360 environmental

Lot 29 Barfield Road,
Hammond Park

Flora and Fauna Survey

Prepared for:
Symbolise Pty Ltd

December 2016

people • planet • professional

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Executive Summary

360 Environmental Pty Ltd (360 Environmental) was commissioned by Symbolise Pty Ltd in September 2016 to undertake a Level 2 flora and vegetation survey, a fauna survey and a Black Cockatoo habitat assessment in support of the preparation of a Local Structure Plan for Lot 29 Barfield Road, Hammond Park (Survey Area).

The flora field survey undertaken on the 27th of September 2016 recorded a total of 65 taxa (including species, subspecies, varieties and forms) from 58 genera and 30 families in the Survey Area, of these 10 were introduced species. One species, **Asparagus asparagoides*, is listed as Declared under the *Biosecurity and Agriculture Management Act 2007 (*BAM Act) and is also listed as a Weeds of National Significance (WONS).

The database searches identified 18 conservation significant flora species as potentially occurring in the vicinity of the Survey Area. Of these, seven are classed as Threatened, six as Priority 3 and five as Priority 4. No Threatened species pursuant to the *Environment Protection and Biodiversity Act* 1999 (EPBC Act) and/or gazetted as Declared Rare Flora (DRF) pursuant to the *Wildlife Conservation Act* 1950 (WC Act) were recorded during the survey. No Priority species were recorded during the survey.

Vegetation condition ranged from Very Good to Completely Degraded with the majority of the Survey Area considered to be in Good to Very Good (2.346 ha) condition. 1.7 ha of the Survey Area has been previously cleared and there has been stockpiling of soil north of the driveway. The land-use of the property has resulted in clearing (house area) which has been a source of weed infestations in the centre of the Survey Area. The weed species have spread into the native vegetation. Firebreaks and proximity to the road has also contributed to the introduction and spread of weeds.

The eastern side of the Survey Area is the location of a High Voltage Powerline and therefore the vegetation under the powerline is accessed for continual maintenance involving control burns, pruning and fuel reduction. This has altered the density; height and structure of the Banksia woodland.

The statistical analysis resulted in the vegetation association “BiEt”, being the most similar to Floristic Community Type (FCT) SCP21c, and “BmXp” with FCT SCP23a, both of these are listed as sub-communities of ‘Banksia woodlands of the Swan Coastal Plain’. As of September 2016, ‘Banksia woodlands of the Swan Coastal Plain’ are listed as Endangered under the EPBC Act. For vegetation remnants to be under national protection the community must meet certain diagnostic characteristics.

Based on this information, and the survey results, there is approximately 0.188 ha of FCT SCP23a rated as Very Good condition and 1.276 ha in Good condition. FCT SCP21c has approximately 0.150 ha rated as Very Good condition and 0.413 ha in Good condition. It is, therefore considered, that the vegetation remnants are both too small and disturbed to be suitable for National protection under the federally listed ‘Banksia woodlands of the Swan Coastal Plain’.

SCP23a and FCT SCP22 are listed by DPaW as Priority 3 communities.

The Survey Area is not identified as an Environmentally Sensitive area (ESA).

The DPaW Geomorphic Wetlands Dataset did not identify any Conservation Category Wetlands (CCW), Resource Enhancement Wetlands, (REW) or Multiple Use Wetlands (MUW) within the Survey Area.

A total of nine conservation significant fauna species (including Priority species) from the database searches are potentially considered to either be likely, possibly or unlikely to occur in the Survey Area. These nine species comprise of two reptile, five bird and two mammal species.

The fauna field assessment was undertaken on 28th September 2016. During the field assessment 16 species from eight families were recorded. This consisted of 15 bird species from seven families and one mammal species. No species of conservation significance were recorded during the field assessment.

During the Black Cockatoo assessment, a total of 2.93 ha of Black Cockatoo foraging habitat was recorded in the Survey Area. This consisted of *Banksia attenuata, Banksia menziesii*, *Banksia ilicifolia, Allocasuarina fraseriana* and *Xanthorrhoea preissii*. These species provide important foraging habitat for all three species of Black Cockatoo. No Black Cockatoo foraging evidence was found in the Survey Area. There were no *Eucalyptus* trees in the Survey Area with a Diameter at Breast Height (DBH) of >500 mm, therefore there were no trees considered to be potential Black Cockatoo breeding habitat.

Five fauna habitat assessments were undertaken during the survey and one fauna habitat was identified in the Survey Area – Banksia Woodland.

In order to minimise the impact on native flora and fauna, the following recommendations are made:

- Avoid unnecessary clearing of vegetation beyond that strictly required; and
- Woody debris (this includes trees felled and logs) and leaf litter formed during clearing should be retained, as they create good microhabitat for a large array of fauna, particularly reptiles;

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1 Introduction

1.1 The Project

360 Environmental Pty Ltd (360 Environmental) was commissioned by Symbolise Pty Ltd in September 2016 to undertake a Level 2 flora and vegetation survey, Level 1 fauna survey and Black Cockatoo habitat assessment in support of the preparation of a Local Structure Plan for Lot 29 Barfield Road, Hammond Park (The Survey Area). The site is approximately 4.8 ha in size and is located within the City of Cockburn.

It is understood that the site is zoned 'Urban' in the Metropolitan Region Scheme (MRS) and 'Development' in the City of Cockburn's Town Planning Scheme No. 3. It is also noted that the site is within the Southern Suburbs District Structure Plan Stage 3 – Hammond Park/Wattleup.

1.1.1 Objectives

The objectives of the flora and vegetation assessment were to:

- Conduct a desktop assessment of relevant literature, databases and spatial datasets to determine the environmental values and any potential issues, such as Threatened/Rare and significant species, Threatened Ecological Communities (TECs) and Priority Ecological Communities (PECs), that may be present in the Survey Area and surrounds;
- Produce a list of plant species;
- Opportunistically document and map the location of any Declared Rare Flora (DRF), Priority flora and any other flora of local or taxonomic significance;
- Identify, map and discuss the significance of any suspected TECs, PECs and any other areas of ecological importance (e.g. National Parks, wetlands and Environmentally Sensitive Areas [ESAs] etc.);
- Assess, map and photograph vegetation condition; and
- Document, describe and map the vegetation associations present.

The objectives of the fauna assessment were to:

- Conduct a desktop assessment of fauna databases and any relevant literature;
- Document and describe the vertebrate fauna habitats present;
- Identify fauna of conservation significance that may potentially occur in the Survey Area; and
- Record opportunistic fauna sightings.

The objective of the Black Cockatoo Survey was to:

- Identify and determine the type and extent of habitat (breeding and foraging) suitable for Black Cockatoos in the Survey Area with reference to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) referral guidelines for three threatened Black Cockatoo species (DSEWPaC 2011).

Legend

- Survey Area (4.81 ha)
- Cadastre
- Roads

- NOTE THAT POSITION ERRORS CAN BE >5M IN SOME AREAS
- LOCALITY MAP SOURCED LANDGATE 2006
- GEOMORPHIC WETLANDS SOURCED DPAW 2015
- AERIAL PHOTOGRAPHY SOURCED LANDGATE OCT 2015 (© Western Australian Land Information Authority 2015)

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0 50 100 150 200
Meters
1:5,000 @A4

LOCALITY MAP

PROJECT ID	DATE
1826	10/11/2016

HORIZONTAL DATUM AND PROJECTION
GDA 1994 MGA Zone 50

CREATED	CHECKED	APPROVED	REVISION
MH	NW	RF	0

Symbolise Holdings Pty Ltd
Lot 29 Barfield Road, Hammond Park

Level 2 Flora Survey

Figure 1 -
Survey Area Location

K:\Projects\1.0 EBS\1826 Lot 29 Barfield Rd Flora,Fauna & Black Cockatoo Survey\Figures\1826 Figure 1 - Survey Area Location.mxd

1.2 Background to the Protection of Flora, Vegetation and Fauna

Western Australian (WA) flora and fauna is protected formally and informally by various legislative and non-legislative measures, which are as follows:

Legislative measures:

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act);
- *Wildlife Conservation Act 1950* (WC Act);
- *Environmental Protection Act 1986* (EP Act); and
- *Biosecurity and Agriculture Management Act 2007* (BAM Act).

Non-legislative measures:

- Western Australian Department of Parks and Wildlife (DPaW) Priority lists for flora, ecological communities and fauna;
- Weeds of National Significance (WONS); and
- Recognition of locally significant populations by the DPaW.

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

1.2.1 EPBC Act

The EPBC Act aims to protect Matters of National Environmental Significance (MNES). Under the EPBC Act, the Commonwealth Department of Environment and Energy (DOEE) lists threatened species and communities in categories determined by criteria set out in the Act (www.environment.gov.au/epbc/index.html) (Appendix A and B).

Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) is listed as Endangered under the EPBC Act. The Forest Red-tailed Black Cockatoo (FRTBC [*Calyptorhynchus banksii naso*]) and Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) are classified as Vulnerable.

Projects likely to cause a significant impact on MNES should be referred to the DOEE for assessment under the EPBC Act.

1.2.2 WC Act

The WA DPaW lists flora and fauna under the provisions of the WC Act as protected according to their need for protection (Appendices A and B).

Flora is given Declared Rare status when populations are geographically restricted or are threatened by local processes. In addition, under the WC Act, by Notice in the WA Government Gazette of 9 October 1987, all native flora (spermatophytes, pteridophytes,

bryophytes and thallophytes) is protected throughout the State. Fauna are classified as Schedule 1 to Schedule 7 according to their need for protection.

