidence of feeding on nectar from <i>Banksia menziesii</i> from two trees	389617	6430407
Recent evidence of feeding on seeds of <i>Banksia attenuata</i>	389552	6430390
Recent evidence of feeding on seeds of <i>Banksia attenuata</i>	389490	6430307
Recent evidence of feeding on seeds of <i>Banksia attenuata</i>	389451	6430277
Recent evidence of feeding on seeds of <i>Banksia attenuata</i> . Several trees.	389446	6430273
Recent evidence of feeding on seeds of <i>Banksia attenuata</i>	389448	6430427
Old evidence of feeding on seeds of <i>Banksia attenuata</i>	389829	6430925

Figure 4 provides a map illustrating the locations where feeding evidence was found. Appendix B provides a summary of data results for the foraging assessment.

4.4 Black Cockatoo Opportunistic Observations

While conducting the foraging activity assessment, four opportunistic Black Cockatoo observations were recorded. One could be identified as a Forest Red-tailed Black Cockatoo, which occurred at 7.45 am in the eastern edge of the site. This bird was visually sighted and identified by its call. The other three were classified as Carnaby's Black Cockatoos based on calls which were recorded at 8.50 am in the southern section and at 9.15 am in the eastern section, followed by two calls at 10.50 am also in the eastern part of the site.

4.5 Black Cockatoo Significant Tree Assessment

In 2010, a significant tree survey was conducted within the site which identified 633 trees with a trunk diameter at breast height (DBH) (approximately 1.5 m above ground level) of 400 mm or greater (360 Environmental, 2010b). The dominant tree species observed were Tuart, Jarrah and Marri with a stand of Sheoak present along the northern border of the site. In total 449 Jarrah, Marri and Tuart trees were recorded with a trunk DBH > 500 mm which SEWPaC classifies as potential breeding habitat for Black Cockatoo Species. A summary of the results of the Black Cockatoo Significant Tree Survey are presented in Table 2 and Figure 3.

Table 2: Summary of Significant Tree Survey Results

Trunk Size (DBH)	Jarrah	Marri	Tuart	Sheoak	Banksia
Small: 400mm – 500mm	66	39	32	5	0
Medium: 500mm – 800mm	90	70	48	28	0
Large: 800mm – 1200mm	62	38	53	10	0
Extra Large: >1200mm	38	13	37	0	0
TOTAL	190	121	138	38	0

5 Discussion

A nesting hollow that could potentially be utilised by Black Cockatoos, was identified within a Marri tree (389690E 6430927N). Another two trees, both Tuarts (389519E 6430602N and 389540E 6430632N), were observed as supporting hollows that may be of an appropriate size for breeding by Black Cockatoos, but did not appear to contain any hollows currently suitable for Black Cockatoo species. Both hollows located in the Tuart trees were occupied with feral bees and Galah nests which would have limited any appeal to Black Cockatoo species. Invasion of tree hollows by feral bees leads to a reduction in the number of suitable hollows left for Black Cockatoos (WAM, 2011). A number of Black Cockatoo chicks have been found dead in such hollows as a result of being stung by feral bees (WAM, 2011). Based on this, it is considered unlikely that a Black Cockatoo would utilise or pursue the invaded tree hollow/s as a nest hollow suitable for breeding. Consequently, only one suitable nesting hollow for Black Cockatoos was identified within the site area during this survey, however this appeared to also be impacted by feral bees with two hives being observed within the hollows trunk.

The occurrence of suitable feeding species (Marri, Jarrah Tuart and Banksia) and the evidence of sparse feeding debris recorded during the field survey suggest that although not extensively utilised, Carnaby's Black Cockatoos and to a lesser extent Forest Red-tailed Black Cockatoos do at least occasionally utilise the survey area for foraging and feeding. There were eight locations which showed evidence of Carnaby's Black Cockatoo feeding and one location which showed evidence of Forest Red-Tailed Black Cockatoo feeding. The majority of the feeding evidence was recent feeding evidence on seeds and nectar with only one location showing old evidence of Black Cockatoo feeding (Carnaby's Black Cockatoo).

This suggests that the survey area is used to some extent by Carnaby's and Forest Red-tailed Black Cockatoos, mainly for feeding but not currently for breeding.

Despite the small amount of hollows found during this assessment, the 2010 Significant Tree Survey (360 Environmental, 2010b) indicated that there are a significant number of large trees species throughout the site. In total 449 trees which meet SEWPaC's criteria of >500mm DBH were recorded onsite. Therefore, the site has the potential to be of significance to Black Cockatoo species in the future.

6 Summary and Recommendations

The evidence recorded during this survey suggests that the study area is used by Carnaby's and Forest Red-Tailed Black Cockatoos for feeding and potentially for breeding. Therefore in order to reduce the impacts of the proposed development on Black Cockatoos, the following are recommended:

- Retain as many trees with a trunk diameter at breast height (DBH) of 500 mm or greater. The Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) considers that trees over 500 mm could provide breeding and foraging habitat for Black Cockatoo species. Trees with DBH less than 500 mm are considered foraging habitat for the Black Cockatoo species. SEWPaC places higher value on potential breeding trees over foraging trees. It is recommended that emphasis be placed on retaining potential breeding and foraging trees to minimise impacts;
- Retain trees that display hollows. These trees may be suitable for breeding of bird species and may become suitable for Black Cockatoo species over time (as the trees grow and the hollows increase in size). If clearing of trees with hollows is unavoidable, it is recommended that hollows are inspected prior to clearing to ensure that hollows are not currently occupied or in use;
- Consider offset of the impacts of clearing of habitat as a last resort after consideration of avoiding, minimising and otherwise mitigating impacts. Offset could include the purchase of land containing appropriate habitat (including suitable Black Cockatoo habitat);
- Clear habitat in stages to allow fauna to disperse away from the site;
- Feral bee control could be implemented on site to remove feral bees from the hollows of trees that remain on site; and
- Conduct clearing operations outside the breeding season for Black Cockatoos. Carnaby's Black Cockatoos breed in late winter to spring (although Carnaby's primarily breed in the wheatbelt) and Red-tailed Black Cockatoos breed within a period from September to April. This will reduce the likelihood of impact to Black Cockatoos during clearing.

7 Limitations

This report is produced strictly in accordance with the scope of services set out in the contract or otherwise agreed in accordance with the contract. 360 Environmental makes no representations or warranties in relation to the nature and quality of biological results other than the visual observation and analytical data in this report.

In the preparation of this report, 360 Environmental has relied upon documents, information, data and analyses (“client’s information”) provided by the client and other individuals and entities. In most cases where client’s information has been relied upon, such reliance has been indicated in this report. Unless expressly set out in this report, 360 Environmental has not verified that the client’s information is accurate, exhaustive or current and the validity and accuracy of any aspect of the report including, or based upon, any part of the client’s information is contingent upon the accuracy, exhaustiveness and currency of the client’s information. 360 Environmental shall not be liable to the client or any other person in connection with any invalid or inaccurate aspect of this report where that invalidity or inaccuracy arose because the client’s information was not accurate, exhaustive and current or arose because of any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to 360 Environmental.

Aspects of this report, including the opinions, conclusions and recommendations it contains, are based on the results of the investigation, sampling and testing set out in the contract and otherwise in accordance with normal practices and standards. The investigation, sampling and testing are designed to produce results that represent a reasonable interpretation of the general conditions of the site that is the subject of this report. However, due to the characteristics of the site, including natural variations in site conditions, the results of the investigation, sampling and testing may not accurately represent the actual state of the whole site at all points.

It is important to recognise that site conditions, including the extent and concentration of contaminants, can change with time. This is particularly relevant if this report, including the data, opinions, conclusions and recommendations it contains, are to be used a considerable time after it was prepared. In these circumstances, further investigation of the site may be necessary.

Subject to the terms of the contract between the Client and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating parts of this report is prohibited (except to the extent required by law) unless the report is produced in its entirety including this page, without the prior written consent of 360 Environmental Pty Ltd.

8 References

- 360 Environmental 2010a. Parmelia Avenue, Parmelia. Spring 2009 Flora and Vegetation Survey.
- 360 Environmental 2010b. Parmelia Avenue, Parmelia. Environmentally Significant Tree Survey.
- Department of Environment and Conservation (DEC) 2009. Carnaby's Black-cockatoo *Calyptorhynchus latirostris* (Carnaby 1948)
www.dec.wa.gov.au/component/option,com_docman/Itemid,/gid,117/task,doc_download/ Accessed on 27/7/2012.
- Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) 2011. Environment Protection and Biodiversity Conservation Act 1999 draft referral guidelines for three threatened black cockatoo species
<http://www.environment.gov.au/epbc/publications/pubs/referral-guidelines-wa-black-cockatoo.pdf> Accessed on 27/7/2012.
- Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) 2012. Species Profiles and Threats Database. Available from
<http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl> Accessed on 27/7/2012
- Johnstone, R.E. and Kirkby, T. 2006. Cockatoos in Crisis. Landscape. 21 (2)
- Johnstone, RE and Storr, GM 1998. Handbook of Western Australian Birds Volume 1 – Nonpasserines (Emu to Dollarbird), Western Australian Museum.
- Western Australian Museum 2011. Feral Bees
<http://www.museum.wa.gov.au/explore/online-exhibitions/cockatoo-care/feral-bees> Accessed 27/7/11.

APPENDIX A

Figures

Legend

- Site Boundary
- Major Roads
- Minor Roads

NOTE: THIS PROPOSED BOUNDARY - SHOWN IN YELLOW
 - WERE PHOTOGRAPHICALLY SOURCED FROM AN AERIAL PHOTO 2006
 - LOCALITY MAP SOURCED FROM TRAVELLERS AT LAE 2006



1:7,402 @A3

LOCALITY MAP

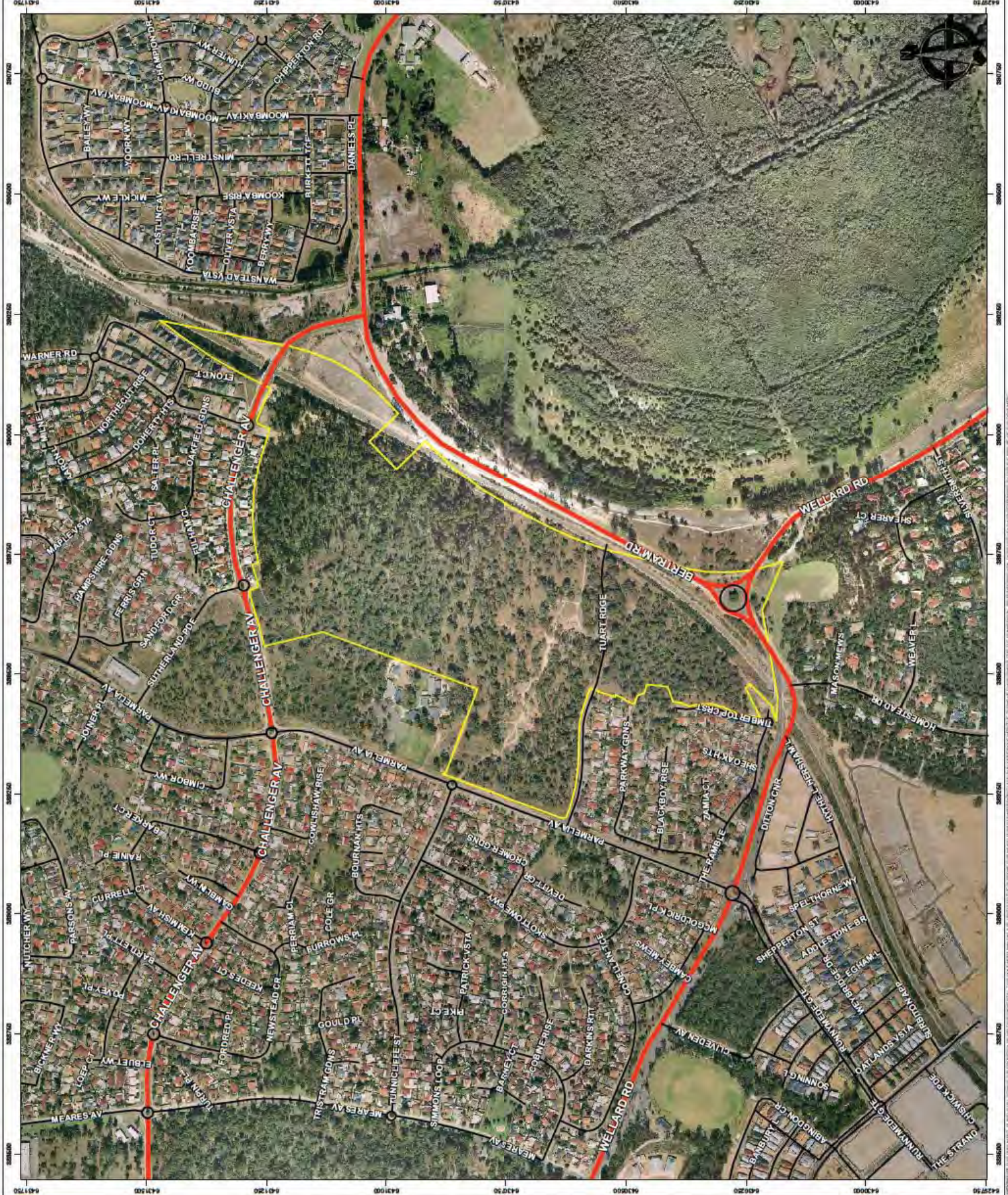


DRAWING ID	DATE		
ES1972-01	12/05/2012		
HORIZONTAL DATUM AND PROJECTION			
GDA 1984 MGA Zone 50			
CREATED	CHECKED	APPROVED	REVISION
JU	AH	FD	D

Satterley Property Group
 Lot 9001, Parmelia

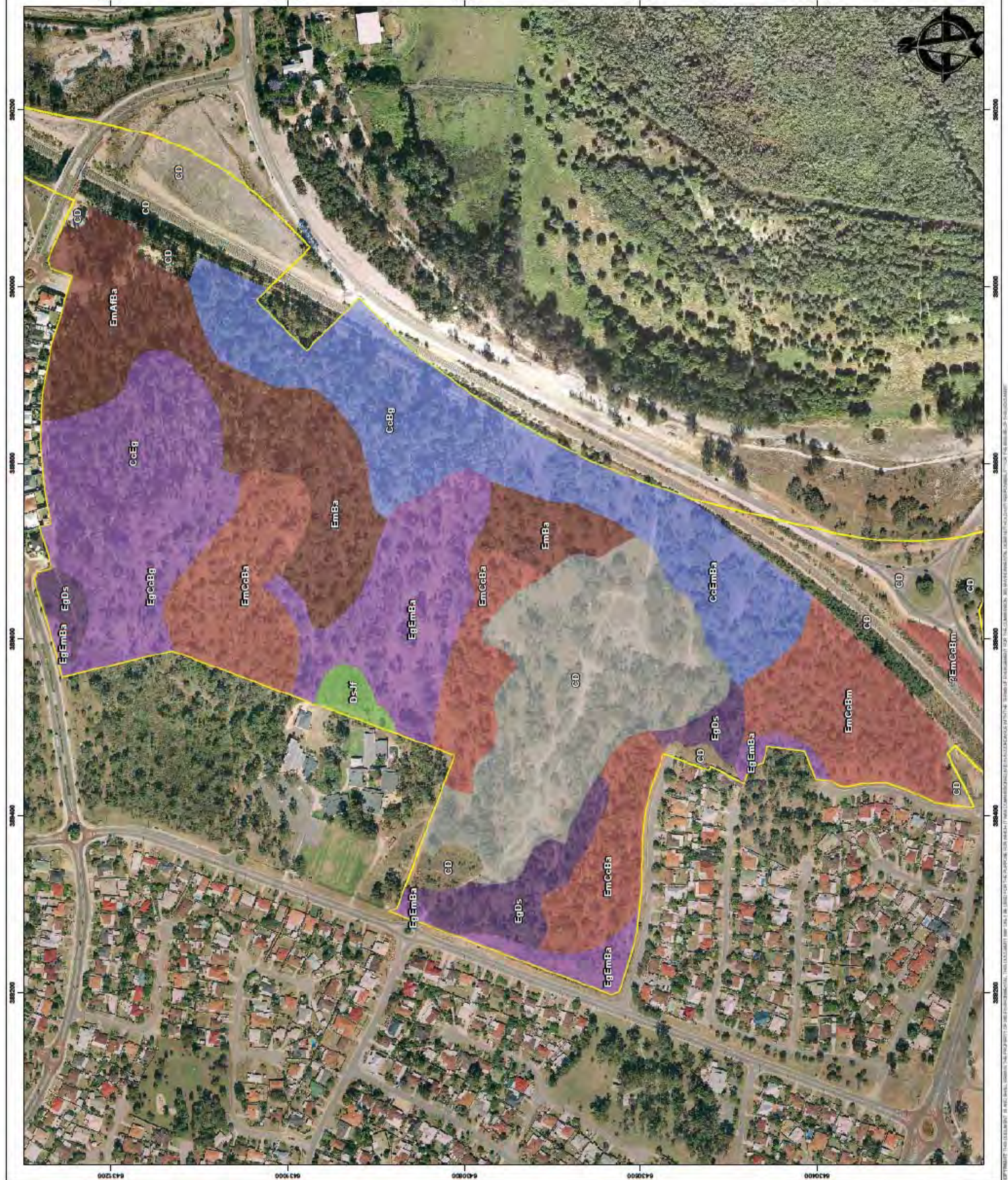
Black Cockatoo Survey
 Site Location

Figure 1

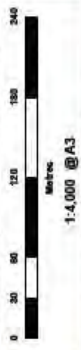


Legend

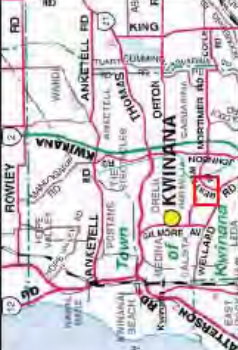
-  Site Boundary
- Vegetation Units**
-  CD - Completely Degraded
-  C. catophylla (Marr) woodland
-  Doyandra seccalis scrub
-  E. gomphocephala (Tuart) mixed woodland
-  E. gomphocephala (Tuart) woodland
-  E. marginata (Jarrah) - Banksia spp. woodland
-  E. marginata (Jarrah) - C. catophylla (Marr) - Banksia spp. woodland



- NOTE THAT POSITION ERRORS CAN BE $\pm 1M$ IN SOME AREAS
 - LOCALITY MAP SOURCED FROM THE BUREAU OF METEOROLOGY AND CLIMATE SERVICES 2006
 - LOCALITY MAP SOURCED FROM THE BUREAU OF METEOROLOGY AND CLIMATE SERVICES 2006
 - VEGETATION UNITS SOURCED FROM 360 ENVIRONMENTAL 2010



LOCALITY MAP



DRAWING ID	DATE		
ES197-2-02	12/09/2012		
HORIZONTAL DATUM AND PROJECTION			
GDA 1994 MGA Zone 50			
CREATED	CHECKED	APPROVED	REVISION
JU	AK	FD	D

Satterley Property Group
 Lot 9001, Parmelia

Black Cockatoo Survey
 Vegetation Descriptions

Figure 2



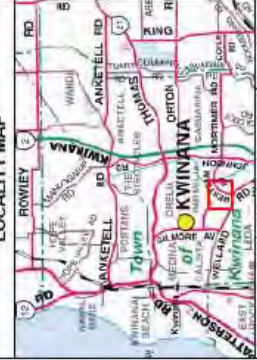
- Legend**
- Site Boundary
 - Species**
 - Jarrah
 - Marri
 - Tuart
 - Trunk Diameter**
 - 400 - 500mm
 - 500 - 800mm
 - 800 - 1200mm
 - >1200mm

NOTE: THIS REPORT PREPARED BY: SAHNS INC. 18/06/16
 - METAL PHOTOGRAMMETER SOURCES FROM AUSTRALIAN GOVERNMENT
 - LOCALITY MAP SOURCED FROM TRAVELLERS AT LAE 2006



1:4,026 @A3

LOCALITY MAP

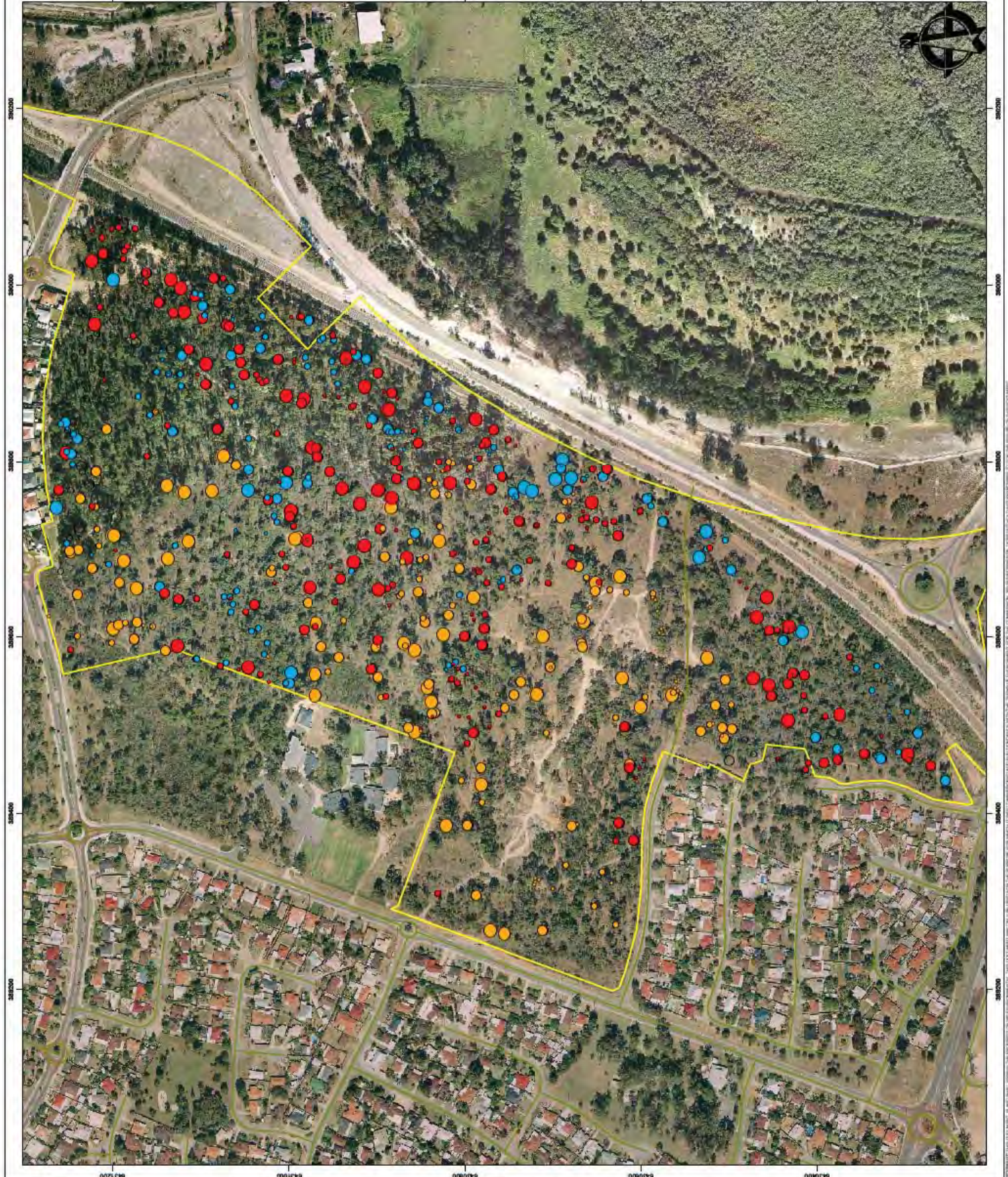


DRAWING ID	DATE		
EB5197-2-03	12/09/2012		
HORIZONTAL DATUM AND PROJECTION			
GDA 1984 MGA ZONE 50			
CREATED	CHECKED	APPROVED	REVISION
JU	AH	FD	D

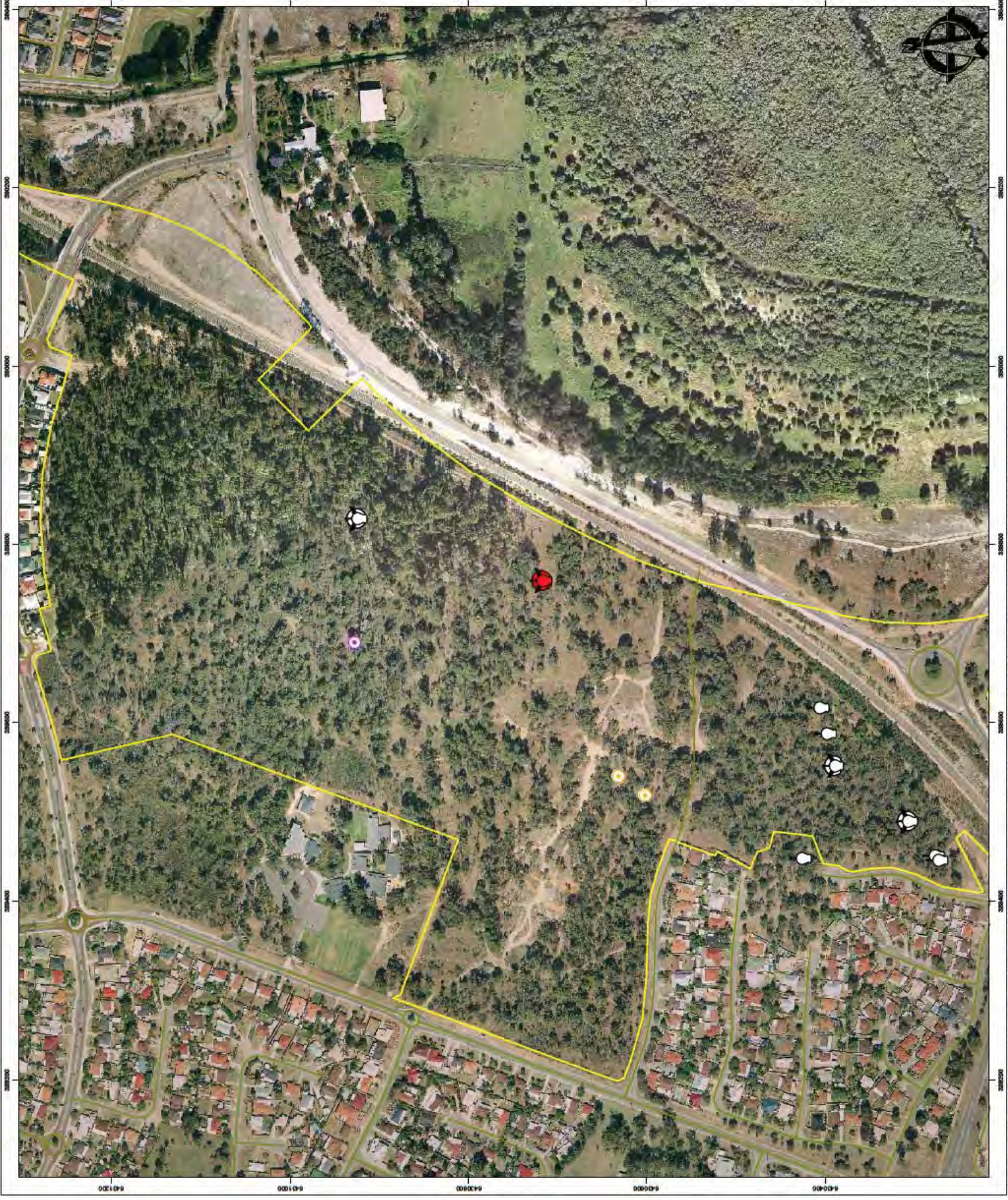
Satterley Property Group
 Lot 9001, Parmelia

Black Cockatoo Survey
 Significant Trees

Figure 3



6431000 6431000 6431000 6431000 6431000 6431000 6431000 6431000 6431000 6431000
 3820000 3820000 3820000 3820000 3820000 3820000 3820000 3820000 3820000 3820000



Legend

- Site Boundary
- Nesting Hollows**
- Possible Cockatoo Nesting Hollow
- Hollow Unsuitable for Cockatoos
- Carnaby's Black Cockatoo
- Calling Location
- Feeding Location
- Red-tailed Black Cockatoo
- Feeding Location
- Sighting Location

NOTE: THIS PROJECT'S FEASIBILITY STUDY WAS CONDUCTED IN 2016.
 - METAL PHOTOGRAM SOURCE FROM AUGUST 2006
 - LOCALITY MAP SOURCED FROM TRAVELLERS AT LAE 2006



LOCALITY MAP

DRAWING ID	DATE		
EB5197-2-04	12/09/2012		
HORIZONTAL DATUM AND PROJECTION			
GDA 1984 MGA ZONE 50			
CREATED	CHECKED	APPROVED	REVISION
JU	AH	FD	D

Satterley Property Group
 Lot 9001, Parmelia

Black Cockatoo Survey
 Sighting and Feeding Sites

Figure 4

APPENDIX B

Black Cockatoo Breeding, Foraging and Sighting Data

DATE	SPECIES	EASTINGS (UTM GDA 94 ZONE 50)	NORTHINGS (UTM GDA 94 ZONE 50)	COMMENTS	
14/07/2012	Red-tailed Black Cockatoo <i>Calyptorhynchus banksii naso</i>	389759	6430717	Recent evidence of feeding on seeds from Marri <i>Corymbia calophylla</i> .	
		389759	6430717	Single bird to the east. At 07:45	
	Carnaby's Cockatoo <i>Calyptorhynchus latirostris</i>		389588	6430399	Recent evidence of feeding on nectar from <i>Banksia menziesii</i> from two trees
			389617	6430407	Recent evidence of feeding on nectar from <i>Banksia menziesii</i> from two trees
			389552	6430390	Recent evidence of feeding on seeds of <i>Banksia attenuata</i>
			389552	6430390	One calling to south at 08:50
			389490	6430307	Recent evidence of feeding on seeds of <i>Banksia attenuata</i>
			389490	6430307	One calling to east at 09:15
			389451	6430277	Recent evidence of feeding on seeds of <i>Banksia attenuata</i>
			389446	6430273	Recent evidence of feeding on seeds of <i>Banksia attenuata</i> . Several trees.
			389448	6430427	Recent evidence of feeding on seeds of <i>Banksia attenuata</i>
			389519	6430602	Large Tuart with both Galah nest and feral bee hive. Good habitat tree but no cockatoo type hollows
			389540	6430632	Large Tuart with both Galah nest and feral bee hive. Good habitat tree but no cockatoo type hollows
			389690	6430927	Chewed hollow and possibly a black cockatoo nest hollow in Marri. Also bees (two hives) in same tree
			389829	6430925	Old evidence of feeding on seeds of <i>Banksia attenuata</i>
			389829	6430925	Two callings to east at 10:50

APPENDIX C

Black Cockatoo Significant Tree Data

Tree Number	EASTINGS (UTM GDA 94 ZONE 50)	NORTHINGS (UTM GDA 94 ZONE 50)	Species	DBH	Hollow
81	389892.818100	6431034.259400	Jarrah	500-800mm	
82	389889.181800	6431030.338900	Jarrah	500-800mm	
83	389891.381900	6431025.809800	Jarrah	500-800mm	
84	389924.727300	6430926.134000	Jarrah	500-800mm	
85	389942.305100	6431176.129100	Jarrah	500-800mm	
86	389868.165100	6431066.311800	Jarrah	500-800mm	
87	389694.058100	6430814.291500	Jarrah	500-800mm	
88	389710.369600	6430776.447900	Jarrah	500-800mm	
89	389686.689300	6430725.555000	Jarrah	500-800mm	
90	389687.923600	6430773.357200	Jarrah	500-800mm	
91	389551.696900	6430815.872700	Jarrah	500-800mm	
92	389557.213500	6431032.885000	Jarrah	500-800mm	
93	389585.434300	6431247.582800	Jarrah	500-800mm	
94	389457.101700	6430409.677200	Jarrah	500-800mm	Hollow
95	390007.997400	6431074.657400	Jarrah	500-800mm	
96	389612.312200	6430969.850400	Jarrah	500-800mm	
97	389963.688700	6430988.471700	Jarrah	500-800mm	Hollow
98	389964.645400	6430986.734100	Jarrah	500-800mm	Hollow
99	389694.106400	6431007.812700	Jarrah	500-800mm	Hollow
100	389731.255800	6430630.019300	Jarrah	500-800mm	Hollow
101	389532.638700	6430889.424500	Jarrah	500-800mm	Hollow
102	389509.795700	6430390.697100	Jarrah	500-800mm	Hollow
103	389701.106800	6430521.242700	Jarrah	500-800mm	
104	389776.386100	6430797.690000	Jarrah	500-800mm	
105	389863.584400	6430926.060900	Jarrah	500-800mm	
106	390013.486500	6431163.639700	Jarrah	500-800mm	
107	389674.209100	6430784.462400	Jarrah	500-800mm	
108	389661.857600	6430775.623800	Jarrah	500-800mm	
109	390053.878400	6431212.206300	Jarrah	500-800mm	
110	389517.093400	6430413.990700	Jarrah	500-800mm	Hollow
111	389607.225900	6430435.414100	Jarrah	500-800mm	
112	390038.488400	6431187.090800	Jarrah	500-800mm	
113	389547.598800	6430809.149400	Jarrah	500-800mm	
114	389534.004600	6430414.565100	Jarrah	500-800mm	Hollow
115	389732.948300	6430650.203000	Jarrah	500-800mm	Hollow
116	389791.429600	6430819.178700	Jarrah	500-800mm	
117	389846.208400	6430814.180600	Jarrah	500-800mm	Hollow
118	389803.534000	6430783.906600	Jarrah	500-800mm	Hollow
119	389841.445400	6430908.645000	Jarrah	500-800mm	Hollow
120	389806.031400	6431161.214000	Jarrah	500-800mm	Hollow

Tree Number	EASTINGS (UTM GDA 94 ZONE 50)	NORTHINGS (UTM GDA 94 ZONE 50)	Species	DBH	Hollow
121	389840.516700	6431137.400700	Jarrah	500-800mm	Hollow
122	390003.532700	6431161.855000	Jarrah	500-800mm	Hollow
123	389898.360000	6431036.918000	Jarrah	500-800mm	Hollow
124	389942.933900	6430949.340600	Jarrah	500-800mm	Hollow
125	389748.063900	6431222.944800	Jarrah	500-800mm	Hollow
126	389832.176600	6431013.729700	Jarrah	500-800mm	Hollow
127	389639.592700	6430947.642900	Jarrah	500-800mm	Hollow
128	389725.487100	6430994.584100	Jarrah	500-800mm	Hollow
129	389679.125200	6431003.812200	Jarrah	500-800mm	Hollow
130	389707.254900	6430787.984300	Jarrah	500-800mm	Hollow
131	389743.348800	6430752.814100	Jarrah	500-800mm	Hollow
132	389824.969200	6430750.402900	Jarrah	500-800mm	Hollow
133	389743.704000	6430600.234400	Jarrah	500-800mm	Hollow
134	389742.420200	6430600.246300	Jarrah	500-800mm	Hollow
135	389726.566000	6430718.146800	Jarrah	500-800mm	Hollow
136	389701.148800	6430678.295000	Jarrah	500-800mm	Hollow
137	389656.728600	6430758.357600	Jarrah	500-800mm	Hollow
138	389512.902000	6430762.395500	Jarrah	500-800mm	Hollow
139	389479.582800	6430797.325800	Jarrah	500-800mm	Hollow
140	389626.130100	6430777.771300	Jarrah	500-800mm	Hollow
141	389643.102000	6431104.644000	Jarrah	500-800mm	Hollow
142	389693.354500	6431070.511100	Jarrah	500-800mm	Hollow
143	389555.602500	6430430.593900	Jarrah	500-800mm	Hollow
144	389975.372900	6431214.324600	Jarrah	500-800mm	Hollow
145	389790.685900	6430655.035400	Jarrah	500-800mm	Hollow
146	389818.360700	6430781.626600	Jarrah	500-800mm	Hollow
147	389567.299600	6431078.125500	Jarrah	500-800mm	Hollow
148	389735.504800	6430660.655300	Jarrah	500-800mm	
149	389662.198500	6430646.206400	Jarrah	500-800mm	
150	389577.091500	6430361.977300	Jarrah	500-800mm	
151	389607.575200	6430444.951000	Jarrah	500-800mm	Hollow
152	390065.304000	6431193.584300	Jarrah	500-800mm	Hollow
153	389728.589000	6430640.079100	Jarrah	500-800mm	Hollow
154	389460.275900	6430294.211800	Jarrah	500-800mm	
155	389835.839200	6430767.465400	Jarrah	800-1200mm	
156	389608.240000	6430983.083000	Jarrah	800-1200mm	
157	389736.547400	6430999.343600	Jarrah	800-1200mm	
158	389649.345900	6431140.771600	Jarrah	800-1200mm	
159	389821.302600	6430776.796500	Jarrah	800-1200mm	
160	389800.109400	6430878.754300	Jarrah	800-1200mm	

Tree Number	EASTINGS (UTM GDA 94 ZONE 50)	NORTHINGS (UTM GDA 94 ZONE 50)	Species	DBH	Hollow
161	389755.363200	6431023.731600	Jarrah	800-1200mm	
162	389987.154500	6431106.932200	Jarrah	800-1200mm	
163	389887.925200	6431094.064500	Jarrah	800-1200mm	
164	389836.762700	6431080.583800	Jarrah	800-1200mm	
165	389665.908800	6430940.312300	Jarrah	800-1200mm	
166	389556.920300	6430414.341500	Jarrah	800-1200mm	
167	389460.790200	6430375.919100	Jarrah	800-1200mm	Hollow
168	389766.390400	6431260.670800	Jarrah	800-1200mm	Hollow
169	389563.742200	6430905.573400	Jarrah	800-1200mm	Hollow
170	389790.795000	6430637.421000	Jarrah	800-1200mm	Hollow
171	389451.439700	6430612.645200	Jarrah	800-1200mm	
172	389497.805100	6430617.602100	Jarrah	800-1200mm	Hollow
173	389779.520700	6430877.008400	Jarrah	800-1200mm	
174	389915.616800	6431012.167000	Jarrah	800-1200mm	
175	389927.850900	6431056.428200	Jarrah	800-1200mm	
176	389788.090700	6431000.728000	Jarrah	800-1200mm	
177	389636.422100	6431039.416700	Jarrah	800-1200mm	
178	389900.726000	6430898.590600	Jarrah	800-1200mm	
179	389558.883400	6430427.094800	Jarrah	800-1200mm	
180	389467.173000	6430344.850800	Jarrah	800-1200mm	
181	389607.682400	6430453.968600	Jarrah	800-1200mm	
182	389546.818900	6430432.473800	Jarrah	800-1200mm	hollow
183	390013.829200	6431162.146600	Jarrah	800-1200mm	
184	389877.660800	6430882.356900	Jarrah	800-1200mm	Hollow
185	389821.097300	6430852.887900	Jarrah	800-1200mm	Hollow
186	389722.320500	6430896.173800	Jarrah	800-1200mm	Hollow
187	389980.127800	6431147.122900	Jarrah	800-1200mm	Hollow
188	389968.592600	6431131.295200	Jarrah	800-1200mm	Hollow
189	389962.301700	6431098.115400	Jarrah	800-1200mm	Hollow
190	389954.727000	6431070.996500	Jarrah	800-1200mm	Hollow
191	389953.331500	6431068.022100	Jarrah	800-1200mm	Hollow
192	389898.681000	6431050.260000	Jarrah	800-1200mm	Hollow
193	389927.332600	6431113.337200	Jarrah	800-1200mm	Hollow
194	389814.898700	6430967.507400	Jarrah	800-1200mm	Hollow
195	389805.468800	6430966.622700	Jarrah	800-1200mm	Hollow
196	389787.626300	6430952.933300	Jarrah	800-1200mm	Hollow
197	389596.022000	6430898.370400	Jarrah	800-1200mm	Hollow
198	389767.773600	6430770.644600	Jarrah	800-1200mm	Hollow
199	389782.016700	6430757.335800	Jarrah	800-1200mm	Hollow
200	389715.026400	6430624.874700	Jarrah	800-1200mm	Hollow

