VASSE FELIX

Level 1 Fauna Survey and Habitat Assessment

LOT 30 TOM CULLITY DRIVE, WILYABRUP

FEBRUARY 2013

ngh environmental

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EXECUTIVE SUMMARY

Vasse Felix Pty Ltd, the proponent, seek to identify fauna values within Lot 30 (DP 46641), Tom Cullity Drive, Wilyabrup. To identify onsite opportunities and constraints, a baseline Level 1 fauna and habitat assessment is required. The study area encompasses Stages two to six of a mix of remnant vegetation (Stages two to five) and paddock trees (Stage six). Stage one (1.42 ha) was recently cleared and is not included in this assessment.

The study area contains 8.6 ha of good quality fauna habitat (Stages two to five), and a number of habitat trees and patches within Stage six. The entire site contains foraging habitat for the threatened Black Cockatoos (Forest Red-tailed Black Cockatoo, Baudin's Cockatoo and Carnaby's Black Cockatoo), including the paddock trees. Forest Red-tailed Black Cockatoo feed signs were observed widely over the site and Baudin's Black Cockatoo was sighted. Western Ringtail Possums (WRP) were present in the drainage line vegetation between Stages five and six and in lower abundances in Stages three to five. Additional target species such as Peregrine Falcon, Rainbow Bee-eater and Western False Pipistrelle may also occur at the site.

There are numerous mature Jarrah and Marri suitable for developing hollows within the study area; 277 trees with a DBH greater than 50cm. A total of 93 trees contained 109 medium or large hollows. It is not clear whether these are actually suitable (i.e. depth) for Black Cockatoo breeding, however a DBH of 50 cm or more is considered to be suitable breeding habitat under the EPBC Act referral guidelines for three threatened black cockatoo species (SEWPaC 2012). No Black Cockatoo roosting sites were observed within the study area.

Depending on the scale of clearing there may be a need for a Referral under the EPBC Act, given the potential for a significant impact on Forest Red-tailed Black Cockatoos but also potentially Baudin's and Carnaby's Black Cockatoo. SEWPaC should also be made aware of the presence of WRP if the project is referred. It is the responsibility of the proponent to refer the proposal (the Black Cockatoo referral guidelines: http://www.environment.gov.au/epbc/publications/wa-black-cockatoos.html).

Adoption of the following measures would assist to minimise the risk posed by the proposal to biodiversity values within the study area:

- Large hollow-bearing trees should be retained wherever possible.
- Where removal of large or hollow-bearing trees is proposed this should be undertaken in accordance with **ngh**environmental's tree removal recommendations (Appendix D), with a qualified/licensed fauna spotter on site (to keep records, handle threatened fauna and prevent injury to fauna during clearing).
- The areas adjacent to the drainage line (between Stages 5 and 6, and possibly the southern part of Stage six) could be revegetated with a variety of local provenance and endemic species, including understory species, if clearing is carried out elsewhere. Peppermint (*Agonis flexuosa*) should be planted heavily in this mix.
- If clearing is required within Stages two to five, this should be minimised and a vegetated corridor retained where possible linking to the creekline between Stages 5 and 6. The wider this corridor is, the more valuable it will be (minimum 20m wide, preferably 40m). It should also be fenced.
- Schedule clearing outside of key breeding periods for target fauna

1 INTRODUCTION

1.1 BACKGROUND

Vasse Felix Pty Ltd, the proponent, seek to identify fauna values within Lot 30 (DP 46641), Tom Cullity Drive, Wilyabrup. To identify onsite opportunities and constraints, enable appropriate land use planning and support any future clearing permit applications (including Federal referral if required) for the expansion of viticulture, a baseline Level 1 fauna and habitat assessment is required.

The study area encompasses Stages two to six of a mix of remnant vegetation (Stages two to five) and paddock trees (Stage six) primarily along the southern boundary of the allotment. Stage one (1.42ha) was recently cleared under permit CPS 5063/1, as approved by the Department of Environment and Conservation (DEC) pursuant to the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. On this basis it is not included in this assessment.