Under the WC Act both Carnaby's Black Cockatoo and Baudin's Black Cockatoo are listed as Endangered and the FRTBC is listed as Vulnerable.

1.2.3 EP Act

Threatened/Declared Rare Flora (T/DRF) and TECs are given special consideration in environmental impact assessments, and have special status as Environmentally Sensitive Areas (ESAs) under the EP Act and the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. Exemptions for a clearing permit do not apply in an ESA. In addition, habitat necessary for the maintenance of indigenous fauna is considered in the clearing principles and assessed during consideration of applications for a clearing permit.

1.2.4 BAM Act

Plants may be 'Declared' by the Agriculture Protection Board (APB) under the BAM Act 2007 (WA). Declared Plants are gazetted under three categories (C1, C2 and C3), which define the action required. Details of the definitions of these categories are provided in Appendix C. A declaration may apply to the whole State, to districts, individual properties or even to single paddocks. If a plant is 'Declared', landholders are obliged to control that plant on their properties (Department of Agriculture and Food Western Australia [DAFWA] 2014).

1.2.5 Weeds of National Significance

The Australian Government along with the State and Territory governments has endorsed 32 WONS. Four major criteria were used in determining WONS:

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

Each WONS has a national strategy and a national coordinator, responsible for implementing the strategy. WONS are regarded as the worst weeds in Australia because of their invasiveness, potential for spread, and economic and environmental impacts (Thorp and Lynch 2000).

1.2.6 DPAW Priority Lists

The DPaW lists 'Priority' flora and fauna that have not been assigned statutory protection as Declared Rare or 'Scheduled' under the WC Act, but which are under consideration for declaration as DRF or 'Scheduled' fauna. Flora and fauna assessed as Priority 1-3 are considered to be in urgent need of further survey. Priority 4 flora and

fauna require monitoring every 5-10 years and Priority 5 flora and fauna are subject to a specific conservation programme (Appendix A).

The DPaW maintains a list of PECs which identifies ecologically valuable communities that need further investigation before possible nomination for TEC status. Once listed, a community is a PEC, and when endorsed by the WA Minister of Environment becomes a TEC, and protected as an ESA under *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* (Appendix B).

1.2.7 Informal Recognition of Flora and Fauna

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

1.3 Background to Black Cockatoos

Three species of Black Cockatoo are found in south-west WA; Carnaby's Black Cockatoo, FRTBC and Baudin's Black Cockatoo. All three Black Cockatoos have suffered a substantial decline in numbers and breeding distribution in the past 50 years (Johnstone and Storr 1998). Direct causes of population decline include the large numbers shot by orchardists (mainly associated with Baudin's Black Cockatoo), clearing and fragmentation of habitat (especially the loss of breeding hollows), the impact of hollow competitors including the Galah (*Cacatua roseicapilla*), corellas including Butler's Corella (*Cacatua pastinator butleri*), Australian Shelduck (*Tadorna tadornoides*), Australian Wood Duck (*Chenonetta jubata*), the feral European honey bee (*Apis mellifera*), and also vehicle strikes. Around 60% of the original vegetation on the Swan Coastal Plain has been cleared and up to 85% in other parts of the south-west region for agriculture (crops), meat production, dairying, farms, orchards, vineyards, pine plantations, mining, timber and wood chipping, cities and towns. At present, extensive tracts of uncleared land only remain in State forest and conservation reserves and what is left of remnant vegetation (in roadside verges etc.) is often disturbed to a varying degree (Johnstone and Kirkby 2011).

The south-west region is now a severely fragmented landscape and the further loss of foraging habitat, the lack of suitable breeding sites, climate change, and alterations in the landscape led to significant changes in forest structure. Almost every part of the Jarrah-Marri forest has been logged in the past, and most present day trees are too young to form hollows, and competition with exotic species, exacerbate the future

conservation of Carnaby's Black Cockatoo, FRTBC's and Baudin's Black Cockatoo (Johnstone and Kirkby 2011).

The distribution of all three Black Cockatoo species can be seen in the 2014 DoE distribution maps in Appendix D. The Survey Area is within the known distribution of Carnaby's Black Cockatoo; however, it is on the northern extremity of Baudin's Cockatoo and FRTBCs distribution. Nevertheless, all three species of Black Cockatoo were returned in the three database searches and have therefore been included for consideration in this document given that these species are all highly mobile and the DoE distribution maps are indicative only. In addition the difficulty in distinguishing Carnaby's Black Cockatoo and Baudin's Black Cockatoo, again make it advisable to include both species.

2 Biophysical Environment

2.1 Climate

The closest official Bureau of Meteorology (BoM) weather station currently operating near to the Survey Area is the Jandakot Airport (Station number 009172), approximately 8 km north of the Survey Area. The climate for Jandakot is described as warm Mediterranean (Mitchell *et al.* 2002), with mean minimum of approximately 11.4 °C and a mean maximum of 24.6°C. Average annual rainfall is 824.3 mm (Figure 2) (BoM 2016).

Jandakot Airport recorded 805.4 mm of rain in the 12 months prior to the survey (October 2015 – September 2016) which is 18.9 mm below the long term average rainfall of 824.3 mm for the same period (BoM 2016). The three months prior to survey (July 2016 – September 2016), Jandakot recorded 364.6 mm of rainfall, 5.6% below the 386 mm average rainfall for the same period (BoM 2016).

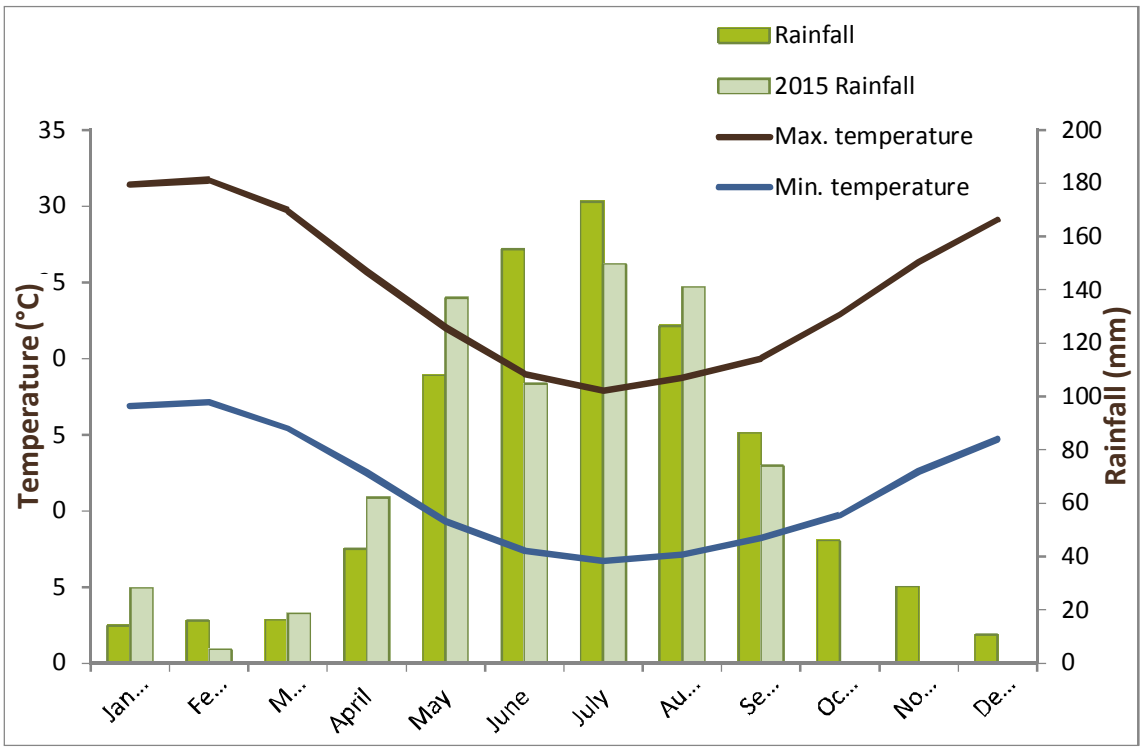

Figure 2: 2016 rainfall and mean rainfall for Jandakot Airport Weather Station (009172) from 1972 to 2016 (BoM 2016).

2.2 Geology and Soils

Soil-landscape mapping of South West WA has been captured at scales ranging from 1:20 000 to 1:250 000. Soil-landscape mapping describes broad soil and landscape characteristics from regional to local scales.

The Survey Area contains the following geological unit:

- Bassendean sand: Basel conglomerate overlain by dune quartz sand with heavy mineral concentrations.

There are 4 soil subsystems in the Survey Area, these are:

- Bassendean B1 Phase: Extremely low to very low relief dunes, undulating sandplain and discrete sand rises with deep bleached grey sands sometimes with a pale yellow B horizon or a weak Iron – organic hardpan at depths generally greater than 2m; Banksia dominant;
- Bassendean B2 Phase: Flat to very gently undulating sandplain with well to moderately well drained deep bleached grey sands with a pale yellow B horizon or a weak Iron-organic hardpan 1-2m;
- Bassendean B3 Phase: Closed depressions and poorly defined stream channels with moderately deep, poorly to very poorly drained bleached sands with an iron-organic pan, or clay subsoil. Surfaces are dark grey sand or sandy loam; and
- Bassendean B4: Broad poorly drained sandplain with deep grey siliceous sands or bleached sands, underlain at depths generally greater than 1.5 m by clay or less frequency a strong Iron-organic hardpan.