Tree Number	EASTINGS (UTM GDA 94 ZONE 50)	NORTHINGS (UTM GDA 94 ZONE 50)	Species	DBH	Hollow
201	389731.074600	6430736.739700	Jarrah	800-1200mm	Hollow
202	389682.607700	6430677.433100	Jarrah	800-1200mm	Hollow
203	389491.295700	6430790.249100	Jarrah	800-1200mm	Hollow
204	389600.851200	6430800.543900	Jarrah	800-1200mm	Hollow
205	389642.337900	6431125.197600	Jarrah	800-1200mm	Hollow
206	390035.482800	6431210.351800	Jarrah	800-1200mm	Hollow
207	390008.073800	6431085.398500	Jarrah	800-1200mm	Hollow
208	389609.748800	6430778.558400	Jarrah	800-1200mm	Hollow
209	389866.180600	6430984.786600	Jarrah	800-1200mm	Hollow
210	389532.614400	6430451.754700	Jarrah	800-1200mm	Hollow
211	389590.383300	6430780.533000	Jarrah	800-1200mm	Hollow
212	389453.613200	6430269.892100	Jarrah	800-1200mm	
213	389457.287700	6430391.975100	Jarrah	800-1200mm	Hollow
214	389912.536600	6431054.637200	Jarrah	800-1200mm	Hollow
215	389644.966400	6430457.843900	Jarrah	>1200mm	
216	389689.992900	6430866.519900	Jarrah	>1200mm	
217	389969.360500	6431120.061100	Jarrah	>1200mm	
218	389757.985100	6430883.895300	Jarrah	>1200mm	Hollow
219	389685.026900	6430926.513700	Jarrah	>1200mm	Hollow
220	389874.259600	6431003.917000	Jarrah	>1200mm	
221	389466.482800	6430296.657700	Jarrah	>1200mm	
222	389743.129500	6430999.005100	Jarrah	>1200mm	
223	389871.489600	6430983.773200	Jarrah	>1200mm	
224	389996.648900	6431123.468100	Jarrah	>1200mm	
225	389505.376100	6430433.686200	Jarrah	>1200mm	Hollow
226	390027.489800	6431224.263900	Jarrah	>1200mm	Hollow
227	390006.186800	6431134.816500	Jarrah	>1200mm	
228	389859.137100	6430887.038500	Jarrah	>1200mm	Hollow
229	389847.717300	6430789.035100	Jarrah	>1200mm	Hollow
230	389774.954100	6430817.861900	Jarrah	>1200mm	Hollow
231	389703.459700	6430914.698400	Jarrah	>1200mm	Hollow
232	389910.720000	6431094.734000	Jarrah	>1200mm	Hollow
233	389815.694700	6430975.131700	Jarrah	>1200mm	Hollow
234	389768.733900	6430939.897900	Jarrah	>1200mm	Hollow
235	389750.468900	6430919.414400	Jarrah	>1200mm	Hollow
236	389766.600300	6430899.298000	Jarrah	>1200mm	Hollow
237	389656.081600	6430976.960600	Jarrah	>1200mm	Hollow
238	389710.012500	6430980.096900	Jarrah	>1200mm	Hollow
239	389752.929100	6430656.320900	Jarrah	>1200mm	Hollow
240	389565.667000	6431047.598000	Jarrah	>1200mm	Hollow

Tree Number	EASTINGS (UTM GDA 94 ZONE 50)	NORTHINGS (UTM GDA 94 ZONE 50)	Species	DBH	Hollow
241	389884.617200	6430914.493500	Jarrah	>1200mm	Hollow
242	389589.477500	6431127.502100	Jarrah	>1200mm	Hollow
243	389955.969100	6431221.423700	Jarrah	>1200mm	Hollow
244	389810.162800	6431253.210100	Jarrah	>1200mm	Hollow
245	389611.575700	6430432.781200	Jarrah	>1200mm	
246	389622.507100	6430469.685300	Jarrah	>1200mm	
247	389553.032100	6430472.883000	Jarrah	>1200mm	
248	389511.733700	6430374.248300	Jarrah	>1200mm	
249	389774.453500	6430859.325600	Jarrah	>1200mm	
250	389917.190000	6430935.127600	Jarrah	>1200mm	
251	389545.204500	6430455.615000	Jarrah	>1200mm	Hollow
252	389653.268500	6430898.357500	Jarrah	>1200mm	Hollow
253	389679.161100	6430739.879300	Marri	400-500mm	
254	389635.921200	6431127.519300	Marri	400-500mm	
255	389915.955600	6431144.055800	Marri	400-500mm	
256	389693.218000	6431223.931500	Marri	400-500mm	
257	389717.350400	6431026.564800	Marri	400-500mm	
258	389660.524800	6430762.104200	Marri	400-500mm	
259	389662.370700	6430761.390300	Marri	400-500mm	
260	389830.568400	6430857.197000	Marri	400-500mm	
261	389844.274500	6430844.326400	Marri	400-500mm	
262	389849.366000	6430844.037500	Marri	400-500mm	
263	389868.738900	6430819.898000	Marri	400-500mm	
264	389856.065600	6430820.294700	Marri	400-500mm	
265	389833.905500	6430807.510100	Marri	400-500mm	
266	389811.809400	6430775.223900	Marri	400-500mm	
267	389807.964400	6430773.050600	Marri	400-500mm	
268	389779.677600	6430871.188900	Marri	400-500mm	
269	389833.714600	6430870.862100	Marri	400-500mm	
270	389984.889900	6431068.716100	Marri	400-500mm	
271	389961.149400	6431063.943000	Marri	400-500mm	
272	389925.662800	6431145.003900	Marri	400-500mm	
273	389898.578500	6431137.202900	Marri	400-500mm	
274	389895.886300	6431129.592300	Marri	400-500mm	
275	389721.137600	6431060.759200	Marri	400-500mm	
276	389795.207600	6430689.449900	Marri	400-500mm	
277	389782.544800	6430660.639000	Marri	400-500mm	
278	389562.954600	6430822.313100	Marri	400-500mm	
279	389563.185200	6430821.230800	Marri	400-500mm	
280	389578.927900	6430786.699900	Marri	400-500mm	

Tree Number	EASTINGS (UTM GDA 94 ZONE 50)	NORTHINGS (UTM GDA 94 ZONE 50)	Species	DBH	Hollow
281	389471.722500	6430371.176800	Marri	400-500mm	
282	389546.017800	6430315.449500	Marri	400-500mm	
283	389510.760500	6430317.144500	Marri	400-500mm	
284	389802.518800	6430788.173400	Marri	400-500mm	
285	389758.216300	6430743.484100	Marri	400-500mm	Hollow
286	389670.493100	6430494.946600	Marri	400-500mm	
287	389813.916300	6430869.605100	Marri	400-500mm	
288	389837.632700	6431251.947600	Marri	400-500mm	
289	389564.134600	6430743.962500	Marri	400-500mm	
290	389464.083500	6430332.384200	Marri	400-500mm	
291	389760.876200	6430589.763400	Marri	400-500mm	Hollow
292	389706.000800	6431252.154300	Marri	500-800mm	
293	389703.393900	6431128.549100	Marri	500-800mm	
294	389875.801500	6430842.035900	Marri	500-800mm	
295	389902.204300	6430948.583200	Marri	500-800mm	
296	389885.882500	6431064.596900	Marri	500-800mm	
297	389899.541200	6431123.010300	Marri	500-800mm	
298	389886.268400	6431121.884800	Marri	500-800mm	
299	389863.265300	6431061.462000	Marri	500-800mm	
300	389826.174600	6431045.903100	Marri	500-800mm	
301	389781.383400	6430977.785400	Marri	500-800mm	
302	389852.958200	6431157.433500	Marri	500-800mm	
303	389873.992400	6431170.676500	Marri	500-800mm	
304	389665.481100	6430756.663900	Marri	500-800mm	
305	389568.282800	6430818.298000	Marri	500-800mm	
306	389564.166200	6430801.649800	Marri	500-800mm	
307	389570.598400	6431071.387000	Marri	500-800mm	
308	389575.008400	6431105.727500	Marri	500-800mm	
309	389645.852600	6431073.343500	Marri	500-800mm	
310	389636.962700	6431063.765800	Marri	500-800mm	
311	389575.038900	6431104.653200	Marri	500-800mm	
312	389835.871200	6430807.963600	Marri	500-800mm	
313	389816.754300	6430883.992700	Marri	500-800mm	
314	389834.389600	6430876.546400	Marri	500-800mm	
315	389833.391300	6430886.207900	Marri	500-800mm	
316	389908.317600	6430979.308000	Marri	500-800mm	
317	389674.972700	6430928.255900	Marri	500-800mm	
318	389965.939700	6431095.888700	Marri	500-800mm	
319	389989.007100	6431100.549100	Marri	500-800mm	
320	389942.049800	6431027.617900	Marri	500-800mm	

Tree Number	EASTINGS (UTM GDA 94 ZONE 50)	NORTHINGS (UTM GDA 94 ZONE 50)	Species	DBH	Hollow
321	389950.858900	6431036.090800	Marri	500-800mm	
322	389964.940700	6431030.284200	Marri	500-800mm	
323	389937.880100	6430963.388700	Marri	500-800mm	
324	389938.590300	6430948.361600	Marri	500-800mm	
325	389913.802400	6430950.105100	Marri	500-800mm	
326	389888.175200	6430943.746200	Marri	500-800mm	
327	389796.854400	6431245.151900	Marri	500-800mm	
328	389831.615300	6431244.410100	Marri	500-800mm	
329	389902.000900	6431149.404800	Marri	500-800mm	
330	389899.482300	6431136.829900	Marri	500-800mm	
331	389758.230600	6431024.866700	Marri	500-800mm	
332	389682.726800	6431203.657400	Marri	500-800mm	
333	389729.987200	6431014.237900	Marri	500-800mm	
334	389737.275900	6431016.450100	Marri	500-800mm	
335	389647.829500	6430805.903000	Marri	500-800mm	
336	389759.116000	6430741.497200	Marri	500-800mm	
337	389571.717600	6430810.711100	Marri	500-800mm	
338	389547.477600	6431003.431900	Marri	500-800mm	
339	389645.289000	6431067.020100	Marri	500-800mm	
340	389652.479600	6431059.205900	Marri	500-800mm	
341	389628.530100	6431065.723000	Marri	500-800mm	
342	389940.191400	6430960.025700	Marri	500-800mm	
343	389539.692400	6430336.926700	Marri	500-800mm	
344	389567.114300	6430331.247400	Marri	500-800mm	
345	389514.798000	6430296.860000	Marri	500-800mm	
346	389469.487700	6430306.498200	Marri	500-800mm	
347	389811.351800	6431251.452000	Marri	500-800mm	Hollow
348	389700.199400	6430524.982200	Marri	500-800mm	
349	389778.628400	6430664.953500	Marri	500-800mm	
350	389833.367700	6430882.681500	Marri	500-800mm	
351	389918.624600	6430981.990000	Marri	500-800mm	
352	389610.163300	6431035.316200	Marri	500-800mm	
353	389606.646800	6431042.136200	Marri	500-800mm	
354	389593.352100	6431024.928300	Marri	500-800mm	
355	389580.299300	6431028.415100	Marri	500-800mm	
356	389564.434200	6430353.987300	Marri	500-800mm	
357	389991.244200	6431107.255400	Marri	500-800mm	
358	389842.957800	6431257.988000	Marri	500-800mm	
359	389816.181300	6430767.086000	Marri	500-800mm	Hollow
360	389748.387600	6430588.803200	Marri	500-800mm	Hollow

Tree Number	EASTINGS (UTM GDA 94 ZONE 50)	NORTHINGS (UTM GDA 94 ZONE 50)	Species	DBH	Hollow
361	389709.538100	6430503.898600	Marri	500-800mm	
362	389676.111600	6430740.305700	Marri	800-1200mm	
363	389657.126000	6431146.810300	Marri	800-1200mm	
364	389756.895100	6431013.384400	Marri	800-1200mm	
365	389916.497800	6430911.215900	Marri	800-1200mm	
366	389920.555200	6431121.548000	Marri	800-1200mm	
367	389809.019000	6431246.610600	Marri	800-1200mm	
368	389844.721700	6431253.260500	Marri	800-1200mm	
369	389790.214600	6431046.550700	Marri	800-1200mm	
370	389774.646600	6430978.790400	Marri	800-1200mm	
371	389834.587300	6431131.494100	Marri	800-1200mm	
372	389764.548900	6430744.255600	Marri	800-1200mm	
373	389473.073200	6430376.887200	Marri	800-1200mm	
374	389463.526600	6430327.797000	Marri	800-1200mm	
375	389461.740700	6430326.076800	Marri	800-1200mm	
376	389861.353000	6430830.135900	Marri	800-1200mm	
377	389837.160800	6430886.680900	Marri	800-1200mm	
378	389848.601100	6430904.441800	Marri	800-1200mm	
379	389976.815300	6431097.489300	Marri	800-1200mm	
380	389995.527300	6431067.231200	Marri	800-1200mm	
381	389920.396300	6431065.545000	Marri	800-1200mm	
382	389928.818000	6431032.546400	Marri	800-1200mm	
383	389960.275300	6430976.777300	Marri	800-1200mm	
384	389921.082300	6430922.977900	Marri	800-1200mm	
385	389825.850100	6431240.349900	Marri	800-1200mm	
386	389767.062700	6430682.459400	Marri	800-1200mm	
387	389782.059400	6430642.184200	Marri	800-1200mm	
388	389756.948800	6430592.313800	Marri	800-1200mm	
389	389547.609900	6430999.263900	Marri	800-1200mm	
390	389730.621300	6430574.123300	Marri	800-1200mm	
391	389595.641500	6430438.394400	Marri	800-1200mm	
392	389437.084800	6430253.509400	Marri	800-1200mm	
393	389486.143500	6430401.679400	Marri	800-1200mm	
394	389790.210600	6430762.187900	Marri	800-1200mm	
395	389791.833000	6430690.622500	Marri	800-1200mm	
396	389490.934300	6430284.142100	Marri	800-1200mm	Hollow
397	389868.044200	6430841.746000	Marri	800-1200mm	Hollow
398	389717.968500	6430856.566700	Marri	800-1200mm	Hollow
399	389675.882500	6430497.644400	Marri	800-1200mm	
400	390006.415500	6431199.753300	Marri	>1200mm	

Tree Number	EASTINGS (UTM GDA 94 ZONE 50)	NORTHINGS (UTM GDA 94 ZONE 50)	Species	DBH	Hollow
401	389775.271800	6431004.346800	Marri	>1200mm	
402	389802.249400	6430689.590100	Marri	>1200mm	
403	389746.496200	6431263.984700	Marri	>1200mm	
404	389766.571900	6431046.907300	Marri	>1200mm	
405	389778.756300	6430697.662300	Marri	>1200mm	
406	389690.298300	6430534.418800	Marri	>1200mm	
407	389720.125900	6430526.441600	Marri	>1200mm	
408	389605.703600	6430418.333300	Marri	>1200mm	
409	389769.819900	6430732.317400	Marri	>1200mm	Hollow
410	389780.921600	6430679.196600	Marri	>1200mm	Hollow
411	389559.357000	6430998.841400	Marri	>1200mm	
412	389765.345600	6430723.721000	Marri	>1200mm	Hollow
413	389836.844600	6431206.975300	Tuart	800-1200mm	
414	389746.910700	6431218.403800	Tuart	500-800mm	
415	389610.030000	6431228.229400	Sheok	400-500mm	
416	389756.084000	6431261.361800	Sheok	400-500mm	
417	389934.580800	6431103.329600	Sheok	400-500mm	Hollow
418	389955.352500	6431158.325900	Sheok	400-500mm	
419	389712.249800	6431237.468700	Sheok	400-500mm	
420	389802.026800	6431066.563000	Sheok	500-800mm	
421	390017.211800	6431190.006000	Sheok	500-800mm	
422	389835.115600	6431250.958300	Sheok	500-800mm	
423	389918.792200	6431242.916400	Sheok	500-800mm	
424	389938.734900	6431225.005000	Sheok	500-800mm	
425	389718.053300	6431244.699400	Sheok	500-800mm	Hollow
426	389782.727800	6431200.257700	Sheok	500-800mm	Hollow
427	389467.417800	6430471.706200	Sheok	500-800mm	
428	390029.301200	6431212.959600	Sheok	500-800mm	
429	389713.067800	6431249.093400	Sheok	500-800mm	
430	389787.502700	6431234.260700	Sheok	500-800mm	
431	389872.066400	6431229.879800	Sheok	500-800mm	
432	389883.235200	6431228.490200	Sheok	500-800mm	
433	389889.623600	6431236.877200	Sheok	500-800mm	
434	389899.576500	6431211.918700	Sheok	500-800mm	
435	389905.332300	6431223.256600	Sheok	500-800mm	
436	389870.218900	6431201.166800	Sheok	500-800mm	
437	389483.082800	6430481.647800	Sheok	500-800mm	
438	390005.443800	6431169.020500	Sheok	500-800mm	
439	389930.327600	6431117.971500	Sheok	500-800mm	Hollow
440	389969.067800	6431210.927900	Sheok	500-800mm	Hollow

Tree Number	EASTINGS (UTM GDA 94 ZONE 50)	NORTHINGS (UTM GDA 94 ZONE 50)	Species	DBH	Hollow
441	389965.451600	6431231.326300	Sheok	500-800mm	Hollow
442	389969.305200	6431236.506300	Sheok	500-800mm	Hollow
443	389765.768900	6431254.630900	Sheok	500-800mm	Hollow
444	389765.840700	6431248.008500	Sheok	500-800mm	Hollow
445	389924.351100	6431233.799300	Sheok	500-800mm	Hollow
446	389945.684200	6431217.414800	Sheok	500-800mm	Hollow
447	389674.260600	6431257.864300	Sheok	500-800mm	Hollow
448	389724.104700	6431238.281400	Sheok	800-1200mm	
449	389935.234100	6431173.118800	Sheok	800-1200mm	
450	390070.369400	6431188.449600	Sheok	800-1200mm	
451	390003.370400	6431075.016900	Sheok	800-1200mm	
452	389794.743700	6431235.516100	Sheok	800-1200mm	
453	389459.620800	6430499.900300	Sheok	800-1200mm	
454	389928.789700	6431133.684600	Sheok	800-1200mm	Hollow
455	389961.535700	6431198.127800	Sheok	800-1200mm	Hollow
456	389773.032100	6431226.987600	Sheok	800-1200mm	Hollow
457	389735.758900	6431195.410600	Sheok	800-1200mm	Hollow
458	389761.953300	6430821.613900	Tuart	400-500mm	
459	389761.843100	6430676.802900	Tuart	400-500mm	
460	389324.016800	6430715.548300	Tuart	400-500mm	
461	389326.377000	6430718.866300	Tuart	400-500mm	
462	389321.399200	6430719.719800	Tuart	400-500mm	
463	389319.166700	6430720.442100	Tuart	400-500mm	
464	389641.693600	6430583.600500	Tuart	400-500mm	
465	389629.487800	6430580.830800	Tuart	400-500mm	
466	389608.942700	6430576.660000	Tuart	400-500mm	
467	389604.360500	6430578.301700	Tuart	400-500mm	
468	389501.633000	6430517.618900	Tuart	400-500mm	
469	389633.358800	6430657.135300	Tuart	400-500mm	
470	389487.905000	6430508.100400	Tuart	400-500mm	
471	389612.006100	6431156.516400	Tuart	400-500mm	
472	389613.060200	6431165.717100	Tuart	400-500mm	
473	389623.518200	6431273.109200	Tuart	400-500mm	
474	389314.180000	6430698.857100	Tuart	400-500mm	
475	389549.774700	6430559.731700	Tuart	400-500mm	
476	389542.185100	6430561.523000	Tuart	400-500mm	
477	389538.903600	6430557.636600	Tuart	400-500mm	
478	389536.006800	6430555.059500	Tuart	400-500mm	
479	389387.051100	6430671.770200	Tuart	400-500mm	
480	389856.770800	6431151.237500	Tuart	400-500mm	

Tree Number	EASTINGS (UTM GDA 94 ZONE 50)	NORTHINGS (UTM GDA 94 ZONE 50)	Species	DBH	Hollow
481	389645.026400	6430586.013700	Tuart	400-500mm	Hollow
482	389789.595600	6430833.651000	Tuart	400-500mm	
483	389788.216500	6430826.162300	Tuart	400-500mm	
484	389492.813100	6430850.185500	Tuart	400-500mm	Hollow
485	389565.741200	6430701.934500	Tuart	400-500mm	Hollow
486	389534.691100	6430764.119600	Tuart	400-500mm	Hollow
487	389578.013900	6431024.053100	Tuart	400-500mm	
488	389618.652700	6430937.013100	Tuart	500-800mm	
489	389753.872300	6430680.955300	Tuart	500-800mm	
490	389560.627200	6430955.513400	Tuart	500-800mm	
491	389593.090700	6431200.541500	Tuart	500-800mm	
492	389508.469500	6430627.347100	Tuart	500-800mm	
493	389531.096900	6430894.779300	Tuart	500-800mm	
494	389774.089400	6430833.842400	Tuart	500-800mm	
495	389778.352100	6430841.332100	Tuart	500-800mm	
496	389687.453500	6430850.424600	Tuart	500-800mm	
497	389725.444800	6430828.416600	Tuart	500-800mm	
498	389531.890300	6430595.060000	Tuart	500-800mm	
499	389341.160600	6430684.486600	Tuart	500-800mm	
500	389678.053200	6431019.108800	Tuart	500-800mm	
501	389621.366800	6430847.255900	Tuart	500-800mm	
502	389635.573700	6430814.391000	Tuart	500-800mm	
503	389500.498100	6430522.157200	Tuart	500-800mm	
504	389650.296300	6430615.732300	Tuart	500-800mm	
505	389653.328100	6430634.277300	Tuart	500-800mm	
506	389611.379800	6431154.674100	Tuart	500-800mm	
507	389793.080300	6430794.797300	Tuart	500-800mm	
508	389797.509600	6430813.858200	Tuart	500-800mm	
509	389708.204300	6430861.720700	Tuart	500-800mm	
510	389685.208600	6430870.685900	Tuart	500-800mm	
511	389646.091900	6430874.701400	Tuart	500-800mm	
512	389648.805200	6430872.089300	Tuart	500-800mm	
513	389648.916400	6430585.980500	Tuart	500-800mm	
514	389537.065600	6430562.332500	Tuart	500-800mm	
515	389601.063000	6431240.046900	Tuart	500-800mm	
516	389665.936500	6430851.485500	Tuart	500-800mm	
517	389690.207100	6430844.003600	Tuart	500-800mm	Hollow
518	389760.681200	6430818.872600	Tuart	500-800mm	
519	389667.516000	6430661.695200	Tuart	500-800mm	
520	389523.089000	6430497.466600	Tuart	500-800mm	

Tree Number	EASTINGS (UTM GDA 94 ZONE 50)	NORTHINGS (UTM GDA 94 ZONE 50)	Species	DBH	Hollow
521	389856.553400	6431151.233600	Tuart	500-800mm	
522	389722.960000	6430892.297200	Tuart	500-800mm	
523	389590.328800	6430867.082400	Tuart	500-800mm	
524	389799.896700	6430817.995300	Tuart	500-800mm	
525	389722.068000	6431216.953800	Tuart	500-800mm	Hollow
526	389753.432200	6430685.591800	Tuart	500-800mm	Hollow
527	389616.322200	6431185.026500	Tuart	500-800mm	Hollow
528	389703.131700	6431215.712100	Tuart	500-800mm	Hollow
529	389551.442600	6430503.881200	Tuart	800-1200mm	
530	389588.974400	6430962.533400	Tuart	800-1200mm	
531	389576.808900	6430943.019300	Tuart	800-1200mm	
532	389588.726900	6430900.960400	Tuart	800-1200mm	
533	389616.736800	6430845.972900	Tuart	800-1200mm	
534	389625.108000	6430819.516100	Tuart	800-1200mm	
535	389493.082400	6430531.899400	Tuart	800-1200mm	
536	389734.827300	6430689.950600	Tuart	800-1200mm	
537	389679.417000	6430669.858900	Tuart	800-1200mm	
538	389652.222100	6430651.912500	Tuart	800-1200mm	
539	389620.402900	6430667.364300	Tuart	800-1200mm	
540	389592.839300	6430667.437800	Tuart	800-1200mm	
541	389588.770900	6430665.665900	Tuart	800-1200mm	
542	389513.697600	6430834.650800	Tuart	800-1200mm	
543	389496.923200	6430864.896100	Tuart	800-1200mm	
544	389613.535700	6431193.071400	Tuart	800-1200mm	
545	389647.882500	6431239.595900	Tuart	800-1200mm	
546	389677.538000	6430807.245500	Tuart	800-1200mm	
547	389519.325300	6430754.203400	Tuart	800-1200mm	
548	389772.443600	6430793.335500	Tuart	800-1200mm	
549	389762.497700	6430834.485200	Tuart	800-1200mm	
550	389691.037900	6430891.554700	Tuart	800-1200mm	
551	389650.925000	6430853.670200	Tuart	800-1200mm	
552	389795.069000	6431060.019500	Tuart	800-1200mm	
553	389694.743400	6431247.148200	Tuart	800-1200mm	
554	389698.769900	6431238.809500	Tuart	800-1200mm	
555	389497.002600	6430507.950300	Tuart	800-1200mm	
556	389495.353200	6430496.641900	Tuart	800-1200mm	
557	389484.609800	6430504.772800	Tuart	800-1200mm	
558	389584.684100	6431140.557400	Tuart	800-1200mm	
559	389616.576700	6431172.641400	Tuart	800-1200mm	
560	389597.190000	6431175.740800	Tuart	800-1200mm	

Tree Number	EASTINGS (UTM GDA 94 ZONE 50)	NORTHINGS (UTM GDA 94 ZONE 50)	Species	DBH	Hollow
561	389385.549800	6430678.186800	Tuart	800-1200mm	
562	389787.703600	6431218.584700	Tuart	800-1200mm	
563	389673.452800	6431020.716800	Tuart	800-1200mm	
564	389534.129600	6430742.867000	Tuart	800-1200mm	
565	389549.133900	6430735.594000	Tuart	800-1200mm	Hollow
566	389677.830500	6431222.765000	Tuart	800-1200mm	
567	389522.630200	6430515.673700	Tuart	800-1200mm	Hollow
568	389697.271100	6431249.060800	Tuart	800-1200mm	Hollow
569	389638.834000	6430978.296400	Tuart	800-1200mm	Hollow
570	389554.424500	6430898.331200	Tuart	800-1200mm	Hollow
571	389566.032400	6430702.211000	Tuart	800-1200mm	Hollow
572	389512.848900	6430837.831900	Tuart	800-1200mm	Hollow
573	389661.655900	6431192.096300	Tuart	800-1200mm	Hollow
574	389756.599400	6431236.362300	Tuart	800-1200mm	Hollow
575	389546.842100	6430841.241300	Tuart	800-1200mm	Hollow
576	389747.059300	6430884.333100	Tuart	>1200mm	
577	389708.575400	6430829.723600	Tuart	>1200mm	
578	389764.098500	6431119.213700	Tuart	>1200mm	
579	389576.075100	6430524.468000	Tuart	>1200mm	
580	389806.196500	6431075.196900	Tuart	>1200mm	
581	389584.862600	6430858.367900	Tuart	>1200mm	
582	389661.298900	6430651.087400	Tuart	>1200mm	
583	389668.928000	6430623.816500	Tuart	>1200mm	
584	389617.308200	6430665.328500	Tuart	>1200mm	
585	389601.071900	6430711.996700	Tuart	>1200mm	
586	389492.243300	6430857.812700	Tuart	>1200mm	
587	389533.948700	6430971.182400	Tuart	>1200mm	
588	389644.854700	6430790.880600	Tuart	>1200mm	
589	389609.568700	6431199.539900	Tuart	>1200mm	
590	389708.332300	6431115.030300	Tuart	>1200mm	
591	389712.095800	6430990.598600	Tuart	>1200mm	
592	389602.937700	6430825.493800	Tuart	>1200mm	
593	389542.501100	6430843.375100	Tuart	>1200mm	
594	389686.069800	6431187.971700	Tuart	>1200mm	
595	389714.845600	6431199.020100	Tuart	>1200mm	
596	389557.642800	6430971.102900	Tuart	>1200mm	
597	389526.387400	6430839.213400	Tuart	>1200mm	
598	389533.931800	6430565.784300	Tuart	>1200mm	
599	389592.845600	6430869.476000	Tuart	>1200mm	
600	389771.884400	6431139.028300	Tuart	>1200mm	

Tree Number	EASTINGS (UTM GDA 94 ZONE 50)	NORTHINGS (UTM GDA 94 ZONE 50)	Species	DBH	Hollow
601	389553.460700	6430621.311900	Tuart	>1200mm	
602	389688.724000	6431137.994600	Tuart	>1200mm	
603	389765.627800	6431088.221200	Tuart	>1200mm	Hollow
604	389711.101600	6430994.301600	Tuart	>1200mm	
605	389520.634400	6430600.804500	Tuart	>1200mm	
606	389615.207200	6430969.413700	Tuart	>1200mm	Hollow
607	389655.231400	6431173.470400	Tuart	>1200mm	Hollow
608	389589.496100	6430897.820700	Tuart	400-500mm	
609	389959.817900	6430963.693700	Unknown	400-500mm	
610	389309.062323	6430830.910459	Jarrah	500-800mm	
611	389306.989374	6430787.378530	Tuart	800-1200mm	
612	389386.279673	6430822.100426	Tuart	>1200mm	
613	389386.279673	6430797.225038	Tuart	800-1200mm	
614	389412.191535	6430780.641446	Tuart	500-800mm	
615	389432.402788	6430782.714395	Tuart	>1200mm	
616	389437.066923	6430803.962122	Tuart	500-800mm	
617	389451.577566	6430781.677921	Tuart	800-1200mm	
618	389490.963596	6430706.533520	Tuart	500-800mm	
619	389535.013762	6430718.452977	Tuart	>1200mm	
620	389267.085106	6430772.349650	Tuart	>1200mm	
621	389263.457445	6430755.766058	Tuart	>1200mm	
622	389267.085106	6430710.679418	Tuart	800-1200mm	
623	389273.303953	6430627.243221	Tuart	500-800mm	
624	389294.551680	6430652.636846	Tuart	500-800mm	
625	389320.463542	6430633.462068	Tuart	400-500mm	
626	389333.419474	6430643.826813	Tuart	500-800mm	
627	389369.177844	6430607.031969	Jarrah	800-1200mm	
628	389368.659606	6430628.279696	Jarrah	500-800mm	
629	389388.870859	6430624.652035	Jarrah	800-1200mm	Hollow
630	389455.723464	6430612.214341	Tuart	800-1200mm	
631	389439.658109	6430604.959020	Jarrah	400-500mm	
632	389461.942311	6430595.630749	Jarrah	400-500mm	
633	389450.541091	6430600.813122	Jarrah	400-500mm	

ATTACHMENT 2K



360
environmental



Black Cockatoo
Survey - Kwinana
Train Station
Precinct

Prepared for:

Department of Housing/
Satterley Property Group

September 2012

● people ● planet ● professional

Document Reference	Revision	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
EBS197_3AC	A INTERNAL DRAFT	AH	FD/TS	-	12/09/12
EBS197_3AC	B CLIENT DRAFT	AH	Client	1 Electronic (email)	26/09/12

Disclaimer

This report is issued in accordance with, and is subject to, the terms of the contract between the Client and 360 Environmental Pty Ltd, including, without limitation, the agreed scope of the report. To the extent permitted by law, 360 Environmental Pty Ltd shall not be liable in contract, tort (including, without limitation, negligence) or otherwise for any use of, or reliance on, parts of this report without taking into account the report in its entirety and all previous and subsequent reports.. 360 Environmental Pty Ltd considers the contents of this report to be current as at the date it was produced. This report, including each opinion, conclusion and recommendation it contains, should be considered in the context of the report as a whole. The opinions, conclusions and recommendations in this report are limited by its agreed scope. More extensive, or different, investigation, sampling and testing may have produced different results and therefore different opinions, conclusions and recommendations. Subject to the terms of the contract between the Client and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating parts of this report is prohibited (except to the extent required by law) unless the report is produced in its entirety including this cover page, without the prior written consent of 360 Environmental Pty Ltd.

© Copyright 2012 360 Environmental Pty Ltd ACN 109 499 041

Executive Summary

360 Environmental Pty Ltd (360 Environmental) was commissioned by Satterley Property Group on behalf of the Department of Housing (DoH) to undertake a Black Cockatoo Survey at the Kwinana Train Station Precinct, Kwinana (the sites) (Figure 1). The survey involved a Black Cockatoo Foraging Habitat Assessment, Black Cockatoo Significant Tree Survey, Black Cockatoo Breeding Assessment and opportunistic Black Cockatoo observations within the Areas A, C, D, E, F and G (Figure 1).

The site comprises an area of approximately 11.8 hectares (ha) and is proposed to be utilised for residential development, located in the Town of Kwinana. The site is composed of uncleared bushland with Jarrah (*Eucalyptus marginata*), Marri (*Corymbia calophylla*), Sheoak (*Allocasuarina fraseriana*) and *Banksia* species present throughout.

A search of the Environment Protection and Biodiversity Conservation (EPBC) database and past site assessments revealed that the Vulnerable Forest Red-tailed Black Cockatoo and the Endangered Carnaby's Black Cockatoo are likely to occur within the area.

The survey found no evidence of Black Cockatoo breeding within the sites. All sites contained suitable feeding species (*Banksia* and Jarrah) and sparse evidence of feeding debris were recorded at the sites. However, while there were eleven locations which showed evidence of Carnaby's Black Cockatoo feeding, there were no locations which showed evidence of Forest Red-Tailed Black Cockatoo feeding. Of these, two locations showed old evidence of Black Cockatoo feeding (Carnaby's Black Cockatoo), while the rest of the feeding evidence was recent foraging evidence on grubs and nectar. This suggests that although not extensively utilised, Carnaby's Black Cockatoos do at least occasionally utilise the survey area for foraging and feeding.

The suggestion that Black Cockatoo's occasionally utilise the site is supported by two callings of Carnaby's Black Cockatoos to the east of the site.

The Black Cockatoo Significant Tree Surveys from 2010 and 2012 revealed that the site contains old trees, many of which have reached a size that the Department of Environment, Water, Population and Communities (SEWPaC) would consider a potential breeding tree. In total, 37 Jarrah trees were recorded which met SEWPaC's criteria of >500 mm trunk Diameter Breast Height (DBH). These trees are considered potentially significant trees for Black Cockatoo as these were the only species recorded that have the potential to form hollows suitable for Black Cockatoo. The presence of the larger Jarrah trees suggests that the site has the potential to be of significance to Black Cockatoo species in the future.

The following points are recommended:

- Retain as many trees with a trunk DBH of 500 mm or greater to increase the potential breeding value of the site in the future. SEWPaC considers that trees

over 500 mm could provide breeding and foraging habitat for Black Cockatoo species. Trees of the appropriate species with DBH less than 500 mm are considered foraging habitat for the Black Cockatoo species. SEWPaC places higher value on potential breeding trees over foraging trees. It is recommended that emphasis be placed on retaining potential breeding and foraging trees to minimise impacts. Should offsets be required for vegetation clearing they are likely to be greater for the clearing of breeding habitat;

- Retain trees that display hollows. These trees may be suitable for breeding of bird species and may become suitable for Black Cockatoo species over time (as the trees grow and the hollows increase in size). If clearing of trees with hollows is unavoidable, it is recommended that hollows are inspected prior to clearing to ensure that hollows are not currently occupied or in use;
- Consider offset of the impacts of clearing of habitat as a last resort after consideration of avoiding, minimising and otherwise mitigating impacts. Offsets could include the purchase of land containing appropriate habitat (including suitable Black Cockatoo habitat);
- Clear habitat in stages to allow fauna to disperse away from the site; and
- Conduct clearing operations outside the breeding season for Black Cockatoos. Carnaby's Black Cockatoo and Baudin's Black Cockatoo breed in late winter to spring (although Carnaby's primarily breed in the wheatbelt) and Red-tailed Black Cockatoos breed within the period from September to April. This will reduce the impact to Black Cockatoos using the site during clearing.

Table of Contents

1	Introduction	5
1.1	Background	5
1.2	Objectives	5
1.3	Scope of the Study	6
2	Site Description.....	7
2.1	Site Location	7
2.2	Broad Habitat Assessment	7
3	Methods.....	9
3.1	Background Research	9
3.2	Black Cockatoo Foraging Assessment Methodology . Error! Bookmark not defined.	
3.3	Black Cockatoo Breeding Assessment Methodology	9
3.4	Black Cockatoo Significant Tree Survey Methodology	10
4	Results	12
4.1	Background Research Results	12
4.2	Black Cockatoo Breeding Assessment	14
4.3	Black Cockatoo Foraging Assessment.....	14
4.4	Black Cockatoo Opportunistic Observations	15
4.5	Black Cockatoo Significant Tree Assessment.....	15
5	Discussion	17
6	Summary and Recommendations.....	18
7	Limitations.....	19
8	References	20

List of Tables

Table 1: Evidence of Foraging Activity	15
Table 2: Black Cockatoo Significant Tree Survey Results (Areas A, C, D, E, F, and G). 16	

List of Figures

Figure 1: Site Location	23
Figure 2: Vegetation Descriptions.....	24
Figure 3: Black Cockatoo Significant Tree Survey.....	25
Figure 4: Black Cockatoo Sightings and Feeding Sites	26

List of Appendices

Appendix A: Figures	22
Appendix B: Black Cockatoo Breeding, Foraging and Sighting Data.....	27
Appendix C: Black Cockatoo Significant Tree Data.....	29
Appendix D: Black Cockatoo Significant Tree Data (Previous Data)	35

1 Introduction

1.1 Background

Three species of Black Cockatoo occur in the south-west of Western Australia. All three species are protected under the following State and Federal legislation:

- The *Wildlife Conservation Act 1950* (WC Act), Western Australia; and
- The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), Commonwealth.

The Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) is listed as Endangered under the EPBC Act. The Red-tailed Black Cockatoo (*Calyptorhynchus banksii*) and Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) are classified as Vulnerable. Both Carnaby's Black Cockatoo and Baudin's Black Cockatoo are listed as Endangered under the WC Act. The Forest Red-tailed Black Cockatoo is listed as Vulnerable.

360 Environmental Pty Ltd was commissioned to undertake a Black Cockatoo Breeding and Foraging Survey and Black Cockatoo Significant Tree Survey at the Kwinana Train Station Precinct. The survey involved a Black Cockatoo Foraging Assessment, Black Cockatoo Breeding Assessment, Black Cockatoo Significant Tree Survey and opportunistic Black Cockatoo observations within Areas A, C, D, E, F and G (the survey) (Figure 1). Area B was excluded from the survey as this area was previously surveyed and is therefore not part of this scope of work.

The sites are approximately 11.8 hectares in size and are located adjacent to Sulphur Road and Durrant Avenue. The vegetation found across the sites is essentially a low to tall woodland of *Banksia attenuate*, *Eucalyptus Marginata* and *Allocasuarina fraseriana* with *Corymbia calophylla*, *Banksia menziesii* and *Xylomelum occidentale* (360 Environmental, 2009).

1.2 Objectives

The objectives of the Black Cockatoo Survey were to:

- Identify significant habitat trees (breeding and feeding) suitable for Black Cockatoo and evidence of Black Cockatoo breeding and feeding at the sites with reference to SEWPaC's (2011) draft referral guidelines for Black Cockatoos; and
- Determine the extent of use of the sites by Black Cockatoos.

1.3 Scope of the Study

In order to determine areas within the sites that would be considered foraging or breeding habitat for Black Cockatoos, a survey of suitable trees within the proposed development area was undertaken (Areas A, C, D, E, F and G). The Black Cockatoo Survey included:

- Background Research;
- On site Black Cockatoo Breeding Assessment;
- On site Black Cockatoo Foraging Assessment;
- On site Black Cockatoo Opportunistic Observations; and
- On site Black Cockatoo Significant Tree Assessment.

2 Site Description

2.1 Site Location

The survey sites, known as Kwinana Train Station Precinct, consist of six smaller sites which in total are approximately 11.8 ha and adjacent to Sulphur Road and Durrant Avenue. The western part has been identified in the past as Train Station West and is comprised of Area A and B. Area B was excluded from this scope of work as it has already been surveyed. The eastern section (previously identified as Train Station East) encompasses five sites, called Area C, D, E, F and G.

All sites are composed of uncleared bushland with several containing areas of disturbance.

2.2 Broad Habitat Assessment

In 2008, 360 Environmental conducted a Level 2 Flora and Vegetation assessment of the area. The vegetation found across the sites is essentially a low to tall woodland of *Banksia attenuata*, *Eucalyptus Marginata* and *Allocasuarina fraseriana* with *Corymbia calophylla*, *Banksia menziesii* and *Xylomelum occidentale* (360 Environmental, 2009).

Floristics did not vary greatly across the survey area, so vegetation descriptions are defined by structural dominants and landforms and shown in Figure 2.

Area A: *Banksia attenuata* - *Allocasuarina fraseriana* woodland with occasional stands of *Jacksonia furcellata* and *Kunzea glabrescens* above a generally low, multi-species understorey with *Acacia pulchella*, *Hibbertia rhadinopoda*, *Petrophile linearis* and *Xanthorrhoea preissii* common low shrubs. Weeds occur throughout.

Area B (excluded from this survey): *Banksia attenuata* - *Allocasuarina fraseriana* - *Xylomelum occidentale* woodland above a generally degraded low, understorey commonly of *Hibbertia rhadinopoda*, *Petrophile linearis* and *Patersonia occidentalis* low shrubs. Weeds occur throughout.

Area C: Variable *Banksia attenuata* to tall woodland of *Corymbia calophylla*. Understorey density and height varies with open areas of low shrubs and herbs below tall trees and taller more dense shrubs occurring below *B. attenuata*. *Hibbertia rhadinopoda*, *Macrozamia riedlei*, *Petrophile linearis* and *Xanthorrhoea preissii* are common shrubs. Weeds occur throughout.

Area D: *Banksia attenuata*- *Allocasuarina fraseriana* woodland above a generally low, multi-species understorey with *Hibbertia rhadinopoda*, *Patersonia occidentalis* and *Xanthorrhoea preissii* common shrubs. Weeds occur throughout.

Area E: *Banksia attenuata* – *Corymbia calophylla* -*Allocasuarina fraseriana* woodland above a generally low, weed dominated understorey.

Area F and Area G: *Banksia attenuata* – *Banksia menziesii* – *Allocasuarina fraseriana* woodland with occasional stands of *Jacksonia furcellata* and *Kunzea glabrescens* above a generally low, multi-species understorey with *Acacia pulchella*, *Hibbertia rhadinopoda*, *Petrophile linearis* and *Xanthorrhoea preissii* common shrubs.

Of the six survey areas within the site, half of them (A, D and E) were generally considered to be in Poor condition while the rest (G, F and C) were considered to be in Good condition. However, there are areas considered to be in Poor and Very Poor condition within survey areas A, C, D, E and G.

3 Methods

3.1 Background Research

The background research is designed to gather existing data on known locations of breeding and feeding for Black Cockatoo. The background research and desktop study included review of the following websites and documents:

- DEC's website on Black Cockatoos;
- SEWPaC's *EPBC Act* draft referral guidelines; and
- Reports of previous studies undertaken in the area.

3.2 Black Cockatoo Breeding and Foraging Assessment Methodology

3.2.1 Survey Personnel

The survey was undertaken by Black Cockatoo specialist Tony Kirkby on 14 July 2012. Tony Kirkby was a technical officer at the WA Museum and has had significant field experience with Black Cockatoos in Western Australia. He is considered an expert in the area of protected Black Cockatoos and has authored a number of papers on the subject. Over the last seven years Tony has collected, recorded and photographed most of the food taken by the three south-west Black Cockatoos and has to date a database of over 20,000 records and an image library of over 3,000 Black Cockatoos and Black Cockatoo food related photographs.

3.2.2 Black Cockatoo Breeding Site Assessment

This assessment involved observation of suitably sized trees with the potential for hollows to be present. Each tree was assessed to determine if hollows were present. If hollows were present each was assessed with the use of binoculars to determine its suitability for use by Black Cockatoo species as a breeding hollow. Any suitable hollows that were located were assessed to determine if they were being utilised by Black Cockatoo species as a breeding hollow. The assessment method takes into consideration the size and shape of the hollow, chew marks around the entrance, feathers nearby or any other signs that indicate that Black Cockatoo may potentially utilise the hollow.

3.2.3 Black Cockatoo Foraging Site Assessment

Tony Kirkby undertook a one day site visit to conduct an observational site survey and feeding assessment across all survey areas to determine the extent of foraging habitat for Black Cockatoos at the same time as the breeding assessment was undertaken. The observational and foraging assessment included:

- General habitat suitability of the sites;

- Analysis of dentition marks in seed and nut material;
- Opportunistic observations of Black Cockatoos within the proposed development area; and
- Casual opportunistic observations of potential breeding habitat.

Feeding trees and opportunistic observations were recorded and located using a hand held Differential Global Positioning System (DGPS) unit (Appendix B).

3.3 Black Cockatoo Significant Tree Survey Methodology

3.3.1 Survey Personnel

The Black Cockatoo Significant Tree Survey for Areas C, D, E, F and G was conducted by two Environmental Scientists from 360 Environmental on 20 July 2012. In addition, data from a previous survey conducted within Area A has been included in this report (360 Environmental, 2010).

3.3.2 Site Survey

The Black Cockatoo Significant Tree Survey was undertaken to determine trees within the sites that were of a certain size, as outlined by SEWPaC, that have the potential in the future to develop hollows suitable for Black Cockatoo breeding. The 2012 survey comprised of recording the location, species, tree trunk diameter at breast height (DBH) and any other important descriptive information about each tree located within the site boundary.

Approximately 40 m wide walking transects were designed across the site. Every tree within a survey transect was assessed based on the Black Cockatoo significant tree criteria (below). Each transect ran parallel or perpendicular to another transect to ensure all trees within the site were included within a transect line. Tree details were individually recorded electronically using a DGPS.

3.3.3 Black Cockatoo Significant Tree Criteria

Trees exceeding 400 mm trunk (DBH) (~1.5 m above ground level) were considered significant for the purposes of this survey based on criteria used by the Town of Kwinana (Town of Kwinana, pers. comm., 9 February 2010). This is a more conservative measure of tree significance than the standard 500 mm used by SEWPaC. Trees with a trunk DBH less than 400 mm were not recorded for the purposes of the 2012 survey.

3.3.3.1 Tree Location (using DGPS)

Each significant tree was individually recorded using a DGPS to obtain Universal Transverse Mercator (UTM GDA 94 Zone 50) coordinates.

3.3.3.2 Tree Species

Each significant tree was individually recorded according to its species, as either:

- Jarrah (*Eucalyptus marginata*);
- Marri (*Corymbia calophylla*);
- Tuart (*Eucalyptus gomphocephala*);
- Sheoak (*Allocasuarina fraseriana*);
- Hakea (*Hakea sp.*);
- Banksia (*Banksia attenuata* or *Banksia menziesii*); or
- Stag (standing dead tree).

The species with the potential to develop hollows were then mapped to visually represent the tree species with the potential to be of breeding significance to Black Cockatoos.

3.3.3.3 Trunk Diameter at Breast Height

Each significant tree was individually recorded according to its trunk DBH, as either:

- Small: 400 mm to 500 mm;
- Medium: 500 mm to 800 mm;
- Large: 800 mm to 1,200 mm; and
- Very Large: 1,200 mm+.

4 Results

The following summarises the results of the Black Cockatoo Breeding, Foraging and Significant Tree Assessments.

4.1 Background Research Results

4.1.1 Black Cockatoo Species

A search of the EPBC database and past site assessments revealed that the Vulnerable Forest Red-tailed Black Cockatoo and the Endangered Carnaby's Black Cockatoo are likely to occur within the area. There is a possibility that Baudin's Black Cockatoo may also occur occasionally within the site. Only three species of Black Cockatoo occur within the south west of Western Australia. Each is described below in detail.

4.1.1.1 Carnaby's Black Cockatoo

Carnaby's Black Cockatoo is a large, Black cockatoo with a white patch on its cheek, white bands on its tail, and a strong curved bill. Carnaby's Black Cockatoo is also known as the Short-billed Cockatoo. In males, the bill is black and the eye-ring dark-pink. Females have a light grey bill, grey eye-ring, and the cheek patch is less distinctive.

Carnaby's Black Cockatoo is endemic to the southwest of Western Australia, extending from the Murchison River to Esperance, and inland to Coorow, Kellerberrin and Lake Cronin (DEC, 2009). There is evidence the species is currently expanding its breeding range westward and south into the Jarrah-Marri forests of the Darling Range and into the Tuart forests of the Swan Coastal Plain (Johnstone and Kirkby, 2006).

Carnaby's Black Cockatoos are believed to breed mostly in the wheatbelt region of Western Australia (DEC, 2009). After breeding, Carnaby's Cockatoo disperse to the higher rainfall coastal areas of the south-west of Western Australia to feed in late December to July (DEC, 2009).

Carnaby's Black Cockatoo display strong pair bonds. They occur in uncleared or remnant areas of Eucalypt woodland, principally Salmon gum (*Eucalyptus salmonophloia*) or Wandoo (*E. wandoo*), and shrubland or kwongan heath dominated by *Hakea* and *Banksia* species. Carnaby's Black Cockatoo nest in the hollows of live or dead smooth-barked Eucalypts (Salmon Gum and Wandoo) but also in Red Morrell (*E. longicornis*), York Gum (*E. loxophleba*), Marri and Tuart (Johnstone and Storr, 1998).

On the Swan Coastal Plain, the birds feed on a large variety of plants including the Proteaceae (*Banksia* and *Grevillea*), Marri nuts and introduced species – notably Pines (DEC, 2009).

Carnaby's Black Cockatoo has undergone a dramatic decline in recent years, declining by 50 percent in the past 45 years, one of the main contributing factors being land

clearing (DEC, 2009). The long-term survival and recovery of this species is linked to the survival of its habitat – both in breeding areas in the Wheatbelt and non-breeding areas such as the Swan Coastal Plain (DEC, 2009). In addition, clearing of heathland near breeding sites has reduced the availability of food for breeding pairs and their young (DEC, 2009).

4.1.1.2 Forest Red-tailed Black Cockatoo

The Forest Red-tailed Black Cockatoo is 55–60 cm in length and weighs between 570 and 870 g (Higgins 1999). Males can be distinguished by broad red tail panels that are only visible when taking off or alighting (Higgins 1999). Females on the other hand can be distinguished by yellow or whitish spots on the feathers of the head and upper wing coverts. Their tail feathers are bright red and orange, grading to yellow on the inner margins, and have variable black horizontal barring.

This species is endemic to the south-west humid and semi-humid zones of Western Australia. It inhabits dense Jarrah, Karri and Marri forests which receive more than 600mm average annual rainfall (SEWPaC, 2012). Although most records are in Jarrah-Marri forests, the Forest Red-tailed Black Cockatoo has been observed in a range of other forest and woodland types, including Blackbutt (*E. patens*), Wandoo (*E. wandoo*), Tuart (*E. gomphocephala*), Albany Blackbutt, Yate (*E. cornuta*), and Flooded Gum (*E. rudis*) (Abbott 1998a,b).

Forest Red-tailed Black Cockatoos feed predominantly on the seeds of Jarrah and Marri fruits. The other species used for feeding include Blackbutt, Albany Blackbutt (*E. staeri*), Forest Sheoak, Snottygobble and the non-indigenous native Spotted Gum (*E. maculata*) and Cape Lilac (Johnstone & Kirkby 1999).

The Forest Red-tailed Black Cockatoo has declined in range by 25–30% as a result of clearing of the margins of the forests for agriculture in the early 1900s (Mawson & Johnstone 1997) and is projected to further decline by 30% or more between 2005 and 2015 (Chapman 2005).

Key threats to the Forest Red-tailed Black Cockatoo are habitat loss, nest hollow shortage and competition for available nest hollows from other species, and injury or death from the European Honeybee (*Apis mellifera*), illegal shooting (Chapman 2005) and fire (WA CALM 2006).

4.1.1.3 Baudin's Black Cockatoo

Baudin's Black Cockatoo is a large black cockatoo which measures 50–57 cm in length, with a wingspan of approximately 110 cm, and a mass of 560–770 g. It is mostly dull black in colour, with pale whitish margins on the feathers, large, rounded patches on the ear coverts, and rectangular white panels in the tail. It has a large bill that is coloured black in the male and whitish-grey with a black tip in the female. It also features a dark

brown iris that is surrounded by a reddish-pink eye-ring in the male and a grey eye-ring in the female. (Higgins 1999; Johnstone & Storr 1998)

This species is only found in the extreme south-west of Western Australia. It occurs in areas of high rainfall and usually in heavily forested locations dominated by Marri, Karri or Jarrah. However, it also occurs in woodlands of Wandoo (*E. wandoo*), Blackbutt (*E. patens*), Flooded Gum (*E. rudis*), Yate (*E. cornuta*) and in orchards, and is occasionally recorded in farmland and grasslands (Johnstone & Kirkby 2008).

The diet of Baudin's Black Cockatoo consists mostly of Eucalyptus seeds (e.g. Marri and Jarrah) and occasionally insect larvae and the seeds of other plants such as *Banksia*, *Dryandra*, *Erodium*, *Hakea*, *Malus sylvestris* (apple) and *Pyrus communis* (pear), and occasionally with nectar from Marri or other plants (Higgins 1999).

Baudin's Black-Cockatoo is gregarious. It is usually seen in groups of three (comprising the adult pair and a single dependent young) or in small parties, but will occasionally gather in large flocks of up to 300 birds during the non-breeding season, usually at sites where food is abundant (Higgins 1999). During the breeding season, adults nest in solitary pairs

4.2 Black Cockatoo Breeding Assessment

No trees containing hollows that may potentially be utilised for breeding by Black Cockatoo species were observed within the survey area.

4.3 Black Cockatoo Foraging Assessment

Across all sites, there was a relatively large amount of recent feeding evidence on grubs of *Banksia attenuata* and nectar from *Banksia menziesii* by Carnaby's Black Cockatoo. Old feeding evidence was also observed on grubs of *Banksia attenuata*. Table 1 provides a summary of feeding evidence observed during the foraging assessment.

Table 1: Evidence of Foraging Activity

EVIDENCE	EASTING	NORTHING
Old evidence of feeding on grubs from <i>Banksia attenuata</i>	390788	6432775
Recent evidence of feeding on nectar from <i>Banksia menziesii</i>	391017	6432794
Recent evidence of feeding on nectar from <i>Banksia menziesii</i>	391077	6432794
Recent evidence of feeding on nectar from <i>Banksia menziesii</i>	391075	6432797
Recent evidence of feeding on nectar from <i>Banksia menziesii</i> . Extensive from several trees.	390997	6432827
Old evidence of feeding on grubs from <i>Banksia attenuata</i>	390801	6432847
Recent evidence of feeding on nectar from <i>Banksia menziesii</i>	390731	6432851
Recent evidence of feeding on seeds of <i>Banksia attenuata</i>	390723	6432881
Recent evidence of feeding on nectar from <i>Banksia menziesii</i>	390520	6432934
Recent evidence of feeding on seeds of <i>Banksia attenuata</i>	390246	6432969
Recent evidence of feeding on nectar from <i>Banksia menziesii</i>	390403	6432993

Appendix B provides a summary of data results for the foraging assessment.

4.4 Black Cockatoo Opportunistic Observations

On 14 July 2012, two callings to the east of Carnaby's Black Cockatoo were recorded at 1.15 pm. The DGPS location from which these calls were heard is displayed in Figure 2. However it was clear the birds were calling from outside of the survey sites.

4.5 Black Cockatoo Significant Tree Assessment

A summary of the results of the Black Cockatoo Significant Tree Assessment undertaken in 2012 for Areas C, D, E, F and G and 2010 for Area A are presented in Table 2. The raw survey data for the 2012 survey is located in Appendix C and the 2010 survey is located in Appendix D.

The Black Cockatoo Significant Tree Assessment found that the dominant tree species were:

- Jarrah (*E. marginata*);
- Banksia (*Banksia attenuata*); and
- Sheoak (*Allocasuarina fraseriana*).

However, according to the SEWPaC draft referral guidelines, only Jarrah are considered significant potential breeding trees as they provide breeding habitat, in contrast to Banksia and Sheoak which only provide feeding habitat and do not form hollows suitable for Black Cockatoo.

In total, 51 Jarrah trees were recorded on site with a trunk DBH greater than 400 mm. A total of 37 (72.5%) of these trees were recorded with a trunk DBH >500 mm which meet the SEWPaC guidelines as large significant trees with the potential to provide breeding habitat for Black Cockatoo species.

Table 2: Black Cockatoo Significant Tree Survey Results (Areas A, C, D, E, F, and G)

TRUNK SIZE (DBH)	JARRAH
Small: 400mm – 500mm	14
Medium: 500mm – 800mm	19
Large: 800mm – 1200mm	14
Extra Large: >1200mm	4
Total	51

During the 2012 Significant Tree Survey, trees were assessed by 360 Environmental to determine if they contained hollows and if they have the potential to be utilised by Black Cockatoo species for breeding.

- Two Jarrah trees were found to contain at least one obvious hollow, however all of the hollows observed appeared too small to be suitable for Black Cockatoo species – 390746E 6432764N and 390745E 6432763N;
- Five Jarrah trees were identified as potentially possessing hollows based on their size and presence of broken limbs and other hollow forming attributes:
 - 390755E 6433058N;
 - 390800E 6433053N;
 - 391037E 6432880N;
 - 391046E 6432809N; and
 - 391100E 6432882N.

None of these contained large hollows suitable for Black Cockatoo.

During the 2010 survey, there were no hollows identified in any of the trees within Area A (360 Environmental, 2010). The larger Jarrah trees were typically located on the more elevated areas of the site. Other tree species on site that were not significant tree species included Banksia and tall Sheoak. It is evident that fires have previously occurred at the site and the majority of significant trees display various degrees of fire scarring. Fire damage has resulted in some trees being completely destroyed, canopy and foliage reductions, hollowing at trunk bases or superficial bark blackening.

Tony Kirkby undertook the Black Cockatoo Breeding Assessment and did not locate any suitable Black Cockatoo hollows in any of the significant trees within the Kwinana Train Station Precinct areas.

5 Discussion

Across the Kwinana Train Station Precinct nesting hollows were found in two Jarrah trees, while five other Jarrahs were classified as featuring the potential to support current hollows. However all hollows were small. None of the trees within the survey are contained hollows that may potentially be utilised by Black Cockatoo species for breeding at the time of the survey.

The Black Cockatoo Significant Tree Surveys from 2010 and 2012 revealed that although most of the site was Banksia Woodland the site still contains old trees, many of which have reached a size that SEWPaC would consider significant as a potential breeding tree. In total, 37 trees were recorded which met SEWPaC's criteria of >500 mm DBH and were of a species that have the potential to develop suitable hollows for the Black Cockatoo species.

The occurrence of suitable feeding species (Banksia and Jarrah) and the sparse evidence of feeding debris recorded during the field survey suggest that although not extensively utilised, Carnaby's Black Cockatoo do at least occasionally utilise the survey area for foraging and feeding. However, while there were eleven locations which showed evidence of Carnaby's Black Cockatoo feeding, there were no locations which showed evidence of Forest Red-Tailed Black Cockatoo or Baudin's Black Cockatoo feeding. Of these, only two locations showed old evidence of Black Cockatoo feeding (Carnaby's Black Cockatoo), while the rest of the feeding evidence was recent foraging evidence on grubs and nectar. This suggests that although not extensively utilised, Carnaby's Black Cockatoos do at least occasionally utilise the survey area for foraging and feeding, but there was no evidence of breeding. The suggestion that Black Cockatoo's occasionally utilise the sites is supported by two callings of Carnaby's Black Cockatoos to the east of the sites.

The results of the Black Cockatoo Significant Tree Survey suggest that the site (Areas A, C, D, E, F and G) has the potential to be of significance to Black Cockatoo species for breeding in the future. However as most of the survey areas is composed of Banksia woodland the primary value of the areas is as a foraging resource for Carnaby's Black Cockatoo.

6 Summary and Recommendations

The evidence recorded during this survey suggests that the study area was used by Carnaby's Black Cockatoo for feeding but not breeding at the time of the survey. Therefore in order to reduce the impacts of the proposed development on Black Cockatoos, the following are recommended:

- Retain as many trees with a trunk diameter at breast height (DBH) of 500 mm or greater to increase the potential breeding value of the site in the future. The Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) considers that trees over 500 mm could provide breeding and foraging habitat for Black Cockatoo species. Trees with DBH less than 500 mm are considered foraging habitat for the Black Cockatoo species. SEWPaC places higher value on potential breeding trees over foraging trees. It is recommended that emphasis be placed on retaining potential breeding and foraging trees to minimise impacts. Should offsets be required for vegetation clearing they are likely to be greater for the clearing of breeding habitat;
- Retain trees that display hollows. These trees may be suitable for breeding of bird species and may become suitable for Black Cockatoo species over time (as the trees grow and the hollows increase in size). If clearing of trees with hollows is unavoidable, it is recommended that hollows are inspected prior to clearing to ensure that hollows are not currently occupied or in use;
- Consider offset of the impacts of clearing of habitat as a last resort after consideration of avoiding, minimising and otherwise mitigating impacts. Offset could include the purchase of land containing appropriate habitat (including suitable Black Cockatoo habitat);
- Clear habitat in stages to allow fauna to disperse away from the site; and
- Conduct clearing operations outside the breeding season for Black Cockatoos. Carnaby's Black Cockatoo and Baudin's Black Cockatoo breed in late winter to spring (although Carnaby's primarily breed in the wheatbelt) and Red-tailed Black Cockatoos breed within a period from September to April. This will reduce the likelihood of Black Cockatoos being impacted during clearing.

7 Limitations

This report is produced strictly in accordance with the scope of services set out in the contract or otherwise agreed in accordance with the contract. 360 Environmental makes no representations or warranties in relation to the nature and quality of biological results other than the visual observation and analytical data in this report.

In the preparation of this report, 360 Environmental has relied upon documents, information, data and analyses (“client’s information”) provided by the client and other individuals and entities. In most cases where client’s information has been relied upon, such reliance has been indicated in this report. Unless expressly set out in this report, 360 Environmental has not verified that the client’s information is accurate, exhaustive or current and the validity and accuracy of any aspect of the report including, or based upon, any part of the client’s information is contingent upon the accuracy, exhaustiveness and currency of the client’s information. 360 Environmental shall not be liable to the client or any other person in connection with any invalid or inaccurate aspect of this report where that invalidity or inaccuracy arose because the client’s information was not accurate, exhaustive and current or arose because of any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to 360 Environmental.

Aspects of this report, including the opinions, conclusions and recommendations it contains, are based on the results of the investigation, sampling and testing set out in the contract and otherwise in accordance with normal practices and standards. The investigation, sampling and testing are designed to produce results that represent a reasonable interpretation of the general conditions of the site that is the subject of this report. However, due to the characteristics of the site, including natural variations in site conditions, the results of the investigation, sampling and testing may not accurately represent the actual state of the whole site at all points.

It is important to recognise that site conditions, including the extent and concentration of contaminants, can change with time. This is particularly relevant if this report, including the data, opinions, conclusions and recommendations it contains, are to be used a considerable time after it was prepared. In these circumstances, further investigation of the site may be necessary.

Subject to the terms of the contract between the Client and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating parts of this report is prohibited (except to the extent required by law) unless the report is produced in its entirety including this page, without the prior written consent of 360 Environmental Pty Ltd.

8 References

- 360 Environmental 2010. Bertram Station West. Significant Tree Survey.
- 360 Environmental 2009. Bertram Station Precinct. Level 2 Flora and Vegetation Survey.
- Abbott, I. (1998a). Counting cockatoos: The status of the Forest Red-tailed Black Cockatoo. *Landscape*. 13 (2):10-16.
- Abbott, I. (1998b). Conservation of the Forest Red-tailed Black Cockatoo, a hollow-dependent species, in the eucalypt forests of Western Australia. *Forest Ecology and Management*. 109:175-185.
- Chapman, T. (2005). Forest Black Cockatoo (Baudin's Cockatoo *Calyptorhynchus baudinii*) and Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) Draft Recovery Plan, June 2005-June 2015 (Department of Conservation and Land Management: Perth). Perth: Department of Conservation and Land Management.
- Department of Environment and Conservation (DEC) 2009. Carnaby's Black-cockatoo *Calyptorhynchus latirostris* (Carnaby 1948)
www.dec.wa.gov.au/component/option,com_docman/itemid,/gid,117/task,doc_download/ Accessed on 30/7/2012.
- Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) 2011. Environment Protection and Biodiversity Conservation Act 1999 draft referral guidelines for three threatened black cockatoo species
<http://www.environment.gov.au/epbc/publications/pubs/referral-guidelines-wa-black-cockatoo.pdf> Accessed on 30/7/2012.
- Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) 2012. Species Profiles and Threats Database. Available from
<http://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl> Accessed on 30/7/2012
- Higgins, P.J., ed. (1999). Handbook of Australian, New Zealand and Antarctic Birds Volume 4: Parrots to Dollarbird. Melbourne: Oxford University Press.
- Johnstone, R.E. & Kirkby, T (1999). Food of the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* in south-west Western Australia. *Western Australian Naturalist*. 22:167-177.
- Johnstone, R.E. and Kirkby, T. 2006. Cockatoos in Crisis. *Landscape*. 21 (2)
- 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 Western Australian Museum*. 25:107-118.

Johnstone, RE and Storr, GM 1998. Handbook of Western Australian Birds Volume 1 – Nonpasserines (Emu to Dollarbird), Western Australian Museum.

Western Australia Department of Conservation and Land Management (WA CALM) (2006). Records held in CALM's Declared Flora Database and rare flora files. Perth, Western Australia: WA CALM.

APPENDIX A

Figures

Legend

-  Train Station Sites
-  Major Roads
-  Minor Roads

NOTE: THIS DRAWING REFERS TO THE - SURVEYING DATA
 - AERIAL PHOTOGRAPH SOURCED FROM LANDSAT 2008
 - LOCALITY MAP SOURCED FROM LANDSAT 2008



LOCALITY MAP

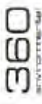


DRAWING ID	DATE		
ES197-3.01	12/09/2012		
HORIZONTAL DATUM AND PROJECTION			
GDA 1994 MGA Zone 50			
CREATED	CHECKED	APPROVED	REVISION
JJ	AK	FD	0

Satterley Property Group
 Kwinana Train Station Precinct

Black Cockatoo Survey
 Site Location

Figure 1



- Legend**
- A
 - C
 - D
 - E
 - F
 - Very Poor Condition

Descriptions:

A: *Banksia attenuata* - *Allocasuarina fraseriana* woodland with occasional stands of *Jacksonia furcillata* and *Kunzea glabrescens* above a generally low, multi-species understorey with *Acacia pulchella*, *Hibbertia madroperoides*, *Pteropile linearis* and *Xanthorrhoea preissii* common low shrubs. Weeds occur throughout.

C: Variable *Banksia attenuata* - to a tall woodland of *Corymbia calophylla*. Understorey density and height varies with open areas of low shrubs and herbs below tall trees and taller more dense shrubs occurring below *B. attenuata*, *Hibbertia madroperoides*, *Microzamia regei*, *Pteropile linearis* and *Xanthorrhoea preissii* are common shrubs. Weeds occur throughout.

D: *Banksia attenuata* - *Allocasuarina fraseriana* woodland above a generally low, multi-species understorey with *Hibbertia madroperoides*, *Falsonia occidentalis* and *Xanthorrhoea preissii* common shrubs. Weeds occur throughout.

E: *Banksia attenuata* - *Corymbia calophylla* - *Allocasuarina fraseriana* woodland above a generally low, weed dominated understorey.

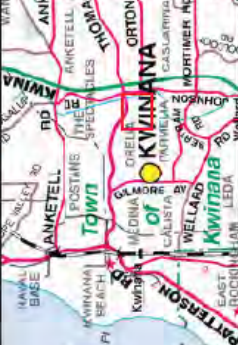
F: *Banksia attenuata* - *Banksia menziesii* - *Allocasuarina fraseriana* woodland with occasional stands of *Jacksonia furcillata* and *Kunzea glabrescens* above a generally low, multi-species understorey with *Acacia pulchella*, *Hibbertia madroperoides*, *Pteropile linearis* and *Xanthorrhoea preissii* common shrubs.

G: *Banksia attenuata* - *Banksia menziesii* - *Allocasuarina fraseriana* woodland with occasional stands of *Jacksonia furcillata* and *Kunzea glabrescens* above a generally low, multi-species understorey with *Acacia pulchella*, *Hibbertia madroperoides*, *Pteropile linearis* and *Xanthorrhoea preissii* common shrubs.

LOCALITY MAP SOURCED FROM LANDSAT 2008
 - LOCALITY MAP SOURCED FROM LANDSAT 2008
 - VEGETATION SURVEY AND CONDITION FROM 360 ENVIRONMENTAL 2011



1:4,000 @ A3
 LOCALITY MAP



DRAWING ID: ESI197-3.02
 DATE: 12/09/2012

HORIZONTAL DATUM AND PROJECTION: GOA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
JU	AH	FD	D

Satterley Property Group
 Kwinana Train Station Precinct

Black Cockatoo Survey
 Vegetation Descriptions

Figure 2

360

ENVIRONMENTAL CONSULTANTS



360 ENVIRONMENTAL CONSULTANTS

Legend

- Train Station Sites
- Major Roads
- Minor Roads
- Species
- Jarraah
- Trunk Diameter (mm)
 - 400 - 500
 - 500 - 800
 - 800 - 1200
 - >1200

NOTE: THIS REPORTING PAPER IS CLASSIFIED AS **SENSITIVE BUT CONTROLLED**.
 - METAL PHOTOGRAPH SOURCED FROM LANDSAT 2008
 - LOCALITY MAP SOURCED FROM LANDSAT 2008

Scale: 1:4,000 @ A3
 0 50 100 150 200 250 Metres

LOCALITY MAP

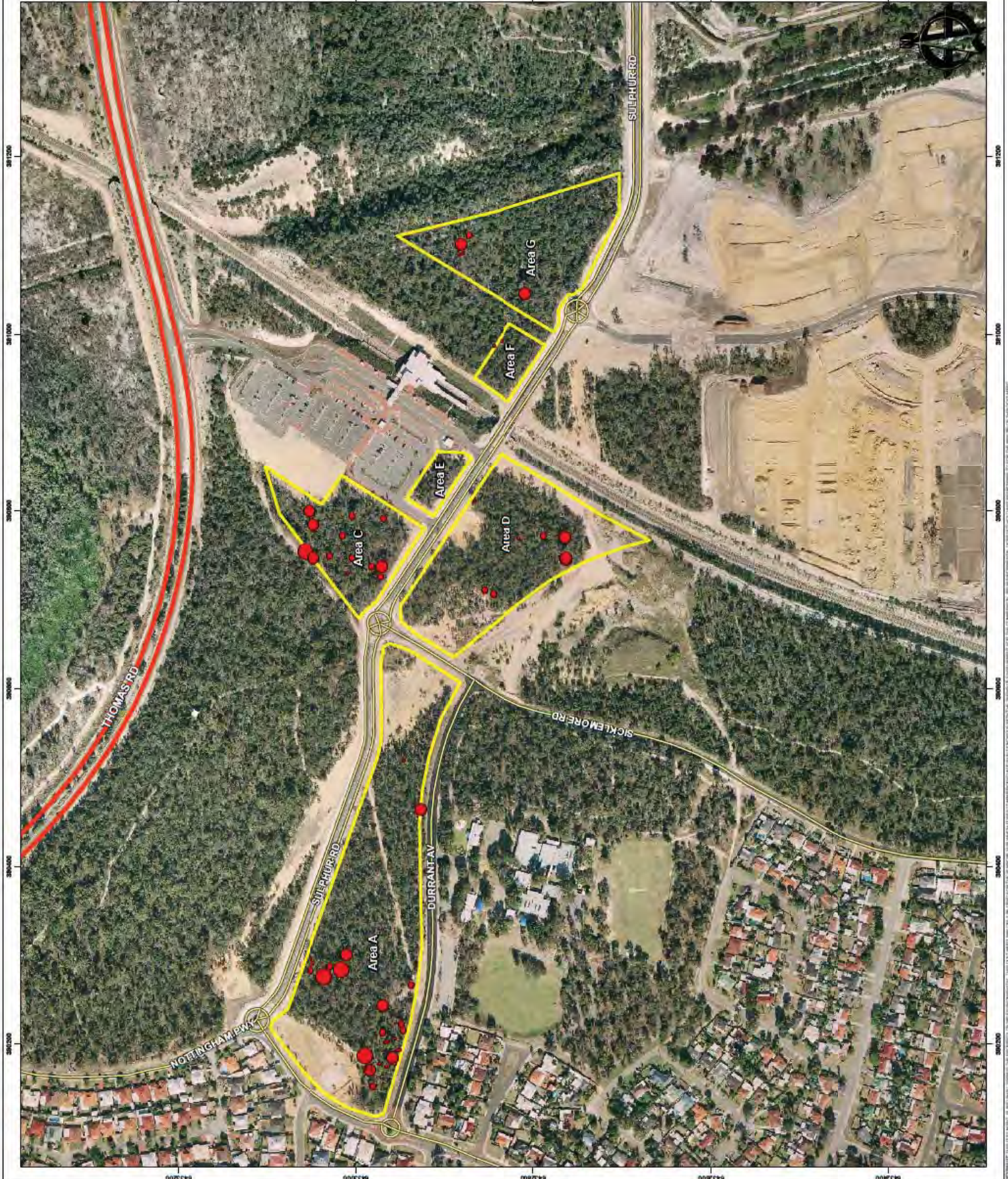
DATE: 12/09/2012
HORIZONTAL DATUM AND PROJECTION: GDA 1994 MGA Zone 50
CREATED: JJ
CHECKED: AH
APPROVED: FD
REVISION: D

DRAWING ID: EBS197-3-03

Satterley Property Group
Kwinana Train Station Precinct

Black Cockatoo Survey
Significant Trees

Figure 3



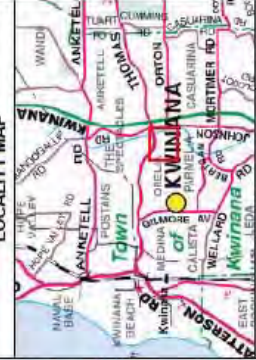
- Legend**
- Train Station Sites
 - Major Roads
 - Minor Roads
 - Nesting Hollows
 - Possible Cockatoo Nesting Hollow
 - Hollow Unsuitable for Cockatoos
 - Carnaby's Black Cockatoo
 - Calling Location
 - Feeding Location

NOTE: THIS REPORTING PERIOD COVERS 30th JULY 2016 TO 31st JULY 2016
 - AERIAL PHOTOGRAPH SOURCED FROM LANDSAT 2016
 - LOCALITY MAP SOURCED FROM LANDGATE 2008



1:4,000 @A3

LOCALITY MAP



DRAWING ID	ES197-3.04	DATE	12/05/2012
HORIZONTAL DATUM AND PROJECTION		GOA 1994 MGA ZONE 50	
CREATED	JU	CHECKED	AH
APPROVED	FD	REVISION	D

Satterley Property Group
 Kwinana Train Station Precinct

Black Cockatoo Survey
 Sighting and Feeding Sites

Figure 4



587200 587000 586800 586600 586400 586200 586000 585800 585600 585400 585200 585000

643200 643000 642800 642600 642400 642200 642000 641800 641600 641400 641200 641000

APPENDIX B

Black Cockatoo Breeding, Foraging and Sighting Data

DATE	SPECIES	EASTINGS (UTM GDA 94 ZONE 50)	NORTHINGS (UTM GDA 94 ZONE 50)	COMMENTS
14/07/2012	Carnaby's Cockatoo <i>Calyptorhynchus latirostris</i>	390788	6432775	Old evidence of feeding on grubs from Banksia attenuata
		391017	6432794	Recent evidence of feeding on nectar from Banksia menziesii
		391077	6432794	Recent evidence of feeding on nectar from Banksia menziesii
		391075	6432797	Recent evidence of feeding on nectar from Banksia menziesii
		390997	6432827	Recent evidence of feeding on nectar from Banksia menziesii . Extensive from several trees
		390801	6432847	Old evidence of feeding on grubs from Banksia attenuata
		390731	6432851	Recent evidence of feeding on nectar from Banksia menziesii
		390731	6432851	Two calling to east at 13:15
		390723	6432881	Recent evidence of feeding on seeds of Banksia attenuata
		390520	6432934	Recent evidence of feeding on nectar from Banksia menziesii
		390246	6432969	Recent evidence of feeding on seeds of Banksia attenuata
		390403	6432993	Recent evidence of feeding on nectar from Banksia menziesii