1.2 LOCATION

Lot 30 is located approximately 30 km southwest of Busselton, six kilometres northwest of Cowaramup, within the City of Busselton local government area. The study area is inland approximately five kilometres from the Indian Ocean (Figure 1). The study area detailing Stages two to six is shown in Figure 1-2.

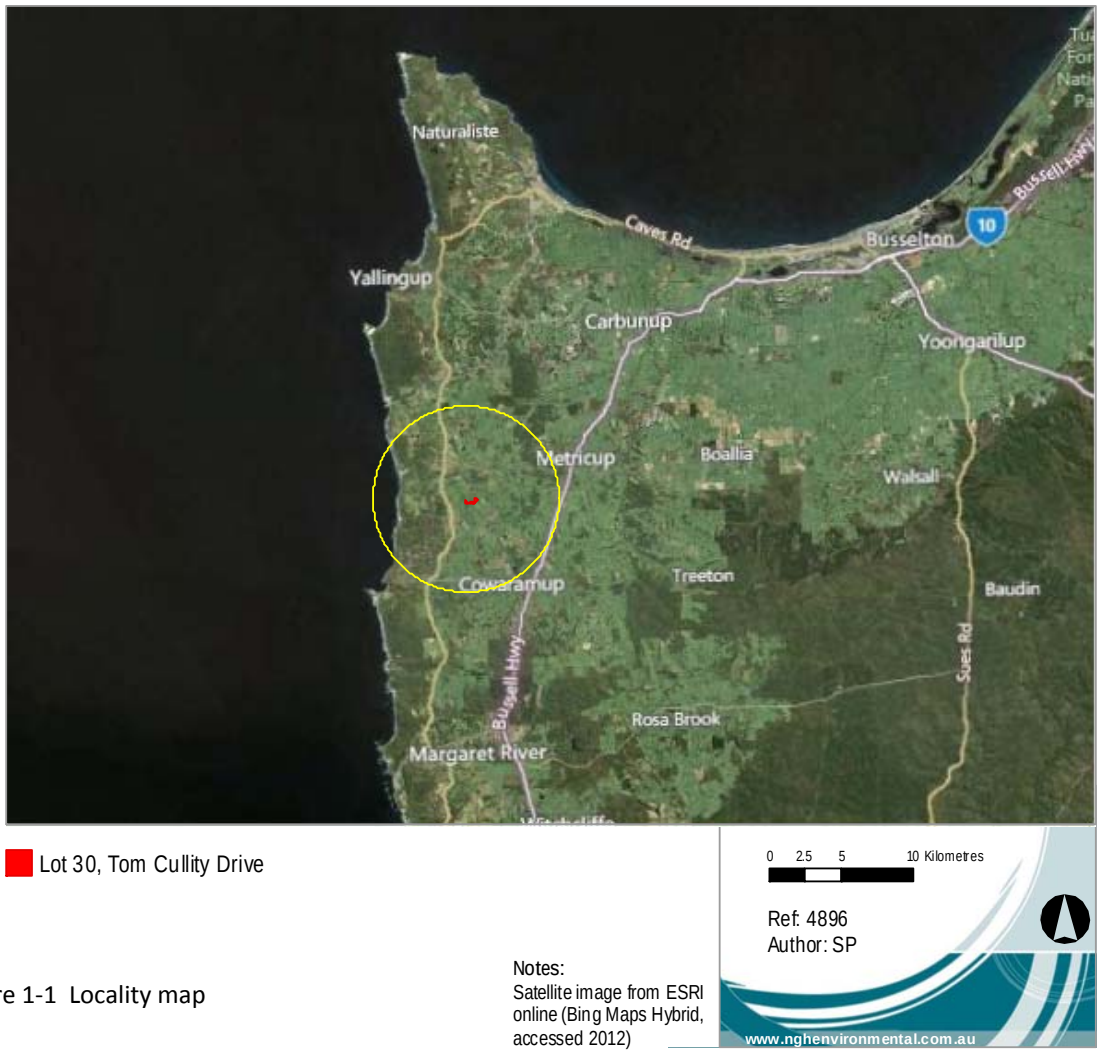

Figure 1-1 Locality map

Notes:
Satellite image from ESRI online (Bing Maps Hybrid, accessed 2012)

The study area can be broken down into four Stages (two to six) shown in the table below.