2.3 Hydrology

The Geomorphic Wetlands dataset is identified and utilised by the Environmental Protection Authority (EPA), Department of Environment Regulation (DER) and the Department of Planning as a basis for planning and decision making.

The DPaW Geomorphic Wetlands Dataset identifies no Geomorphic Wetlands occur within the Survey Area (Figure 3).

There are two geomorphic wetlands in close proximity to the Survey Area (Table 1).

Table 1: Geomorphic Wetlands in the Survey Area

MANAGEMENT CATEGORY	WETLAND UFI	DISTANCE FROM SURVEY AREA
Conservation Wetland	14104	1 km
Multiple Use Wetland	15886	1 km

Based on the vegetation present in the north- west corner of Lot 29, it is assumed that there is water at the surface during high rainfall periods, if not, then very close to the

surface. The species at this location are known as wetland dependent and are commonly found in wetlands in the Perth region.

2.4 Bush Forever

Bush Forever is a State Government Policy and programme that identifies 51,200 ha of regionally significant vegetation for protection, covering 26 vegetation complexes. This amounts to approximately 18% of the original vegetation on the SCP biogeographic region of the Perth metropolitan area.

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

The Survey Area does not intersect with any Bush Forever sites. The two closest Bush Forever Sites are BF 392 which is located approximately one kilometre east of the Survey Area and BF 492 which is located approximately 1.1 km north-east of the Survey Area (Figure 4).

2.5 Ecological Linkages

The purpose of the Regional Ecological Linkages identified by the Perth Biodiversity Project was to link protected natural areas with other areas of mapped native vegetation. Priority was given to identifying linkages through those areas having the greatest assumed protection and to those areas that maximised opportunities to form continuous corridors of native vegetation. The Survey Area does not intersect any Ecological Linkages (Figure 4).

2.6 Environmentally Sensitive Areas

No part of the Survey Area is intersected by an Environmentally Sensitive Area (ESA) (Figure 4).

2.7 Broad Vegetation Types

Vegetation across the State has been mapped at different scales by various people. The Survey Area has been mapped by both Beard (1979) which was later reassessed by Shepherd *et al*. (2001). Heddle *et al*. (1980) also undertook vegetation mapping for the region and therefore both these studies have been used to demonstrate the broad vegetation types in the Survey Area (Tables 2 and 3).

The Shepherd *et al.* (2001) and Heddle *et al.* 1980) studies have been used to estimate how much vegetation is currently present in comparison to the pre-European extent of

the same vegetation types. From these comparisons, it can be determined what vegetation types have been extensively cleared and therefore in need of protection. This is later discussed in Section 5.5.

Mapping of the vegetation of the Perth region of WA was completed on a broad scale (1:250,000) by Beard (1979). These vegetation units were re-assessed by Shepherd *et al*. (2001) to account for clearing in the intensive land use zone, dividing some larger vegetation units into smaller units.

There is one Beard / Shepherd vegetation unit in the Survey Area. The Shepherd *et al*. (2001) vegetation type (along with the corresponding Beard [1979] type in brackets), is described below, and its representation within the Survey Area, subregion, region and State is shown in Table 2.

- 1001 (e2Mb cbLi) – Medium very sparse woodland; Jarrah, with low woodland; Banksia & Casuarina

Table 2: Broad Vegetation Types within the Survey Area and its State and Regional Representation (Government of Western Australia 2015).

	Pre-European area (ha)	Current extent (ha) 1	Remaining (%)	Current extent % in IUCN Class I-IV Reserves1
Vegetation Types (Beard 1979/ Shepherd *et al*. 2001) in the State				
1001	57,410.23	12,879.81	22.43	12.46
Vegetation Types (Beard 1979/ Shepherd *et al*. 2001) in the Swan Coastal Bioregion				
1001	57,410.23	12,879.81	22.43	12.46
Vegetation Types (Beard 1979/ Shepherd *et al*. 2001) in the Perth Subregion				
1001	57,410.23	12,879.81	22.43	12.46

Mapping by Heddle *et al.* (1980) based in relation to the landform-soil units determined by Churchward and McArthur (1978) identified two vegetation complexes occurring in the Survey Area which are summarised in Table 3. The delineation of vegetation complexes is based on the concept of series of plant communities forming regularly repeating complexes associated with a particular soil unit. The Heddle *et al.* (1980) vegetation complex that occurs across the Survey Area is described below:

- Bassendean Complex – Central and South

Table 3: Vegetation Complexes within the Survey Area and its State and Regional Representation.

	Pre-European area (ha)	Current extent (ha)	Remaining (%)	Current extent % Secure Tenure Reserves
Vegetation Complex (Heddle *et al*. 1980) in the System 6/part System 1 area (EPA 2006)				
Bassendean Complex – Central and South	87,477	23, 624	27	0.7
Vegetation (Heddle *et al*. 1980) in the Swan Coastal Bioregion (PBP 2013)				
Bassendean Complex – Central and South	87,392.73	24,206.24	27.70	2.57

3 Methods

3.1 Background

The flora survey was undertaken out within the optimum season and done according to EPA requirements for environmental surveying and reporting for flora and vegetation in Western Australia, where possible and as set out in the following documents:

- EPA Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia No. 51 (EPA 2004a); and
- EPA Guidance for the Level of Assessment for Proposals affecting Natural Areas within the System 6 Region and Swan Coastal Plain Portion of the System 1 region. Guidance Statement No. 10 (EPA 2006); and
- Technical Guide – Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment (EPA-DPaW 2015).

The fauna survey was compliant with the EPA requirements for the environmental surveying and reporting of fauna in Western Australia where practical and relevant, and as set out in the following documents:

- Terrestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3 (EPA 2002);
- Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia. Guidance Statement No. 56 (EPA 2004b);
- Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA-DEC 2010); and
- EPBC Act referral guidelines for three threatened black cockatoo species (DSEWPaC 2012).

3.2 Flora and Vegetation Survey Methods

3.2.1 Flora and Vegetation Database Review

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

- DPaW Threatened and Priority Flora database (DPaW 2016a);
- DPaW Threatened and Priority Ecological Communities database (DPaW 2016b); and
- DoE Protected Matters Search Tool (PMST) (DoE 2016a).

A request for a database search was submitted to the DPaW on the 7th September 2016 (five kilometre radial search around the Survey Area) (Appendix F) to obtain a list of Declared Rare Flora/Threatened or Priority flora, and TECs and PECs in and near the Survey Area (Figure 5). These sources were used to compile a list of expected DRF or Priority species and TECs and PECs that may occur based on the landforms in the Survey Area.

3.2.2 Flora and Vegetation Field assessment

The field assessment was undertaken on the 27th of September 2016. The survey included the assessment of three quadrats and vegetation mapping notes. Quadrats are vegetation survey plots which are accurately measured out as 10 x 10 m (or an area equivalent to 100 m^2) and marked at the NW corner using a handheld Garmin GPS unit.

Permits

This flora survey was conducted under the following licences issued by DPaW; Licence to take flora for scientific or other prescribed purposes SL011541 and Permit to take Declared Rare Flora 44-1516 issued to 360 Environmental's Botanist, Narelle Whittington.

3.2.3 Searches for Conservation Species

In addition to the information collected from the Quadrats, opportunistic searches for conservation significant flora likely to occur in the Survey Area based on database searches, habitat present and the botanist's previous experience were undertaken.

3.2.4 Taxonomy and Nomenclature

Where field identification of plant taxa was not possible, specimens were collected systematically for later identification utilising resources of the Western Australian Herbarium (WAH).

The species list was checked against FloraBase (WAH 2016) to determine the species conservation status. Threatened and Priority Flora were verified against the EPBC Act listing of threatened species to determine Commonwealth listing.

Introduced species were checked against the DPaW Weed Prioritisation Process (WPP) (DPaW 2013), to determine their ranking in terms of environmental impact. The BAM Act Declared Plants list was consulted to determine if any are Declared Plants, and the WONS list to determine the presence of any WONS (Thorp & Lynch 2000).

3.2.5 Vegetation Mapping

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

Vegetation condition was mapped in the field using handheld GPS (Garmin) units and high-resolution aerial photographs, which in the office were digitised using GIS software. Vegetation condition was assessed based on Keighery B.J (1994) from Bush Forever (Government of WA 2000).

3.3 Fauna Survey Methods

3.3.1 Fauna Database Review

A five kilometre radial DPaW threatened fauna database, NatureMap and EPBC Protected Matters Search Tool (PMST) searches were undertaken from the centre of the Survey Area (Appendix G). The searches were undertaken to identify fauna species of conservation significance potentially occurring in the Survey Area (DPaW 2016c; DPaW 2016d, DoE 2016b).

Collectively, these sources were used to compile a list of species that have been previously recorded in the vicinity of the Survey Area (Appendix K). This list invariably includes some species that do not occur in the Survey Area, as some fauna have a limited or patchy distribution or a high level of habitat specificity for habitats which are not located in the Survey Area e.g. waders/shorebirds that require coastal shores for habitat. Some fauna may also have become locally extinct or were erroneously identified in previous surveys. These fauna were examined and then excluded from the list where relevant.