APPENDIX C

Black Cockatoo Significant Tree Data

TREE NUMBER	EASTINGS	NORTHINGS	SPECIES	DBH	HOLLOW
	(UTM GDA 94 ZONE 50)	(UTM GDA 94 ZONE 50)			
1	390753.3971	6433005.68	Sheoak	401.0704566	N
2	390715.3558	6432985.534	Sheoak	401.0704566	N
3	390823.3414	6432811.416	Sheoak	402.662006	N
4	390754.6696	6432879.081	Sheoak	404.2535555	N
5	390761.739	6432966.189	Sheoak	404.2535555	N
6	390721.7322	6432831.384	Sheoak	405.8451049	N
7	390768.9161	6432816.372	Jarrah	407.4366543	N
8	390986.4743	6432844.773	Jarrah	407.4366543	N
9	391089.5116	6432884.687	Jarrah	407.4366543	N
10	391092.186	6432785.045	Sheoak	407.4366543	N
11	391091.1551	6432880.824	Jarrah	410.6197532	N
12	390728.6269	6432864.83	Sheoak	412.2113026	N
13	390729.8067	6433008.64	Jarrah	413.802852	N
14	391060.8131	6432924.513	Jarrah	413.802852	N
15	390787.3726	6432852.493	Sheoak	416.9859509	N
16	391038.1962	6432802.091	Sheoak	420.1690498	N
17	390779.1999	6432832.67	Sheoak	423.3521486	N
18	390743.2277	6432769.307	Banksia	428.4451068	N
19	390824.0527	6432832.821	Sheoak	429.7183463	N
20	391061.4093	6432772.85	Unknown	429.7183463	N
21	390773.2476	6432991.259	Jarrah	432.9014452	N
22	391035.1818	6432854.5	Banksia	432.9014452	N
23	391077.995	6432895.317	Sheoak	439.2676429	N
24	391093.8415	6432762.556	Sheoak	439.2676429	N

TREE NUMBER	EASTINGS	NORTHINGS	SPECIES	DBH	HOLLOW
	(UTM GDA 94 ZONE 50)	(UTM GDA 94 ZONE 50)			
25	390829.9997	6432901.735	Sheoak	442.4507418	N
26	390715.6197	6432917.463	Sheoak	444.0422912	N
27	390807.4159	6432802.707	Sheoak	445.6338407	N
28	390770.542	6432840.337	Sheoak	445.6338407	N
29	390833.6194	6432906.874	Sheoak	445.6338407	N
30	390719.2623	6432885.572	Sheoak	447.2253901	N
31	391085.3528	6432868.345	Hakia?	448.8169395	N
32	391109.5355	6432854.081	Banksia	448.8169395	N
33	390736.3195	6432868.017	Sheoak	450.408489	N
34	390763.7725	6432804.01	Sheoak	464.7324338	N
35	390709.8003	6432810.633	Sheoak	467.9155327	N
36	390972.1945	6432840.739	Sheoak	467.9155327	N
37	391060.4338	6432924.73	Jarrah	471.0986316	N
38	390760.8868	6432984.03	Sheoak	474.2817304	N
39	390992.6942	6432835.97	Jarrah	474.2817304	N
40	390750.6404	6432824.6	Sheoak	475.8732798	N
41	390795.6131	6433023.209	Sheoak	480.6479281	N
42	390811.0563	6432867.05	Jarrah	483.831027	N
43	391067.3651	6432823.581	Banksia	483.831027	N
44	390766.0254	6432804.81	Sheoak	493.3803236	N
45	390703.2614	6432997.266	Sheoak	496.5634224	N
46	390949.4442	6432844.485	Sheoak	496.5634224	N
47	391088.9127	6432905.302	Sheoak	496.5634224	N
48	390971.4928	6432862.129	Sheoak	499.7465213	N

TREE NUMBER	EASTINGS	NORTHINGS	SPECIES	DBH	HOLLOW
	(UTM GDA 94 ZONE 50)	(UTM GDA 94 ZONE 50)			
49	390793.8478	6432811.319	Sheoak	502.9296202	N
50	390710.7216	6432856.21	Jarrah	504.5211696	N
51	390823.7683	6432850.446	Sheoak	512.4789168	N
52	390749.0858	6433029.692	Jarrah	515.6620156	N
53	390783.2899	6432960.103	Sheoak	522.0282133	N
54	390791.295	6432969.28	Jarrah	525.2113122	N
55	390715.2736	6433010.59	Sheoak	531.5775099	N
56	390771.4789	6432788.46	Jarrah	534.7606088	N
57	390728.7215	6432794.983	Sheoak	537.9437077	N
58	390772.1423	6433015.084	Jarrah	541.1268065	N
59	390943.7738	6432863.493	Sheoak	541.1268065	N
60	390781.4154	6432950.437	Sheoak	544.3099054	N
61	390752.3334	6432842.358	Sheoak	547.4930042	N
62	390780.8934	6433077.376	Sheoak	547.4930042	N
63	390707.1039	6432807.278	Sheoak	550.6761031	N
64	390775.333	6432806.795	Sheoak	552.2676525	N
65	390761.8467	6432956.212	Sheoak	566.5915974	N
66	390687.6167	6432945.1	Sheoak	569.4563864	N
67	390798.1975	6432775.001	Sheoak	593.6479377	N
68	390686.8897	6432933.894	Sheoak	595.2394872	N
69	391043.4442	6432901.043	Jarrah	614.3380803	N
70	390772.1959	6433018.854	Sheoak	627.0704758	N
71	390717.7022	6433003.853	Sheoak	630.2535746	N
72	391045.6986	6432875.457	Jarrah	630.2535746	N

TREE NUMBER	EASTINGS	NORTHINGS	SPECIES	DBH	HOLLOW
	(UTM GDA 94 ZONE 50)	(UTM GDA 94 ZONE 50)			
73	390733.274	6433036.617	Sheoak	633.4366735	N
74	390725.8699	6432971.789	Jarrah	639.8028712	N
75	391085.419	6432739.626	Sheoak	639.8028712	N
76	390775.7858	6432817.222	Sheoak	642.9859701	N
77	390718.1279	6433008.07	Sheoak	646.169069	N
78	390994.5169	6432815.479	Sheoak	646.169069	N
79	390691.4141	6433003.569	Sheoak	649.3521678	N
80	390736.9686	6432982.441	Jarrah	655.7183655	N
81	391015.8885	6432799.744	Sheoak	655.7183655	N
82	390772.174	6432793.9	Sheoak	675.1352686	N
83	390793.6626	6433038.045	Sheoak	687.5493542	N
84	390793.9332	6433004.233	Jarrah	693.9155519	N
85	390966.7252	6432893.564	Jarrah	703.4648485	N
86	391060.4695	6432938.922	Jarrah	716.1972439	N
87	390706.0264	6432845.96	Jarrah	751.2113314	N
88	390746.6322	6433003.833	Jarrah	754.3944303	N
89	391111.1181	6432873.389	Jarrah	783.04232	N
90	390770.2311	6432764.388	Jarrah	800.5493638	N
91	391100.8468	6432882.148	Jarrah	830.7888029	?
92	390744.9967	6432762.563	Jarrah	864.211341	Y
93	391036.613	6432984.122	Jarrah	875.352187	N
94	390737.2804	6432971.025	Jarrah	884.9014836	N
95	391045.7576	6432808.714	Jarrah	900.8169779	?
96	390746.5889	6432763.467	Jarrah	945.380362	Y

TREE NUMBER	EASTINGS	NORTHINGS	SPECIES	DBH	HOLLOW
	(UTM GDA 94 ZONE 50)	(UTM GDA 94 ZONE 50)			
97	390746.7116	6433048.847	Jarrah	954.9296586	N
98	390784.5071	6433048.146	Jarrah	996.3099438	N
99	390799.5409	6433052.189	Jarrah	1176.155029	?
100	390754.5306	6433057.801	Jarrah	1222.309963	?
101	391037.2687	6432879.468	Jarrah	1330.535324	?

APPENDIX D

Black Cockatoo Significant Tree Data (Previous Data)

TREE NUMBER	EASTINGS	NORTHINGS	SPECIES	DBH	HOLLOW
	(UTM GDA 94 ZONE 50)	(UTM GDA 94 ZONE 50)			
1	390275.78400	6433036.20700	Jarrah	1200mm+	N
2	390186.96300	6432989.78500	Jarrah	1200mm+	N
3	390283.65500	6433016.61000	Jarrah	1200mm+	N
4	390223.20900	6433045.12900	Sheoak	400-500mm	N
5	390246.30700	6433060.17700	Sheoak	400-500mm	N
6	390249.21500	6433059.82400	Sheoak	400-500mm	N
7	390261.10100	6433046.37000	Sheoak	400-500mm	N
8	390260.63800	6433029.70600	Sheoak	400-500mm	N
9	390287.70700	6433051.44800	Jarrah	400-500mm	N
10	390290.81200	6433048.77200	Jarrah	400-500mm	N
11	390296.68300	6433050.72000	Jarrah	400-500mm	N
12	390340.64200	6432993.55000	Sheoak	400-500mm	N
13	390409.10800	6432976.36900	Sheoak	400-500mm	N
14	390411.42100	6432976.43000	Sheoak	400-500mm	N
15	390413.59800	6432980.19000	Sheoak	400-500mm	N
16	390411.97700	6432963.72400	Sheoak	400-500mm	N
17	390478.95800	6432953.55300	Sheoak	400-500mm	N
18	390489.06200	6432945.74000	Sheoak	400-500mm	N
19	390494.97200	6432949.48900	Sheoak	400-500mm	N
20	390501.72900	6432959.64600	Sheoak	400-500mm	N
21	390513.96500	6432956.07900	Sheoak	400-500mm	N
22	390518.18800	6432954.05200	Sheoak	400-500mm	N
23	390519.13200	6432946.71800	Jarrah	400-500mm	N
24	390587.96700	6432896.85800	Sheoak	400-500mm	N

TREE NUMBER	EASTINGS	NORTHINGS	SPECIES	DBH	HOLLOW
	(UTM GDA 94 ZONE 50)	(UTM GDA 94 ZONE 50)			
25	390472.62700	6432941.92000	Sheoak	400-500mm	N
26	390203.58500	6432952.02400	Sheoak	400-500mm	N
27	390205.95900	6432956.44100	Jarrah	400-500mm	N
28	390202.50700	6432963.76300	Jarrah	400-500mm	N
29	390201.90000	6432966.80700	Jarrah	400-500mm	N
30	390192.72200	6432958.64200	Sheoak	400-500mm	N
31	390193.16300	6432950.27300	Jarrah	400-500mm	N
32	390192.71000	6432954.11100	Jarrah	400-500mm	N
33	390178.79600	6432958.76500	Jarrah	400-500mm	N
34	390177.57200	6432956.31100	Jarrah	400-500mm	N
35	390174.51600	6432963.54500	Jarrah	400-500mm	N
36	390174.89100	6432965.80100	Jarrah	400-500mm	N
37	390177.90100	6432973.83500	Jarrah	400-500mm	N
38	390214.44000	6433006.30300	Sheoak	400-500mm	N
39	390216.13600	6433005.85500	Sheoak	400-500mm	N
40	390235.64100	6432994.09100	Sheoak	400-500mm	N
41	390262.47600	6432972.32600	Sheoak	400-500mm	N
42	390259.89600	6432965.37500	Sheoak	400-500mm	N
43	390235.28200	6433055.02200	Sheoak	500-800mm	N
44	390256.13200	6433062.58100	Sheoak	500-800mm	N
45	390258.39400	6433064.63200	Sheoak	500-800mm	N
46	390242.36100	6433040.67500	Sheoak	500-800mm	N
47	390278.27700	6433048.70000	Sheoak	500-800mm	N
48	390282.11700	6433051.58500	Jarrah	500-800mm	N

TREE NUMBER	EASTINGS	NORTHINGS	SPECIES	DBH	HOLLOW
	(UTM GDA 94 ZONE 50)	(UTM GDA 94 ZONE 50)			
49	390286.74600	6433029.75400	Jarrah	500-800mm	N
50	390292.18100	6433028.05100	Sheoak	500-800mm	N
51	390316.73600	6433002.41000	Sheoak	500-800mm	N
52	390394.18400	6432961.30700	Sheoak	500-800mm	N
53	390439.92400	6432987.47000	Sheoak	500-800mm	N
54	390447.59500	6432997.82300	Sheoak	500-800mm	N
55	390457.51300	6432981.83500	Woody Pear	500-800mm	N
56	390523.53800	6432954.67000	Sheoak	500-800mm	N
57	390548.66900	6432914.66800	Sheoak	500-800mm	N
58	390516.62500	6432921.44600	Sheoak	500-800mm	N
59	390516.59100	6432929.01900	Sheoak	500-800mm	N
60	390360.88300	6432962.39500	Sheoak	500-800mm	N
61	390351.54300	6432959.89300	Sheoak	500-800mm	N
62	390266.15900	6432938.61100	Jarrah	500-800mm	N
63	390259.13500	6432964.18100	Sheoak	500-800mm	N
64	390231.20500	6432960.71000	Sheoak	500-800mm	N
65	390222.27000	6432949.16500	Jarrah	500-800mm	N
66	390215.16600	6432946.89400	Jarrah	500-800mm	N
67	390212.86500	6432970.26700	Jarrah	500-800mm	N
68	390172.77700	6432985.92200	Jarrah	500-800mm	N
69	390152.07800	6432980.98600	Jarrah	500-800mm	N
70	390300.15000	6433010.90500	Jarrah	800-1200mm	N
71	390350.78000	6432980.24500	Sheoak	800-1200mm	N
72	390385.15700	6432996.79700	Sheoak	800-1200mm	N

TREE NUMBER	EASTINGS	NORTHINGS	SPECIES	DBH	HOLLOW
	(UTM GDA 94 ZONE 50)	(UTM GDA 94 ZONE 50)			
73	390499.02400	6432928.57700	Sheoak	800-1200mm	N
74	390463.80400	6432927.09400	Jarrah	800-1200mm	N
75	390311.51700	6432948.84700	Sheoak	800-1200mm	N
76	390294.26900	6432948.99500	Sheoak	800-1200mm	N
77	390270.99200	6432939.49100	Sheoak	800-1200mm	N
78	390246.76500	6432935.81000	Sheoak	800-1200mm	N
79	390243.15400	6432969.93500	Jarrah	800-1200mm	N
80	390184.32700	6432958.71300	Jarrah	800-1200mm	N
81	390170.79200	6432984.72800	Jarrah	800-1200mm	N
82	390260.78300	6433018.29400	Sheoak	800-1200mm	N

ATTACHMENT 2L

Lot 2 Corner Durrant Avenue and Sicklemore Road, Parmelia

Significant Tree Survey

November 2010

Prepared for:

Department of Housing/Satterley Property
Group

Document Reference	Revision	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
LD024-2 AB	A INTERNAL DRAFT	MH, SB	JT	-	-
LD024-2 AB	B CLIENT DRAFT	MH, SB	JT	1 Electronic (email)	25/10/10
LD024-2 AC	C CLIENT FINAL	MH	JT	1 Electronic (email)	2/11/10

Disclaimer

This report is issued in accordance with, and is subject to, the terms of the contract between Department of Housing/Satterley Property Group and 360 Environmental Pty Ltd, including, without limitation, the agreed scope of the report. To the extent permitted by law, 360 Environmental Pty Ltd shall not be liable in contract, tort (including, without limitation, negligence) or otherwise for any use of, or reliance on, parts of this report without taking into account the report in its entirety and all previous and subsequent reports. 360 Environmental Pty Ltd considers the contents of this report to be current as at the date it was produced. This report, including each opinion, conclusion and recommendation it contains, should be considered in the context of the report as a whole. The opinions, conclusions and recommendations in this report are limited by its agreed scope. More extensive, or different, investigation, sampling and testing may have produced different results and therefore different opinions, conclusions and recommendations. Subject to the terms of the contract between the Client and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating parts of this report is prohibited (except to the extent required by law) unless the report is produced in its entirety including this cover page, without the prior written consent of 360 Environmental Pty Ltd.

© Copyright 2010 360 Environmental Pty Ltd ACN 109 499 041



Executive Summary

360 Environmental Pty Ltd (360 Environmental) was commissioned by Satterley Property Group on behalf of the Department of Housing (the client) to undertake a Significant Tree Survey (the survey) of the Lot 2 Corner Durrant Avenue and Sicklemore Road, Parmelia (the site) (Figure 1). The site assessed trees in accordance with Department Sustainability, Environment, Water, Population and Communities (DSEWPC) (formally Department of Environment, Water, Heritage and the Arts) significant tree guidelines. The purpose of the survey was to assess trees considered significant for the purposes of the *Environmental Protection and Biodiversity Conservation Act 1999* referral documentation.

The area of the site is approximately 3.3 hectares (ha) and is located in the Town of Kwinana, approximately 31 kilometres (km) south of Perth.

The survey identified 4 trees considered by the DSEWPC as breeding habitat for Black Cockatoos (ie trees with a trunk diameter at breast height [DBH; approximately 1.5 m above ground level] of 500 mm or greater and of species considered by DSEWPC to be used for nesting).

The following summarises the results of the survey:

- Sheoak (*Allocasuarina fraseriana*), Jarrah (*Eucalyptus marginata*) and Banksia (*Banksia attenuata*) were the dominant tree species observed across the site.
- 4 trees (all Jarrah) of DBH > 500 mm were located on the site. These trees are not distributed across the site evenly, but occur in one distinct area of the site.
- The following summarises the results of the size of the trees:
 - 3 of 500- 800 mm DBH
 - 1 of 800 – 1,200 mm DBH
- Fire damage, causing the hollowing of tree trunk bases and a reduction in canopy and foliage condition, was observed as the main reason as to why trees had declined in condition.
- Several trees exhibited typical symptoms of infection from dieback (*Phytophthora cinnamomi*); however, confirmation of dieback infection would be required by a dieback specialist.
- There were no hollows identified in any of the trees on the site.





Table of Contents

1	Introduction	1
1.1	Site Location and Current Features.....	1
1.2	Objectives	1
1.3	Scope of Work	2
2	Significant Tree Survey Method	3
2.1	Site Survey.....	3
2.2	Environmentally Significant Tree Criteria.....	3
3	Results	5
3.1	Tree Species	5
3.2	Trunk Diameter at Breast Height	5
3.3	Presence of tree hollows (located 3 m or higher above ground level) and other information	5
4	Discussion	6
5	Limitations	7
6	References	8





List of Tables

Table 1 Tree numbers in relation to trunk size

List of Figures

Figure 1 Site Location

Figure 2 Significant Trees (DSEWPC criteria) and size

List of Appendices

Appendix A Logged Raw Data Points



1 Introduction

360 Environmental Pty Ltd (360 Environmental) was commissioned by Satterley Property Group on behalf of Department of Housing (the client) to provide environmental consultancy services for the proposed development of Lot 2 Corner Durrant Avenue and Sicklemore Road, Parmelia (the site) (Figure 1). Part of this work includes undertaking a Significant Tree Survey (the survey) of the site to assist in the collection of information to support documentation for referral under the *Environment Protection and Biodiversity Conservation Act 1999*. The results of the flora and vegetation survey undertaken at the site in 2008 indicated the presence of Black Cockatoo habitat. The survey was undertaken to provide additional information to assist in determining the type of black cockatoo habitat present that is foraging or breeding.

DSEWPC define foraging habitat as including but not limited to proteaceous shrublands dominated by Banksia (including all species formerly known as Dryandra), Hakea and Grevillea, Karri (*Eucalyptus diversicolor*) and Marri (*Corymbia calophylla*). Tree species in foraging habitat may be of any size.

DSEWPC define breeding habitat as including but not limited to species of Salmon Gum (*Eucalyptus salmonophloia*), Wandoo (*E. wandoo*), Jarrah (*E. marginata*), Flooded gum (*E. rudis*), York Gum (*E. loxophleba*), Tuart (*E. gomphocephala*) and Marri (*Corymbia calophylla*) with diameters at breast height (DBH) of 500 mm or greater.

1.1 Site Location and Current Features

The site is located at Lot 2 Train Station Precinct, Bertram, located in the Town of Kwinana, approximately 31 km south of Perth (Figure 1). The site is surrounded by residential housing to the south and east and remnant bushland to the north and east. Kwinana Train Station is to the northeast of the site. The site is approximately 3.3 ha.

The site is predominately remnant vegetation with some cleared areas. There are some tracks and illegal dumping of rubbish is evident throughout the site.

1.2 Objectives

The objective of the survey was to locate trees that met the significant trees criteria as defined by DSEWPC. More specifically, this survey had the following aims:

- Electronically log significant tree details (location, species and important features, such as hollows) using a Differential Global Positioning System (DGPS).
- Compile logged data into a tree survey report, including a significant tree map and dataset.



1.3 Scope of Work

The following scope of work was undertaken for the Significant Tree Survey:

- A 25 m x 25 m grid was designed across the site.
- Each grid transect was walked by two environmental scientists who electronically logged significant tree details (location, species and important features, such as hollows) using a DGPS.
- Formulation of a Significant Tree Survey Report, including a significant tree map and provision of the dataset.



2 Significant Tree Survey Method

2.1 Site Survey

On 14 October 2010, two environmental scientists conducted the survey across the site. The survey comprised of recording the location, species, indicative tree health, tree diameter at breast height, presence of tree hollows and any other important descriptive information about each significant tree located within the site boundary.

25 m x 25 m grids were designed across the site. Each consecutive grid was surveyed to ensure all trees were included. Tree details were individually recorded electronically using a DGPS.

2.2 Environmentally Significant Tree Criteria

2.2.1 Significant Tree Size Species

The DSEWPC has set the significant tree criteria as:

- Species used by Black Cockatoos for breeding, and
- Tree size exceeding 500 mm trunk diameter at breast height (DBH) (~1.5 m above ground level).

Trees with trunk DBH less than 500 mm, *Banksia* spp. and other shrubs were not recorded for the purposes of this survey.

The following tree species are considered breeding habitat for Carnaby's Black Cockatoos (Johnstone and Kirk 1998):

- Salmon Gums (*Eucalyptus salmonophloia*).
- Jarrah (*E. marginata*).
- Wandoo (*E. wandoo*).
- Red Morrell (*E. longicornis*).
- York Gum (*E. loxophleba*).
- Tuart (*E. gomphocephala*).
- Marri (*Corymbia calophylla*).

The following tree species are considered breeding habitat for Forest Red-tailed Black Cockatoos (Johnstone and Kirk 1999):

- Marri (*E. calophylla*).
- Jarrah (*E. marginata*).
- Karri (*E. diversicolor*).



2.2.2 Trunk diameter at breast height (DBH)

Each significant tree was individually recorded according to its trunk DBH, as either:

- Medium: 500 mm to 800 mm.
- Large: 800 mm to 1,200 mm.
- Very Large: 1,200 mm +.

2.2.3 Presence of tree hollows (located 3 m or higher above ground level)

It was noted if significant trees contained hollows 3 m or higher above ground level and with a diameter of greater than 12 cm. Hollows matching this criteria are considered suitable for Black Cockatoo breeding habitat.

2.2.4 Other recorded information

Any other features that were noteworthy were recorded, such as if Black Cockatoos were sighted within the tree or if other species of bird had visible nests in tree branches.

3 Results

3.1 Tree Species

The dominant tree species at the site were:

- Jarrah (*E. marginata*).
- Banksia (*Banksia attenuata*)
- Sheoak (*Allocasuarina fraseriana*).

However the only significant trees considered by DSEWPC found on site were four Jarrah. The four significant trees were located in the centre portion of the site (Figure 2). The larger Jarrah trees were typically located on the more elevated areas of the site.

3.2 Trunk Diameter at Breast Height

The significant trees at the site were predominately between 500-800 mm DBH (Table 1).

Table 1. Tree numbers in relation to trunk size.

TRUNK SIZE (DBH)	NUMBER
Medium: 500 mm – 800 mm	3
Large: 800 mm – 1,200 mm	1
TOTAL	4

Figure 2 maps the tree trunk diameters in relation to size.

It was evident from site observations that fires have previously occurred at the site and the majority of significant trees display various degrees of fire scarring. Fire damage has resulted in some trees being completely destroyed, canopy and foliage reductions, hollowing at trunk bases or superficial bark blackening.

3.3 Presence of tree hollows (located 3 m or higher above ground level) and other information

No trees containing hollows (located 3 m or higher above ground level) were observed within the site.



4 Discussion

Discussions with DSEWPC should address the presence of significant trees prior to the completion of referral documentation to assist in determining environmental management and approvals for the site.



5 Limitations

This report is produced strictly in accordance with the scope of services set out in the contract or otherwise agreed in accordance with the contract. 360 Environmental makes no representations or warranties in relation to the nature and quality of soil and water other than the visual observation and analytical data in this report.

In the preparation of this report, 360 Environmental has relied upon documents, information, data and analyses (“client’s information”) provided by the client and other individuals and entities. In most cases where client’s information has been relied upon, such reliance has been indicated in this report. Unless expressly set out in this report, 360 Environmental has not verified that the client’s information is accurate, exhaustive or current and the validity and accuracy of any aspect of the report including, or based upon, any part of the client’s information is contingent upon the accuracy, exhaustiveness and currency of the client’s information. 360 Environmental shall not be liable to the client or any other person in connection with any invalid or inaccurate aspect of this report where that invalidity or inaccuracy arose because the client’s information was not accurate, exhaustive and current or arose because of any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to 360 Environmental.

Aspects of this report, including the opinions, conclusions and recommendations it contains, are based on the results of the investigation, sampling and testing set out in the contract and otherwise in accordance with normal practices and standards. The investigation, sampling and testing are designed to produce results that represent a reasonable interpretation of the general conditions of the site that is the subject of this report. However, due to the characteristics of the site, including natural variations in site conditions, the results of the investigation, sampling and testing may not accurately represent the actual state of the whole site at all points.

It is important to recognise that site conditions, including the extent and concentration of contaminants, can change with time. This is particularly relevant if this report, including the data, opinions, conclusions and recommendations it contains, are to be used a considerable time after it was prepared. In these circumstances, further investigation of the site may be necessary.

Subject to the terms of the contract between the Client and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating parts of this report is prohibited (except to the extent required by law) unless the report is produced in its entirety including this page, without the prior written consent of 360 Environmental Pty Ltd.





6 References

Johnstone, R.E. & Storr, G.M. 1998. *Handbook of Western Australian Birds. Volume 1 - Non-Passerines (Emu to Dollarbird)*. Oxford University Press.

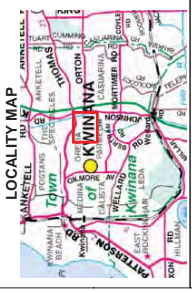


FIGURES



Legend
 Site Boundary

NOTE THAT POSITION ERRORS CAN BE ±M IN SOME AREAS
 - AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2009
 - LOCALITY MAP SOURCED FROM LANDGATE 2006



COPYRIGHT

THIS DOCUMENT IS AND SHALL REMAIN THE PROPERTY OF THE ENVIRONMENTAL SERVICES GROUP AND IS TO BE USED ONLY FOR THE PURPOSES OF THE PROJECT AND NOT BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM.

METADATA RECORDED	100%	PROJECTION	MGA ZONE 50
HORIZONTAL DATUM	GDA 94	HEIGHT DATUM	N/A
CREATED BY	GWH	CHECKED BY	JT
DATE	02.11.10	REVISION	0
		DRAWING NO.	LD024-2.AC.01

Department of Housing/Satterley Property Group
 KWINANA
 Kwinana Landholdings Significant Tree Survey
 Train Station West - Site Location
 Figure 1



Legend

- Site Boundary
- Significant Trees
- Jarrah, 500-800mm
- Jarrah, 800-1200mm

NOTE THAT POSITION ERRORS CAN BE ±5M IN SOME AREAS
 - AERIAL PHOTOGRAPHY SOURCED FROM LANDGATE 2009
 - LOCALITY MAP SOURCED FROM LANDGATE 2006

SCALE
 0 5 10 20 30 40
 Metres
 1:1,200 @ A3

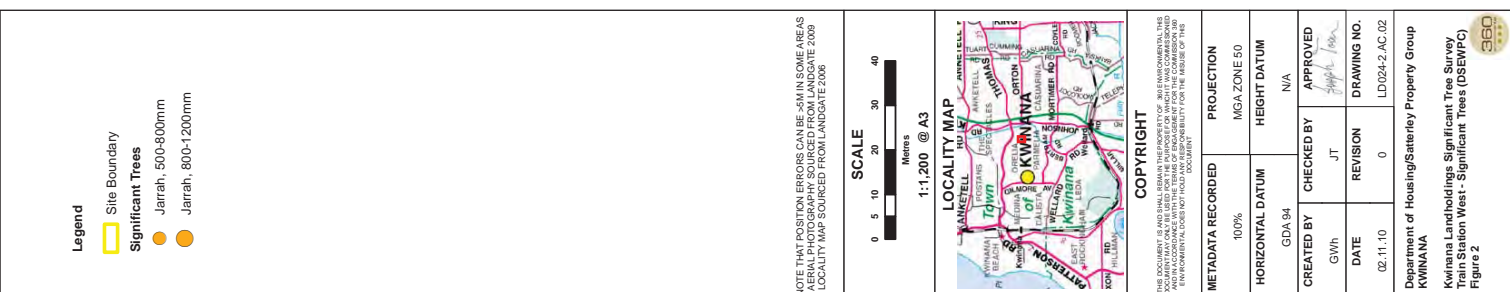
LOCALITY MAP

COPYRIGHT

THIS DOCUMENT IS AND SHALL REMAIN THE PROPERTY OF THE ENVIRONMENTAL TREE SURVEYORS AND CONSULTANTS (PVT) PTY LTD. IT IS TO BE USED ONLY FOR THE PROJECT AND SITE SPECIFIC PURPOSES AND IN ACCORDANCE WITH THE TERMS OF AGREEMENT FOR THE COMMISSIONING OF ENVIRONMENTAL TREE SURVEY SERVICES FOR THE ABOVE PROJECT DOCUMENT

METADATA RECORDED	100%	PROJECTION	MGA ZONE 50
HORIZONTAL DATUM	GDA 94	HEIGHT DATUM	N/A
CREATED BY	GVH	CHECKED BY	APPROVED
DATE	02.11.10	REVISION	0
		DRAWING NO.	LD024-2.AC.02

Department of Housing/Satterley Property Group
 KWINANA
 Kwinana Landholdings Significant Tree Survey
 Train Station West - Significant Trees (OSEWPC)
 Figure 2





APPENDIX A

Logged Raw Data Points

New ID	Easting	Northing	Species	Diameter	Hollows	Health	Additional Info	Date	Time
1	390522.78	6432704.1	Jarrah	500-800mm	0	Good		DATE:10-14-2010	TIME:11:44:02
2	390534.05	6432743.9	Jarrah	800-1200mm	0	Excellent		DATE:10-14-2010	TIME:11:47:23
4	390466.31	6432718	Jarrah	500-800mm	0	Poor	Trunk	DATE:10-14-2010	TIME:12:10:47
5	390481.57	6432704.4	Jarrah	500-800mm	0	Poor	Trunk	DATE:10-14-2010	TIME:12:12:08

ATTACHMENT 2M



360
environmental



Black Cockatoo
Survey - Bush
Forever Site 272,
Kwinana

Prepared for:

Department of Housing/
Satterley Property Group

November 2012

● people ● planet ● professional

Document Reference	Revision	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
EBS223AB	A INTERNAL DRAFT	JJ/AH	FD/TS	-	31/10/12
EBS223AB	B CLIENT DRAFT	JJ/AH	Client	1 Electronic (email)	02/11/12

Disclaimer

This report is issued in accordance with, and is subject to, the terms of the contract between the Client and 360 Environmental Pty Ltd, including, without limitation, the agreed scope of the report. To the extent permitted by law, 360 Environmental Pty Ltd shall not be liable in contract, tort (including, without limitation, negligence) or otherwise for any use of, or reliance on, parts of this report without taking into account the report in its entirety and all previous and subsequent reports.. 360 Environmental Pty Ltd considers the contents of this report to be current as at the date it was produced. This report, including each opinion, conclusion and recommendation it contains, should be considered in the context of the report as a whole. The opinions, conclusions and recommendations in this report are limited by its agreed scope. More extensive, or different, investigation, sampling and testing may have produced different results and therefore different opinions, conclusions and recommendations. Subject to the terms of the contract between the Client and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating parts of this report is prohibited (except to the extent required by law) unless the report is produced in its entirety including this cover page, without the prior written consent of 360 Environmental Pty Ltd.

© Copyright 2012 360 Environmental Pty Ltd ACN 109 499 041

Executive Summary

360 Environmental Pty Ltd (360 Environmental) was commissioned by Satterley Property Group on behalf of the Department of Housing (DoH) to undertake a Black Cockatoo Survey at a 20.4 hectare (ha) section of Bush Forever (BF) site 272 along Sicklemore Road Parmelia, located within the City of Kwinana (the Site) (Figure 1). The survey involved a Black Cockatoo Foraging Habitat Assessment, Black Cockatoo Significant Tree Survey, Black Cockatoo Breeding Assessment and opportunistic Black Cockatoo observations within the Site (Figure 1). The Site is composed of uncleared bushland with Jarrah (*Eucalyptus marginata*), Sheoak (*Allocasuarina fraseriana*) and *Banksia* species present throughout.

The Site is being considered for use as an environmental offset area by Satterley Property Group / Department of Housing.

A search of the Environment Protection and Biodiversity Conservation (EPBC) database and past site assessments revealed that the Vulnerable Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii*) and the Endangered Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) are likely to occur within the area.

The survey found no evidence of Black Cockatoo breeding within the Site however it contained suitable feeding species (*Banksia* and Jarrah) and sparse evidence of feeding debris were recorded. While there were fourteen locations which showed evidence of Carnaby's Black Cockatoo feeding, there were no locations found which showed evidence of Forest Red-Tailed Black Cockatoo feeding. Of these, twelve locations showed old evidence of Black Cockatoo feeding (Carnaby's Black Cockatoo), while the rest of the feeding evidence was recent foraging evidence on nectar. This suggests that although not extensively utilised, Carnaby's Black Cockatoos do at least occasionally utilise the Site for foraging and feeding.

The Black Cockatoo Significant Tree Surveys conducted as part of this study revealed that the Site contains mature trees, many of which have reached a size that the Department of Environment, Water, Population and Communities (SEWPaC) would consider a potential breeding tree. In total, 89 Jarrah trees were recorded which met SEWPaC's criteria of >500 mm trunk Diameter Breast Height (DBH). These trees are considered potential breeding trees for Black Cockatoos as these were the only species recorded within the Site that have the potential to form hollows suitable for Black Cockatoo. The presence of the larger Jarrah trees suggests that the Site has the potential to be of breeding significance to Black Cockatoo species in the future.

The following points are recommended:

- The Site did not display any potential breeding hollows of suitable size for Black Cockatoo species at the time of the survey. As hollows enlarge over time, it is likely that hollows may become suitable for Black Cockatoo in the future; and

- Although no hollows of suitable size for Black Cockatoos were found, the presence of bees at the Site indicates that it is likely that some of the recorded hollows have been rendered unusable by native fauna species. It is recommended that the hollows identified in this survey are regularly monitored and treated for feral bee infestations. This should be done with the aim to maintain the offset potential for avian fauna breeding habitat at the Site.

Table of Contents

1	Introduction	5
1.1	Background	5
1.2	Objective	5
1.3	Scope of the Study	5
2	Site Description.....	7
2.1	Site Location	7
2.2	Broad Habitat Assessment	7
3	Methods.....	8
3.1	Background Research	8
3.2	Black Cockatoo Breeding and Foraging Assessment Methodology.....	8
3.3	Black Cockatoo Significant Tree Survey Methodology	9
4	Results	11
4.1	Background Research Results	11
4.2	Black Cockatoo Breeding Assessment	13
4.3	Black Cockatoo Foraging Assessment.....	13
4.4	Black Cockatoo Opportunistic Observations	14
4.5	Black Cockatoo Significant Tree Assessment.....	14
5	Discussion	16
6	Limitations.....	17
7	References	18

List of Tables

Table 1: Evidence of Foraging Activity (Carnaby's Black Cockatoo) 14
Table 2: Black Cockatoo Significant Tree Survey Results (Jarrah) 15

List of Figures

Figure 1: Site Location 21
Figure 2: Breeding and Foraging Assessment..... 22
Figure 3: Significant Tree Survey 23

List of Plates

Plate 1: Typical Floral Assemblages at the Site31
Plate 2: Evidence of Carnaby's Black Cockatoo Feeding on *Banksia attenuata* Seeds...31
Plate 3: Evidence of Carnaby's Black Cockatoo Feeding on *Banksia menziesii* Nectar..32

List of Appendices

Appendix A: Figures 20
Appendix B: Black Cockatoo Significant Tree Data 24
Appendix C: Plates..... 30

1 Introduction

1.1 Background

Three species of Black Cockatoo occur in the south-west of Western Australia. All three species are protected under the following State and Commonwealth legislation:

- The *Wildlife Conservation Act 1950* (WC Act), Western Australia; and
- The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), Commonwealth.

The Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) is listed as Endangered under the EPBC Act. The Red-tailed Black Cockatoo (*Calyptorhynchus banksii*) and Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) are classified as Vulnerable. Both Carnaby's Black Cockatoo and Baudin's Black Cockatoo are listed as Endangered under the WC Act. The Forest Red-tailed Black Cockatoo is listed as Vulnerable under the WC Act.

360 Environmental Pty Ltd was commissioned to undertake a Black Cockatoo Breeding and Foraging Survey at a section of Bush Forever Site 272 on Sicklemore Road, Parmelia. The survey involved a Black Cockatoo Foraging Assessment, Black Cockatoo Breeding Assessment, Significant Tree Survey and an opportunistic Black Cockatoo observation survey within the survey area (the Site) (Figure 1; Appendix A).

The Site is approximately 20.4 hectares in size and is located between the Kwinana train line and Sicklemore Road.

1.2 Objective

The objective of the Black Cockatoo Survey was to provide information regarding the quality of Black Cockatoo habitat to determine the Site as a suitable offset for development sites in Kwinana.

1.3 Scope of the Study

- Identification of significant habitat trees (breeding and feeding) suitable for Black Cockatoos and evidence of Black Cockatoo breeding and feeding at the Site;
- Assessment of the extent of use of the Site by Black Cockatoos;

A Black Cockatoo Survey was undertaken to meet the scope of work above, this included:

- Background Research;
- On site Black Cockatoo Breeding Assessment;

- On site Black Cockatoo Foraging Assessment;
- On site Black Cockatoo Opportunistic Observations; and
- On site Black Cockatoo Significant Tree Assessment.

2 Site Description

2.1 Site Location

The Site is a section of Bush Forever site 272 bounded by the Kwinana train line and Sicklemore Road. The Site is a proposed offset area of Satterley Property Group's / Department of Housing's residential developments in the surrounding areas. The Site is composed mostly of uncleared bushland with areas of disturbance throughout.