Table 1-1 Area (ha) of stages two to six

Stage	Area (ha)
Two	1.88
Three	1.41
Four	2.32
Five	3.04
Six	8.15
Total	16.80

Figure 1-2 Study area (Stages in yellow text)

1.3 PROJECT SCOPE

nghenvironmental were engaged by the proponent to prepare this Level 1 Fauna and Habitat Assessment within Stages two to six shown in Figure 1-2. The assessment involved the following:

- Desktop / background survey: Relevant databases were searched, a list of local conservation significant species compiled and a risk assessment carried out to determine likely presence and level of impact if all stages were to be cleared.
- On site habitat assessment: The project area was assessed and broad fauna habitat types identified. Habitat elements that were assessed included vegetation, rock outcrops, ground litter, habitat trees and fallen logs.
- Opportunistic fauna survey: Opportunistic observations of fauna species were made during the survey.
- Black Cockatoo habitat assessment: This included a breeding habitat survey which involved the identification of all suitable breeding tree species (e.g. Marri and Jarrah) that have a Diameter at Breast Height (DBH) of over 50 cm. The location of each tree identified was recorded with a GPS and details on tree species, number and size of hollows noted. Evidence of Black Cockatoos foraging or roosting within the site was also recorded.

In addition, this report provides preliminary advice on referral requirements under the *Environmental Protection and Biodiversity Conservation Act 1999*. Practical and achievable mitigation measures to reduce potential biodiversity impacts and avoid significant impact to fauna, in particular threatened, migratory or priority listed species have also been provided.

1.4 LEGISLATIVE FRAMEWORK

This fauna survey is designed to meet the requirements of the following relevant State and Commonwealth legislation:

- *Environmental Protection Act 1986* (EP Act),
- *Wildlife Conservation Act 1950* (WC Act),
- Federal *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act).

WC Act

Species of fauna, flora and ecological communities are afforded Declared Rare or Priority conservation status where their populations are restricted geographically or threatened by local processes. The Department of Environment and Conservation (DEC) administers this Act. DEC recognises these threats of extinction and consequently applies regulations towards population and species protection. The Western Australian Minister for the Environment regularly gazettes a notice where taxa are listed as protected and classified as Schedule 1 through to Schedule 4 according to their conservation status or need for protection. The most recent was issued on 6 November 2012 and included a number of status revisions.

The DEC also produces a list of priority species that have not been assigned statutory protection under the WC Act, but are under consideration as 'Scheduled' taxa, and are in urgent need of further survey or regular monitoring, and although not currently threatened may become so in the future.

EPBC Act

In accordance with Federal legislation, the EPBC Act also provides a list of matters of 'National Environmental Significance' (NES), which includes significant fauna, flora and communities. Any proposal

that is likely to result in a significant impact to any matters of NES will require referral to the Department of Sustainability, Environment, Water, Population and Communities (SEWPAC) for assessment in accordance with the EPBC Act.

1.5 GUIDELINES

The assessment also considers the following guidelines:

- 'Environmental Protection of Native Vegetation in Western Australia' Position Statement No. 2, EPA (2000),
- Commonwealth 'Matters of National Environmental Significance – Significant impact guidelines 1.1 *Environmental Protection and Biodiversity Conservation Act 1999*, Department of the Environment, Water, Heritage and the Arts (DEWHA)', (2009),
- Commonwealth 'EPBC Act referral guidelines for three threatened black cockatoo species: Carnaby's cockatoo (endangered), *Calyptorhynchus latirostris*, Baudin's cockatoo (vulnerable), *Calyptorhynchus baudinii*, Forest red-tailed black cockatoo (vulnerable) *Calyptorhynchus banksii naso*', (2012),
- EPA Guidance Statement No. 56 'Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia', (2004), in particular 'Level 1 surveys', outlined in Appendix 2 of the Guidance Statement,
- 'Terrestrial Biological Surveys as an Element of Biodiversity Protection. Position Statement No. 3', EPA (2002).

2 APPROACH

2.1 DESKTOP REVIEW

2.1.1 Database searches

Prior to field surveys, desktop reviews were undertaken to determine the potential presence of fauna listed under the WC Act or EPBC Act matters of NES or afforded priority status (by the DEC).