3.3.2 Field assessment

The field assessment was undertaken on 28th September 2016 by one Zoologists. The survey was consistent with standard protocols for the region and relevant EPA Guidance Statements and EPBC Act Survey Guidelines as outlined above in section 3.1 (where relevant and practical).

The purpose of the field assessment was to verify the accuracy of the desktop assessment and to further delineate and characterise the fauna assemblages and fauna habitat in the Survey Area. The assessment consisted primarily of a fauna habitat assessment and opportunistic observations.

3.3.3 Opportunistic Observation

Fauna were opportunistically observed and recorded during the assessment. The assessment included looking through leaf litter, overturning rocks, looking under decorticating bark and searches for scats, tracks, burrows and other traces of animals throughout the Survey Area (when the habitat supported such features). If conservation significant species were located, the coordinates were recorded with a GPS.

3.3.4 Taxonomy

For species identified in the desktop assessment, where there is doubt as to their true taxonomy (through subsequent name changes or taxonomic reviews), an effort was made to determine the current scientific name for each taxon. In some cases, old scientific names may be presented where correct nomenclature could not be determined due to name changes. Some taxon names may be followed by 'sp.', meaning that the species name was not given in the data source or the identification is in doubt. Where there are previously recorded taxa such as this that have the potential to be a conservation significant species, they are discussed specifically in the results and discussion section.

Taxonomy and nomenclature in this report follows the accepted listing of published terrestrial vertebrate species. The listing for amphibians and reptiles follows Cogger (2014), birds follows Christidis and Boles (2008) and mammals Van Dyck and Strahan (2008).

3.4 Black Cockatoo Survey Methods

The Black Cockatoo Assessment was undertaken on 28th September 2016 and involved traversing the Survey Area by foot. Any trees meeting each of the following criteria for potential breeding were recorded and electronically logged using a hand held Global Positioning System (GPS) unit:

- Native trees (e.g. Jarrah, Tuart, Marri etc.);
- Diameter at breast height (DBH) > 500 mm (300 mm for Wandoo and Salmon Gum) regardless of the presence or absence of hollows;
- Trees were placed in the following size class categories:
  - A = 500 – 1000 mm DBH
  - B = 1000 – 2000 mm DBH
  - C = >2000 mm DBH

The Black Cockatoo assessment involved assessing the habitat for tree and shrub species known to be important dietary items e.g. Marri and *Banksia sp.* It also included looking for:

- Evidence of feeding (chewed cones, seed and nut material); and
- Opportunistic observations of Black Cockatoos in the Survey Area.

4 Results

4.1 Flora, Vegetation and Fauna Survey Limitations and Constraints

It is important to note the specific constraints imposed on surveys. Constraints are often difficult to predict, as is the extent to which they influence survey effort. Survey constraints of the flora and fauna survey are detailed in Table 4.

Table 4: Limitations and Constraints Associated with the Survey Area.

VARIABLE	IMPACT ON SURVEY OUTCOMES
Access	The Survey Area was accessed and traversed. Particular focus was given to areas expected to be impacted that may have species of conservation significance and where there was relatively intact native vegetation present.
Experience	The personnel who executed these surveys were practitioners suitably qualified in their respective fields: • Field Staff: Narelle Whittington (Botanist) and Laura Stevens (Zoologists); • Data Interpretation and Reporting: Laura Stevens, Narelle Whittington and Amy Dalton • Report Review: Michelle Rhodes. The closest official Bureau of Meteorology (BoM) weather station currently operating near to the Survey Area is the Jandakot Airport (Station number 009172), approximately eight kilometres north of the Survey Area. The climate for Jandakot is described as warm Mediterranean (Mitchell *et al*. 2002), with mean minimum of approximately 11.4 °C and a mean maximum of 24.6°C. Average annual rainfall is 824.3 mm (Figure 2) (BoM 2016). Jandakot Airport recorded 805.4 mm of rain in the 12 months prior to the survey (October 2015 – September 2016) which is 18.9 mm below the long term average rainfall of 824.3 mm for the same period (BoM 2016). The three months prior to survey (July 2016 – September 2016), Jandakot recorded 364.6 mm of rainfall, 5.6% below the 386 mm average rainfall for the same period (BoM 2016).
Timing, weather, season	The survey was conducted during September after three months of below average rainfall (refer to section 2.1). The climate for Jandakot is described as warm Mediterranean (Mitchell *et al*. 2002), with a mean minimum of approximately

VARIABLE	IMPACT ON SURVEY OUTCOMES
	11.4 °C and a mean maximum of 24.6°C. Rainfall totals, on average, 824.3 mm per annum (Figure 2) (BoM 2016). Flora composition changes with time, particularly seasonally as a result of seasonal conditions. Therefore, botanical surveys completed at different times will have varying results. Fauna were opportunistically observed throughout the day, but especially in the first few hours following dawn, when birds in particular are most active.
Scope: Life forms sampled	The scope of this project included the high level sampling of flora and vegetation and searching for perennial conservation significant species or communities. The fauna survey was primarily a habitat assessment, many species that occur in the Survey Area would not have been observed, particularly small ground-dwelling fauna that are normally captured by methods such as trapping. All conservation significant species previously recorded in the area have been considered. Based on the habitat present, those species deemed to potentially occur in the Survey Area have been addressed in this report. The scope of this project also included the surveying of potential Black Cockatoo habitat.
Sources of information	The desktop analysis used several sources to produce a list of flora and fauna species previously recorded in the vicinity of the project area. This includes records from the EPBC Protected Matters Search Tool (DoE 2016a&b), and DPaW Threatened flora (DPaW 2016a), TECs and PECs (DPaW 2016b) NatureMap (DPaW 2016d) and NatureMap fauna search (DPaW 2016e) and DPaW Threatened Fauna Database search (DPaW 2016c) as well as field guides and other scientific literature.
Completeness	The entire Survey Area was accessible; the time spent conducting the survey was considered adequate for the size and complexity of the site. All vegetation associations were sufficiently surveyed; with four quadrats and additional vegetation mapping notes recorded. All vegetation associations were sufficiently surveyed; with 3 quadrats and additional vegetation mapping notes recorded. Five fauna habitat assessments were carried out and all trees considered to be potential breeding trees in the Survey Area were measured.
Disturbances	The disturbance of the Survey Area varies. The Survey Area includes several sheds (one is utilised as a home), cleared areas and a powerline easement.

4.2 Flora Results

4.2.1 Database Results

The review of the database searches identified 18 conservation significant flora potentially occurring in the vicinity of the Survey Area. Of these, seven are classed as Threatened, six as Priority 3 and five as Priority 4.

The likelihood of these 18 conservation significant flora occurring in the Survey Area is shown in Appendix H.

A search of the DPaW TEC and PEC database and EPBC PMST identified Three Priority communities as occurring within five kilometres of the Survey Area (Figure 5) and one TEC listed under the EPBC Act. The communities are:

- FCT SCP21c – Low lying *Banksia attenuata* woodlands or shrublands (Priority 3 [DPaW]);
- FCT SCP22 – *Banksia ilicifolia* woodlands (Priority 3 [DPaW]);
- FCT SCP24 – Northern Spearwood scrublands and woodlands (Priority 3 [DPaW]); and
- Banksia Woodlands of the Swan Coastal Plain (Endangered [EPBC]).

4.2.2 Overview of Flora

A total of 65 taxa (including species, subspecies, varieties and forms) from 58 genera and 30 families were recorded in the Survey Area, of these 10 were introduced species. The commonly occurring families were; Myrtaceae (8 taxa), Fabaceae (7 taxa) and Asparagaceae (7 taxa). The flora inventory is provided in Appendix I and the Survey Area data sheets in Appendix J.

4.2.3 Flora of Conservation Significance

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

4.2.4 Introduced Flora

A total of 10 introduced species were recorded during the survey (Table 5). One species, **Asparagus asparagoides,* is listed as Declared under the BAM Act and is also listed as a WONS.

None of these species are Declared under the BAM Act, or listed as WONS.

Table 5: Introduced Flora Recorded in the Survey Area.

TAXON	(COMMON NAME)	DECLARED BAM ACT	WONS
**Agave americana*	Century Plant	No	No
**Asparagus asparagoides*	Bridal Creeper	Yes	Yes
**Avena barbata*	Bearded Oat	No	No
**Briza maxima*	Blowfly Grass	No	No
**Carpobrotus edulis*	Pigface	No	No
**Ehrharta calycina*	Perennial Veldt Grass	No	No
**Gladiolus caryophyllaceus*	Wild Gladiolus	No	No
**Hypochaeris glabra*	Smooth Catsear	No	No
**Pelargonium capitatum*	Rose Pelargonium	No	No
**Ursinia anthemoides*	Ursinia	No	No

4.2.5 Vegetation Associations

Three natural vegetation associations were described for the Survey Area. In addition to the associations, two units were also mapped, which included non-endemic trees and cleared areas. Descriptions of these are provided in Table 6 and Figure 6.

Table 6: Vegetation Association and unit Descriptions and their Extent in the Survey Area.