2.2 Broad Habitat Assessment

As the Site is a proposed offset area for Black Cockatoo Habitat, a detailed Flora and Vegetation Survey was not necessary to determine habitat suitability for Black Cockatoos.

The Site straddles the border between two Heddlé Vegetation Complexes (DEC 2009a; DEP 2000). These were:

- **Karrakatta Complex-Central \ South:** This vegetation complex consists of open forests and woodlands growing on Swan Coastal Plain Aeolian deposits; and
- **Bassendean Complex-Central \ South:** This vegetation complex consists of woodland to low woodland and sedgelands growing on Swan Coastal Plain Aeolian Deposits.

The vegetation habitat of the Site can generally be described as a Banksia Woodland (*Banksia attenuata*, *B. menziesii* and to a lesser extent, *B. ilicifolia*) with an over storey of Jarrah (*Eucalyptus marginata*), a mid-storey of Sheoak (*Allocasuarina fraseriana*), Woolly Bush (*Adenanthos sp.*) and an understorey of Grass trees (*Xanthorea spp*), Zamia Palms (*Macrozamia sp.*) and annual weed species (Appendix C, Plate 1) (DEP 2000).

There was also fire evidence noted at the Site. It is estimated that the Site was burnt at least two to five years ago.

3 Methods

3.1 Background Research

The background research is designed to gather existing data on known locations of breeding and feeding for Black Cockatoo. The background research and desktop study included review of the following:

- DEC's website on Black Cockatoos;
- SEWPaC's *EPBC Act* draft referral guidelines; and
- Reports of previous studies undertaken in the area.

3.2 Black Cockatoo Breeding and Foraging Assessment Methodology

3.2.1 Survey Personnel

The survey was undertaken by Black Cockatoo specialist Tony Kirkby and on 24 October 2012. Tony Kirkby was a technical officer at the WA Museum and has had significant field experience with Black Cockatoos in Western Australia. He is considered an expert in the area of protected Black Cockatoos and has authored a number of papers on the subject. Over the last seven years Tony has collected, recorded and photographed most of the food taken by the three south-west Black Cockatoos and has to date a database of over 20,000 records and an image library of over 3,000 Black Cockatoos and Black Cockatoo food related photographs.

3.2.2 Black Cockatoo Breeding Site Assessment

This assessment involved observation of suitably sized trees with the potential for hollows to be present. Each tree was assessed to determine if hollows were present. If hollows were present each was assessed with the use of binoculars to determine its suitability for use by Black Cockatoo species as a breeding hollow. Any suitable hollows that were located were assessed to determine if they were being utilised by Black Cockatoo species as a breeding hollow. The assessment method takes into consideration the size and shape of the hollow, chew marks around the entrance, feathers nearby or any other signs that indicate that Black Cockatoo may potentially utilise the hollow.

3.2.3 Black Cockatoo Foraging Site Assessment

Tony Kirkby undertook a one day site visit to conduct an observational site survey and feeding assessment across the survey area to determine the extent of foraging habitat for Black Cockatoos at the same time as the breeding assessment was undertaken. The observational and foraging assessment included:

- General habitat suitability of the Site;

- Analysis of dentition marks in seed and nut material;
- Opportunistic observations of Black Cockatoos within the Site; and
- Casual opportunistic observations of potential breeding habitat.

Feeding trees and opportunistic observations were recorded and located using a hand held Differential Global Positioning System (DGPS) unit (Appendix B).

3.3 Black Cockatoo Significant Tree Survey Methodology

3.3.1 Survey Personnel

The Black Cockatoo Significant Tree survey was conducted on 18 and 19 October 2012. The survey team was led by Andrew Hide with assistance from Judy Ruppert from 360 Environmental. Andrew is the Team Leader of the Environmental and Biological Services Team at 360 Environmental. His degree in Natural Resource Management (Honours) is complemented with extensive field experience with threatened fauna monitoring and conservation, along with fauna habitat assessments throughout Western Australia. He has been involved in detailed studies of many of Australia's endangered and threatened species and has led group expeditions in the Southwest, Pilbara, Gascoyne, Midwest and Wheatbelt.

3.3.2 Site Survey

The Black Cockatoo Significant Tree Survey was undertaken to determine trees within the Site that were of a certain size, as outlined by SEWPaC, that have the potential in the future to develop hollows suitable for Black Cockatoo breeding. The survey comprised of recording the location, species, tree trunk diameter at breast height (DBH) and any other important descriptive information about each tree located within the Site boundary.

Approximately 40 m wide walking transects were designed across the Site. Every tree within a survey transect was assessed based on the Black Cockatoo significant tree criteria (below). Each transect ran parallel or perpendicular to another transect to ensure all trees within the Site were included within a transect line. Tree details were individually recorded electronically using a DGPS.

3.3.3 Black Cockatoo Significant Tree Criteria

Trees exceeding 500 mm trunk DBH (~1.5 m above ground level) were considered significant for Black Cockatoo species for the purposes of this survey based on criteria used by SEWPaC to define Black Cockatoo 'breeding habitat'. In addition trees exceeding a 400 mm trunk DBH were also recorded as the City of Kwinana has a more conservative measure of significance (City of Kwinana, pers. comm., 9 February 2010).

3.3.3.1 Tree Location (using DGPS)

Each significant tree was individually recorded using a DGPS to obtain Universal Transverse Mercator (UTM GDA 94 Zone 50) coordinates.

3.3.3.2 Tree Species

Each significant tree was individually recorded according to its species, as either:

- Jarrah (*Eucalyptus marginata*);
- Marri (*Corymbia calophylla*);
- Tuart (*Eucalyptus gomphocephala*);
- Sheoak (*Allocasuarina fraseriana*);
- Hakea (*Hakea sp.*);
- Banksia (*Banksia attenuata* or *Banksia menziesii*); or
- Stag (standing dead tree).

The trees outlined above have the potential to provide foraging material or breeding hollows. The species with the potential to develop hollows were then mapped to visually represent the tree species with the potential to be of breeding significance to Black Cockatoos.

3.3.3.3 Trunk Diameter at Breast Height

Each significant tree was individually recorded and mapped according to its trunk DBH, as either:

- Small: 400 mm to 500 mm;
- Medium: 500 mm to 800 mm;
- Large: 800 mm to 1,200 mm; and
- Very Large: 1,200 mm+.

4 Results

The following summarises the results of the Black Cockatoo Breeding, Foraging and Significant Tree Assessments.

4.1 Background Research Results

4.1.1 Black Cockatoo Species

A search of the EPBC database revealed that the Vulnerable Forest Red-tailed Black Cockatoo and the Endangered Carnaby's Black Cockatoo are likely to occur within the area. There is a possibility that Baudin's Black Cockatoo may also occur occasionally within the Site. Only three species of Black Cockatoo occur within the south west of Western Australia. Each is described below in detail.

4.1.1.1 Carnaby's Black Cockatoo

Carnaby's Black Cockatoo is a large, black cockatoo with a white patch on its cheek, white bands on its tail, and a strong curved bill. Carnaby's Black Cockatoo is also known as the Short-billed Cockatoo. In males, the bill is black and the eye-ring dark-pink. Females have a light grey bill, grey eye-ring, and the cheek patch is less distinctive.

Carnaby's Black Cockatoo is endemic to the southwest of Western Australia, extending from the Murchison River to Esperance, and inland to Coorow, Kellerberrin and Lake Cronin (DEC 2009b). There is evidence the species is currently expanding its breeding range westward and south into the Jarrah-Marri forests of the Darling Range and into the Tuart forests of the Swan Coastal Plain (Johnstone and Kirkby, 2006).

Carnaby's Black Cockatoos are believed to breed mostly in the wheatbelt region of Western Australia (DEC 2009b). After breeding, Carnaby's Cockatoo disperse to the higher rainfall coastal areas of the south-west of Western Australia to feed in late December to July (DEC 2009b).

Carnaby's Black Cockatoo display strong pair bonds. They occur in uncleared or remnant areas of Eucalypt woodland, principally Salmon gum (*Eucalyptus salmonophloia*) or Wandoo (*E. wandoo*), and shrubland or kwongan heath dominated by Hakea and Banksia species. Carnaby's Black Cockatoo nest in the hollows of live or dead smooth-barked Eucalypts (Salmon Gum and Wandoo) but also in Red Morrell (*E. longicornis*), York Gum (*E. loxophleba*), Marri and Tuart (Johnstone and Storr, 1998).

On the Swan Coastal Plain, the birds feed on a large variety of plants including the Proteaceae (Banksia and Grevillea), Marri nuts and introduced species – notably Pines (DEC 2009b).

Carnaby's Black Cockatoo has undergone a dramatic decline in recent years, declining by 50 percent in the past 45 years, one of the main contributing factors being land

clearing (DEC 2009b). The long-term survival and recovery of this species is linked to the survival of its habitat – both in breeding areas in the Wheatbelt and non-breeding areas such as the Swan Coastal Plain (DEC 2009b). In addition, clearing of heathland near breeding sites has reduced the availability of food for breeding pairs and their young (DEC 2009b).

4.1.1.2 Forest Red-tailed Black Cockatoo

The Forest Red-tailed Black Cockatoo is 55–60 cm in length and weighs between 570 and 870 g (Higgins 1999). Males can be distinguished by broad red tail panels that are only visible when taking off or alighting (Higgins 1999). Females on the other hand can be distinguished by yellow or whitish spots on the feathers of the head and upper wing coverts. Their tail feathers are bright red and orange, grading to yellow on the inner margins, and have variable black horizontal barring.

This species is endemic to the south-west humid and semi-humid zones of Western Australia. It inhabits dense Jarrah, Karri and Marri forests which receive more than 600 mm average annual rainfall (SEWPaC 2012). Although most records are in Jarrah-Marri forests, the Forest Red-tailed Black Cockatoo has been observed in a range of other forest and woodland types, including Blackbutt (*E. patens*), Wandoo (*E. wandoo*), Tuart (*E. gomphocephala*), Albany Blackbutt, Yate (*E. cornuta*), and Flooded Gum (*E. rudis*) (Abbott 1998a,b).

Forest Red-tailed Black Cockatoos feed predominantly on the seeds of Jarrah and Marri fruits. The other species used for feeding include Blackbutt, Albany Blackbutt (*E. staeri*), Forest Sheoak, Snottygobble and the non-indigenous native Spotted Gum (*E. maculata*) and Cape Lilac (Johnstone & Kirkby 1999).

The Forest Red-tailed Black Cockatoo has declined in range by 25–30% as a result of clearing of the margins of the forests for agriculture in the early 1900s (Mawson & Johnstone 1997) and is projected to further decline by 30% or more between 2005 and 2015 (Chapman 2005).

Key threats to the Forest Red-tailed Black Cockatoo are habitat loss, nest hollow shortage and competition for available nest hollows from other species, and injury or death from the European Honeybee (*Apis mellifera*), illegal shooting (Chapman 2005) and fire (CALM 2006).

4.1.1.3 Baudin's Black Cockatoo

Baudin's Black Cockatoo is a large black cockatoo which measures 50–57 cm in length, with a wingspan of approximately 110 cm, and a mass of 560–770 g. It is mostly dull black in colour, with pale whitish margins on the feathers, large, rounded patches on the ear coverts, and rectangular white panels in the tail. It has a large bill that is coloured black in the male and whitish-grey with a black tip in the female. It also features a dark

brown iris that is surrounded by a reddish-pink eye-ring in the male and a grey eye-ring in the female (Higgins 1999; Johnstone & Storr 1998)

This species is only found in the extreme south-west of Western Australia. It occurs in areas of high rainfall and usually in heavily forested locations dominated by Marri, Karri or Jarrah. However, it also occurs in woodlands of Wandoo (*E. wandoo*), Blackbutt (*E. patens*), Flooded Gum (*E. rudis*), Yate (*E. cornuta*) and in orchards, and is occasionally recorded in farmland and grasslands (Johnstone & Kirkby 2008).

The diet of Baudin's Black Cockatoo consists mostly of Eucalyptus seeds (e.g. Marri and Jarrah) and occasionally insect larvae and the seeds of other plants such as *Banksia*, *Dryandra*, *Erodium*, *Hakea*, *Malus sylvestris* (apple) and *Pyrus communis* (pear), and occasionally with nectar from Marri or other plants (Higgins 1999).

Baudin's Black-Cockatoo is gregarious. It is usually seen in groups of three (comprising the adult pair and a single dependent young) or in small parties, but will occasionally gather in large flocks of up to 300 birds during the non-breeding season, usually at sites where food is abundant (Higgins 1999). During the breeding season, adults nest in solitary pairs

4.2 Black Cockatoo Breeding Assessment

No trees containing hollows that were utilised for breeding by Black Cockatoo species were observed within the Site, although numerous small hollows were recorded (Figure 2). The locations of trees with hollows at the Site are detailed in Appendix B.

4.3 Black Cockatoo Foraging Assessment

The entire Site was composed of *Banksia* woodland with an over storey of Jarrah. Both *Banksia* and Jarrah are suitable foraging species for Black Cockatoo.

A significant amount of old feeding evidence was found at the Site. A total of fourteen foraging locations were recorded as old with two recorded as recent. All the foraging sites displayed the characteristic feeding habits of Carnaby's Black Cockatoo (Figure 2). All records showed that Carnaby's Black Cockatoo have frequented the area to feed on the nectar and clippings of *B. attenuata*, *B. menziesii* and *B. ilicifolia*. Table 1 provides a summary of all feeding evidence observed at the Site during the foraging assessment. Plate 2 (Appendix C) illustrates Carnaby's Black Cockatoo feeding evidence on the seeds of *Banksia attenuata* while Plate 3 (Appendix C) illustrates feeding evidence on *Banksia menziesii* nectar. Both photographs were taken by Tony Kirkby.

Table 1: Evidence of Foraging Activity (Carnaby's Black Cockatoo)

EVIDENCE	EASTING	NORTHING
Old evidence of feeding on seeds from <i>Banksia attenuata</i>	390653	6432611
Old evidence of feeding on seeds from <i>Banksia attenuata</i>	390643	6432579
Old evidence of feeding on nectar from <i>Banksia menziesii</i>	390672	6432514
Old evidence of feeding on nectar from <i>Banksia menziesii</i>	390673	6432494
Old evidence of feeding on seeds from <i>Banksia attenuata</i>	390664	6432483
Old evidence of feeding on nectar from <i>Banksia menziesii</i>	390610	6432475
Old evidence of feeding on nectar from <i>Banksia menziesii</i>	390550	6432486
Old evidence of feeding on nectar from <i>Banksia menziesii</i>	390585	6432392
Old evidence of feeding on nectar from <i>Banksia menziesii</i>	390550	6432187
Old evidence of feeding on seeds from <i>Banksia attenuata</i>	390383	6431840
Recent evidence of feeding on nectar from <i>Banksia ilicifolia</i>	390304	6431677
Old evidence of feeding on nectar from <i>Banksia menziesii</i>	390289	6431646
Old evidence of feeding on nectar from <i>Banksia menziesii</i>	390217	6431605
Clippings from <i>Banksia attenuate</i>	390479	6432447

4.4 Black Cockatoo Opportunistic Observations

No sightings or callings were recorded during the field survey.

4.5 Black Cockatoo Significant Tree Assessment

A summary of the results of the Black Cockatoo Significant Tree Assessment undertaken for the Site are presented in Table 2 and displayed in Figure 3 (Appendix A). The raw survey data for the survey is located in Appendix B.

The Black Cockatoo Significant Tree Assessment found that the dominant tree species were:

- Jarrah (*Eucalyptus marginata*);
- Banksia (*Banksia attenuata*); and
- Sheoak (*Allocasuarina fraseriana*).

According to the SEWPaC Black Cockatoo EPBC Act referral guidelines, only Jarrah can be considered as significant potential breeding trees as they provide breeding habitat for both Carnaby's Black Cockatoo and Forest Red-tailed Black Cockatoo, in

contrast to Banksia and Sheoak which only provide feeding habitat and do not form hollows suitable for Black Cockatoo (SEWPaC 2012).

In total, 112 Jarrah trees were recorded on the Site with a trunk DBH greater than 400 mm. A total of 89 (79.5%) of these trees were recorded with a trunk DBH >500 mm which meet the SEWPaC guidelines as large significant trees with the potential to provide breeding habitat for Black Cockatoo species.

Table 2: Black Cockatoo Significant Tree Survey Results (Jarrah)

TRUNK SIZE (DBH)	JARRAH
Small: 400mm – 500mm	23
Medium: 500mm – 800mm	50
Large: 800mm – 1200mm	30
Extra Large: >1200mm	9
Total	112

During the Significant Tree Survey, trees were assessed by 360 Environmental to determine if they contained hollows and if they have the potential to be utilised by Black Cockatoo species for breeding. A total of 25 trees with hollows were recorded. Several trees contained three or more hollows, putting the total hollow count above 25.

However, none of these hollows were found to be suitable for Black Cockatoo species in the current state. Tony Kirkby, who undertook the Black Cockatoo Breeding Assessment, also confirmed that no suitable Black Cockatoo hollows were present in any of the significant trees within the Bush Forever site 272 study area.

5 Discussion

Across the survey area, 89 trees were recorded which met SEWPaC's criteria of >500 mm DBH and were of a species that have the potential to develop suitable hollows for the Black Cockatoo species. A total of 25 trees containing hollows were recorded, however, none of the hollows in these trees were large enough for Black Cockatoo species. Therefore these trees are defined by SEWPaC, based on the Black Cockatoo referral guidelines as Black Cockatoo 'breeding habitat'. At the Site, Jarrah was the only species capable of supporting hollows.

The occurrence of suitable feeding species (Banksia and Jarrah) and the sparse evidence of feeding debris recorded during the field survey suggest that although not currently extensively utilised, Carnaby's Black Cockatoo do at least occasionally utilise the Site for foraging and feeding. However, while there were fourteen locations which showed evidence of Carnaby's Black Cockatoo feeding, there were no locations which showed evidence of Forest Red-Tailed Black Cockatoo or Baudin's Black Cockatoo feeding. Of these, twelve locations showed old evidence of Black Cockatoo feeding (Carnaby's Black Cockatoo), with two recent foraging evidence on Banksia nectar.

The results of the Black Cockatoo Significant Tree Survey suggest that the Site contains medium to good quality Black Cockatoo habitat due to the presence of foraging species and breeding trees. Although no hollows of suitable size for Black Cockatoos were found, the presence of bees at the Site indicates a high likelihood that some of the recorded hollows have been rendered unusable for native fauna species. It is recommended that the identified hollows are regularly monitored for feral bee infestations and/or treated if necessary. This will help in maintaining the breeding habitat offset potential of the Site for the future.

6 Limitations

This report is produced strictly in accordance with the scope of services set out in the contract or otherwise agreed in accordance with the contract. 360 Environmental makes no representations or warranties in relation to the nature and quality of biological results other than the visual observation and analytical data in this report.

In the preparation of this report, 360 Environmental has relied upon documents, information, data and analyses (“client’s information”) provided by the client and other individuals and entities. In most cases where client’s information has been relied upon, such reliance has been indicated in this report. Unless expressly set out in this report, 360 Environmental has not verified that the client’s information is accurate, exhaustive or current and the validity and accuracy of any aspect of the report including, or based upon, any part of the client’s information is contingent upon the accuracy, exhaustiveness and currency of the client’s information. 360 Environmental shall not be liable to the client or any other person in connection with any invalid or inaccurate aspect of this report where that invalidity or inaccuracy arose because the client’s information was not accurate, exhaustive and current or arose because of any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to 360 Environmental.

Aspects of this report, including the opinions, conclusions and recommendations it contains, are based on the results of the investigation, sampling and testing set out in the contract and otherwise in accordance with normal practices and standards. The investigation, sampling and testing are designed to produce results that represent a reasonable interpretation of the general conditions of the Site that is the subject of this report. However, due to the characteristics of the Site, including natural variations in site conditions, the results of the investigation, sampling and testing may not accurately represent the actual state of the whole site at all points.

It is important to recognise that site conditions, including the extent and concentration of contaminants, can change with time. This is particularly relevant if this report, including the data, opinions, conclusions and recommendations it contains, are to be used a considerable time after it was prepared. In these circumstances, further investigation of the Site may be necessary.

Subject to the terms of the contract between the Client and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating parts of this report is prohibited (except to the extent required by law) unless the report is produced in its entirety including this page, without the prior written consent of 360 Environmental Pty Ltd.

7 References

- Abbott, I. 1998a. Counting cockatoos: The status of the Forest Red-tailed Black Cockatoo. *Landscape*. 13 (2):10-16.
- Abbott, I. 1998b. Conservation of the Forest Red-tailed Black Cockatoo, a hollow-dependent species, in the eucalypt forests of Western Australia. *Forest Ecology and Management*. 109:175-185.
- Chapman, T. 2005. Forest Black Cockatoo (Baudin's Cockatoo *Calyptorhynchus baudinii*) and Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) Draft Recovery Plan, June 2005-June 2015 (Department of Conservation and Land Management: Perth). Perth: Department of Conservation and Land Management.
- Conservation and Land Management, Department of (CALM) 2006. Records held in CALM's Declared Flora Database and rare flora files. Perth, Western Australia: WA CALM.
- Department of Environment and Conservation (DEC) 2009a. *Heddlle Vegetation Complexes*, GIS Dataset. Accessed 28 October 2012.
- Department of Environment and Conservation (DEC) 2009b. Carnaby's Black-cockatoo *Calyptorhynchus latirostris* (Carnaby 1948)
www.dec.wa.gov.au/component/option,com_docman/itemid,/gid,117/task,doc_download/ Accessed on 30/7/2012.
- Department of Environmental Protection (DEP) 2000. Bush Forever Volume 2 – Directory of Bush Forever Sites. Department of Environmental Protection, Government of Western Australia.
- Department of Sustainability, Environment, Water, Population and Communities (SEWPaC) 2012. EPBC Act Referral guidelines for three threatened black cockatoo species.
<http://www.environment.gov.au/epbc/publications/pubs/referral-guidelines-wa-black-cockatoo.pdf> Accessed on 30/7/2012.
- Higgins, P.J., ed. 1999. Handbook of Australian, New Zealand and Antarctic Birds Volume 4: Parrots to Dollarbird. Melbourne: Oxford University Press.
- Johnstone, R.E. & Kirkby, T 1999. Food of the Forest Red-tailed Black Cockatoo *Calyptorhynchus banksii naso* in south-west Western Australia. *Western Australian Naturalist*. 22:167-177.
- Johnstone, R.E. and Kirkby, T. 2006. Cockatoos in Crisis. *Landscape*. 21 (2)
- 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 Western Australian Museum*. 25:107-118.

Johnstone, R.E. and Storr, G.M. 1998. Handbook of Western Australian Birds Volume 1
– Nonpasserines (Emu to Dollarbird), Western Australian Museum.

Mawson, P. & Johnstone, R.E. 1997. Conservation status of parrots and cockatoos in
Western Australia, *Eclectus*. 2:4-9.

APPENDIX A

Figures

Legend

-  Bush Forever Site 272
-  Proposed Offset Area (the Site)

DATE THIS PROJECT WAS CHECKED FOR THE PURPOSES OF THE ACT: 20/10/2012
 DRAWING ID: EBS233 01
 BUSH FOREVER SITE 272
 LOCALITY MAP SOURCED FROM DEP 2007
 LOCALITY MAP SOURCED FROM LANDUSE 2008



Scale @ A4 1:10,000

LOCALITY MAP







DRAWING ID		DATE	
EBS233 01		20/10/2012	
HORIZONTAL DATUM AND PROJECTION			
GDA 1984 MGA ZONE 50			
CREATED	CHECKED	APPROVED	REVISION
JJ	AH	FD	0

Satterley Property Group/
 Department of Housing
 Bush Forever Site 272
 Black Cockatoo Survey
 Site Location



Figure 1



- Legend**
-  Survey Area
 -  Foraging Evidence
 -  Carnaby's Black Cockatoo
 -  Currently unsuitable to support Black Cockatoo breeding

NOTE: THIS POSITION MATCHES COORDINATES FROM AN AMALGAMATED SURVEY OF THE LOCALITY MAP SOURCED FROM LANDSAT 8 2013



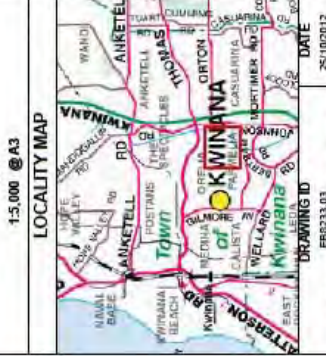
DRAWING ID		DATE	
EBS233.02		30/10/2012	
HORIZONTAL DATUM AND PROJECTION			
GDA 1984 MGA Zone 50			
CREATED	CHECKED	APPROVED	REVISION
JJ	AH	FD	0

Satterley Property Group/
Department of Housing
Bush Forever Site 272
Black Cockatoo Survey
Breeding and Foraging Assessment



- Legend**
- Survey Area
 - Trunk Diameter**
 - 400 - 500mm
 - 500 - 800mm
 - 800 - 1200mm
 - >1200mm
 - Species**
 - Jarrah
 - Stag (Jarrah)

-NOTE THAT POSITION ERRORS CAN BE ±4M IN SOME AREAS
 -LOCALITY MAP SOURCED FROM LANDSAT 2008



DRAWING ID	EB0233.03	DATE	25/10/2012
HORIZONTAL DATUM AND PROJECTION			
GDA 1984 MGA Zone 50			
CREATED	JU	CHECKED	AN
APPROVED	PD	REVISION	B

Satterley Property Group
 Department of Housing
 Bush Forever Site 272
 Black Cockatoo Survey
 Significant Trees



Figure 3

APPENDIX B

Black Cockatoo Significant Tree Data

Tree Number	Eastings (GDA 94 MGA 50)	Northings (GDA 94 MGA 50)	Species	DBH (mm)	Hollow
1	390592	6432806	Sheoak	977.21	N
2	390704	6432571	Sheoak	604.79	N
3	390180	6431800	Jarrah	531.58	N
4	390176	6431812	Jarrah	509.30	N
5	390210	6431806	Jarrah	872.17	Y
6	390209	6431817	Jarrah	891.27	Y
7	390201	6431819	Stag (Jarrah)	432.90	N
8	390215	6431814	Jarrah	512.48	N
9	390203	6431832	Jarrah	493.38	N
10	390256	6431839	Sheoak	452.00	N
11	390281	6431853	Jarrah	681.18	N
12	390281	6431863	Sheoak	474.28	N
13	390328	6431911	Banksia	557.04	N
14	390392	6431953	Jarrah	448.82	N
15	390388	6431965	Banksia	522.03	N
16	390402	6431976	Jarrah	598.42	N
17	390405	6431975	Jarrah	553.86	Y
18	390421	6432029	Banksia	423.35	N
19	390419	6432037	Jarrah	875.35	N
20	390413	6432042	Jarrah	977.21	Y
21	390416	6432076	Sheoak	477.47	N
22	390421	6432092	Banksia	420.17	N
23	390416	6432106	Sheoak	588.87	N
24	390434	6432111	Sheoak	496.56	N
25	390431	6432121	Sheoak	760.76	N
26	390422	6432155	Stag (Jarrah)	668.45	N
27	390410	6432155	Jarrah	477.47	N
28	390422	6432169	Jarrah	401.07	N
29	390417	6432177	Jarrah	436.08	N
30	390451	6432258	Sheoak	509.30	N
31	390451	6432266	Sheoak	467.92	N
32	390460	6432286	Jarrah	1034.51	Y
33	390455	6432292	Jarrah	448.82	N
34	390456	6432294	Jarrah	464.73	N
35	390447	6432316	Jarrah	1152.28	Y
36	390439	6432313	Stag (Jarrah)	926.28	N
37	390439	6432324	Jarrah	512.48	N

Tree Number	Eastings (GDA 94 MGA 50)	Northings (GDA 94 MGA 50)	Species	DBH (mm)	Hollow
38	390436	6432326	Jarrah	442.45	N
39	390454	6432361	Sheoak	445.63	N
40	390447	6432415	Jarrah	681.18	N
41	390450	6432439	Sheoak	693.92	N
42	390458	6432437	Jarrah	1145.92	Y
43	390474	6432416	Jarrah	690.73	N
44	390464	6432459	Sheoak	426.54	N
45	390490	6432490	Jarrah	993.13	N
46	390502	6432518	Jarrah	401.07	N
47	390500	6432522	Jarrah	436.08	N
48	390514	6432496	Sheoak	464.73	N
49	390516	6432486	Sheoak	461.55	N
50	390513	6432475	Banksia	448.82	N
51	390514	6432463	Stag (Jarrah)	1464.23	Y
52	390523	6432442	Jarrah	1496.06	N
53	390511	6432447	Jarrah	795.78	N
54	390491	6432395	Sheoak	572.96	N
55	390480	6432366	Sheoak	404.25	N
56	390467	6432336	Stag (Jarrah)	636.62	Y
57	390470	6432277	Sheoak	636.62	N
58	390471	6432274	Sheoak	604.79	N
59	390473	6432264	Jarrah	541.13	N
60	390468	6432247	Sheoak	732.11	N
61	390464	6432206	Banksia	410.62	N
62	390449	6432155	Jarrah	544.31	N
63	390441	6432148	Jarrah	668.45	N
64	390452	6432121	Jarrah	452.00	N
65	390451	6432047	Jarrah	795.78	N
66	390421	6431975	Jarrah	738.48	N
67	390417	6431966	Jarrah	506.11	N
68	390404	6431925	Jarrah	563.41	Y
69	390344	6431854	Jarrah	687.55	N
70	390343	6431851	Jarrah	592.06	N
71	390300	6431799	Jarrah	1222.31	Y
72	390259	6431753	Jarrah	1145.92	Y
73	390240	6431758	Stag (Jarrah)	954.93	Y
74	390229	6431761	Jarrah	1050.42	N

Tree Number	Easting (GDA 94 MGA 50)	Northings (GDA 94 MGA 50)	Species	DBH (mm)	Hollow
75	390215	6431766	Jarrah	954.93	Y
76	390209	6431781	Jarrah	671.63	N
77	390217	6431748	Jarrah	1400.56	Y
78	390184	6431722	Jarrah	636.62	N
79	390190	6431689	Jarrah	1365.55	N
80	390193	6431682	Jarrah	420.17	N
81	390207	6431680	Sheoak	678.00	N
82	390231	6431681	Sheoak	795.78	N
83	390270	6431677	Sheoak	665.27	N
84	390281	6431674	Sheoak	792.59	N
85	390318	6431743	Jarrah	1114.09	N
86	390327	6431797	Jarrah	674.82	N
87	390339	6431799	Stag (Jarrah)	773.49	N
88	390400	6431909	Jarrah	537.94	N
89	390410	6431901	Sheoak	671.63	N
90	390412	6431918	Jarrah	>2500	Y
91	390411	6431926	Jarrah	681.18	N
92	390419	6431945	Jarrah	534.76	N
93	390416	6431949	Jarrah	722.56	N
94	390430	6431979	Jarrah	1034.51	Y
95	390450	6432012	Sheoak	464.73	N
96	390464	6432004	Sheoak	795.78	N
97	390468	6432113	Jarrah	1305.07	Y
98	390508	6432087	Jarrah	1254.14	N
99	390527	6432075	Sheoak	792.59	N
100	390495	6432062	Sheoak	700.28	N
101	390512	6432052	Sheoak	537.94	N
102	390470	6432029	Jarrah	560.23	N
103	390465	6432010	Sheoak	681.18	N
104	390489	6431994	Sheoak	840.34	N
105	390494	6431995	Jarrah	945.38	N
106	390476	6431988	Jarrah	617.52	N
107	390462	6431982	Jarrah	627.07	N
108	390455	6431961	Jarrah	681.18	N
109	390448	6431955	Jarrah	703.47	N
110	390450	6431949	Jarrah	547.49	N

Tree Number	Eastings (GDA 94 MGA 50)	Northings (GDA 94 MGA 50)	Species	DBH (mm)	Hollow
111	390456	6431950	Jarrah	1024.96	N
112	390458	6431950	Jarrah	499.75	N
113	390483	6431949	Banksia	448.82	N
114	390457	6431920	Sheoak	499.75	N
115	390414	6431873	Jarrah	1149.10	N
116	390426	6431875	Jarrah	754.40	N
117	390431	6431869	Stag (Jarrah)	652.54	N
118	390371	6431804	Jarrah	986.76	N
119	390371	6431778	Stag (Jarrah)	986.76	N
120	390346	6431781	Stag (Jarrah)	805.32	Y
121	390342	6431751	Jarrah	1273.24	Y
122	390349	6431736	Sheoak	662.09	N
123	390361	6431715	Sheoak	448.82	N
124	390325	6431726	Jarrah	588.87	N
125	390267	6431619	Sheoak	541.13	N
126	390258	6431609	Jarrah	534.76	N
127	390249	6431573	Jarrah	881.72	N
128	390243	6431551	Jarrah	948.56	N
129	390267	6431541	Sheoak	700.28	N
130	390250	6431598	Jarrah	846.71	N
131	390215	6431609	Jarrah	738.48	N
132	390215	6431615	Jarrah	636.62	N
133	390555	6432507	Sheoak	636.62	N
134	390558	6432469	Sheoak	642.35	N
135	390535	6432436	Banksia	426.54	N
136	390514	6432318	Jarrah	445.63	N
137	390511	6432316	Jarrah	407.44	N
138	390505	6432310	Jarrah	833.97	Y
139	390508	6432299	Jarrah	827.61	N
140	390502	6432290	Sheoak	464.73	N
141	390484	6432283	Jarrah	697.10	N
142	390481	6432279	Jarrah	789.41	N
143	390485	6432252	Jarrah	951.75	N
144	390477	6432181	Sheoak	649.35	N
145	390482	6432159	Jarrah	477.47	N
146	390477	6432159	Jarrah	416.99	N
147	390472	6432158	Jarrah	448.82	N

Tree Number	Eastings (GDA 94 MGA 50)	Northings (GDA 94 MGA 50)	Species	DBH (mm)	Hollow
148	390473	6432144	Jarrah	407.44	N
149	390502	6432128	Sheoak	722.56	N
150	390521	6432128	Sheoak	604.79	N
151	390527	6432119	Jarrah	1222.31	N
152	390528	6432110	Stag (Jarrah)	1098.17	Y
153	390548	6432152	Sheoak	627.07	N
154	390549	6432152	Sheoak	658.90	N
155	390557	6432167	Jarrah	518.85	N
156	390525	6432190	Jarrah	471.10	N
157	390549	6432212	Sheoak	627.07	N
158	390575	6432207	Sheoak	697.10	N
159	390550	6432234	Sheoak	662.09	N
160	390549	6432273	Sheoak	706.65	N
161	390567	6432302	Sheoak	674.82	N
162	390594	6432344	Jarrah	464.73	N
163	390572	6432392	Sheoak	728.93	N
164	390570	6432430	Sheoak	856.25	N
165	390641	6432407	Sheoak	585.69	N
166	390650	6432407	Sheoak	687.55	N
167	390624	6432442	Sheoak	865.80	N
168	390625	6432501	Banksia	471.10	N
169	390664	6432473	Jarrah	493.38	N
170	390659	6432613	Jarrah	607.97	N
171	390595	6432586	Sheoak	502.93	N
172	390176	6431647	Jarrah	709.83	Y
173	390599	6432063	Stag (Jarrah)	668.45	N
174	390595	6432048	Banksia	518.85	N
175	390578	6431997	Sheoak	658.90	N
176	390525	6431927	Sheoak	579.32	N
177	390498	6431833	Stag (Jarrah)	913.55	Y
178	390472	6431819	Jarrah	779.86	Y
179	390478	6431806	Jarrah	547.49	N
180	390470	6431791	Jarrah	738.48	N

APPENDIX C

Plates



Plate 1: Typical Floral Assemblages at the Site



Plate 2: Evidence of Carnaby's Black Cockatoo Feeding on *Banksia attenuata* Seeds



Plate 3: Evidence of Carnaby's Black Cockatoo Feeding on *Banksia menziesii* Nectar

ATTACHMENT 2M

1 Attachment 2M Public Consultation

The following consultation has been undertaken for the proposed development:

1.1 Kwinana Town Centre

Public consultation of the Local Structure Plan (LSP) for KTC has been undertaken as part of the planning process. Public consultation for KTC included:

- Consultation on design of Master Plan with Urban Design Centre WA;
- Council Staff and Councillors – Workshops with City of Kwinana council staff and councillors; and
- Community Forum and local residents letter drop.

1.2 Local Residents and Community Groups

Advertising of the proposed Department of Housing Kwinana Project EPBC referral for public comment has been undertaken as follows:

- Advertisement of the proposed Department of Housing Kwinana Project EPBC Referral in the West Australian- advertisement published 11/11/2013;
- Advertisement of the proposed Department of Housing Kwinana Project EPBC Referral in the Community Newspaper Group – advertisement published 15/11/2013;
- Submission of the Department of Housing Kwinana Project EPBC Referral to the Department of Environment & Regulation (for reference)- hard copy and electronic copy sent 8/11/2013;
- Submission of the Department of Housing Kwinana Project EPBC Referral to the Kwinana Library (for reference)- hard copy and electronic copy sent 8/11/2013;
- Advertisement of the Department of Housing Kwinana Project EPBC Referral on the 360 Environmental Pty Ltd website.