These involved searches of the following to develop an understanding of the ecological values of the site and assist in identifying the likelihood of target species (threatened, migratory or priority listed fauna) occurring within the study area:

- NatureMap online database (which includes compiled records from DEC, WA Museum and others) for conservation significant fauna within 10 km of the study area (NatureMap, 2012).
- The SEWPAC Protected Matters Search Tool for matters of NES within 5 km of the study area (SEWPAC, 2012).
- Atlas of Living Australia (regularly updated with other database records) (ALA, 2012).
- Soils (DAFWA 2004), Pre-European Vegetation from Beard vegetation associations (1975, 1981), Mattiske and Havel vegetation complexes (1998), EPP and geomorphic wetlands and other open source datasets (SLIP, 2012) for baseline information.
- Analysis of aerial photography (Nearmap 2012, accessed 13.09.2012)

2.1.2 Review of available literature

No previous surveys within the vicinity of the study area were available or able to be accessed for this report. Publications consulted for general habitat and distribution of fauna included:

- Common Birds of the South West Forests (Thomson-Dans & Hunter, 2009).
- Common Trees of the South West (Wheeler, 2007).
- Frogs of Western Australia (Thomson-Dans & Wardell-Johnson, 2002).
- Mammals of the South West (Johnson & Thompson Dans, 2003).
- Reptiles and Frogs in the Bush: Southwestern Australia (Bush *et al*., 2007).
- Scats, Tracks & Other Traces: A field guide to Australian mammals (Triggs, 2004).
- The Field Guide to the Birds of Australia (Pizzey & Knight, 2007).
- Threatened and Rare Birds of Western Australia (Burbidge & Blight, 2008).
- Waterbirds of South-west Wetlands (Thomson-Dans & Halse, 2001).

This information and a brief review of the ecology, habitat and range of each species was used in a evaluation matrix to determine the likely presence/absence of threatened, migratory or priority listed fauna species and populations and their habitats identified under the WC Act and EPBC Act. This is included in Appendix A.

2.2 FIELDWORK

2.2.1 Fauna

A Level 1 fauna survey was undertaken on 13 and 14 December, 2012 by suitably qualified personnel (Shane Priddle). This included a general habitat assessment with particular consideration of the target species identified during the desktop assessment (Appendix A). Two habitat assessment plots were undertaken within each stage along with opportunistic surveys across the entire site. Nocturnal surveys were not carried out. Survey methods and effort are described further below and shown in Appendix G.

Habitat assessment

In general terms, fauna habitat quality is rated on the complexity of habitat structure, mosaic and presence of breeding and foraging resources for a range of fauna including arboreal, scansorial and ground-dwelling. Notes were made about the quality of habitat based on the descriptions in Table 2-1 below.

Table 2-1 Fauna habitat quality categories and descriptions

Quality	Description
Good	• Diverse habitat structure, that is, structural components present at a range of stratum levels (ground, understorey, midstorey, canopy) and age classes. • Presence of shelter and refuges, that is, low shrub or tussock, rocky outcrop, hollow logs (ground dwelling fauna). • If forest or woodland: moderate to high abundance of hollow-bearing trees, including mature trees which are more likely to bear hollows of a range of sizes, including those with large internal dimensions. Mature trees also produce more foraging resources for nectar and seed eating fauna.

Quality	Description
	• Habitat complexity, that is, areas of ecotones between vegetation types or areas with different management regimes, which produce a habitat mosaic. This increases the range of foraging and shelter opportunities within a habitat. • Presence of key foraging and microhabitat components, which depend on subject species. • Little to no obvious weed invasion. • May be large patch in extent and connected to other areas of native vegetation.
Moderate	• Medium complexity of habitat structure appropriate to vegetation type. Ground litter layer intact or slightly disturbed. More than one age class present. • Some shelter and refuge present for ground dwelling fauna. • If forest or woodland: hollow-bearing trees present in low to moderate abundance. • Habitat complexity, that is, areas of ecotones between vegetation types or areas with different management regimes, which produce a habitat mosaic. This increases the range of foraging and shelter opportunities within a habitat. • Presence of key microhabitat components, which depend on subject species. • Native flora species dominant. • May be small or large in scale, and isolated or well connected.
Poor	• Habitat highly disturbed and simplified with very little structural complexity. Ground litter layer absent or highly modified. Complexity reduced by only one age class present. • Little or no shelter and refuge for ground dwelling fauna. • If forest or woodland: low abundance of hollow-bearing trees. • Lack of key foraging and microhabitat components, which depend on subject species. • May be narrow or small area and substantially influenced by edge effects, and isolated from other areas of native vegetation.