VEGETATION ASSOCIATION CODE (AND SITES WHICH REPRESENT THIS ASSOCIATION)	DESCRIPTION	AREA (HA)
BiEt (Q1)	Woodland of *Banksia ilicifolia, Eucalyptus todtiana, Melaleuca preissiana* and *Banksia attenuata* over *Phlebocarya ciliata, Lepidosperma leptostachyum, Dasypogon bromeliifolius, Melaleuca seriata, Bossiaea eriocarpa* and *Adenanthos cygnorum.*	1.144
BiMp *(Q2)*	Woodland of *Banksia ilicifolia, Melaleuca preissiana, Banksia menziesii* over *Kunzea glabrescens, Dasypogon bromeliifolius, Phlebocarya ciliata, Astartea scoparia, Jacksonia furcellata, Hypocalymma angustifolium, Xanthorrhoea preissii* and *Melaleuca*	0.318

Vegetation Association Code (and sites which represent this Association)	Description	Area (ha)
	thymoides.	
BmXp (Q3)	Low Woodland of *Banksia menziesii* over *Xanthorrhoea preissii*, *Leucopogon conostephioides*, *Eremaea asterocarpa* subsp. *brachyclada*, *Hibbertia hypericoides* and *Conostephium pendulum.*	1.468
Ne	Non-Endemic trees	0.120
Cleared	Cleared land	1.761

4.2.6 Vegetation Condition

Vegetation condition ranged from Very Good to Completely Degraded with the majority of the Survey Area considered to be in Good to Very Good (2.346 ha) condition (Table 7, Figure 7). 1.7 ha of the Survey Area has been previously cleared and there has been stockpiling of soil north of the driveway. The land-use of the property has been a source of extensive weed infestations in the centre of the Survey Area (cleared/house area) and this has been a source of introduction into the vegetation. Firebreaks and proximity to the road has also contributed to the introduction and spread of weeds.

The eastern side of the Survey Area is the location of a High Voltage Powerline and therefore the vegetation under the powerline is subject to continual maintenance involving control burns, pruning and fuel reduction. This has altered both the density, height and structure of the *Banksia* woodland. Weeds do not appear to be the dominating disturbance factor, and therefore, the vegetation that is still present is considered to be in Good condition. Not-with-standing this, the *Banksia* woodland is in an altered state.

Table 7: Vegetation Condition and Extent in the Survey Area.

Condition	Extent (ha)
Very Good	0.338
Good-Very Good	0.318
Good	1.69
Good-Degraded	0.127
Degraded	0.499

CONDITION	EXTENT (HA)
Completely Degraded	0.126
Cleared	1.712

4.2.7 Floristic Community Types

Statistical analysis (multivariate analysis) and data interpretation, as shown in Table 8 was undertaken to help determine the FCTs represented by the vegetation in the project area. This involves reviewing site data for other factors that are diagnostic for FCTs, including the presence of indicator species, soil types and landform position. The quadrat data was tested for similarity against each of Gibson *et al.* FCT's that were determined and mapped as part of a regional study to describe the vegetation types present on the Swan Coastal Plain in 1994.

Results from the statistical analyses and the site information, identified three FCTs as occurring in the Survey Area.

Table 8: Floristic Community Type Analysis

VEGETATION ASSOCIATION	FLORISTIC COMMUNITY TYPES[1]	SIMILARITY	COMMENTS	INFERRED FLORISTIC COMMUNITY TYPE
BiEt	SCP22-*Banksia ilicifolia* woodlands	25.3%	The vegetation is not representative of SCP22, as this system is likely to be seasonally waterlogged. Even though wetland species were located on site there was no evidence that the site is subject to season waterlogging or surface water.	**SCP21c** - Low lying *Banksia attenuata* woodlands or shrublands
	SCP 23a – Central *Banksia attenuata – B. menziesii* woodlands	21.8%	The vegetation is not believed to represent of SCP23a, due to the low lying position of the community and the associated species present.	
	SCP21c- Low lying *Banksia attenuata* woodlands or shrublands	20.9%	360 Environmental believes the vegetation on site is representative of FCT SCP21c, as the key indicator species (*Banksia* spp.) are present along with other species (e.g. *Kunzea glabrescens*) that are commonly found in a lower lying situation. FCT SCP21c is also known to occur in close proximity to the study area.	
BiMp	SCP22 - *Banksia ilicifolia* woodlands	22.3%	This area of the Survey Area resembled more of a wetland, including wetter soils and wetland indicator species.	**SCP4** – *Melaleuca preissiana*

Vegetation Association	Floristic Community Types[1]	Similarity	Comments	Inferred Floristic Community Type
	SCP14 – Deeper wetlands on sandy soils	18.18%	This vegetation community resembled the inter-zone between a wetland and an upland community; it is not considered to have an affinity with the three top similarity results from the statistical analysis and has more in common with FCT SCP 4 based on its location in the landscape, species present and the occurrence of the FCT in nearby bushland remnants.	damplands
	SCP21c - Low lying *Banksia attenuata* woodlands or shrublands	17.9%	This area of the Survey Area resembled more of a wetland, including wetter soils and wetland indicator species.	
BmXp	SCP22 - *Banksia ilicifolia* woodlands	19.75%	The dryer soils and the species present in the vegetation community instigates that it is not reprehensive of a lower lying FCT such as SCP22 or SCP21c.	SCP 23a – Central *Banksia attenuata – B. menziesii* woodlands
	SCP21c - Low lying *Banksia attenuata* woodlands or shrublands	19.57%		
	SCP 23a – Central *Banksia attenuata – B. menziesii* woodlands	18.32%	Due to the position in the landscape of this vegetation community being on the higher dune system it is more likely to be SCP23a.	

4.2.8 Threatened and Priority Ecological Communities

Vegetation association BiEt, has been determined to have the highest affiliation with FCT SCP21c, and BmXp with FCT SCP23a, both of these are listed as sub-communities of '*Banksia woodlands of the Swan Coastal Plain*'. As of September 2016, '*Banksia woodlands of the Swan Coastal Plain'* are listed as Endangered under the EPBC Act. TECs and their associated buffers are regarded as ESAs.

FCT SCP21c and FCT SCP23a are not listed as TECs under state legislation however are considered to form part of the Priority 3 Ecological community '*Banksia dominated woodlands of the Swan Coastal Plain'* IBRA region", all vegetation that has an over storey dominated by *Banksia* are all listed as a Priority 3 ecological community. The key feature of these *Banksia* woodlands is the presence of *Banksia attenuata* and/or *B. menziesii* occurring on deep sands. With this taken into consideration vegetation association BiEt and BmXp are considered Priority 3 by the State.

4.2.9 Regional Representation

Vegetation mapping units described in the Survey Area were correlated with the Beard (1978) and Shepherd *et al*. (2001) broad vegetation types as much as possible by examining similarities in vegetation descriptions (Table 9). Differences exist with the terminology used in the descriptions as they are based on different methods of categorising and characterising vegetation types, and the different spatial scale of the analysis (i.e. region vs. local scale).

Table 9: Representation of broad Vegetation Types and corresponding Vegetation Associations.

Vegetation Type and Description (Shepherd *et al*. 2001/Beard 1978)	Corresponding Vegetation Association (Current Survey)	Vegetation Association Extent in Survey Area (ha)
1001 (e2Mb cbLi)	BiEt, BiMp and BmXp	2.93

4.3 Fauna Results

4.3.1 Database Searches

Database searches returned 224 vertebrate species from 70 families as potentially occurring in the vicinity of the Survey Area. Of these, seven species were amphibians from three families, 34 were reptiles from seven families, 156 were bird species from 46 families and 25 were mammals from 14 families.

A total of 45 conservation significant vertebrate species (including Priority species) from 25 families were identified during the desktop review of the database searches (Appendix K). These were comprised of three reptile species from three families, 33 bird species from 16 families, and nine mammals from six families.

Waterbirds

A number of wetland bird species were returned from the database searches:

Waders - Wetland avifauna such as wading birds, including Plovers, Stints and Sandpipers inhabit estuaries, mudflats, saltmarshes, sandflats and beaches, where they feed on invertebrates such as worms, molluscs, insects and crustaceans (Garnett *et al*. 2011). The Survey Area does not contain this habitat and so all wading birds returned from the database searches have been omitted from further discussion.

Coastal Birds - A number of coastal birds were returned from the database searches. Coastal birds such as the White-bellied Sea-eagle and Osprey require coasts and near-coastal wetland habitat, where they feed mainly on fish, sea snakes and nesting seabirds (Johnstone & Storr 1998). This habitat is not present in the Survey Area and these species have been omitted from further discussion.

The Survey Area does not contain suitable wetland habitat for other wetland species such as the Water Rat, so have been omitted from further discussion.

Now Regionally Extinct

A number of species returned were also known to be historical records of species now locally extinct, for example the Malleefowl, Western Quoll, Numbat, Southern Brush-tailed Phascogale, Western Ringtail Possum and Tammar Wallaby. These species have been omitted from further discussion.

Database Errors

Occasionally there are inconsistencies in the database searches that are sourced from the various government departments. For example, the Grey Wagtail has only two confirmed sightings in north-west WA (Johnstone and Storr 2004) yet it was present in the EPBC database search. The Priority 3 listed Keeled Legless Lizard subspecies (*Pletholax gracilis edelensis*) was returned from NatureMap. This subspecies however, is limited to dunes with *Spinifex longifolius* and brown loam supporting *Triodia* in the Shark Bay area (Wilson & Swan 2013). Species such as these have therefore been omitted from further discussion.

In addition, many fauna are not distributed evenly across the landscape, are more abundant in some places than others are, and consequently more detectable (Currie 2007). Furthermore, some small, common ground-dwelling reptile and mammal species tend to be habitat specific, and many bird species can occur as regular migrants, occasional visitors or vagrants. Therefore, these species have been omitted from further discussion regarding fauna results.