1.3 Government Departments and Authorities

The following table outlines government authorities that have been consulted during the planning process for KTC. It is expected that the same agencies/authorities will be consulted with for Parmelia and the Train Station Precinct once Local Structure Plans have been finalised:

Agency/ Authority	Comments/Recommendations Provided	Agency/Local Authority contact(s) for proposal
City of Kwinana	The overall 'Development Concept' (in the form of a Local Structure Plan) and the Local Water Management Strategy will require adoption by the City of Kwinana	Ashley Harding Manager Environment Services. (08) 9439 0206
Department of Planning (DoP) on behalf of Western Australian Planning Commission (WAPC)	Due to the site being zoned 'Kwinana Town Centre' the WAPC is not afforded a role to either approve or endorse a Structure Plan within this Zone. Therefore the DoP will take no further action to assess the proposed Structure Plan on behalf of the WAPC	Anika Chhabra Metropolitan Planning South West (08) 6551 9000
Water Corporation	<u>Wastewater planning</u> a) Section 6 of the LSP servicing report does not accurately reflect the long-term wastewater conveyance for the site and surrounding area. The Mearns Avenue Wastewater Pump Station ("WWPS") is a temporary pump station that is currently pumping close to its maximum capacity and number of pump hours per day. It is planned that this temporary pump station will be replaced and graded out when the new Type 40 WWPS 'F' is built within the	Brett Coombes Development Services Branch

	<p>development site. WWPS 'F' will be required in order to service the subject land.</p> <p>b) Section 6 of the proposed LSP servicing report is to be modified as necessary to indicate that the existing Meares Avenue pump station is a temporary pump station and that a site and a 30m radius odour buffer around the centre of the permanent Type 40 WWPS 'F' must be identified on the LSP in a suitable catchment location, using information provided by the Water Corporation in their submission. The location of the permanent pump station has been determined based on existing natural ground levels and the need to ultimately grade out WWPS 10 (Rhodes Crescent) and to serve its catchment by a gravity sewer that will discharge to WWPS 'F'.</p> <p><u>Water planning</u></p> <p>c) The proposed subdivision and development of this land will be able to be served from mains extensions from the surrounding water reticulation network. Any unplanned system upgrades to sustain services to the full development of the site will need to be funded by the developer.</p>	
<p>Department of Water (DoW)</p>	<p>Yes – Approval of Local Water Management Strategy (LWMS). The DoW advised that the following further detail is required in the LWMS:</p> <p>a) In section 2.4 – Landscape, Table A: Summary of drainage associated with public open space areas; the table should be supported with figures including cross sections of the basins/swales illustrating top water levels, flow paths and inundation areas for the 1 year, 5 year and 100 year storm events; Stormwater inlet type, its location and invert level; and Location and extent of vegetated bio-retention areas within the basins/swales.</p> <p>b) In section 4.9 – Soils, the phosphorus retention index (PRI) of the existing soils is recommended to be increased from 3.5 to 8.6 to at least 10 through soil amendments being applied in the drainage areas and around the soakwells.</p> <p>c) In section 6 – Stormwater Management Strategy include: 1 year, 5 year and 100 year flow paths, inundation areas and top water levels; Drainage management within lots; Pre and post development drainage catchments including post development runoff volumes for each</p>	<p>Brett Dunn Urban Water Management Peel Region (08) 6364 7600</p>

	<p>storm event; Modelling parameters and assumptions; Final surface level of the proposed lots to ensure there is a 0.5m clearance above the 100-year flood level.</p> <p>d) In section 8 – The Next Stage – Subdivision and Urban Water Management Plan, this section lacks details regarding the content and coverage of future urban water management plans to be completed including areas requiring further investigation.</p> <p>e) In section 10 – Implementation, there are no details regarding contingency measures and action plans. It is recommended that the proponent refers to DoW's Interim: Developing a local water management strategy (DoW, 2008) for guidance on what is required within the LWMS.</p>	
Department of Education	<p>Based upon the proposed Lot yield summary the anticipated student yield from the residential development will be accommodated within the local Calista Primary School and therefore the Department do not have any objections</p>	<p>Richard Bloor Strategic Asset Planning (08) 9264 4111</p>
Western Power	<p>Western Power advised that a transmission line is located within the Gilmore Avenue road reserve before traversing the road at the bottom south-west corner of the subject land at the Wellard Road intersection. Where it traverses the subject land, it will need to be adequately protected in an easement or relocated at the developers cost.</p>	<p>Mandy Martin State Planning and Development Assessment Officer</p>
Telstra	<p>Telstra advised that any network extension that may be required for development will require the submission of an application before construction to Telstra.</p>	<p>Norm Walkerden Forecasting & Area Planning</p>
Department of Sport and Recreation (DSR)	<p>DSR recommended the following be considered prior to final consideration of the LSP:</p> <ol style="list-style-type: none"> 1. The DSR's <i>Classification Framework for Public Open Space</i> (2012); and 2. The DSR's <i>Research on Active Open Space (Playing Fields) in a Growth Perth-Peel Region Emerging Constraints for Public Open Space (POS) in Perth Metropolitan Suburbs</i> (2013) 	<p>Rob Didcoe Facilities and Camps (08) 9492 9700</p>

Department of Aboriginal Affairs (DAA)	DAA advised that there are no known heritage sites within the areas of the proposed development	Cesar Rodriguez Heritage Advice and Approvals – Government (08) 6551 8004
State Heritage Office (SHO)	SHO Advised that the proposal does not appear to impact upon any place of State cultural heritage significance	Callum Crofton Local Government Services Graham Hardy Planning Officer (08) 6552 4000
Department of Fire and Emergency Services	No objections or recommendations received from Department of Fire and Emergency Services for proposed development	Graham Hardy Planning Officer (08) 6552 4000
Department of Health (DoH)	DoH advised that the following guidelines be considered in the proposed development: 1. <i>Government Sewerage Policy – Perth Metropolitan Region;</i> 2. <i>DoH's Residential Estates, Precincts and Urban Developments(2011)</i>	Jim Dodds (08) 9222 4222
Main Roads Western Australia	No objections or recommendations received from Department of Fire and Emergency Services for proposed development	Lindsay Broadhurst Road Planning

ATTACHMENT 2N



Kwinana EPBC Referral

Offsets Strategy

Prepared for:

Satterley Property Group /
Department of Housing

June 2014

● people ● planet ● professional

Document Reference	Revision	Prepared by	Reviewed by	Submitted to Client	
				Copies	Date
V4	A INTERNAL DRAFT	JJ	LR/TS	1 Electronic (Email)	-
V4	B CLIENT DRAFT	JJ	LR/TS	1 Electronic (Email)	28/11/13
V5	C DEPARTMENT OF THE ENVIRONMENT COMMENTS	JJ	LR/TS	1 Electronic (Email)	02/12/13
V5	D CLIENT DRAFT	JJ	LR/TS/ DM	1 Electronic (Email)	19/12/13
V6	E CLIENT DRAFT	JJ	LR/TS	1 Electronic (Email)	19/03/14
V7	F CLIENT DRAFT	JJ/CL/LR	LR/TS	1 Electronic (Email)	26/05/14
V8	G CLIENT DRAFT	JJ	TS/LR	1 Electronic (Email)	12/06/14
V9	H FINAL FOR ISSUE	LR	LR	1 Electronic	16/06/14

Disclaimer

This report is issued in accordance with, and is subject to, the terms of the contract between the Client and 360 Environmental Pty Ltd, including, without limitation, the agreed scope of the report. To the extent permitted by law, 360 Environmental Pty Ltd shall not be liable in contract, tort (including, without limitation, negligence) or otherwise for any use of, or reliance on, parts of this report without taking into account the report in its entirety and all previous and subsequent reports. 360 Environmental Pty Ltd considers the contents of this report to be current as at the date it was produced. This report, including each opinion, conclusion and recommendation it contains, should be considered in the context of the report as a whole. The opinions, conclusions and recommendations in this report are limited by its agreed scope. More extensive, or different, investigation, sampling and testing may have produced different results and therefore different opinions, conclusions and recommendations. Subject to the terms of the contract between the Client and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating parts of this report is prohibited (except to the extent required by law) unless the report is produced in its entirety including this cover page, without the prior written consent of 360 Environmental Pty Ltd.

© Copyright 2013 360 Environmental Pty Ltd ACN 109 499 041

Executive Summary

The Department of Housing (DoH) Kwinana Housing Project is proposing to clear native vegetation in Kwinana, just south of Perth for the development of affordable housing. The approximately 74.7 and 55.4 hectares (ha) of the development (impact) site is of value as foraging habitat to Carnaby's Black Cockatoo (CBC) and Forest Red Tailed Black Cockatoo (FRTBC) respectively. Both species are listed as a Matters of National Environmental Significance (MNES) under the *Environmental Protection and Biodiversity Conservation (EPBC) Act (1999)*.

This offset strategy proposes a mix of direct and indirect contributions, including the transfer of suitable habitat land into conservation estate (to be protected in perpetuity and rehabilitated), as well as the provision of a substantial amount of funding towards research into all three Threatened Black Cockatoo Species. It is anticipated that the research proposed will be of higher value than disjointed parcels of habitat that are chosen only on the basis of suitable vegetation, and not actual evidence of cockatoo behaviour. These research projects will fulfil a large number of recovery actions as set out in both State and Federally endorsed Recovery Plans for all three species. The Department will contribute \$532,000 in research funding over four years.

In addition, approximately \$100,000 will be contributed towards the rehabilitation and management of the Kwinana direct offset Site, a 22 ha portion of Bush Forever Site 272.

Table of Contents

1	Introduction	1
1.1	Background	1
1.2	Purpose	1
2	Site Description.....	2
2.1	Vegetation.....	2
2.2	Flora and Fauna Habitat.....	4
2.3	Wetlands/Hydrology.....	5
2.4	Topography	5
2.5	Soils and Geology	6
3	Potential Impacts to Matters of National Environmental Significance	7
3.1	Introduction	7
3.2	Carnaby's Black Cockatoo.....	7
3.3	Forest Red-Tailed Black Cockatoo.....	7
4	Offset Strategy	8
4.1	Introduction	8
4.2	Proposed Offset Strategy	11
5	Offset Principles.....	19
6	Offset Implementation.....	21
6.1	Direct Offsets	21
6.2	Indirect Offsets	24
7	Summary of Offset Strategy	34
8	Limitations.....	35
9	References	36

List of Tables

Table 1. Timing of Revegetation Works	23
Table 2. Estimated Cost of Revegetation Activities.....	23
Table 3. Actions, Responsibilities and Outputs Black Cockatoo Satellite Tracking Project	25
Table 4. Actions, Responsibilities and Outputs Black Cockatoo Ecology Research Project	28
Table 5. Estimated Cost Black Cockatoo Research Projects.....	32

List of Figures

Figure 1. Proposed Impact Sites	39
Figure 2. Train Station Precinct Vegetation Mapping	40
Figure 3. Parmelia Vegetation Mapping	41
Figure 4. Kwinana Town Center Vegetation Mapping.....	42
Figure 5. Train Station Precinct Inferred Black Cockatoo Habitat	43
Figure 6. Parmelia Inferred Black Cockatoo Habitat	44
Figure 7. Kwinana Town Center Black Cockatoo Habitat	45

List of Appendices

Appendix A: EPBC Protected Matters Search Tool Results	46
Appendix B: Offset Calculator for the Kwinana Offset Site CBC	47
Appendix C: Offset Calculator for the Kwinana Offset Site FRTBC.....	48

1 Introduction

1.1 Background

The Department of Housing is proposing to develop three sites of bushland in Kwinana for residential purposes. This is to meet the need for affordable housing in the area. It is anticipated that the proposal will impact Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) and the Forest Red-Tailed Black Cockatoo (*Calyptorhynchus banksii naso*), listed as Endangered and Vulnerable respectively under the EPBC Act.

1.2 Purpose

The purpose of this document is to present the proposed Offset Strategy (the strategy) in consistency with the Department of the Environment's Environmental Offset's Policy for the proposed Kwinana development recently referred to the Department of the Environment (DotE) (EPBC 2013/6916). Preparation of the strategy has been undertaken by 360 Environmental in consultation with of Satterley Property Group, the Department of Housing as well as incorporating the advice of the Department of the Environment. The strategy will be submitted in conjunction with the Kwinana Residential Housing and Mixed-use Development, Kwinana, Western Australia (EPBC 2013/6916).

This Offset Strategy outlines the approach to the provision of offsets for the Kwinana Residential Housing and Mixed-use Development, Kwinana, Western Australia.

The strategy presented in this document is a departure from the standard offset policy for a project of this size. Ongoing negotiations between the Department of the Environment and the Department of Housing, facilitated by 360 Environmental has resulted in the preparation of a strategy that comprises primarily of indirect offsets, as these have the potential to provide a greater benefit to all three Black Cockatoo Species in the long term.

2 Site Description

The proposed development will occur at several sites within the City of Kwinana (Figure 1). As a group, they are located approximately 35 kilometres (km) south of Perth. The sites can be grouped into three areas:

- **Kwinana Town Centre (KTC):** This site is bounded by Gilmore Avenue, Challenger Avenue, Wellard Road and Meares Avenue. The site is predominately remnant bushland. It is adjacent to residential housing to the west and east, a commercial shopping centre to the north and uncleared bushland to the south (Figure 1);
- **Parmelia:** This site is bounded by Parmelia Avenue (in parts), St Vincent's Primary School and Bush Forever Site 67 on the west side, Challenger Avenue to the north, the Perth to Mandurah rail line and Bollard Bullrush Swamp to the east and Tuart and Wellard Roads on the southern side. The site is predominately remnant bushland with a number of tracks throughout the site and two areas that have been excavated in the past for quarrying (Figure 1); and
- **Train Station Precinct:** The precinct consists of seven sub-sites adjacent to the Kwinana Train Station, Sulphur Road and Durrant Avenue. The sub-sites contain some previously cleared areas (Figure 1).

2.1 Vegetation

Vegetation types are fairly uniform throughout all sites. Based on Flora and Vegetation surveys conducted by 360 Environmental (2006; 2009; 2012), the entirety of all three site areas are considered to contain vegetation that may be used for foraging and breeding by FRTBC and CBC species (Figures 2-4).

The vegetation within Kwinana Town Centre and Parmelia sites can be described as:

- **Jarrah-Marri-Banksia woodland:** Mixed open forest mainly consisting of *Eucalyptus marginata*, *Corymbia calophylla*, and to a lesser extent, *Eucalyptus gomphocephala* over low woodland and shrublands of *Banksia attenuata*, *Banksia menziesii*, *Banksia grandis*, *Banksia sessilis* with some scattered *Xanthorrhoea preisii* and *Allocasuarina fraseriana* over low shrubs. In areas of disturbance, a weedy understorey is prevalent.

The vegetation in the Train station sites however, can be mainly described as:

- **Banksia woodland:** *Banksia attenuata* and variable *Allocasuarina fraseriana* woodlands over shrubland of *Jacksonia furcellata*, *Kunzea glaberescens*, over a generally low understorey of *Acacia pulchella*, *Hibbertia rhadinopoda*, *Petrophile linearis* and *Xanthorrhoea preisii*.

With the exception of highly degraded areas, it is considered that the vast majority of the site is of foraging value to one or both Black Cockatoo species (Figures 5-7).

Vegetation condition at the three sites mostly ranged from 'Good' to 'Very Poor' and in some cases 'Completely Degraded'. Small patches of vegetation in 'Very Good' condition also occurred. The main factor affecting the vegetation condition was weed cover. Perennial veldt grass (*Ehrhartacalycina*) formed a grassland and sometimes a closed grassland over most of the sites and was the most dominant and widespread weed. Some physical disturbance occurred in various places throughout the sites.

The three development sites fall within three pre-European vegetation associations (DAFWA 2012a; DPaW 2013). These are:

- **Spearwood_998:** Medium woodland – Tuart. It is estimated that 38% of the pre-European extent of this vegetation type remains, with 12% of the current extent protected for conservation purposes.
- **Spearwood_6:** Medium woodland: Tuart and Jarrah. It is estimated that 25% of the pre-European extent of this vegetation type remains, with 3% of the current extent protected for conservation purposes.
- **Bassendean_1001:** Medium very sparse woodland; Jarrah, with low woodland; banksia and casuarina. It is estimated that 25% of the pre-European extent of this vegetation type remains, with 1% of the current extent protected for conservation purposes.

In contrast, several different Heddle vegetation complexes were identified. A detailed breakdown of the Heddle (1980) vegetation complexes which make up the three sites is given below.

2.1.1 Kwinana Town Centre

At a regional level, the KTC site is listed as being within the Cottesloe Complex - central and south by Heddle (1980). This vegetation complex is described as:

- Mosaic of woodland of *E. gomphocephala* and open forest of *E. gomphocephala* – *E. marginata*– *E. calophylla*; closed heath on the limestone outcrops.

2.1.2 Parmelia

The Parmelia site is identified as being between two Heddle (1980) vegetation complexes. These are:

- Karrakatta Complex - central and south: Open forest of *E. gomphocephala*, *E. marginata*, *C. calophylla* and woodland of *E. marginata* and *Banksia spp.*
- Herdsman Complex: Sedgelands and fringing woodlands of *Eucalyptus rudis* and *Melaleuca presianna*, *M. raphiophylla* and *Banksia illicifolia* forest to woodland with *Kunzea glabrescens*, *Acacia saligna* and *Agonis linearifolia*;

Melaleuca teretifolia tall shrubland; and *Baumea articulata* and *Typha orientalis* sedgelands.

Vegetation associated with the Herdsman Complex is not found within the sites (likely a symptom of the mapping scale).

2.1.3 Train Station Sites

The train station sites straddle two Heddlé (1980) vegetation complexes. These are:

- Karrakatta Complex - central and south: Open forest of *E. gomphocephala*, *E. marginata*, *C. calophylla* and woodland of *E. marginata* and *Banksia spp.*, and
- Bassendean Complex – Central and South: Woodland of *E. marginata*, *C. calophylla* with well-defined second storey of *Calytrixfraseriana* and *Banksia spp.* on the deeper soils and a closed scrub on the moister sites.

2.2 Flora and Fauna Habitat

The Protected Matters Search Tool was used to produce a list of species with potential to occur in the vicinity of the site. This was generated using a much larger search area than the actual proposal areas. The list below summarises the non-marine species that have potential to occur within the search area:

- Birds:
 - Australasian Bittern (*Botaurus poiciloptilus*) – Endangered;
 - Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksia naso*) – Vulnerable;
 - Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) - Endangered;
 - Gibson's Albatross (*Diomedea exulans gibsoni*) – Vulnerable;
 - Malleefowl (*Leipoa ocellata*) – Vulnerable;
 - Southern Giant-Petrel (*Macronectes giganteus*) – Endangered;
 - Northern Giant-Petrel (*Macronectes halli*) – Vulnerable;
 - Australian Painted Snipe (*Rostratula benghalensis*) – Vulnerable;
 - Fairy Tern (Australian) (*Sternula nereis nereis*) – Vulnerable;
 - Shy Albatross (*Thalassarch caudata*) – Vulnerable;
- Mammals:
 - Chuditch (*Dasyurus geoffroii*) - Vulnerable;
 - Red-tailed Phascogale (*Phascogale calura*) - Endangered;
 - Quokka (*Setonix brachyurus*) - Vulnerable;
- Plants:
 - Slender Andersonia (*Andersonia gracilis*) - Endangered
 - King Spider-orchid, Grand Spider-orchid or Rusty Spider-orchid (*Caladenia huegelii*) - Endangered;
 - *Centrolepis caespitosa* - Endangered;
 - Muchea Bell (*Darwinia foetida*) - Critically Endangered;
 - Dwarf Bee-orchid (*Diuris micranta*) – Vulnerable;
 - Glossy-leaved Hammer-orchid, Praying Virgin (*Drakea elastica*) – Endangered;
 - Cadda Road Mallee (*Eucalyptus balanites*) – Endangered;
 - Hook-leaf Isopogon (*Isopogon uncinatus*) – Endangered; and

- o Beaked *Lepidosperma* (*Lepidosperma rostratum*) - Endangered.

The *Protected Matters Search Tool* indicates that there are no known Threatened Ecological Communities (TECs) within the proposal sites. The flora and vegetation surveys also indicated there were no known TECs located at the sites (360 Environmental, 2012a, 2010, 2009).

CBC and FRTBC and their habitat have been recorded in the proposed development area (360 Environmental, 2012e, 2012f, 2012g, 2010c). No other threatened fauna species were recorded during fauna surveys (360 Environmental, 2012b, 2012c, 2012d).

The following listed flora species were not identified during field surveys. These species are highly unlikely to be located in the proposed development sites due to specific habitat requirements (360 Environmental, 2012a, 2010, 2009):

- Slender Andersonia;
- King Spider-orchid;
- *Centrolepis caespitosa*;
- Muchea Bell;
- Dwarf Bee-orchid;
- Glossy-leaved Hammer-orchid;
- Cadda Road Mallee;
- Hook-leaf Isopogon; and
- Beaked *Lepidosperma*.

2.3 Wetlands/Hydrology

No wetlands or surface hydrological features are present on any of the sites however several wetlands are located in the vicinity. The Parmelia Site is located approximately 200m west of the Wellard Wetland, whereas the Train Station Sites are located approximately 300m south of The Spectacles Wetlands and Beeliar Regional Park.

2.4 Topography

The topography of the KTC site is undulating with ground levels ranging between approximately 6 to 16 m AHD. This topography is also consistent with the area surrounding the site (DoW, 2012).

The Parmelia site topography rises from a low point at the east of the site at approximately 10 m Australian Height Datum (AHD) to approximately 50 m AHD at the south-west of the site (DoW 2012).

The topography at the Train Station Precinct ranges between approximately 15 meters Australian Height Datum (AHD) and 40 m AHD on all sites (DoW, 2012).

2.5 Soils and Geology

The sites are located within the Swan Coastal Plain bioregion of the Interim Biogeographic Regionalisation of Australia (IBRA) (SEWPaC, 2012b). The sites consist mostly of Tamala Limestone, predominantly calcarenite.

3 Potential Impacts to Matters of National Environmental Significance

3.1 Introduction

As the majority of species identified as potentially occurring by the Protected Matters Search Tool are unlikely to be on-site due to lack of adequate habitat, the proposal is only expected to impact two Black Cockatoo species listed as Matters of National Environmental Significance (MNES); the Forest Red-Tailed Black Cockatoo (FRTBC) and the Carnaby's Black Cockatoo (CBC). The extent of expected impacts to these species resulting from the proposed action is described below.

3.2 Carnaby's Black Cockatoo

Field studies conducted by 360 Environmental in 2011 and 2012 identified that the three sites are frequently used by CBC for foraging (360 Environmental 2012c; 2012d; 2012e; 2012f). A considerable number of breeding trees, as defined by DotE guidance, were found. Four hollows of suitable size were found during the survey, two of which were considered as unlikely to be of use to the CBC due to the low height of one hollow, and the presence of feral bees in the other.

The total area of habitat potentially utilised by the CBC that is proposed to be cleared is 74.7 hectares of foraging habitat and 1068 significant habitat trees (with a diameter at breast height greater than 500mm, as defined by DotE guidance) (Figure 5-7).

3.3 Forest Red-Tailed Black Cockatoo

As foraging habitat requirements for the FRTBC is similar to that of the CBC, it is expected that the vast majority of impacts to this species will be from the loss of foraging habitat rather than breeding habitat. As it is also known that approximately 90% of the FRTBC diet consist of the seeds of Jarrah and Marri, foraging habitat for this species was determined to be all communities with Jarrah or Marri present. This excludes the *Banksia sessilis* scrublands within the KTC site and the Banksia woodlands in the Train Station Precinct (Figures 2-4 and 5-7).

The total area of FRTBC habitat scheduled for clearing is 55.4 hectares of foraging habitat and 1,060 significant habitat trees (with a diameter at breast height greater than 500mm) (Figure 5-7). Field surveys concluded that the development site was more frequently used by CBC as opposed to the FRTBC (360 Environmental 2012c; 2012d; 2012e; 2012f).

4 Offset Strategy

4.1 Introduction

The DotE requested a proposed offsets package be made after considering the EPBC referral 2015/6916. The following issues have been considered and evaluated:

4.1.1 What is the nature of likely impacts on protected matters?

It has been known from the field and desktop investigations of the development site, that the only MNES likely to be impacted by the proposal would be the FRTBC and the CBC.

4.1.2 Can impacts on protected matters be avoided?

A reduced clearing footprint has been negotiated to avoid impacts to some areas on the site. Approximately six hectares and several breeding trees have been avoided.

4.1.3 Can impacts on protected matters be mitigated?

Impacts can be mitigated through commitments such as planting species suitable for Black Cockatoo, clearing at appropriate times, and developing appropriate landscaping of the site to encourage development of Black Cockatoo habitat. Development of conservation estate to protect habitat for protected matters in perpetuity will also assist in mitigating impacts resulting from clearing of black cockatoo habitat.

4.1.4 Are the residual impacts likely to be significant?

An assessment of the significance of the impact is outlined in accordance with the significant impact criteria.

4.1.4.1 Will the action lead to a long-term decrease in the size of a population or species?

As the sites do not contain suitable breeding sites, it is unlikely that long-term decreases to the species are expected.

The retention of suitable areas of foraging and breeding habitat within the two proposed offset sites (outlined in Section 4.2 below) as conservation estate in perpetuity will ensure the two black cockatoo species will have access to suitable habitat long term. Therefore the action is unlikely to lead to a long-term decrease in the two species.

4.1.4.2 Will the action reduce the area of occupancy of the species or population?

Several stands of bushland suitable for foraging and breeding exist within conservation estate nearby, inclusive of the offset site located on Lot 9241 in Parmelia. Replanting of cockatoo relevant species (over 1000 proteaceous and eucalypt) on the site will also

ensure foraging habitat in the area is available in the area over the long term. Therefore the action is unlikely to reduce the area of occupancy of both species.

4.1.4.3 Will the action fragment an existing population into two or more populations

Given that both Black Cockatoo species have large ranges of travel, and that suitable habitat still exists in the vicinity of the development site, the action is not expected to fragment any populations. The proposed indirect offset will likely fill in the knowledge gap that exists with understanding patterns of Black Cockatoo movement and therefore increase the potential effectiveness of future conservation efforts.

4.1.4.4 Will the action adversely affect habitat critical to the survival of a species

It is expected that the action will affect habitat for the species, however due in part to the mitigation measures associated with the proposal such as planting of black cockatoo habitat species and the preservation of habitat for conservation estate (outlined in Section 4.2 below) and the availability of suitable habitat in conservation reserves located nearby, the action is unlikely to remove habitat that is critical to the survival of the species.

4.1.4.5 Will the action disrupt the breeding cycle of a population?

It is not expected that the action will affect breeding cycle of the species, no actual breeding was recorded on site and there is significant habitat nearby in conservation reserves. Will the action modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline?

Due in part to the mitigation measures associated with the development such as replanting of suitable foraging species and the availability of suitable habitat in conservation reserves located nearby, the action is unlikely to result in the decline of the species. In fact, the indirect offset proposed may result in higher breeding success rates for all three species.

4.1.4.6 Will the action result in the invasive species that are harmful to a vulnerable or endangered species becoming established in the endangered or critically endangered species habitat?

As standard hygiene procedures will be followed during clearing and construction, it is unlikely that any invasive species will become established in surrounding habitat.

4.1.4.7 Will the action introduce disease that may cause the species to decline?

Although dieback is known to occur in the area, standard hygiene procedures will be followed during clearing and construction, it is unlikely that any invasive species will

become established in surrounding habitat. As the development will result in the removal of habitat, it is unlikely that impacts from disease will occur.

4.1.4.8 Will the action interfere with the recovery of species

The retention of suitable areas of foraging and breeding habitat within the two proposed offset sites (outlined in Section 4.2 below) as conservation estate in perpetuity will ensure the two black cockatoo species will have access to suitable habitat long term. Therefore the action is unlikely to interfere with species recovery.

4.1.5 Are offsets a suitable approach?

The process of avoidance and minimisation has been extensively considered, in the context of the likely impacts to the Black Cockatoo species, as well as the designated land use of the site (i.e. urban development). Offsets are therefore considered a suitable approach to mitigate the likely impacts that will result from the eventual development of these sites and protect the long term viability of these species.

Offsets were also considered to be a suitable approach as it would fulfil other ecological protection principles in addition to offsetting the impacts to the two MNES identified.

4.2 Proposed Offset Strategy

The proposed offset for the three Kwinana sites will consist of the transfer of land to the conservation estate (direct offset), as well as the provision of funding for research (indirect offsets).

Initially, the proposed offset package was designed based on the Department of the Environment's Offsets Assessment Guide (the offsets calculator) to provide an estimate of the contributions of the direct offsets and the likely requirement for indirect offsets. Standard use of the calculator requires that direct offset strategies offset at least 90% of the impact to a protected matter, with the remaining 10% consisting of indirect strategies.

The lack of suitable offset sites with good quality Jarrah-Marri woodland of sufficient size however, is becoming increasingly rare in the south-west as a large portion of these are already managed by the West Australian Department of Parks and Wildlife (DPaW), or are locked into mining leases. Based on discussions with both the Department of the Environment and DPaW, an alternate strategy with minimal reliance on the calculator was developed and largely consists of indirect offsets rather than direct offsets.

Section 4.2.1 describes the proposed direct offset, while Section 4.2.2. outlines the proposed approach to the indirect offset package.

4.2.1 Direct Offsets

The provision of direct offsets will involve the transfer of land (Bush Forever Site 272) for conservation purposes to be maintained in perpetuity. Rehabilitation works will also be carried out within the site to raise its overall value to both Black Cockatoo species.

The offset calculator estimates that the direct offset will account approximately 10% and 15% of impacts offset for the CBC and FRTBC respectively.

4.2.1.1 Kwinana Offset Site

The Kwinana offset site is part of Lot 9241 Parmelia, which is currently owned by the Department of Housing, and is listed as a Bush Forever Site. The 22 ha site will be transferred to the West Australian Planning Commission (WAPC) which will ultimately transfer the land to the State Government, to be managed by the City of Kwinana for conservation purposes. The transfer process of land management is already in progress. The Western Australian Planning Commission has confirmed that the site will be reserved as crown land for conservation in perpetuity and vested with the Conservation Commission for management by the City of Kwinana, ensuring the risk of loss in the future is removed (Tim Hillyard – Manager Strategic Property Unit, Department of Planning, pers. comms. 2 September 2013).

The vegetation type of Lot 9241 can generally be described as a Banksia Woodland (*Banksia attenuata*, *B. menziesii* and to a lesser extent, *B. ilicifolia*) with an over storey

of Jarrah (*Eucalyptus marginata*), a mid-storey of Sheoak (*Allocasuarina fraseriana*), Woolly Bush (*Adenanthos* sp.) and an understorey of Grass trees (*Xanthorea* spp), Zamia Palms (*Macrozamia* sp.) and annual weed species (360 Environmental 2012h). Banksia woodland is a predominant vegetation type of the project area. A targeted Black Cockatoo survey carried out by 360 Environmental (2012h) found that the site contained suitable feeding species (Banksia and Jarrah).

The last vegetation and flora survey of Bush Forever site 272 was conducted by the Department of Environment Protection in 1999. Vegetation condition of the site was recorded as <40% excellent; >30% Very Good; >30% Good to Degraded with areas of severe localised disturbance (DEP, 2000). Bush Forever site 272 is part of a significant contiguous bushland/wetland linkage (DEP, 2000).

Large intact areas of bushland containing suitable breeding and foraging habitat on the Swan Coastal Plain are rare due to the significant cost of these landholdings. As a result, the protection of this bushland in perpetuity is considered a valuable component of the offsets package, particularly to the FRTBC, which will benefit from this retained habitat within their core foraging and breeding zone.

4.2.1.2 Revegetation within the Kwinana Offset Site

Approximately two hectares of Bush Forever site 272 will be revegetated as part of the proposed offset. Seed will be collected from native vegetation in the proposed development sites prior to clearing. This seed will then be treated (if required) and spread within the area to be revegetated.

The first 10 – 15 cm of topsoil will also be stripped from areas to be developed and stockpiled. This topsoil will contain the seed bank of local provenance native species. Stored topsoil will be re-spread in the area to be revegetated.

Vegetation within development sites will be chipped and stockpiled. Chipped vegetation will then be spread within the area to be revegetated once seeding and re-spreading of topsoil have been completed. The application of chipped vegetation will support seedling establishment through the provision of organic matter and nutrients. Once mulching has been completed, tubestock will be planted within the area to be revegetated. Flora species to selected to be used as tubestock will be typical of vegetation communities present at the site (Eucalypt overstorey with a Proteaceous understorey), with a focus on selecting species that provide habitat to both the CBC and the FRTBC.

4.2.2 Indirect Offsets

Discussions with Dr Kristin Warren (Murdoch University) and Dr Ron Johnstone (West Australian Museum, WAM) have resulted in two large scale research projects into the ecology and physiology of all three Threatened Black Cockatoo species. Details of these projects are listed below.

These projects have been designed around proposed recovery actions for Black Cockatoos were consolidated from a variety of sources, which includes:

- Carnaby's Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan (2012), Department of Environment and Conservation, Australian Government;
- Forest Black Cockatoo (Baudin's Cockatoo *Calyptorhynchus baudinii* and Forest Red-Tailed Black Cockatoo *Calyptorhynchus banksii naso*) Recovery Plan (2008), Department of Environment and Conservation, Australian Government.

4.2.2.1 Black Cockatoo Satellite Tracking Project – Murdoch University

The Black Cockatoo Satellite Tracking Project is spearheaded by Dr Kristin Warren from the College of Veterinary Medicine in the School of Veterinary and Life Sciences at Murdoch University whose team have developed techniques and approaches which allow real-time monitoring of Black Cockatoo's via GPS, a concept which have been proven to work in Proof of Concept trials. This technique allows a wealth of information, such as flock location and health to be gathered and monitored for the first time.

The project is proposed to run over four years at the end of which , enough information will be collected to provide the Department of Environment, the Department of Environment Regulation and the Department of Parks and Wildlife with policy advice to assist with future conservation efforts and offset proposals.

The overall aims of the project are:

- Investigate long-term movements of the FRTBC and CBC; including predicted residential and migratory patterns; and
- Determine flock movements and habitat use of FRTBC and CBC (and also indirectly for Baudins Black Cockatoo at both local and regional scales.

The project has been designed and developed specifically so that its outcomes meet key Actions and Objectives of the Recovery Plans for Western Australia's black cockatoos (DEC 2007, DEC 2012). These outcomes and the associated Recovery Plan Actions and Objectives are summarised in bullet points below. The project has a particular focus on the FRTBC and the CBC, with additional indirect benefits for Baudin's cockatoos.

Specific benefits that the project will have towards the recovery actions and objectives for each black cockatoo species are listed below:

Forest Red Tail Black Cockatoo

- Map feeding and breeding habitat critical to survival and important populations - Action 13.10 (DEC 2007, p26);
- Identify important breeding sites, thereby assisting with Action 13.6, i.e. identifying factors affecting the number of breeding attempts and breeding success, and managing nest hollows to increase recruitment - Action 13.6 (DEC 2007, p23);
- Determine the patterns and significance of flock movements- Action 13.12 (DEC 2007, p27);
- Identify and manage important groups of forest red-tailed black cockatoos, and protect from threatening processes - Action 13.9 (DEC 2007, p25);
- Determine population numbers and distribution - Action 13.10 (DEC 2007, p 26);
- Address declines in breeding populations – key objective of the Recovery Plan. This will be done through identification of critical feeding and breeding habitat; enabling conservation of habitat of high conservation value for this species; and
- Contribute to ensuring the persistence of the species throughout their current range in the south-west of Western Australia – key objective of the Recovery Plan. As with the point above, this will be done through identification of critical feeding and breeding habitat; enabling conservation of habitat of high conservation value for this species.

Carnaby's Black Cockatoo

- Protect and manage important habitat, specifically through the key task: Locate and map important breeding and feeding sites– Action 14.1 (DEC 2012, p37-8);
- Conduct Research to Inform Management; in particular the following key Tasks: Confirm habitat preferences of the CBC south coast as well as conducting research into CBC movements, feeding and roosting behaviour to better understand how they use resources – Action 14.2 (DEC 2012, p39);
- Manage Other Impacts; in particular the following key Task: Support rehabilitation programs which ensure that injured and debilitated wild black cockatoos receive specialised veterinary treatment and assessment, and monitor the success rate of rehabilitating injured birds back to the wild – Action 14.4 (DEC 2012, p41);
- Undertake Information and Communication Activities; in particular, providing resources to contribute to the following key Task: Develop and distribute awareness raising and guidance materials for decision makers and proponents aimed at increasing awareness of the habitat and conservation requirements of CBCs and importance of local areas – Action 14.5 (DEC 2012, p41); and

- Engage with the Broader Community; in particular the following Tasks: (1) Promote awareness of the conservation needs of the CBC and support for its recovery within the broader community (public, industry, business and government); (2) Develop information and guidelines for management of CBC habitat in formats that can be used by individuals, groups and organisations/agencies –Action 14.6 (DEC 2012, p42).

Baudins Black Cockatoo

Although the project will focus on tracking the FRTBC and CBC, it is anticipated that it will contribute indirectly to the Objectives of the Recovery Plan for Baudin's cockatoos as well. It will do this in two ways:

Previous research by Murdoch University shows that Baudin's and the FRTBC often occur in the same (forest) habitat. During all tracking of Forest Red-tailed black (and Carnaby's) cockatoos, information of Baudin's Black Cockatoo will also be recorded to be fed into the management objectives for the species.

In addition to this, the technologies and methods used to track Forest red-tailed black cockatoos in dense forest will be directly applicable to studying Baudin's cockatoos. The project will also have numerous other benefits to the species, such as:

- [Identify] feeding and breeding habitat critical to survival and important populations - Action 13.10 (DEC 2007 p26).
- Identify important breeding sites, thereby assisting with Action 13.6, i.e. identifying factors affecting the number of breeding attempts and breeding success, and managing nest hollows to increase recruitment - Action 13.6 (DEC 2007 p23).
- Identify and manage important groups of forest red-tailed black cockatoos, and protect from threatening processes - Action 13.9 (DEC 2007 p25).
- Determine population numbers and distribution - Action 13.10 (DEC 2007, p26).
- Determine the patterns and significance of flock movements- Action 13.12 (DEC 2007, p27).
- Address declines in breeding populations – key Objective of the Recovery Plan. This will be done through contributing to the identification of critical feeding and breeding habitat (as per above).
- Contribute to ensuring the persistence of the species throughout their current range in the south-west of WA – key Objective of the Recovery Plan. As above, this will be done through contributing to the identification of critical feeding and breeding habitat.

4.2.2.2 Black Cockatoo Research Project – Western Australian Museum

This project, supervised by Dr Ron Johnstone at the WAM is targeted toward all three species, not specifically towards the CBC or FRTBC. It is anticipated that the project will help to meet targets in all recovery actions for the Threatened Black Cockatoo species, similar to that anticipated for the Satellite Tracking Project by Murdoch University.

Specifically, the project will help to:

- Identify, protect and manage breeding, feeding and roosting habitat. Migration and movement corridors across non-breeding range will also be identified;
- Undertake research into the breeding biology, ecology and conservation of all three species of black cockatoo in the southwest of Western Australia;
- Undertake regular monitoring of important sites for all three species;
- Develop and implements ways to remove feral species including European honeybees from nesting hollows;
- Identify factors affecting breeding attempts and breeding success;
- Determine and implement ways to minimise the effects of mining on habitat loss;
- Determine and implement ways to manage forests for the conservation of Baudin's and FRTBC;
- Identify isolated populations of each species and look at ways to protect them from threatening processes;
- Map important habitat critical to the survival of isolated populations and helps with management guidelines for these habitats;
- Determine population numbers and distribution. Our study includes all three species throughout the SW with focus on Swan Coastal Plain;
- Determine patterns of migration, movements and changes in foraging ecology;
- Undertake information and communication activities and engages with broader community (enormous public engagement through cockatoo care program). This includes the development of educational material e.g. information sheets on each species and raising public awareness; and
- Develop of artificial nest hollows and protocols for their use and installation. (The use of PVC cockatubes came from the cockatoo care program).

While the satellite tracking program by Murdoch University aims to study landscape scale movement patterns and flock dynamics, this WAM project will involve a larger amount of on ground site specific work, such as implementing feral bee control measures, installing and developing artificial nesting boxes and facilitating community engagement. These two projects running in conjunction and in parallel with each other

has the potential to provide long lasting benefits for all three Black Cockatoo species at various scales.

4.2.3 Indirect Offset Benefits

As indicated, these research projects will deliver major new ecological information to enable informed decision-making for the management and recovery of the FRTBC and CBC, through landscape-scale assessment of flock movements and habitat use and identification of critical breeding, foraging and roosting habitat. These outcomes are listed as priorities in the EPBC Act Referral Guidelines for both of these black cockatoo species (SEWPaC 2012).