During the habitat assessment, areas were searched for:

- Rocky outcrops,
- Large water bodies,
- Scats, tracks and other signs (e.g. burrows),
- Termite mounds,
- Habitat types and resources for target species (Appendix A)

Given that the Western Ringtail Possum (WRP) has the potential to utilise the site but only sparsely and in small numbers, nocturnal surveys were not carried out. This was deemed adequate given that the site is located outside of the Busselton-Bunbury area and therefore not subject to the DEC's Preliminary WRP Assessment requirements as outlined in the DEC's *Draft development guidelines for WRP (2009*).

Black Cockatoo habitat assessment

The Black Cockatoo habitat assessment involved walking over the entire site, in transects (width was based on GPS tracks and density of large trees, to ensure all trees were accounted for). Specifically it included searches for:

- Black Cockatoo foraging habitat, roosting and habitat trees[1]: Individual habitat trees were mapped i.e. those with the potential to develop hollows (Jarrah, Marri, Karri, Tuarts, etc with a diameter at breast height (DBH) 50cm or over). Species, height and DBH were also recorded.
- Hollow-bearing trees: Recorded likely hollows, including height and hollow diameter (different Black Cockatoos utilise different microhabitat attributes). Hollow heights and sizes were grouped into classes that could be used to differentiate hollows suitable for each of the Black Cockatoos (see Section 3.2.2). Hollow height was classified as low (less than 10 metres from the ground), moderate (10 to 20 metres from ground) or high (more than 20 metres from ground). Hollow sizes were classified as small (less than 10 cm in diameter), moderate (10-20 cm) or large (greater than 20 cm).
- Black Cockatoo feed signs.

2.2.2 Weather conditions

Fauna surveys were undertaken in mid December 2012. Weather conditions were average for the time of year and fairly consistent in the week leading up to the survey (Table 2-2). Fauna species were unlikely to be exhibiting unseasonal behaviour during the survey period.

Table 2-2 Weather conditions at the Witchcliffe weather station during fauna surveys (BOM 2012)

Date	Temperature (°C)		Rainfall (mm)	Wind (direction, km/hour)	
	Min	Max		9am	3pm
13.12.12	16.2	24.5	11	SE, 19	SSE, 24
14.12.12	15.3	24.4	0	S, 15	SSW, 20

2.3 MAPPING

Field data was collected with a Garmin GPS Map 60Cx. Mapping was carried out using ArcGIS 10 software. Base layers were digitised from PDF layers provided by the proponent unless noted on the maps. All maps and waypoints are shown in co-ordinate system GDA (MGA) 94 zone 50.

2.4 LIMITATIONS

In accordance with the EPA Guidance Statement No. 56, potential limitations of the surveys have been considered below:

Competency

Suitability qualified individuals carried out the survey work:

- Shane Priddle, Certified Environmental Practitioner, **ngh**environmental

Shane has completed numerous Level 1 and Targeted Threatened Fauna surveys through WA and south eastern NSW since 2003. He has also carried out targeted Black Cockatoo habitat surveys (as stand alone or components of broader