4.3.2 Conservation Significant Fauna

With the afore mentioned species removed, a total of nine conservation significant species (including Priority species) from the database searches are potentially considered to either be likely, possibly or unlikely to occur in the Survey Area. These nine species comprise of two reptile, five bird and two mammal species.

Of these nine conservation significant species, no species were recorded during the field assessment, seven species are considered as 'Likely' to occur, no species are considered 'Possible' and two species are considered 'Unlikely' to occur within the Survey Area (Table 10).

The Likelihood of each species is based on the following criteria:

- Recorded: Recorded during the field assessment;
- Likely: Suitable habitat is present in the Survey Area and the Survey Area is in the species' known distribution;
- Possible: Limited or no suitable habitat is present in Survey Area, but is nearby. The species has good dispersal abilities and is known from the general area; and

- Unlikely: No suitable habitat is present in Survey Area but is nearby, the species has poor dispersal abilities, but is known from the general area; or suitable habitat is present, however the Survey Area is outside of the species' known distribution.

Table 10: Conservation significant fauna potentially occurring in the Survey Area.
En = Listed as Endangered under the EBPC Act, Vu = Listed as Vulnerable under the EBPC Act, Mi = Listed as Migratory under the EBPC Act, Ma = Listed as Marine under the EBPC Act, S = Scheduled under the WC Act, and P = Listed as Priority by the DPaW.

TAXA	CONSERVATION STATUS	LIKELIHOOD
Reptiles		
Perth Slider (*Lerista lineata*)	P3	Likely
Black-striped Snake (*Neelaps calonotos*)	P3	Likely
Birds		
Peregrine Falcon (*Falco peregrinus*)	S7	Unlikely
Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*)	Vu, S3	Likely
Baudin's Black Cockatoo (*Calyptorhynchus baudinii*)	Vu, S2	Likely
Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*)	En, S2	Likely
Rainbow Bee-eater (*Merops ornatus*)	Ma, S5	Likely
Mammals		
Southern Brown Bandicoot (*Isoodon obesulus fusciventer*)	P5	Likely
Western False Pipistrelle (*Falsistrellus mackenziei*)	P4	Unlikely

4.3.3 Field Assessment Results

During the field assessment 16 species from eight families were recorded. This consisted of 15 bird species from seven families and one mammal species.

4.3.3.1 Amphibians

From the database searches, seven amphibian species have been previously recorded from the following three families in the surrounding area: Limnodynastidae, Myobatrachidae and Hylidae (Appendix K). During the survey, no amphibians were recorded.

4.3.3.2 Reptiles

From the database searches, a total of 34 reptile species have been previously recorded from the following seven families in the surrounding area; Gekkonidae, Pygopodidae, Scincidae, Agamidae, Varanidae, Typhlopidae and Elapidae. No reptile species were recorded during the field assessment (Appendix K).

4.3.3.3 Birds

From the database searches, a total of 156 bird species from 46 families have been previously recorded in the surrounding area. During the field assessment 15 bird species were recorded from the following seven families: Columbidae, Psittacidae, Cucilidae, Meliphagidae, Dicruridae, Cracticidae and Corvidae (Appendix K).

4.3.3.4 Mammals

From the database searches, a total of 25 mammal species from 14 families have been previously recorded in the surrounding area. During the field assessment one mammal was indirectly recorded through tracks and scats; the Western Grey Kangaroo (Appendix K).

4.3.4 Black Cockatoo Results

The DPaW, NatureMap and EPBC PMST searches identified all three Black Cockatoo species as occurring in the surrounding area; Carnaby's Black Cockatoo, Baudin's Black Cockatoo and FRTBC (Appendix K).

During the survey, no Black Cockatoos were observed and no foraging evidence was observed in the Survey Area.

4.3.4.1 Foraging Habitat

There is a total of 2.93 ha of Black Cockatoo foraging habitat in the Survey Area. This consists of *Banksia attenuata*, *Banksia menziesii*, *Banksia ilicifolia*, *Allocasuarina fraseriana* and *Xanthorrhoea preissii*. These species provide important foraging habitat for all three species of Black Cockatoo.

No foraging evidence was found in the Survey Area.

4.3.4.2 Potential Breeding Trees

There were no *Eucalyptus* trees in the Survey Area with a DBH of >500 mm, therefore there were no trees considered to be potential Black Cockatoo breeding habitat.

4.3.5 Fauna Habitat

Five fauna habitat assessments were undertaken during the survey (Appendix L) and one fauna habitat was identified in the Survey Area:

Banksia Woodland

This habitat has an overstorey that consists of *B. attenuata*, *B. menziesii* and *B. ilicifolia* with very scattered *E. todtiana* and *Melaleuca preissii* over a midstorey of *Adenanthos sp. A. fraseriana* and *X. preissii* over an understorey of mixed native grasses and weeds.

5 Discussion

5.1 Flora Context

The vegetation in the Survey Area has been altered by various land use practices such at housing, firebreaks and powerline protection maintenance. Due to these activities the quality of vegetation varies greatly across the Survey Area. The survey resulted in 65 taxa (including species, subspecies, varieties and forms) from 58 genera and 30 families being recorded in the Survey Area, of these, 10 were introduced species.

5.2 Flora of Conservation Significance

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

The review of the database searches identified seven T/DRF flora species potentially occurring in the vicinity of the Survey Area. Of these species, six are considered unlikely based on the habitat type present in the Survey Area and one is considered likely. The one potential species, *Caladenia huegelii*, is a perennial (tuberous) short-lived herb (orchid) that needs various conditions to flower and exhibits different flowering patterns. The survey was undertaken during the known flowering period for this species; however, no specimens were recorded. *Caladenia huegelii* grows to 0.6 m high and is easily recognizable during its flowering period from September to October (WAH 2014). Outside of this period *C. huegelii* remains as an underground tuber and is difficult to detect. Throughout its range the species tends to favour areas of dense undergrowth with soil usually deep grey-white sand usually associated with the Bassendean sand-dune system (DEC 2009). Due to the disturbance associated with the continual maintenance of the vegetation surrounding the high voltage powerlines the vegetation that would have been considered suitable habitat for *Caladenia huegelii* no longer possesses the attributes favoured by the species and therefore it is unlikely that the species occur in the Survey Area.

No Priority flora was recorded during the survey. Of the Priority Flora (11 taxa) identified as potentially occurring within the Survey Area during the desktop assessment, four do not have ecological information available to determine whether they could occur in the Survey Area i.e. habitat type and preference and their distribution. The remaining six species are considered unlikely to occur.

5.3 Vegetation of Conservation Significance

A search of the DPaW TEC and PEC database and EPBC PMST identified three State listed PECs occurring within 5 km of the Survey Area and one TEC listed under the EPBC Act. FCT SCP21c – Low lying *Banksia attenuata* woodlands or shrublands is thought to occur in the Survey Area which is listed as a Priority 3 by DPaW.

FCT SCP23a is considered to form part of the Priority 3 Ecological community Banksia dominated woodlands of the Swan Coastal Plain IBRA region, all vegetation that has an over storey dominated by Banksia are all listed as a Priority 3 ecological community by DPaW. This listing is likely to be upgraded to a State listed TEC when DPaW undertakes its yearly review of its database listings. There is no written policy on how to respond to the presence of PECs within proposed development sites and the presence of these communities is dealt with by DPaW on a case by case basis.

'Banksia woodlands of the Swan Coastal Plain' ecological community have also been listed (16 September 2016) as an Endangered community under the EPBC Act. A key diagnostic feature is a prominent tree layer of Banksia, with scattered Eucalypts and other tree species often present among emerging Banksia canopy. To determine if the TEC is present in the Survey Area, the results of the statistical analysis were compared to the list of sub-communities which were drawn from the FCT descriptions outlined in Gibson *et al*. (1994), Government of WA (2000) and Keighery *et al*. (2008).

The Statistical analysis resulted in the BiEt vegetation community being the most similar to FCT SCP21c – Low lying *Banksia attenuata* woodlands or shrublands and BmXp being most similar to FCT SCP23a. These two FCTs have been listed as sub-communities under the EPBC Act listed Banksia woodlands of the Swan Coastal Plain (DEE 2016). For vegetation remnants to be under full national protection the community has to meet key diagnostic characteristics. In regards to the presence of the TEC, the Approved Conservation Advice for the thresholds state that for vegetation in Excellent Condition the minimum patch size should be 0.5 ha, while vegetation in Very Good condition should be a minimum of one hectare and vegetation in Good condition should be a minimum of two hectares. If a vegetation patch is considered Degraded or worse it is not considered favourable for national protection.

Based on this information, and the survey results, there is approximately 0.188 ha of FCT SCP23a rated as Very Good condition and 1.276 ha in Good condition. FCT SCP21c has approximately 0.150 ha rated as Very Good condition and 0.413 ha in Good condition. It is, therefore considered, that the vegetation remnants are both too small and disturbed to be suitable for National protection under the federally listed Banksia woodlands of the Swan Coastal Plain.

Vegetation association BiMp is considered to have an affiliation with FCT SCP4. FCT SCP4 is not a State listed TEC or PECs and is not listed under the EPBC Act.