Currently, significant knowledge gaps exist at the state and federal level concerning what habitat areas should be conserved when offset funding is available for black cockatoo habitat acquisition. Identification of breeding, foraging and roosting habitat use, through following seasonal flock movements, will enable high conservation value habitat for black cockatoos to be determined and prioritised for conservation through future offset proposals.

For the FRTBC, the National Recovery Plan highlights the importance of research for this species (DEC 2007), of which less is known than for the CBC. The identification of feeding, roosting and breeding habitat revealed by both on ground monitoring and telemetry data is considered the major priority for forest red-tailed black cockatoos. It is also one of the key priorities for the CBC. Similarly research into improving breeding success, such as the development of feral bee control techniques and artificial nest boxes is also considered a key priority for continued survival of the species'.

Current gaps in knowledge about black cockatoo ecology and habitat use are preventing governments from being able to take appropriate conservation action; and in light of these information gaps, identifying appropriate habitat for off-set programs remains challenging. To assist governments with this task, the findings from this proposed tracking study will provide empirically derived knowledge to inform and guide future management and land procurement decisions, at the scale of the whole species distribution.

As populations of black cockatoo species continue to decline across WA, the Recovery Plans have identified the federal government's priorities with respect to the specific ecological and habitat information that the government most urgently requires. This project will deliver much of this information. It will answer key ecological questions that have not been able to be answered to date. This new information will be able to inform government decisions regarding assessing proposed land uses; enabling proponents to deliver best-practice land use to protect black cockatoos; and facilitating procurement of habitat that is considered to be of high conservation value for the recovery of black cockatoo species.

4.2.3.1 Other - Construction Management

Several strategies are currently in place to minimise impacts to Black Cockatoos during the construction phase, such as:

- If Black Cockatoos are present at the site during clearing the construction will cease until the Black Cockatoos leave the area;
- All hollows will be visually checked prior to clearing. Should Black Cockatoos be present at the hollow the tree will be retained until the nest is abandoned or relocation will be undertaken in consultation with DPaW;
- Tree hollows and logs that may be potentially suitable for fauna habitat will be salvaged and relocated to the areas of POS if possible; and
- Construction personnel will be inducted prior to commencing work on site of the procedures for encountering fauna on site during clearing.

5 Offset Principles

A brief description on how the proposed offset package meets the core principles of the DotE's Offsets Policy is outlined below:

5.1.1 (1) Deliver an overall conservation outcome that improves or maintains the viability of the aspect of the environment that is protected by national environment law and affected by the proposed action

While the direct offset package will maintain some foraging habitat in the surroundings of the impact site, it is expected that the focus on providing funding to research will help provide an increased and more effective overall conservation outcome. As described, the proposed research will help fill in several important knowledge gaps which will provide a more accurate direction for the policy and protection of all the three Black Cockatoo species.

5.1.2 (2) Be built around direct offsets but may include other compensatory measures

The proposed offset strategy for this proposal consists of both direct and indirect offsets. The direct offset, while smaller than most packages still provides a high level of ecological benefit as it ensures that a portion of Linkage 50, a regionally important ecological linkage between two conservation estates is protected in perpetuity.

If this proposal was to consist of primarily direct offsets, it is likely that the 90% requirement would be met by providing a package that was made up of numerous parcels of habitat (foraging, not necessarily breeding). These parcels of land may or may not have an effect on the continued survival of these species, as only foraging habitat will be provided.

A key theme of the research projects proposed is the emphasis on improving breeding success and identifying key breeding areas, widely acknowledged to hold higher value than preservation of primarily foraging habitat (as cockatoos have shown to be highly adaptable to changes in food resources; eg. CBC with pine, and the FRTBC with Cape Lilac).

5.1.3 (3) Be in proportion to the level of statutory protection that applies to the protected matter

The large portion of research conducted by the WAM and Murdoch University has directly contributed to policy on the protection of Black Cockatoo species in the south west. For instance, research by the WAM has resulting in the conservation status' of Baudins Cockatoos and the FRTBC to be upgraded by both State and Federal agencies.

5.1.4 (4) Be of a size and scale proportionate to the residual impacts on the protected matter

It is anticipated that the provision of funding towards these research projects will fill in the gaps in the current understanding of the three species and allow more effective direction and prioritisation of future conservation and offset efforts.

5.1.5 (5) Effectively account for and manage the risks of the offset not succeeding

Risks of failure for the direct offset site only extends as far as the risks associated with rehabilitation. The risks associated with the research projects only extends as far as the results of the studies not providing as much information as anticipated, although this is highly unlikely. The projects are headed by academics who are at the forefront of the field and who have demonstrated their capability in the past. Risks associated with funding are considered minimal as the Department of Housing has committed support towards the proposed funding package.

5.1.6 (6) 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, see section 7.6)

The proposed research package is considered to have benefits beyond that required to offset the impact of this proposal. Specifically, although the Kwinana Housing Development will impact foraging habitat for two Black Cockatoo Species, the research proposed will show benefits for all three species, not just on foraging habitat, but on breeding and roosting habitat as well.

5.1.7 (7) Be efficient, effective, timely, transparent, scientifically robust and reasonable

The transfer of land for the direct offset site is already partially completed. And will be completed within a year of the strategy being endorsed by the Federal Government. A budgeting plan for the proposed research projects has been developed to scope out the content and timeline of the study.

5.1.8 (8) Have transparent governance arrangements including being able to be readily measured, monitored, audited and enforced.

The commitments surrounding the direct offset (rehabilitation works) have been designed so that it is readily measured, monitored, audited and enforced (Section 6.1.2). The research proposed is being undertaken by agencies and individuals who have demonstrated previous experience and capability in the field.

6 Offset Implementation

6.1 Direct Offsets

6.1.1 Transfer of Land for the Kwinana Offset Site

The transfer of land to the WAPC is already underway. The details of rehabilitation works carried out within the site are detailed in Section 6.1.2. Management of the site will be undertaken by the City of Kwinana.

6.1.2 Rehabilitation of the Kwinana Offset Site

A Revegetation Management Plan will be prepared prior to revegetation of degraded areas of Bush Forever Site 272 and POS being undertaken. The following section provides an overview of information to be included in the plan.

6.1.2.1 Objectives

The overall purpose of revegetation is to provide a net increase in the area of native vegetation in degraded areas of vegetation within Bush Forever Site 272 and POS, where possible through:

- Managing clearing to generate topsoil and vegetation for use in revegetation;
- Setting timeframes for revegetation;
- Preparing species lists for revegetation, including specifications as to what will be planted as seed and what will be planted as tube stock;
- Achieving a species diversity that is not less than 70 percent of the known original species diversity;
- Achieving an 80% survival rate of planted seedlings within three years of planting.

6.1.2.2 Site Preparation

Prior to the commencement of revegetation, topsoil will be scalped from development sites to 10-15cm depth and stockpiled. Seed will also be collected prior to vegetation clearing and vegetation will be chipped and stockpiled.

Activities involved in preparing the site for revegetation are likely to include:

- Weed control;
- Spread of topsoil; and
- Spread of chipped vegetation.

6.1.2.3 Planting and Seeding

Once site preparation has been completed, seed collected from development sites will be spread and tubestock planted. Areas to be seeded will be lightly harrowed to loosen topsoil prior to planting. Tubestock will be protected from herbivore grazing (e.g. rabbits) through the installation of tree guards. A ratio of 40-50% overstorey, 20-30% midstorey and 30-40% understorey will be used for seed and tubestock mixes.

Overstorey revegetation will focus on selecting species that provide high foraging value for the FRTBC, such as *Eucalyptus marginata* (Jarrah), *Corymbia calophylla* (Marri). Midstorey vegetation will comprise of *Allocasuarina fraseriana* and *Banksia* spp. Although of little value to the FRTBC, *Banksia* species will provide benefit to the CBC, while maintaining diversity. Understorey vegetation will comprise of shorter proteaceous species as well as *Xanthorrhoea preissii*. Specific species lists will be presented in the Rehabilitation Management Plan.

6.1.2.4 Maintenance

Monitoring of revegetation after completion of revegetation works may determine that additional management measures are required to aid vegetation establishment. Additional measures may include weed control, infill planting or fertiliser application. Infill planting will be undertaken at a rate of 15% in the first year, 10% in the second year and 0% in the third year.

6.1.2.5 Monitoring

Monitoring will be conducted yearly over three years to assess the success of revegetation. The success of revegetation will be determined via comparison to completion criteria which will be detailed in the Revegetation Management Plan. Monitoring will be conducted via surveying of permanent quadrats established within revegetated areas.

In the event that revegetation does not meet some completion criteria, contingency measures may be required. Contingency measures may include:

- Additional weed control;
- Fertiliser application;
- Additional watering; and
- Pest control (e.g. rabbit baiting).

6.1.2.6 Timeline

Planting of tubestock and seeding will be undertaken between May and July after the break of the season, when sufficient soil moisture is present to adequately support the establishment of seedlings. All other revegetation activities will be scheduled to occur

before or after seeding and planting commences. Table 1 provides the estimated timing of tasks required to complete revegetation works.

Table 1. Timing of Revegetation Works

Tasks	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Weed Control												
Spread of topsoil												
Spread of chipped vegetation												
Seeding												
Planting												
Monitoring)												
Follow up weed control (if required)												

6.1.2.7 Estimated Cost

\$100,000 will be provided to the revegetation of degraded areas in Bush Forever Site 272. Table 2 provides a breakdown of costs assigned to each activity required to revegetate two hectares of Bush Forever Site 272. A surplus of approximately \$30,000 will be available for replanting and maintenance of the rehabilitation.

Table 2. Estimated Cost of Revegetation Activities

ACTIVITY	ESTIMATED COST (EXCL GST)
Preparation of Revegetation Management Plan	\$7,000
Weed control	\$1,000
Seed collection	\$2,500
Spread of seed	\$1,000
Respread of topsoil	\$15,000
Respread of chipped vegetation	\$15,000
Tubestock supply (1500 tubestock/ha)	\$4,500
Planting of tubestock	\$3,500

Supply of tree guards	\$1,380
Project Management	\$3,500
Monitoring (for three years)	\$12,000
Follow up weed control (one event per year for three years)	\$3,000
TOTAL:	\$69,380
BUDGET	\$100,000

6.1.2.8 Timing and Provision of Funding

The DoH will be responsible for undertaking the initial rehabilitation works, up to the supply and install of the seedlings. Following this a total of \$15,000 for monitoring (over 3 years) and follow up weed control will be handed to the responsible management authority (likely City of Kwinana) to undertake post rehabilitation works. It is noted that land will eventually be ceded to the Conservation Commission, however it is likely that the City as the current management authority will continue to manage this reserve.

Evidence of invoicing for the rehabilitation works and project management, along with receipt of the handover of the \$15,000 will be provided after the rehabilitation works are completed to demonstrate the expenditure of these funds to the City for this purpose.

6.2 Indirect Offsets

6.2.1 Black Cockatoo Satellite Tracking Project – Murdoch University

Table 3 outlines the actions, responsibilities and outputs of the Black Cockatoo Satellite Tracking Project.

Table 3. Actions, Responsibilities and Outputs Black Cockatoo Satellite Tracking Project

ACTION	OUTPUT (AVAILABLE TO DATE)	OUTCOME	RESPONSIBILITY
Track wild flocks using satellite and GPS at the landscape scale and ground truth telemetry data	Mapping of flock movements	Determine current flock movements and confirm habitat preferences of Black Cockatoos at both local and regional scales Allows for the investigation of long-term movements of Black Cockatoos including predicted residential and migratory patterns Allows for better understanding of Black Cockatoo behaviour Contributes to increasing awareness of proponents and decision makers to the habitat and conservation requirements of Black Cockatoos Improves information in guidelines provided to the broader community (individuals, groups, organisations/agencies)	Murdoch University
	Estimation of current population numbers	Allows for investigation of future population trends	Murdoch University
	Mapping of critical breeding sites	Address decline in breeding populations and contribute to ensuring the persistence of the species throughout their current range	Murdoch University
		Allow for management of nest hollows to increase recruitment	
	Mapping of critical feeding habitat	Identification of critical feeding habitat which contributes to ensuring the persistence of the species throughout their current	Murdoch University

ACTION	OUTPUT (AVAILABLE TO DOTE)	OUTCOME	RESPONSIBILITY
	Mapping of preferred roosting habitat	range Identification of critical roosting habitat and contribution to a better understanding of Black Cockatoo behaviour	Murdoch University
Identify and manage important groups of Forest Red-tailed Black Cockatoos		Protect from threatening processes	Murdoch University
Track rehabilitated Black Cockatoos using satellite and GPS at regional scale	Monitor the success rate of rehabilitating injured birds back to the wild	Support of rehabilitation programs and provision of a better understanding of the recovery of rehabilitated birds	Murdoch University

6.2.2 Black Cockatoo Ecology Research Project - Western Australia Muuseum

WAM, through the cockatoo care program, has been providing valuable information to the DotE on the conservation of Black Cockatoos for the past decade. Funding will be provided towards the continuance of this program. The following table outlines the outputs and outcomes that will be produced from continuation of this program.

Table 4. Actions, Responsibilities and Outputs Black Cockatoo Ecology Research Project

ACTION	OUTPUT (AVAILABLE TO DATE)	OUTCOME	RESPONSIBILITY
Undertake targeted surveys for breeding, feeding and roosting sites	Mapping of critical breeding, feeding and roosting habitat	Address decline in breeding populations and contribute to ensuring the persistence of the species throughout their current range	WAM
		Allow for management of nest hollows to increase recruitment	
		Identification of critical feeding habitat which contributes to ensuring the persistence of the species throughout their current range	
		Identification of critical roosting habitat which contributes to a better understanding of Black Cockatoo behaviour	
		Contributes to increasing awareness of proponents and decision makers to the habitat and conservation requirements of Black Cockatoos	

ACTION	OUTPUT (AVAILABLE TO DATE)	OUTCOME	RESPONSIBILITY
Undertake information and communication activities and engages with broader community (enormous public engagement through cockatoo care program)		Raise awareness of conservation significance of Black Cockatoos to the broader community (individuals, groups, organisations/agencies)	WAM
Development of artificial nest hollows and protocols for their use and installation	Results of artificial nest monitoring	Address decline in breeding populations and contribute to ensuring the persistence of the species throughout their current range	WAM
		Allow for management of nest hollows to increase recruitment	
Complete studies on current population numbers and distribution of Black Cockatoos	Information on current population status and distribution of Black Cockatoos	Improves information in guidelines provided to the broader community (individuals, groups, organisations/agencies)	WAM
	Identify isolated populations	Allow for protection of isolated populations from threatening processes	
Determine patterns of migration , movements and changes in foraging ecology	Information on migration , movements and changes in foraging ecology	Allows for the investigation of long-term movements of Black Cockatoos including predicted residential and migratory patterns	WAM

ACTION	OUTPUT (AVAILABLE TO DOTE)	OUTCOME	RESPONSIBILITY
		<p>Allows for better understanding of Black Cockatoo behaviour</p> <p>Contributes to increasing awareness of proponents and decision makers to the habitat and conservation requirements of Black Cockatoos</p> <p>Allows for the investigation of long-term movements of Black Cockatoos including predicted residential and migratory patterns</p>	
Develop and implement ways to remove feral species including European honeybees from nesting hollows	Results of feral bee management in nesting hollows	Protect Black Cockatoos from threatening processes	WAM
Undertakes regular monitoring of important sites for all three Black Cockatoo species	Results of regular monitoring for all three Black Cockatoo species	<p>Protect Black Cockatoos from threatening processes</p> <p>Address and mitigate decline in population numbers for Black Cockatoos</p>	WAM
Undertakes research into the breeding biology , ecology and conservation of all three species	Updated information on nomenclature and taxonomy, diet, biology and behaviour and habitat preferences	Improves information in guidelines provided to the broader community (individuals, groups, organisations/agencies)	WAM

ACTION	OUTPUT (AVAILABLE TO DOTE)	OUTCOME	RESPONSIBILITY
		Contribute to ensuring the persistence of Black Cockatoo species throughout their current range	

6.2.3 Estimated Cost Black Cockatoo Research Projects

The following table provides an estimation of costs associated with each activity of the Black Cockatoo Satellite Tracking Project (Murdoch University) and Black Cockatoo Research Project (WA Museum).

Table 5. Estimated Cost Black Cockatoo Research Projects

ITEM	YEAR	ESTIMATED COST (\$ EXCL GST)
Black Cockatoo Satellite Tracking Project (Murdoch University)		
Year 1		\$117,000
Year 2		\$110,000
Year 3		\$30,000
Year 4		\$15,000
Sub-total		\$272,000
Black Cockatoo Research Project (WA Museum)		
Year 1		\$65,000
Year 2		\$65,000
Year 3		\$65,000
Year 4		\$65,000
Sub-total		\$260,000
Total for both projects		
TOTAL BUDGET		\$532,000

6.2.4 Timing and Provision of Funding

Funding will be provided to each research agency annually at the beginning of each year of the research project for a total of 4 payments in accordance with the annual funding requirement stipulated above for each project. A receipt of payment will be provided to the DotE within 4 weeks following the transfer of funds each year.

6.2.5 Demonstration of Project Achievements

In order to demonstrate achievement of the project outcomes as outlined above, a report will be prepared annually for each of the 4 years of the project, commencing one year after commencement of each research project. At this stage the satellite tracking project by Murdoch University will commence in January 2015, and the WA Museum project is proposed to commence shortly after receiving approval to proceed under the EPBC Act. The initial receipt demonstrating transfer of funds will be provided within 4 weeks of the transfer of these funds.

The annual reports will provide a brief summary of the achievements of each of the research projects, with the actual project deliverables appended and provided in this report.

An assessment of each of the projects progress in achieving the outcomes identified in this report will also be provided, along with any explanation for why specific outcomes have not been achieved in the designated timeframes. The receipt of funds transfer for the following year will also be provided with the annual report.

7 Summary of Offset Strategy

To adequately offset impacts resulting from the Kwinana Housing Development, the Department of Housing is proposing to contribute a direct and indirect offset package. This will consist of a land transfer of a 22 ha Bush Forever block in Kwinana with a contribution of \$100,000 towards rehabilitation. Funding of \$532,000 will be made towards two holistic Black Cockatoo research projects run by Murdoch University and the WA Museum. In total, the offset package is worth approximately \$632,000 over a four year period.

The direct offset land transfer and rehabilitation works will focus on transferring a 22 ha portion of Bush Forever Site 272. A two hectare portion of this site will be rehabilitated with Jarrah and Marri, with a monitoring program over three years, with the aim of providing additional future foraging habitat for the FRTBC and the CBC. Perpetually integrating this site into conservation estate will also offset impacts from the proposal in other ways, such as ensuring that the ecological linkage running alongside the Parmelia Site is maintained.

It is anticipated that the indirect offset package alone will likely result in a greater net benefit for the protection of all three Threatened Black Cockatoo species, as opposed to the likely benefit on the whole stemming from the purchase of isolated parcels of land for each individual species. The two research projects running in parallel will likely fulfil most if not all related recovery actions for these species. The benefit of the proposed projects have been supported by leading experts in the field of Black Cockatoo conservation, who have previously provided information to the State and Federal Governments on policy direction in relation to these species.

This offset strategy proposes a set of outcomes and deliverables that the Department of Housing will ultimately be responsible for in the provision of these deliverables annually over the 4 year project period. This will include annual reporting, commencing one year after receipt of the EPBC approval over the 4 years.

The rehabilitation works at the Kwinana Offset Site will also initially be undertaken by DoH, with the City of Kwinana likely to assume responsibility for ongoing management. The City is currently responsible for the management of this reserve.

8 Limitations

This report is produced strictly in accordance with the scope of services set out in the contract or otherwise agreed in accordance with the contract. 360 Environmental makes no representations or warranties in relation to the nature and quality of soil and water other than the visual observation and analytical data in this report.

In the preparation of this report, 360 Environmental has relied upon documents, information, data and analyses ("client's information") provided by the client and other individuals and entities. In most cases where client's information has been relied upon, such reliance has been indicated in this report. Unless expressly set out in this report, 360 Environmental has not verified that the client's information is accurate, exhaustive or current and the validity and accuracy of any aspect of the report including, or based upon, any part of the client's information is contingent upon the accuracy, exhaustiveness and currency of the client's information. 360 Environmental shall not be liable to the client or any other person in connection with any invalid or inaccurate aspect of this report where that invalidity or inaccuracy arose because the client's information was not accurate, exhaustive and current or arose because of any information or condition that was concealed, withheld, misrepresented, or otherwise not fully disclosed or available to 360 Environmental.

Aspects of this report, including the opinions, conclusions and recommendations it contains, are based on the results of the investigation, sampling and testing set out in the contract and otherwise in accordance with normal practices and standards. The investigation, sampling and testing are designed to produce results that represent a reasonable interpretation of the general conditions of the site that is the subject of this report. However, due to the characteristics of the site, including natural variations in site conditions, the results of the investigation, sampling and testing may not accurately represent the actual state of the whole site at all points.

It is important to recognise that site conditions, including the extent and concentration of contaminants, can change with time. This is particularly relevant if this report, including the data, opinions, conclusions and recommendations it contains, are to be used a considerable time after it was prepared. In these circumstances, further investigation of the site may be necessary.

Subject to the terms of the contract between the Client and 360 Environmental Pty Ltd, copying, reproducing, disclosing or disseminating parts of this report is prohibited (except to the extent required by law) unless the report is produced in its entirety including this page, without the prior written consent of 360 Environmental Pty Ltd.

9 References

- 360 Environmental 2006, Level 2 Flora and Vegetation Survey – Kwinana Town Centre (Document Reference Number 70/1 AD)
- 360 Environmental 2009, Bertram Station Precinct Level 2 Flora and Vegetation Survey (Document Reference Number 583 AC)
- 360 Environmental 2010a, Parmelia Avenue, Parmelia Spring 2009 Flora and Vegetation Survey (Document Reference Number 819 AC)
- 360 Environmental 2010b, Lot 2 Corner Durrant Avenue and Sicklemore Road, Parmelia Significant Tree Survey (Document Reference Number LD024-2 AB)
- 360 Environmental 2010c Bertram Train Station West Significant Tree Survey (sub-site B) (Document Reference Number LD024-2AC)
- 360 Environmental 2012a, Level 2 Flora and Vegetation Survey – Kwinana Town Centre (Document Reference Number EBS197-1 AB)
- 360 Environmental 2012b, Level 1 Vertebrate Fauna Survey – Lot 9001 Bertram Road, Parmelia (Document Reference Number 197-2AC)
- 360 Environmental 2012c, Level 1 Vertebrate Fauna Survey – Kwinana Town Centre (Document Reference Number EBS165-3 AB)
- 360 Environmental 2012d, Level 1 Vertebrate Fauna Survey – Kwinana Train Station Precinct (Document Reference Number EBS197-3 AD)
- 360 Environmental 2012e, Black Cockatoo Survey – Kwinana Town Centre (Document Reference Number EBS165-1 AB)
- 360 Environmental 2012f, Black Cockatoo Survey – Lot 9001 Bertram Road, Parmelia (Document Reference Number EBS197-2 AC)
- 360 Environmental 2012g, Black Cockatoo Survey – Kwinana Train Station Precinct (Document Reference Number EBS197-3 AD)
- 360 Environmental 2012h, Black Cockatoo Survey- Bush Forever Site 272, Kwinana (Document Reference Number EBS233-AB)
- Department of Agriculture and Food (DAFWA) 2012a, Pre-European Vegetation Extents, GIS Dataset, Government of Western Australia.
- Department of Agriculture and Food (DAFWA) 2012b, Native Vegetation Extents, GIS Dataset, Government of Western Australia.
- Department of Environment (DotE) 2009, Matters of National Environmental Significance – Significant Impact Guidelines 1.1, Government of Australia.
- Department of the Environment (DotE) 2010, Protected Matters Search Tool, Government of Australia, Accessed: 24 September 2012, <http://www.environment.gov.au/erin/ert/epbc/index.html>
- Department of the Environment (DotE) 2012a, EPBC Act referral guidelines for three threatened black cockatoo species. Government of Australia.

Department of the Environment (DotE) 2012b, *Environmental Protection and Biodiversity Act 1999* Environmental Offsets Policy. Government of Australia.

Department of the Environment (DotE) 2013, Matters of National Environmental Significance – Significant impact guidelines 1.1. Government of Australia.

Department of Environment and Conservation (DEC) 2007, Forest Black Cockatoo and Forest Red-tailed Black Cockatoo Recovery Plan 2007-2016, Department of Environment and Conservation (Now DPaW), Government of Western Australia.

Available

at:

http://www.dec.wa.gov.au/pdf/plants_animals/threatened_species/frps/FBC_Recovery_Plan_2007_2016_FEB2007.pdf

Department of Environment and Conservation (DEC) 2012, Carnaby's Cockatoo (*Calyptorhynchus latirostris*) Recovery Plan, Western Australian Wildlife Management Program No. 52, Department of Environment and Conservation, Government of Western Australia.

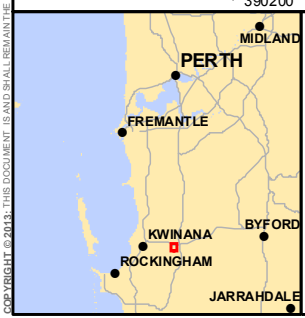
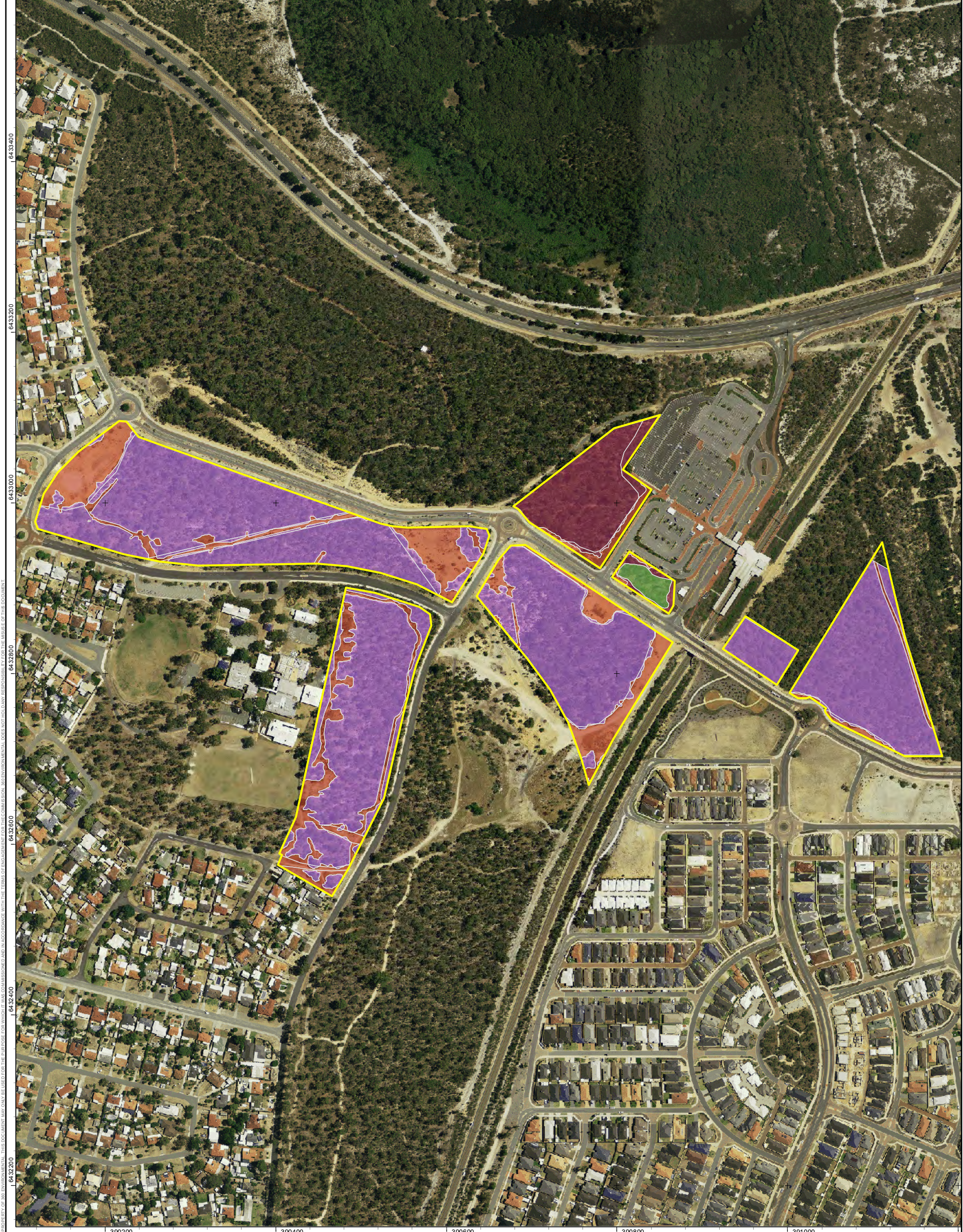
Department of Parks and Wildlife (DPaW) 2013, 2012 Statewide Vegetation Statistics (formerly the CAR Reserve Analysis – Full Report. Government of Western Australia.

Department of Water (DoW) 2012, Perth Groundwater Atlas. Perth groundwater atlas, Second Edition, 2004. Accessed: 17 October <http://www.water.wa.gov.au/idelve/gwa/>

Hedde, 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, Western Australia.

Tim Hillyard – Manager Strategic Property Unit, Department of Planning (Personal Communication) – email received on the 2nd September, 2013.

FIGURES



LEGEND
Vegetation Mapping

 Tuart Mixed Woodland (CBC/FRITBC)
 Banksia Woodlands and Scrublands (CBC)
 Jarrah Banksia Woodland (CBC/FRITBC)
 Limestone Shrubland (CBC)
 Marri Woodland (CBC/FRITBC)
 Tuart Woodland (CBC)
 Completely Degraded Vegetation
 Exotic Grasslands and Clearings

Note: Areas that are mapped as being 'Exotic Grasslands and Clearings' were mapped using Aerial Imagery.

Data was mapped at a 1:1000 scale using aerial imagery from January 2013 (Summer) which was checked against imagery from September 2013 (Winter). This was done to consider seasonal variations and sun/shadow positions.

DATA SOURCES
LOCALITY MAP: TRAVELLERS ATLAS 2006
AERIAL IMAGERY: LANDGATE JANUARY 2013
(© Western Australian Land Information Authority 2013)

NOTE THAT POSITIONAL ERRORS MAY BE >5M IN SOME AREAS

SLIP ENABLER

360 environmental a 10 Bermondsey St, West Leederville, 6007 WA
t (08) 9388 8360 f (08) 9381 2360
www.360environmental.com.au

Government of Western Australia
Department of Housing

Satterley

SIZE A3	SCALE 1:4,000	REVISION A	STATUS DRAFT	DRAWN JJ	DATE 21-Mar-2014
HORIZONTAL DATUM GDA MGA ZONE 50	VERTICAL DATUM -	CHECKED RM	APPROVED RH		

0 20 40 80 120 160
Meters

PROJECT NUMBER
27

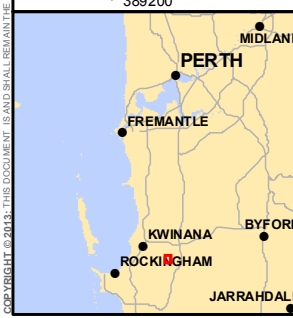
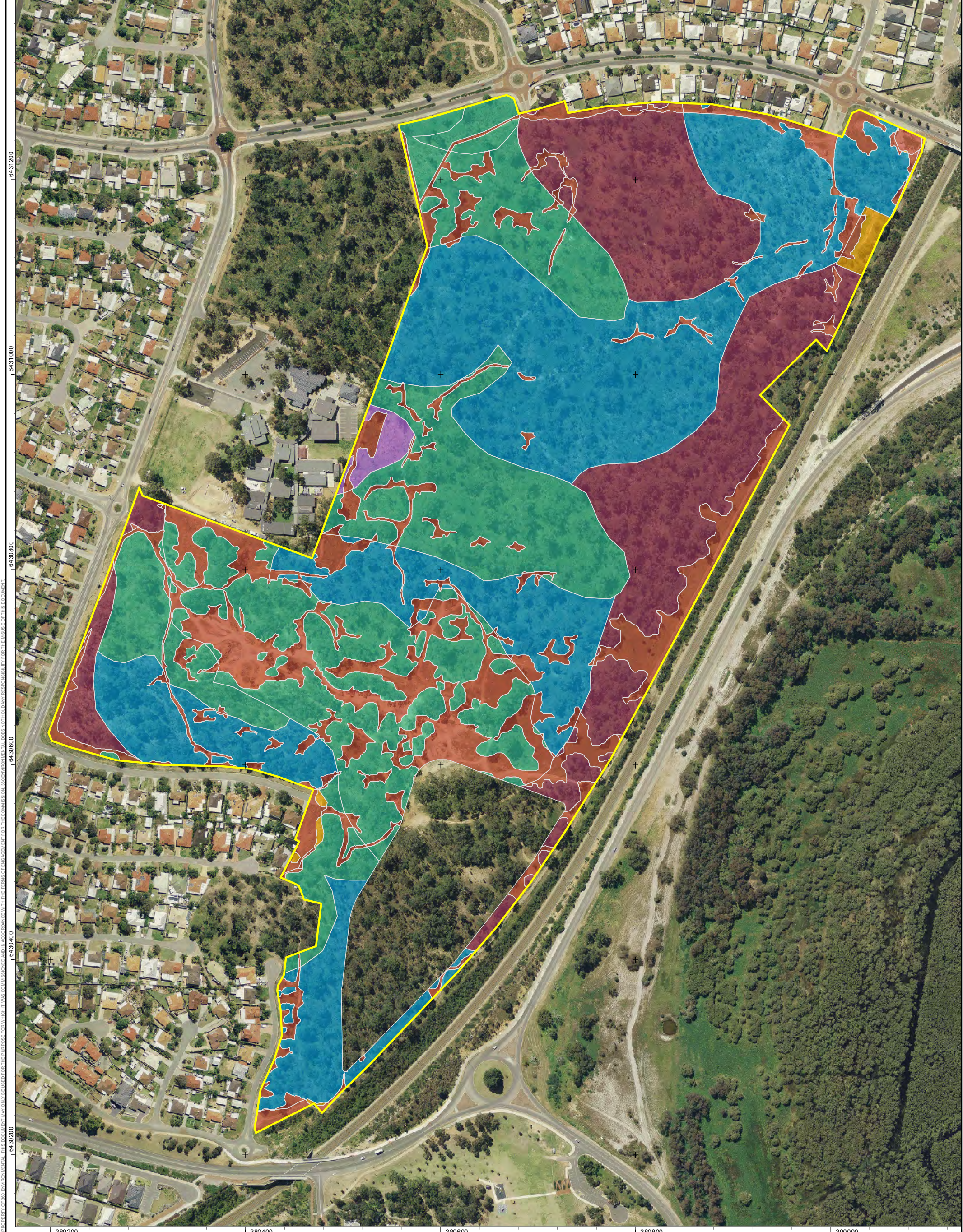
DRAWING NO.

people planet professional

Department of Housing
Satterley Property Group

Kwinana Housing Development
Offset Strategy
Train Station Precinct

Figure 2 - Inferred Vegetation Types



LEGEND
Vegetation Mapping

- Tuart Mixed Woodland (CBC/FRITBC)
- Banksia Woodlands and Scrublands (CBC)
- Jarrah Banksia Woodland (CBC/FRITBC)
- Limestone Shrubland (CBC)
- Marri Woodland (CBC/FRITBC)
- Tuart Woodland (CBC)
- Completely Degraded Vegetation
- Exotic Grasslands and Clearings

Note: Areas that are mapped as being 'Exotic Grasslands and Clearings' were mapped using Aerial Imagery.

Data was mapped at a 1:1000 scale using aerial imagery from January 2013 (Summer) which was checked against imagery from September 2013 (Winter). This was done to consider seasonal variations and sun/shadow positions.

NOTE THAT POSITIONAL ERRORS MAY BE >5M IN SOME AREAS

DATA SOURCES
LOCALITY MAP: TRAVELLERS ATLAS 2006
AERIAL IMAGERY: LANDGATE JANUARY 2013
(© Western Australian Land Information Authority 2013)

SLIP ENABLER

360 environmental a 10 Bernonsey St, West Leederville, 6007 WA
t (08) 9388 8360 f (08) 9381 2360
www.360environmental.com.au

Government of Western Australia
Department of Housing

Satterley

SIZE A3	SCALE 1:3,500	REVISION A	STATUS DRAFT	DRAWN JJ	DATE 21-Mar-2014
HORIZONTAL DATUM GDA MGA ZONE 50	VERTICAL DATUM -	CHECKED RM	APPROVED RH		

0 20 40 80 120 160
Meters

PROJECT NUMBER
27

DRAWING NO.

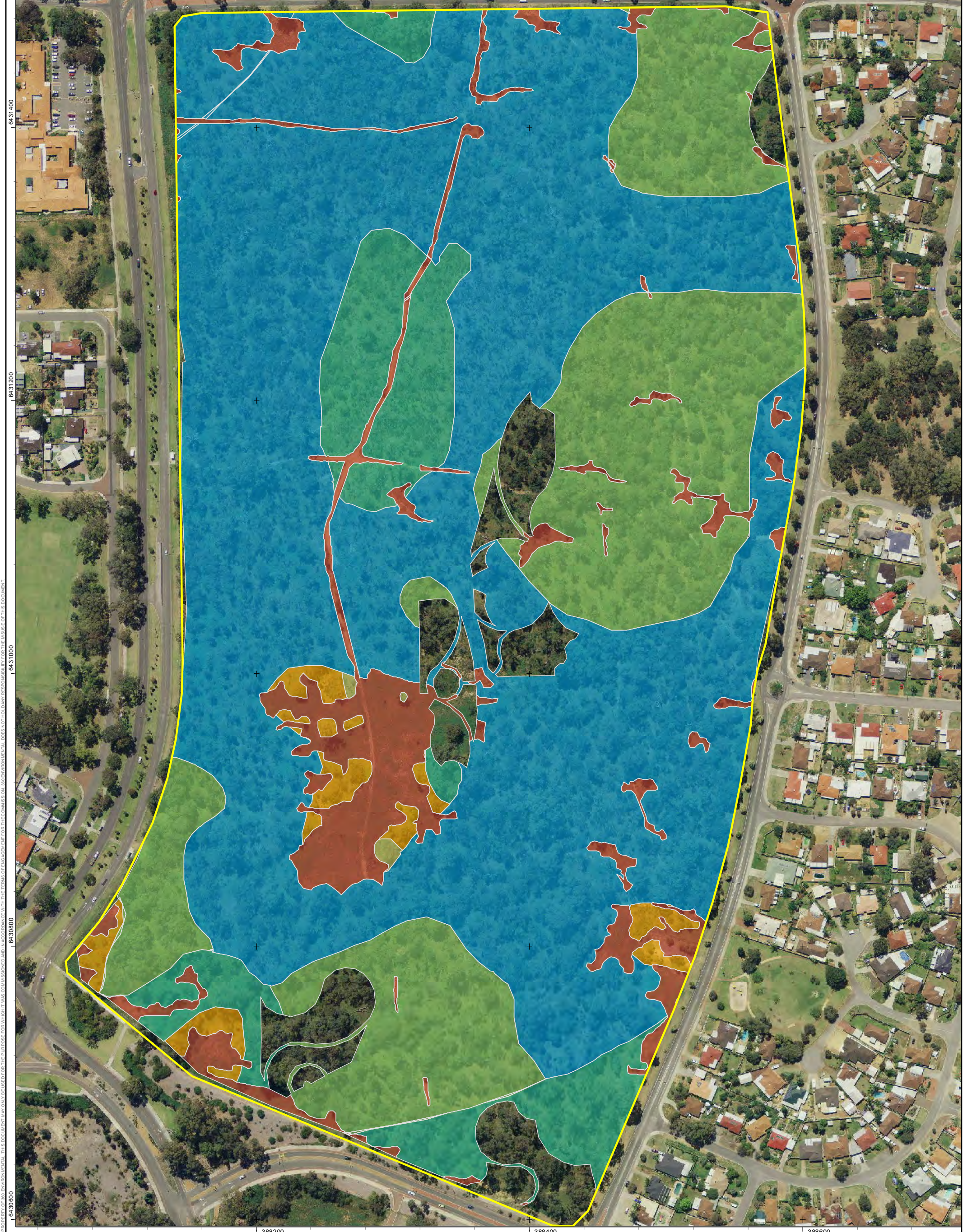
people planet professional

Department of Housing
Satterley Property Group

Kwinana Housing Development
Offset Strategy
Parmelia

Figure 3 - Inferred Vegetation Types

COPYRIGHT © 2013, THIS DOCUMENT IS AND SHALL REMAIN THE PROPERTY OF 360 ENVIRONMENTAL. THIS DOCUMENT MAY ONLY BE USED FOR THE PURPOSE FOR WHICH IT WAS COMMISSIONED AND IN ACCORDANCE WITH THE TERMS OF ENGAGEMENT FOR THE COMMISSION. 360 ENVIRONMENTAL DOES NOT HOLD ANY RESPONSIBILITY FOR THE MISUSE OF THIS DOCUMENT.