5.4 Environmentally Sensitive Areas

The Survey Area does not intersect with any Environmentally Sensitive Areas (ESA's). ESAs are declared to prevent degradation of important environmental values such as T/DRF, TECs or significant wetlands. Exemptions contained in the Environmental Protection (Clearing of Native vegetation) Regulations 2004 for low impact land clearing do not apply in ESAs and a native vegetation clearing permit is required.

5.5 Vegetation Condition and Introduced Flora

Vegetation condition ranged from Very Good to Completely Degraded with the majority of the Survey Area considered being in Good to Very Good condition. The land-use of the property has been a source of ongoing disturbance. Disturbance sources clearing, sheds (one being used as a home), a concrete slab, firebreaks and weeds.

The eastern side of the Survey Area is the location of a High Voltage Powerline and therefore the vegetation under the powerline is subject to continual maintenance involving control burns, pruning and fuel reduction. This has altered the density, height and structure of the *Banksia* woodland. Weeds do not appear to be the dominating disturbance factor, and therefore, the vegetation that is still present is considered to be in Good condition. Not-with-standing this, the *Banksia* woodland is in an altered state.

A total of 10 introduced species were recorded during the survey (Table 5). One species, **Asparagus asparagoides,* is listed as Declared under the BAM Act and is listed as a WONS. The land-use of the property has been a source of extensive weed infestations in the centre of the Survey Area (cleared/house area) and this has been a source of introduction into the vegetation. Firebreaks and proximity to the road has also contributed to the introduction and spread of weeds. The majority of these weeds are common bushland and agricultural weeds (Hussey *et al.* 2007).

5.6 Regional Representation

The Perth Biodiversity Project (PBP 2013) has mapped native vegetation extent by vegetation complex on the Swan Coastal Plain. It is estimated that Karrakatta Complex – Central and South is estimated to have 23.91% native vegetation remaining based on the pre-European extent and the Herdsman Complex has 34.63% remaining.

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

These levels may be modified for 'Constrained Areas'. Such areas include the Swan Coastal Plain portion of the Perth Metropolitan Region (in which the Survey Area lies), and may include urban, urban deferred and industrial zoned lands, and lands with development approvals.

The modified objective for Constrained Areas are 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.

The remaining extent of both of these vegetation communities is greater than the 10% threshold set by the EPA for protecting Australia's biological diversity in constrained areas.

5.7 Ecological Linkages

The Survey Area does not form part of the Perth Biodiversity Project's Draft Regional Ecological linkage network. The Survey Area is not part of a non-continuous linkage of bushland that connects parcels of bushland, undeveloped land or private properties. The area in which the Survey Area lies, is undergoing many housing development projects, and as a consequence there is no continuous linkage of Bushland.

5.8 Fauna of Conservation Significance

5.8.1 Species Recorded

During the field assessment, no conservation significant species were recorded.

5.8.2 Species Considered Likely to Occur

Seven species are considered Likely to occur in the Survey Area; the Perth Slider, the Black-striped Snake, FRTBC, Baudin's Black Cockatoo, Carnaby's Black Cockatoo, the Rainbow Bee-eater and the Southern Brown Bandicoot. As a Black Cockatoo Assessment forms part of this report, all three Black Cockatoo species will be discussed in detail in section 5.8.

Perth Slider

The Perth Slider is listed as P3 under the DPaW priority list. This species is mainly found in coastal heath and shrubland on the lower west coast between Perth and Mandurah (Wilson & Swan 2013). It is one of 71 reptile species occurring in the Perth region which make this area as diverse as any similar sized coastal region in Australia (How & Dell 1994). The Perth Slider is a burrowing species found in coastal heaths and low shrubland, where it feeds at night on ants, termites and other small insects (Cogger 2014).

The DPaW threatened fauna database search returned 127 records of the Perth Slider from within a five kilometres of the Survey Area. The majority of the Survey Area has deep sandy soils considered suitable for the Perth Slider and as such the species is considered Likely to occur in the Survey Area.

Black-striped Snake

The Black-striped Snake is listed as P3 under the DPaW priority list. This species is restricted to a 90 km sandy coastal strip near Perth from Mandurah to Lancelin. It occurs in dunes and sand-plains with heaths as well as eucalypt/banksia woodland (Cogger 2014). It is one of 71 reptile species occurring in the Perth region which make this area as diverse as any similar sized coastal region in Australia (How and Dell 1994).

The Black-striped Snake is a burrowing species found in coastal heaths and low shrubland, where it feeds on lizards mostly of the burrowing skink genus Lerista (Cogger 2014), which were also returned in the desktop searches. DPaW threatened fauna database results returned five records of the Black Striped Snake from within a five kilometre radius of the Survey Area.

The majority of the Survey Area has deep sandy soils considered suitable for the Black-striped Snake and suitable prey available. As such the Black-striped Snake is considered Likely to occur in the Survey Area.

Rainbow Bee-eater

The Rainbow Bee-eater is listed as Marine under the EPBC Act and Schedule 5 under the WC Act. This species is one of the most common and widespread birds in Australia with a distribution that covers the majority of Australia (Barrett *et al*. 2003). It occurs in lightly wooded, often sandy country, preferring areas near water. It feeds on airborne insects, and nests throughout its range in WA in burrows excavated in sandy ground or banks, often at the margins of roads and tracks. In WA this species can occur as a 'resident, breeding visitor, postnuptial nomad, passage migrant and winter visitor' (Johnstone and Storr 2004). The Survey Area contains potential foraging habitat for this species.

The DPaW threatened fauna database returned 54 records of the Rainbow Bee-eater, and due to its numbers and distribution, the Rainbow Bee-eater is considered Likely to occur in the Survey Area.

Southern Brown Bandicoot

The Southern Brown Bandicoot is listed as Priority 5 under the DPaW Priority List. It once occurred throughout south-west WA; it now occurs from Guilderton southwards on the SCP, including the Perth Metropolitan area, in Jarrah and Karri (*Eucalyptus diversicolor*) forests and adjacent coastal vegetation complexes. The species inhabits scrubby, often swampy, vegetation with dense cover up to about 1m high. It feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover. The Southern Brown Bandicoot is patchily distributed in suitable habitat, with populations inhabiting Jarrah and Wandoo forests usually associated with watercourses. On the Swan Coastal Plain it is often associated with wetlands with dense vegetation where they feed on fruit, seeds, insects and fungi (Woinarski *et al*. 2012).

The DPaW threatened fauna database returned 182 records from a five kilometre radial search as such the Southern Brown Bandicoot is considered Likely to occur in the Survey Area.

5.8.3 Species Considered as Possibly Occurring

No species are considered as Possibly occurring in the Survey Area.

5.8.4 Species Considered as Unlikely to Occur

A total of two species of conservation significance are considered Unlikely to occur in the Survey Area; the Peregrine Falcon and the Western False Pipistrelle.

Peregrine Falcon

The Peregrine Falcon is listed as Schedule 7 under the WC Act and is an uncommon but a wide-ranging bird across Australia. It occurs mainly along rivers and ranges as well as wooded watercourses and lakes and nests primarily on cliffs, granite outcrops and quarries. The diet of the Peregrine Falcon has been well studied and includes primarily flocking species such as European Starlings (Olsen *et.al.* 2008).

The DPaW results returned five records of the Peregrine Falcon, however the Survey Area lacks suitable habitat and as such the Peregrine Falcon is considered Unlikely to occur.

Western False Pipistrelle

The Western False Pipistrelle is listed as Priority 5 under the DPaW Priority List. The species is a small insectivorous bat that inhabits tall forests and woodlands in the higher rainfall parts of south-west WA. Most records come from the Karri forests, but they have been found in Tuart and jarrah. They forage under the tree canopy and above the shrub layer (Woinarski 2014).

The DPaW database search returned a single record of the Western false pipistrelle from 1993. A lack of records and a lack of suitable habitat in the way of Karri, Tuart, or jarrah woodland results in the Western False Pipistrelle being considered Unlikely to occur in the Survey Area.

5.9 Black Cockatoo Assessment

Forest Red-tailed Black Cockatoo

The FRTBC is listed as Vulnerable under the EPBC Act and was returned from the EPBC PMST, NatureMap and DPaW searches.

The FRTBC is distributed through the humid and subhumid south-west of WA from Gingin through the Darling Ranges to the south-west from Bunbury to Albany. It occasionally occurs in the southern Swan Coastal Plain, and rarely in the Perth metropolitan area. The FRTBC occurs in pairs or small flocks, or occasionally large flocks of up to 200 birds (Johnstone & Storr 1998). The FRBC inhabits dense Jarrah, Karri and Marri forests that receive more than 600 mm average annual rainfall.

The FRTBC feeds primarily on Marri and Jarrah fruit (Johnstone & Kirkby 1999) and to a lesser extent on Blackbutt (*Eucalyptus patens*), Albany Blackbutt (*Eucalyptus staeri*),

Karri, Sheoak (*Allocasuarina fraseriana*) and Snottygobble (*Persoonia longifolia*). FRTBC can obtain energy faster when feeding on Marri and Jarrah than other food sources (Cooper *et al.* 2002) and these two plant species make up 90% of the diet of the FRTBC.

The Survey Area is located within the known distribution of this species and the vegetation consists of *Banksia sp. E. todtiana. A. fraseriana* and X. *preissii*. These species provide important foraging habitat for all three species of Black Cockatoo.

Baudin's Black Cockatoo

Baudin's Black Cockatoo is listed as Vulnerable under the EPBC Act. It was returned from the EPBC PMST and DPaW searches.

This species is distributed through the south-western humid and subhumid zones, from the northern Darling Range and adjacent far east of the SCP (south of the Swan River), south to Bunbury and across to Albany (Johnstone and Kirkby 2011). Baudin's Black Cockatoo rarely occurs near the coast north of Mandurah, and rarely occurs north of the Swan River (Johnstone and Kirkby 2008, Johnstone and Storr 1998). Baudin's Black Cockatoo usually occur in small flocks of up to 30, or occasionally up to 50 and rarely in aggregations of up to 1200 (Johnstone and Kirkby 2008). Baudin's Black Cockatoo is distinguished from Carnaby's Black Cockatoo by its longer bill and slightly different call.

This species forages primarily in Eucalypt forest, where it feeds on Marri seeds, flowers, nectar and buds. They also feed on a wide range of seeds of Eucalypt, Banksia, Hakea and Pines (*Pinus* sp.) as well as fruiting apples and pears and beetle larvae from under the bark of trees (Johnstone and Kirkby 2008, Johnstone and Storr 1998). Baudin's Black Cockatoo forages at all levels of the forest from the canopy to the ground, often feeding in the understorey on proteaceous trees and shrubs, especially Banksia, and in orchards both in trees and on dropped or fallen fruit on the ground.

The breeding biology of this species is poorly known. It has been recorded breeding in deep south-west, north to the Whicher Range and Lowden and also isolated records at Wungong Catchment, Serpentine (hills area) and east to Kojonup and near Albany (Johnstone and Kirkby 2008). They nest in large, mostly vertical, hollows of Karri (*E. diversicolor*), Marri, Wandoo, and Bullich (*E. megacarpa*). Baudin's Black Cockatoos display strong pair bonds are monogamous and most likely mate for life (Johnstone and Kirkby 2008). The pair remain together all year round except when the female is incubating and brooding. Both adults play a part in selecting the nest hollow, but only the female is responsible for renovation and preparing the hollow for breeding. Preparation of the hollow consists of chewing around the entrance of the hollow and down one part of the interior wall. Pairs have also been recorded prospecting for hollows in most months and also outside the breeding range (Johnstone and Kirkby 2008).

The Survey Area is located within the known distribution of this species and the vegetation consists of *Banksia sp. E. todtiana, Allocasuarina, A. fraseriana* and X. *preissii*. These species provide important foraging habitat for all three species of Black Cockatoo.

Carnaby's Black Cockatoo

Carnaby's Black Cockatoo is listed as Endangered under the EPBC Act and was returned from the EPBC PMST, NatureMap and DPaW searches. Carnaby's Black Cockatoo is endemic to south-west WA, and is distributed from the Murchison River to Esperance and inland to Coorow, Kellerberrin and Lake Cronin (Cale 2003). The species was once common, but the population has declined significantly in the last half century, and is now locally extinct in some areas (Johnstone and Storr 1998, Shah 2006). In the last 45 years the species has suffered a 50% reduction in its abundance (Cale 2003). This reduction is due to the clearing of core breeding habitat in the wheatbelt, the deterioration of nesting hollows, and clearing of food resources on the Swan Coastal Plain (Cale 2003). Results from the 2015 Great Cocky Count (Birdlife 2015) recorded 9,082 white-tailed black-cockatoos (Carnaby's and Baudin's Black Cockatoo) across the species range, which is the lowest total number recorded in the last three GCCs (2013-15).

Carnaby's Black Cockatoos feed on seeds, nuts and flowers of a variety of native and exotic plants. Food plants include Banksia (including those previously included in the genus Dryandra), Pine trees (*Pinus* sp.), Marri, Jarrah, Grevillea, Allocasuarina, and Hakea species (Shah 2006). Marri nuts that are damaged extensively, especially on the main body of the nut, are likely to have been chewed by Carnaby's Black Cockatoo or Forest Red-tailed Black Cockatoos. The severed new growth, developing flower heads and chewed seed pods of Banksia species are also a good indicator of Black Cockatoo feeding. Recent damage to bark is regarded as Black Cockatoo feeding activity along with the stripping of pine needles and cones (Cale 2003).

The seeds from seed pods of Banksia and the cones of Pine trees provide the highest energetic yield (Cooper *et al*. 2002). Carnaby's Black Cockatoo are less efficient at extracting Marri seeds than (the long-billed) Baudin's Black Cockatoo (Cooper *et al.* 2002).

Breeding has been recorded from early July to mid-December, and primarily occurs in the wheatbelt in the semi-arid and subhumid interior (Johnstone and Storr 1998).

The Survey Area is located within the known distribution of this species and the vegetation consists of *Banksia sp. E. todtiana, A. fraseriana* and X. *preissii*. These species provide important foraging habitat for all three species of Black Cockatoo.

5.9.1 Foraging Habitat

The total area of foraging habitat present in the Survey Area is 2.93 ha. This foraging habitat consists of B. *attenuata, B. menziesii*, *B. ilicifolia, A. fraseriana* and X. *preissii*. These are known dietary items of Black Cockatoos, (Johnstone & Kirkby 2011) and so provide important foraging habitat for all three species.

There was no evidence of Black Cockatoo foraging in the form of chewed Banksia cones.

5.9.2 Breeding Habitat

Black Cockatoos breed in large hollow-bearing trees, generally within woodlands or forests (Johnstone *et al.* 2013). The size of the tree can be a useful indication of the hollow-bearing potential of the tree. Trees of suitable DBH are potentially important for maintaining breeding in the long-term, through maintaining the integrity of the habitat and allowing trees to provide future nest hollows. Maintaining the long-term supply of trees of a size to provide suitable nest hollows is particularly important in woodland stands that are known to support Black Cockatoo breeding (SEWPaC, 2012).

The Black Cockatoo habitat assessment revealed that the Survey Area contained no large Eucalyptus trees with a DBH of > 500 mm [>300 mm for Wandoo]) and therefore are not considered potential breeding trees according to the EPBC Act Black Cockatoo referral guidelines.

5.10 Fauna Habitat Types

Five fauna habitat assessments were undertaken during the survey (Appendix L) and one fauna habitat was identified in the Survey Area:

Banksia Woodland

This habitat has an overstorey that consists of *B. attenuata*, *B. menziesii* and *B. ilicifolia* with very scattered *E. todtiana* and *M. preissii* over a midstorey of *Adenanthos sp. A. fraseriana* and *X. preissii* over an understorey of mixed native grasses and weeds.

The *E. todtiana*, *B. attenuata,* B. *menziesii, B. ilicifolia, A. fraseriana* and *X. preissii* provide foraging habitat for Black Cockatoos.

This habitat has vegetation in multiple strata (canopy, midstorey and understorey), small amounts of woody debris and leaf litter which provides habitat for small reptile, bird and mammal species. The small wetland area present towards the northern side of the Survey Area may provide some habitat for frog species.

6 Conclusions

The survey was undertaken within the recommended season and flowering period for the south west botanical province. The Survey Area was sufficiently surveyed and as such the following conclusions can be drawn:

- The condition varies greatly across the site, this being influenced by historical land use. The land-use of the property has been a source of ongoing disturbance. Disturbance sources include clearing, sheds (one being used as a home), a concrete slab, firebreaks and weeds;
- The eastern side of the Survey Area is the location of a High Voltage Powerline and therefore the vegetation under the powerline is subject to continual maintenance involving control burns, pruning and fuel reduction. This has altered the density; height and structure of the Banksia woodland;
- The statistical analysis resulted in the vegetation association "BiEt", being the most similar to FCT SCP21c, and "BmXp" with FCT SCP23a, both of these are listed as sub-communities of 'Banksia woodlands of the Swan Coastal Plain'. As of September 2016, 'Banksia woodlands of the Swan Coastal Plain' are listed as Endangered under the EPBC Act. For vegetation remnants to be under national protection the community must meet key diagnostic characteristics;
- Based on this information, and the survey results, there is approximately 0.188 ha of FCT SCP23a rated as Very Good condition and 1.276 ha in Good condition. FCT SCP21c has approximately 0.150 ha rated as Very Good condition and 0.413 ha in Good condition. It is, therefore considered, that the vegetation remnants are both too small and disturbed to be suitable for National protection under the federally listed Banksia woodlands of the Swan Coastal Plain;
- FCT SCP23a and FCT SCP21c are listed as Priority 3 communities;
- No Threatened species listed under the EPBC Act and/or gazetted as Declared Rare Flora (Threatened) pursuant to the WC Act were recorded during the survey;
- No Priority flora were recorded during the survey;
- No Bush Forever sites occur in the Survey Area;
- The Survey does not form part of the Draft Regional Ecological linkage network;
- No DPaW Geomorphic Wetlands have been identified; and
- The Survey Area is not identified as an ESA.

The fauna assessment was undertaken at a time considered appropriate for the species of conservation significance considered likely to be present on site. The following conclusions can be made:

- During the desktop review of database searches, nine conservation significant species were identified;
- No species of conservation significance were recorded in the Survey Area:
- 2.93 ha of Black Cockatoo foraging habitat was recorded in the Survey Area;
- No foraging evidence was recorded in the Survey Area;
- No Black Cockatoo potential breeding trees were recorded; and
- One fauna habitats were identified in the Survey Area.

7 Recommendations

In order to minimise the impact on native flora and fauna, it is recommended that future development avoid unnecessary clearing of vegetation beyond that strictly required.

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