COPYRIGHT © 2013, THIS DOCUMENT IS AND SHALL REMAIN THE PROPERTY OF 360 ENVIRONMENTAL. THIS DOCUMENT MAY ONLY BE USED FOR THE PURPOSE FOR WHICH IT WAS COMMISSIONED AND IN ACCORDANCE WITH THE TERMS OF ENGAGEMENT FOR THE COMMISSION. 360 ENVIRONMENTAL DOES NOT HOLD ANY RESPONSIBILITY FOR THE MISUSE OF THIS DOCUMENT.



LEGEND
Vegetation Mapping

■	Tuart Mixed Woodland (CBC/FRITBC)
■	Banksia Woodlands and Scrublands (CBC)
■	Jarrah Banksia Woodland (CBC/FRITBC)
■	Limestone Shrubland (CBC)
■	Marri Woodland (CBC/FRITBC)
■	Tuart Woodland (CBC)
■	Completely Degraded Vegetation
■	Exotic Grasslands and Clearings

Note: Areas that are mapped as being 'Exotic Grasslands and Clearings' were mapped using Aerial Imagery.

Data was mapped at a 1:1000 scale using aerial imagery from January 2013 (Summer) which was checked against imagery from September 2013 (Winter). This was done to consider seasonal variations and sun/shadow positions.

DATA SOURCES
LOCALITY MAP: TRAVELLERS ATLAS 2006
AERIAL IMAGERY: LANDGATE JANUARY 2013
(© Western Australian Land Information Authority 2013)

SLIP ENABLER

360 environmental a 10 Bermondsey St, West Leederville, 6007 WA
t (08) 9388 8360 f (08) 9381 2360
w www.360environmental.com.au

Government of Western Australia
Department of Housing

Satterley

SIZE A3	SCALE 1:2,500	REVISION A	STATUS DRAFT	DRAWN JJ	DATE 21-Mar-2014
HORIZONTAL DATUM GDA MGA ZONE 50	VERTICAL DATUM -	CHECKED RM	APPROVED RH		

NOTE THAT POSITIONAL ERRORS MAY BE >5M IN SOME AREAS

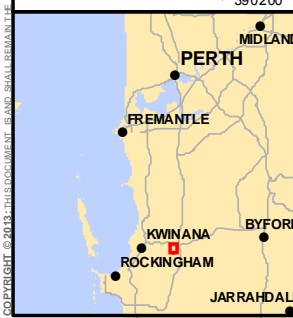
PROJECT NUMBER: 27
DRAWING NO.:

people planet professional

Department of Housing
Satterley Property Group

Kwinana Housing Development
Offset Strategy
Kwinana Town Center

Figure 4 - Inferred Vegetation Types



LEGEND
Cockatoo Foraging Habitat (TS)
■ CBC only (10.84 ha)
■ CBC and FRTBC (1.53 ha)
■ None

Note: Areas that are mapped as being Exotic Grasslands and Clearings were mapped using Aerial Imagery.

Data was mapped at a 1:1000 scale using aerial imagery from January 2013 (Summer) which was checked against imagery from September 2013 (Winter). This was done to consider seasonal variations and sun/shadow positions.

DATA SOURCES
 LOCALITY MAP: TRAVELLERS ATLAS 2006
 AERIAL IMAGERY: LANDGATE JANUARY 2013
 © Western Australian Land Information Authority 2013

360 environmental
 a 10 Bermondsey St, West Leederville, 6007 WA
 t (08) 9388 8360 f (08) 9381 2360
 www.360environmental.com.au

Government of Western Australia
 Department of Housing

Satterley

SIZE A3	SCALE 1:4,000	REVISION A	STATUS DRAFT	DRAWN JJ	DATE 21-Mar-2014
HORIZONTAL DATUM GDA MGA ZONE 50	VERTICAL DATUM -	CHECKED RM	APPROVED RH		

0 20 40 80 120 160
Meters

PROJECT NUMBER: 27
 DRAWING NO.:

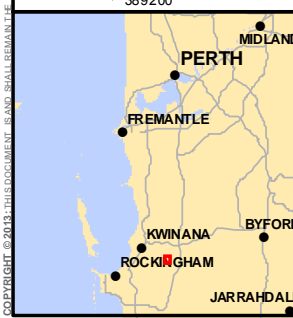
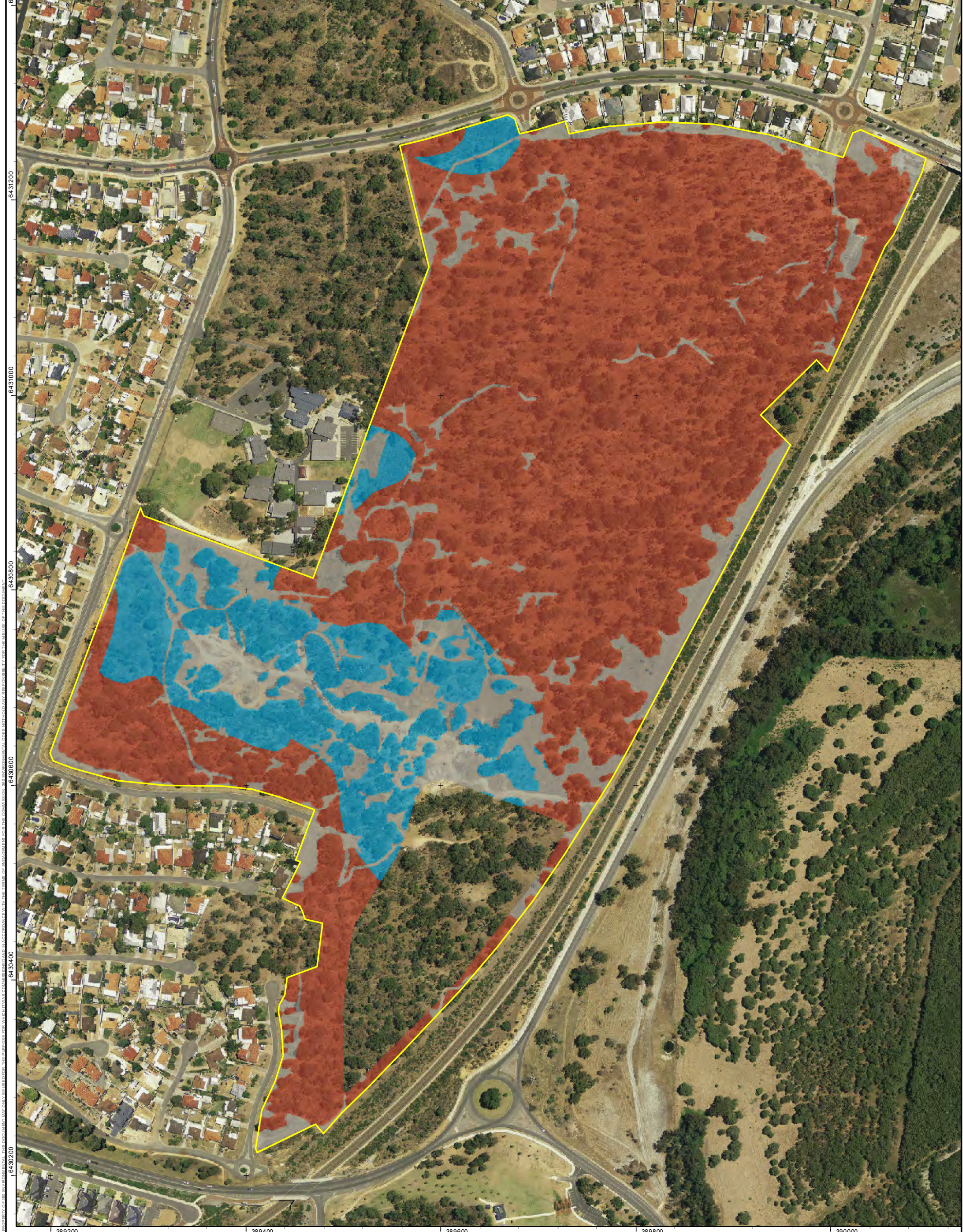
people planet professional

Department of Housing
Satterley Property Group

Kwinana Housing Development
Offset Strategy
 PHUjb'GHUjcb'DfYWjbWb

Figure) - Cockatoo Habitats

COPYRIGHT © 2013, THIS DOCUMENT, IS AND SHALL REMAIN THE PROPERTY OF 360 ENVIRONMENTAL. THE RELEASE OF THIS DOCUMENT, IN ACCORDANCE WITH THE TERMS OF ENGAGEMENT, DOES NOT CONSTITUTE AN ENVIRONMENTAL ASSESSMENT. 360 ENVIRONMENTAL DOES NOT ASSUME ANY RESPONSIBILITY FOR THE REUSE OF THIS DOCUMENT.



LEGEND
Cockatoo Foraging Habitat (P)

- CBC only (5.42 ha)
- CBC and FRTBC (25.76 ha)
- None

Note: Areas that are mapped as being Exotic Grasslands and Clearings were mapped using Aerial Imagery.

Data was mapped at a 1:1000 scale using aerial imagery from January 2013 (Summer) which was checked against imagery from September 2013 (Winter). This was done to consider seasonal variations and sun/shadow positions.

NOTE THAT POSITIONAL ERRORS MAY BE -5M IN SOME AREAS

DATA SOURCES
 LOCALITY MAP: TRAVELLERS ATLAS 2006
 AERIAL IMAGERY: LANDGATE JANUARY 2013
 © Western Australian Land Information Authority 2013

SLIP ENABLER

360 environmental
 a 10 Bermondsey St, West Leederville, 6007 WA
 t (08) 9388 8360 f (08) 9381 2360
 www.360environmental.com.au

Government of Western Australia
 Department of Housing

Satterley

SIZE A3	SCALE 1:3,500	REVISION A	STATUS DRAFT	DRAWN JJ	DATE 21-Mar-2014
HORIZONTAL DATUM GDA MGA ZONE 50	VERTICAL DATUM -	CHECKED RM	APPROVED RH		

0 20 40 80 120 160
Meters

PROJECT NUMBER
27

DRAWING NO.

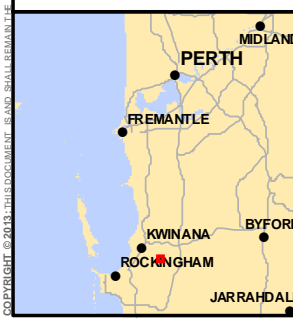
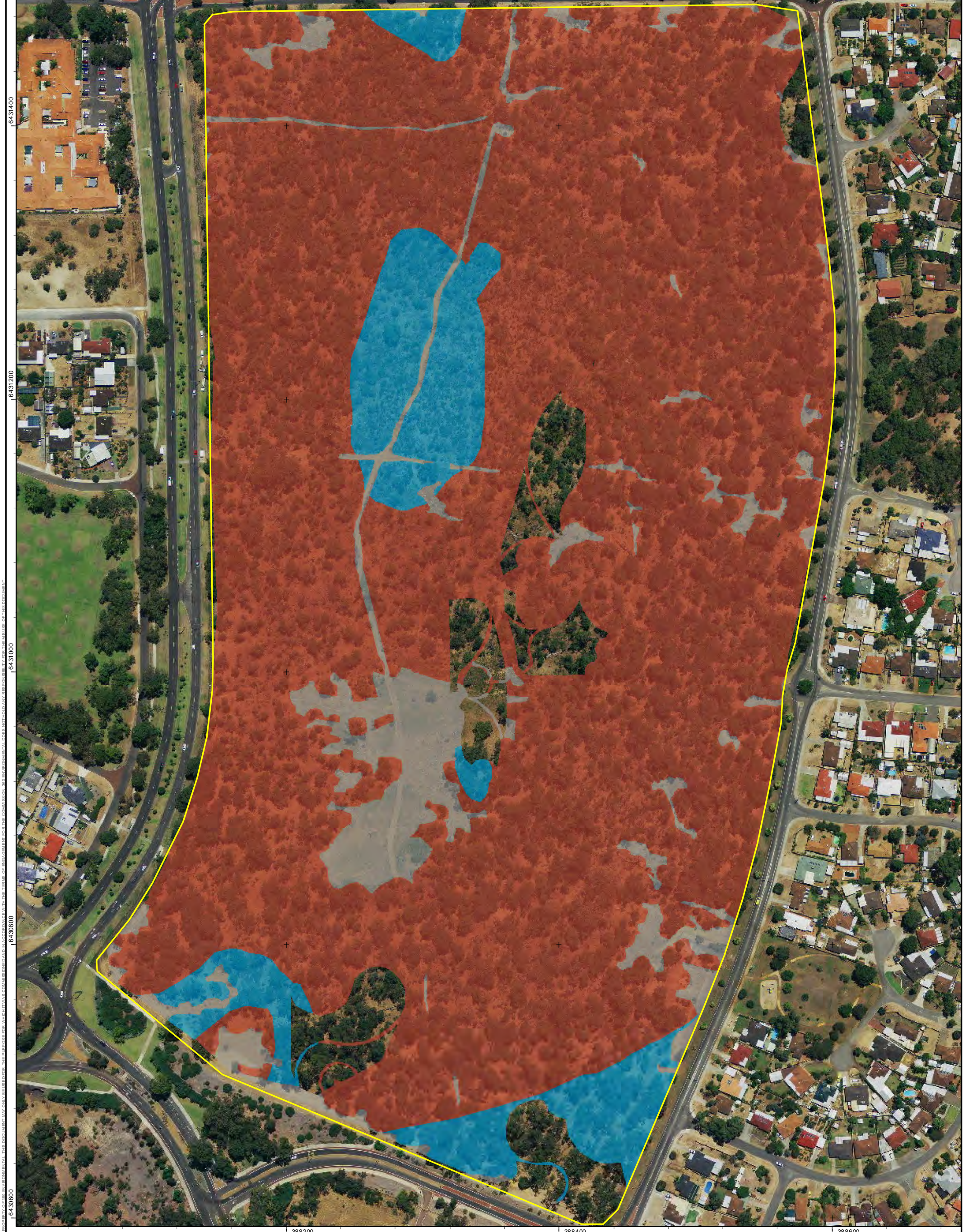
people planet professional

Department of Housing
 Satterley Property Group

Kwinana Housing Development
 Offset Strategy
 Parmelia

Figure * - Cockatoo Habitats

COPYRIGHT © 2013, THIS DOCUMENT IS AN ENVIRONMENTAL DESIGN AND SHALL REMAIN THE PROPERTY OF 360 ENVIRONMENTAL. THIS DOCUMENT MAY ONLY BE REPRODUCED, EITHER WHOLLY OR PARTIALLY, WITHOUT THE WRITTEN PERMISSION OF 360 ENVIRONMENTAL. 360 ENVIRONMENTAL DOES NOT ACCEPT ANY RESPONSIBILITY FOR THE REUSE OF THIS DOCUMENT.



LEGEND
Cockatoo Foraging Habitat (KTC)

- CBC only (3.06 ha)
- CBC and FRTBC (28.09 ha)
- None

environmental

Note: Areas that are mapped as being Exotic Grasslands and Clearings were mapped using Aerial Imagery.

Data was mapped at a 1:1000 scale using aerial imagery from January 2013 (Summer) which was checked against imagery from September 2013 (Winter). This was done to consider seasonal variations and sun/shadow positions.

NOTE THAT POSITIONAL ERRORS MAY BE -5M IN SOME AREAS

DATA SOURCES
 LOCALITY MAP: TRAVELLERS ATLAS 2006
 AERIAL IMAGERY: LANDGATE JANUARY 2013
 © Western Australian Land Information Authority 2013

SLIP ENABLER

360 environmental
 a 10 Bermondsey St, West Leederville, 6007 WA
 t (08) 9388 8360 f (08) 9381 2360
 www.360environmental.com.au

Government of Western Australia
 Department of Housing

Satterley

SIZE A3	SCALE 1:2,500	REVISION A	STATUS DRAFT	DRAWN JJ	DATE 21-Mar-2014
HORIZONTAL DATUM GDA MGA ZONE 50	VERTICAL DATUM -	CHECKED RM	APPROVED RH		

0 20 40 80 120
Meters

PROJECT NUMBER
27

DRAWING NO.

people planet professional

Department of Housing
Satterley Property Group

Kwinana Housing Development
Offset Strategy
Kwinana Town Center

Figure 7 - Inferred Vegetation Types

COPYRIGHT © 2013, THIS DOCUMENT, IS AND SHALL REMAIN THE PROPERTY OF 360 ENVIRONMENTAL. THE RELEASE OF THIS DOCUMENT, IS AND SHALL REMAIN THE RESPONSIBILITY FOR THE USER OF THIS DOCUMENT.

APPENDIX A

EBPC Protected Matters Search Tool Report



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 about the EPBC Act including significance guidelines, forms and application process details can be found at <http://www.environment.gov.au/epbc/assessmentsapprovals/index.html>

LGA KWINANA, WA

Report created: 24/09/12 17:35:02

[Summary](#)

[Details](#)

[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

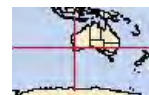
[Extra Information](#)

[Caveat](#)

[Acknowledgements](#)



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



Summary

Matters of National Environment 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 - see <http://www.environment.gov.au/epbc/assessmentsapprovals/guidelines/index.html>

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International	3
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Threatened Ecological Communities:	None
Threatened Species:	33
Migratory Species:	27

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. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage/index.html>

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. Information on EPBC Act permit requirements and application forms can be found at <http://www.environment.gov>.

Commonwealth Lands:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	43
Whales and Other Cetaceans:	13
Critical Habitats:	None
Commonwealth Reserves:	None

Extra Information

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

Place on the RNE:	8
State and Territory Reserves:	5
Regional Forest Agreements:	None
Invasive Species:	16
Nationally Important Wetlands:	2

Details

Matters of National Environmental Significance

Wetlands of International Significance (RAMSAR)		[Resource Information]
Name		Proximity
Becher point wetlands		Upstream from Ramsar
Forrestdale & thomsons lakes		Within 10km of Ramsar
Peel-yalgorup system		Upstream from Ramsar
Threatened Species		[Resource Information]
Name	Status	Type of Presence
BIRDS		

Name	Status	Type of Presence
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo [67034]	Vulnerable	Species or species habitat may occur within area
Calyptorhynchus latirostris Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat likely to occur within area
Diomedea exulans gibsoni Gibson's Albatross [82271]	Vulnerable	Species or species habitat may occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Vulnerable	Species or species habitat may occur within area
Sternula nereis nereis Fairy Tern (Australian) [82950]	Vulnerable	Species or species habitat known to occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Species or species habitat may occur within area
INSECTS		
Synemon gratiosa Graceful Sun Moth [66757]	Endangered	Species or species habitat may occur within area
MAMMALS		
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Neophoca cinerea Australian Sea-lion [22]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Phascogale calura Red-tailed Phascogale [316]	Endangered	Species or species habitat may occur within area
Setonix brachyurus Quokka [229]	Vulnerable	Species or species habitat may occur within area
PLANTS		

Name	Status	Type of Presence
Andersonia gracilis Slender Andersonia [14470]	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
Darwinia foetida Muccha Bell [83190]	Critically Endangered	Species or species habitat likely to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area
Drakaea elastica Glossy-leaved Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat likely to occur within area
Eucalyptus balanites Cadda Road Mallee, Cadda Mallee [24264]	Endangered	Species or species habitat may occur within area
Isopogon uncinatus Hook-leaf Isopogon [20871]	Endangered	Species or species habitat may occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area

REPTILES

Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area

SHARKS

Carcharias taurus (west coast population) Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat may occur within area
Carcharodon carcharias Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area

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 may occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within

Name	Threatened	Type of Presence area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Species or species habitat may occur within area
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Sterna caspia Caspian Tern [59467]		Foraging, feeding or related behaviour known to occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Species or species habitat may occur within area
Migratory Marine Species		
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Carcharodon carcharias Great White Shark [64470]	Vulnerable	Species or species habitat may occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Migratory Terrestrial Species		
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur 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 may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Vulnerable*	Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Commonwealth Lands [\[Resource Information \]](#)

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 may occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat may occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Diomedea gibsoni Gibson's Albatross [64466]	Vulnerable*	Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Larus pacificus Pacific Gull [811]		Foraging, feeding or related behaviour may occur within area

Name	Threatened	Type of Presence
Macronectes giganteus Southern Giant-Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant-Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Puffinus assimilis Little Shearwater [59363]		Foraging, feeding or related behaviour known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Vulnerable*	Species or species habitat may occur within area
Sterna caspia Caspian Tern [59467]		Foraging, feeding or related behaviour known to occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Species or species habitat may occur within area
Fish		
Acentronura australe Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Hippocampus subelongatus West Australian Seahorse [66722]		Species or species habitat may occur within area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish [66249]		Species or species habitat may occur within area
Lissocampus fatiloquus Prophet's Pipefish [66250]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Mitotichthys meraculus Western Crested Pipefish [66259]		Species or species habitat may occur within area
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri New Zealand Fur-seal [20]		Species or species habitat may occur within area
Neophoca cinerea Australian Sea-lion [22]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Species or species habitat likely to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Species or species habitat likely to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Whales and other Cetaceans		[Resource Information]
Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat may occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Delphinus delphis Common Dolphin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur within area
Tursiops truncatus s. str. Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

Places on the RNE		[Resource Information]
Note that not all Indigenous sites may be listed.		
Name	State	Status
Natural		
Bollard Bulrush Swamp	WA	Indicative Place
Leda Area	WA	Indicative Place

Name	State	Status
Beeliar Regional Park and Adjacent Areas	WA	Interim List
Banksia Road Nature Reserve	WA	Registered
Wandi Nature Reserve	WA	Registered
Historic		
Greenkeepers Cottage	WA	Indicative Place
Woodlands Cottage and Reserve 25132	WA	Indicative Place
Smirks Cottage	WA	Registered

State and Territory Reserves [\[Resource Information \]](#)

Name	State
Banksia	WA
Leda	WA
Unnamed WA39584	WA
Unnamed WA39752	WA
Wandi	WA

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 Resources Audit,

Name	Status	Type of Presence
Mammals		
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area

Plants

Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat may occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area

Name	Status	Type of Presence
Pinus radiata		
Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate		
Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii		
Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta		
Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla		
Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Nationally Important Wetlands		[Resource Information]
Name		State
Gibbs Road Swamp System		WA
Spectacles Swamp		WA

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

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

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](#)
- 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.](#)

APPENDIX B

CBC - DoE Offsets Calculator Results for Kwinana

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	CBC
EPBC Act status	Endangered
Annual probability of extinction 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
<i>Ecological communities</i>					
Area of community	No		Area		
			Quality		
			Total quantum of impact	0.00	
<i>Threatened species habitat</i>					
Area of habitat	Yes		Area	74.7	Hectares
			Quality	6	Scale 0-10
			Total quantum of impact	44.82	Adjusted hectares
Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact	Units	Information source
Number of features e.g. Nest hollows, habitat trees	No				
Condition of habitat Change in habitat condition, but no change in extent	No				
<i>Threatened species</i>					
Birth rate e.g. Change in nest success	No				
Mortality rate e.g. Change in number of road kills per year	No				
Number of individuals 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						
<i>Ecological Communities</i>																						
Area of community	No				Risk-related time horizon (max. 20 years)	Start area (hectares)	Risk of loss (%) without offset Future area without offset (adjusted hectares)	0.0	Risk of loss (%) with offset 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)														
					→																	
<i>Threatened species habitat</i>																						
Area of habitat	Yes	44.82	Adjusted hectares	22	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	22	Risk of loss (%) without offset Future area without offset (adjusted hectares)	15% 18.7	Risk of loss (%) with offset Future area with offset (adjusted hectares)	2% 21.6	2.86	90%	2.57	2.03	4.58	10.22%	No	\$188,000.00		
					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)	8	2.00	80%	1.60	1.58						
					→																	
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 e.g. Nest hollows, habitat trees	No																					
Condition of habitat Change in habitat condition, but no change in extent	No																					
<i>Threatened species</i>																						
Birth rate e.g. Change in nest success	No																					
Mortality rate e.g. Change in number of road kills per year	No																					
Number of individuals 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	44.82	4.58	10.22%	No	\$188,000.00	\$176,154,820.68	\$176,342,820.68
Area of community	0				\$0.00		\$0.00
					\$188,000.00	\$176,154,820.68	\$176,342,820.68

APPENDIX C

FRTBC - DoE Offsets Calculator Results for Kwinana

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	FRTBC
EPBC Act status	Vulnerable
Annual probability of extinction Based on IUCN category definitions	0.2%

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
<i>Ecological communities</i>					
Area of community	No		Area		
			Quality		
			Total quantum of impact	0.00	
<i>Threatened species habitat</i>					
Area of habitat	Yes		Area	55.4	Hectares
			Quality	6	Scale 0-10
			Total quantum of impact	33.24	Adjusted hectares
Protected matter attributes	Attribute relevant to case?	Description	Quantum of impact	Units	Information source
Number of features e.g. Nest hollows, habitat trees	No				
Condition of habitat Change in habitat condition, but no change in extent	No				
<i>Threatened species</i>					
Birth rate e.g. Change in nest success	No				
Mortality rate e.g. Change in number of road kills per year	No				
Number of individuals 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												
<i>Ecological Communities</i>																												
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)																				
<i>Threatened species habitat</i>																												
Area of habitat	Yes	33.24	Adjusted hectares	22	Time over which loss is averted (max. 20 years)	20	Start area (hectares)	22	Risk of loss (%) without offset	15%	Risk of loss (%) with offset	2%	Raw gain	2.86	Confidence in result (%)	90%	Adjusted gain	2.57	Net present value	2.47	% of impact offset	4.72	Minimum (90%) direct offset requirement met?	No	Cost (\$ total)		Information source	
					Future area without offset (adjusted hectares)	18.7	Future area with offset (adjusted hectares)	21.6																				
					Time until ecological benefit	1	Start quality (scale of 0-10)	6	Future quality without offset (scale of 0-10)	5	Future quality with offset (scale of 0-10)	7	Raw gain	2.00	Confidence in result (%)	80%	Adjusted gain	1.60	Net present value	1.60								
<i>Threatened species</i>																												
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 e.g. Nest hollows, habitat trees	No																											
Condition of habitat Change in habitat condition, but no change in extent	No																											
Birth rate e.g. Change in nest success	No																											
Mortality rate e.g. Change in number of road kills per year	No																											
Number of individuals 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	33.24	4.72	14.19%	No	\$0.00	#DIV/0!	#DIV/0!
Area of community	0				\$0.00		\$0.00
					\$0.00	#DIV/0!	#DIV/0!

ATTACHMENT 20



Approval

Kwinana Residential Housing and Mixed-use Development, Kwinana, WA (EPBC 2013/6916)

This decision is made under sections 130(1) and 133 of the *Environment Protection and Biodiversity Conservation Act 1999*.

Proposed action

person to whom the approval is granted Housing Authority

proponent's ACN (if applicable) ABN: 56 167 671 885

proposed action To develop three sites into residential housing and mixed use developments at Kwinana, Western Australia [See EPBC Act referral 2013/6916].

Approval decision

Controlling Provision	Decision
Listed threatened species and communities (sections 18 & 18A)	Approved

conditions of approval

This approval is subject to the conditions specified below.

expiry date of approval

This approval has effect until 31 July 2024.

Decision-maker

name and position Dr Simon Banks
Assistant Secretary
West Assessment Branch

signature

date of decision 29 August 2014

Conditions attached to the approval

1. The **approval holder** must not **clear** more than 75 hectares of **Black Cockatoo habitat** from the **project area**.
2. To avoid and mitigate impacts to the **Black Cockatoos** during the breeding season (July – November), within 7 days prior to **clearing**, the **approval holder** must investigate **potential breeding trees** within the **project area** to detect the presence of **Black Cockatoos** using hollows. The investigation must be undertaken by a **suitably qualified and experienced person**.

If a **Black Cockatoo** is detected using a hollow in a tree or trees, the **approval holder** must:

- clearly identify the tree or trees with fencing and signage;
- not **clear** the tree or trees; and
- undertake measures to avoid the tree or trees from being cut down, felled, removed, killed, destroyed, poisoned, ring-barked, uprooted or burned

until the hollow/s are no longer being used by the **Black Cockatoos** as determined by a **suitably qualified and experienced person**.

3. To offset the loss of **Black Cockatoo habitat**, the **approval holder** must within six (6) months from the date of this approval, provide the **Department** with written evidence that the **offset property** has been transferred to the **West Australian Planning Commission** to be reserved for conservation in perpetuity.

The written evidence must include a textual description and map clearly defining the location and boundaries of the **offset property** and be accompanied with the **offset attributes and shapefile**.

4. Within six (6) months from the date of this approval, the **approval holder** must prepare and submit a Revegetation Management Plan to the **Minister** for approval to **rehabilitate** two (2) hectares within the **offset property** to increase **Black Cockatoo habitat**. The **approval holder** must not commence **rehabilitation** of the **offset property** unless the Minister has approved the Revegetation Management Plan. The approved Revegetation Management Plan must be implemented. The Revegetation Management Plan must include:

- a. Objectives;
- b. The location of revegetation areas;
- a. Planting methodology, including soil preparation;
- b. Species to be planted;
- c. Ongoing weed and feral animal control;
- d. Bush fire management;
- e. A monitoring program (including how survival rates and success criteria will be determined);
- f. Contingency measures; and
- g. Roles and responsibilities, including timeframes for implementation and reporting.

5. To compensate for residual impacts to **Black Cockatoos** the **approval holder** must provide a financial contribution of \$532,000 over a four-year timeframe for research that will

contribute to the better protection and long term conservation of **Black Cockatoos**. The research must include, but is not limited to:

- a. provision of \$272,000 in funding to **Murdoch University** for a **Black Cockatoo Satellite Tracking Project** that will track wild flocks of **Black Cockatoos** using satellite and GPS to:
 - i. map of flock movements;
 - ii. estimate current population numbers;
 - iii. map critical breeding sites;
 - iv. map critical feeding habitat;
 - v. map preferred roosting habitat;
 - vi. identify important groups of **Forest Red-tailed Black Cockatoos**; and
 - vii. monitor rehabilitated **Black Cockatoos** released back into the wild.
- b. provision of \$260,000 in funding to the **Western Australian Museum** for a **Black Cockatoo Research Project** that will:
 - i. undertake targeted surveys for breeding, feeding and roosting sites to map critical breeding, feeding and roosting habitat;
 - ii. develop artificial nest hollows and protocols for their use and installation;
 - iii. conduct studies on current population numbers and distribution of **Black Cockatoos**, including identifying isolated populations;
 - iv. determine patterns of migration, movements and changes in foraging ecology;
 - v. develop and implement ways to remove feral species, including European honeybees, from nesting hollows;
 - vi. regularly monitor important **Black Cockatoo** sites; and
 - vii. update information on the breeding biology, ecology and conservation of **Black Cockatoos**.

Within three (3) months of the date of this approval decision, the **approval holder** must enter into agreements with **Murdoch University** and the **Western Australian Museum** to provide the financial contribution. The agreements must include clear timeframes in which financial contributions will be paid. A copy of the agreements must be provided to the **Minister** within 10 business days of the agreements being finalised. The **approval holder** must implement the agreements.

The **approval holder** must provide the results of the research projects to the **Department**, and make them publically available, within 12 months of completion of the research. During the implementation timeframe for the research projects, research results and progress must be reported to the **Department** annually.

6. Within 30 days after the **commencement** of the action, the **approval holder** must advise the **Department** in writing of the actual date of commencement.
7. The **approval holder** must maintain accurate records substantiating all activities associated with or relevant to the conditions of approval, and make them available upon request to the **Department**. Such records may be subject to audit by the **Department** or an independent auditor in accordance with section 458 of the **EPBC Act**, or used to verify compliance with

the conditions of approval. Summaries of audits will be posted on the **Department's** website. The results of audits may also be publicised through the general media.

8. Within three months of every 12 month anniversary of the **commencement** of the action, the **approval holder** must publish a report on their website addressing compliance with each of the conditions of this approval over the previous 12 months, including implementation of the Revegetation Management Plan as specified in the conditions. Documentary evidence providing proof of the date of publication must be provided to the **Department** at the same time as the compliance report is published. The compliance reports must remain on the website for 12 months from the date of publishing. Potential or actual contraventions of the conditions of the approval must be reported to the **Department** in writing within 2 business days of the **approval holder** becoming aware of the actual or potential contravention. All contraventions must also be included in the compliance reports.
9. If the **approval holder** wishes to carry out any activity otherwise than in accordance with the Revegetation Management Plan as specified in the conditions, the **approval holder** must submit to the **Department** for the **Minister's** written approval a revised version of that Revegetation Management Plan. The varied activity shall not commence until the **Minister** has approved the varied Revegetation Management Plan in writing. The **Minister** will not approve a varied Revegetation Management Plan unless the revised Revegetation Management Plan would result in an equivalent or improved environmental outcome over time. If the **Minister** approves the revised Revegetation Management Plan, that Revegetation Management Plan must be implemented in place of the Revegetation Management Plan originally approved.
10. If the **Minister** believes that it is necessary or convenient for the better protection of listed threatened species and communities to do so, the Minister may request that the **approval holder** make specified revisions to the Revegetation Management Plan specified in the conditions and submit the revised Revegetation Management Plan for the **Minister's** written approval. The **approval holder** must comply with any such request. The revised approved Revegetation Management Plan must be implemented. Unless the **Minister** has approved the revised Revegetation Management Plan, then the **approval holder** must continue to implement the Revegetation Management Plan originally approved, as specified in the conditions.
11. Unless otherwise agreed to in writing by the **Minister**, the **approval holder** must publish the Revegetation Management Plan referred to in these conditions of approval on their website. The Revegetation Management Plan must be published on the website within one (1) month of being approved and must remain on the website for the period this approval has effect.

Definitions

approval holder - the person to whom the approval is granted, or to whom the approval is transferred under s145B of the **EPBC Act**.

Black Cockatoo/s - the black cockatoo species Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) and Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*).

Black Cockatoo habitat - any foraging and potential breeding habitat for **Black Cockatoos**, including vegetation containing Jarrah (*Eucalyptus marginata*), Marri (*Corymbia calophylla*), Tuart (*E. gomphocephala*), *Banksia menziesii*, *B. attenuata*, *B. grandis*, *B. sessilis* and *Allocasuarina fraseriana*, as defined in the *EPBC Act Referral Guidelines for three threatened black cockatoo species: Carnaby's cockatoo, Baudin's cockatoo and Forest red-tailed black cockatoo*.

clear or clearing - the cutting down, felling, thinning, logging, removing, killing, destroying, poisoning, ring-barking, uprooting or burning of native vegetation.

commence, commenced or commencement - any preparatory works required to be undertaken including **clearing**, the erection of any fences, signage or on-site temporary structures and the use of construction or excavation equipment on-site for the purpose of breaking the ground for buildings, infrastructure or resource extraction.

Department - the Australian Government Department administering the **EPBC Act**.

EPBC Act - the *Environment Protection and Biodiversity Conservation Act 1999*

Forest Red-tailed Black-Cockatoo - the black cockatoo species *Calyptorhynchus banksii naso*.

Minister - the Minister administering the **EPBC Act** and includes a delegate of the Minister.

Murdoch University – the university established under the *Murdoch University Act 1973*.

offset attributes - an excel file (.xls) capturing relevant attributes of the **offset properties**, including the **EPBC Act** reference ID number, the physical address of the offset site, coordinates of the boundary points in decimal degrees, the **EPBC Act** protected matters that the offset compensates for, any additional **EPBC Act** protected matters that are benefiting from the offset, and the size of the offset in hectares.

offset property - an area approximately 22 hectares in size, located at Lot 9241 Parmelia, Western Australia (identified as Lot 9241 – Parmelia Offset Area (Bush Forever 272) (21.9 ha) at Attachment A).

potential breeding trees includes mature *Eucalyptus gomphocephala* (Tuart), *E. marginata* (Jarrah) and *Corymbia calophylla* (Marri) trees with a hollow at least 20 cm in diameter and therefore large enough for a **Black Cockatoo** to nest in.

project area - the three sub-sites at Kwinana, Western Australia, identified as Kwinana Town Centre (36.3 ha), Parmelia (41.1 ha) and Train Station Precinct (15.1 ha) at Attachment A.

Rehabilitate/rehabilitation – reestablishment of vegetation through methods such as ground preparation, topsoil movement, weed control, direct seeding and/or seedling planting.

shapefile - an ESRI shapefile containing '.shp', '.shx' and '.dbf' files and other files capturing attributes of the offset area, including the shape, **EPBC Act** reference ID number and **EPBC Act** protected matters present at the relevant site. Attributes should also be captured in '.xls' format.

suitably qualified and experienced person - a person with relevant tertiary qualifications with experience surveying for **Black Cockatoos**.

Western Australian Museum – is the statutory authority established under the *Western Australian Museum Act 1969*.

Western Australian Planning Commission - the Western Australian statutory authority responsible for acquiring land for public requirement reservations in region planning schemes under the *Western Australian Planning and Development Act 2005*.