[1] Trees with DBH of 50cm or more are considered of sufficient age to begin to form hollows and hollow entrances greater than 10 cm entrance diameter are required for Black Cockatoos (DEC 2007; *pers.comm.* Raana Scott, BirdLife Australia 2010). These are described as "breeding habitat" by SEWPAC in the Black Cockatoo guidelines (SEWPAC, 2012)

	biodiversity assessments) in WA since 2009 and for eastern States species since 2003. He is considered competent to carry out the work required within this assessment. Competency was not a limitation of this assessment in relation to target fauna species.
Access	All areas requiring survey were accessible by vehicle and foot. Access was not a limitation of this assessment.
Timing	Weather was usual for the time of year during fauna surveys. Timing is not considered a limitation to the fauna assessment.
Scope	A level 1 fauna assessment was undertaken with onsite fauna survey and habitat assessments. Field information was supplemented with a desktop review. Any field visit represents a snap shot of conditions and species present on site. Without regular surveys over a longer period of time, the scope is a limitation to assessment in terms of accurately recording the suite of species present at a site. Nocturnal fauna that may utilise the hollows on site for daytime refuge and escaped detection. Nocturnal surveys are typically the method used to identify WRP presence and abundances, but were outside of the scope of this assessment. A number of species may also utilise the site only periodically. Higher Level surveys may also improve the identification of some species, e.g. bats through the use of an Anabat (for call detection and analysis) that may not have been seen on site (e.g. Western False Pipistrelle). These limitations are partly overcome by the precautionary approach, below.
Hollow-bearing trees	While every effort has been made to obtain accurate and reliable data about presence of hollows, it is difficult to be certain about whether an apparent hollow is actually hollow, and vice versa, without physical inspection. Thus, it is likely that some hollows have been overlooked while others have been recorded when they are in fact not hollow. **ngh**environmental are confident that, on balance, the figures obtained are a reliable estimation of type and number of hollows located within the study area. Hollows less than 10 cm diameter may have been overlooked as they are too small to be utilised by Black Cockatoos and were outside of the scope of work. GPS can be affected by woodland environments. Waypoints and tracks within woodland areas therefore may be less accurate than the open paddock areas.
Other	Stage one was already cleared prior to this assessment and was therefore not included. Stages 2 and 3 had also been recently burnt. Burning will affect the habitat quality and species diversity in the short - medium term and result in lower values than may otherwise have been present prior to the burn or in the long term once vegetation has regenerated. The recent burning of Stages two and three is therefore a limitation in those locations.
Precautionary approach	As it is difficult to rule out the presence of any particular species without rigorous and replicated scientific surveys, a precautionary approach has been adopted. That is, if suitable habitat is present and desktop assessment has determined the species could occur in the area, the species has been assumed to have potential to utilise habitat within the proposal area. This approach is not a limitation to this assessment.

3 DESKTOP REVIEW

3.1 ENVIRONMENTAL CONTEXT

3.1.1 Interim Biogeographic Regionalisation of Australia (IBRA) values

The Interim Biogeographic Regionalisation for Australia (IBRA) classifies Australia's landscapes into 89 large geographically distinct bioregions based on common climate, geology, landform, native vegetation and species information. IBRA also provides for the national and regional planning framework for the systematic development of a comprehensive, adequate and representative (CAR) National Reserve System, endorsed by all levels of government as a key tool for identifying land for conservation under Commonwealth's Australia's Strategy for the National Reserve System 2009-2030 (SEWPAC, 2012).

According to the latest IBRA update (7), the subject site is located within the WAR01 sub-region of the Warren bioregion (Environment Australia, 2000). This is described by Hearn et al (2002) as "dissected undulating country of the Leeuwin Complex, Southern Perth Basin (Blackwood Plateau), South-West intrusions of the Yilgarn Craton and western parts of the Albany Orogen with loamy soils supporting Karri forest, laterites supporting Jarrah-Marri forest, leached sandy soils in depressions and plains supporting low Jarrah woodlands and paperbark/sedge swamps, and Holocene marine dunes with *Agonis flexuosa* and Banksia woodlands and heaths".

The high rainfall and low evaporation and plant transpiration within the bioregion contributes to high forests, perennial rivers and wetlands making it unique within WA, and has subsequently assisted in the development of highly endemic flora and (invertebrate) fauna.

3.1.2 Brief land use summary

Land uses within the Warren region are typically characterised by grazing (improved pastures), cultivation (irrigated horticulture and vineyards), and conservation reserves. Forestry, rural residential, mining and utility infrastructure easements also occur but to a lesser degree (Hearn et al. 2002). Lot 30 has a history of viticulture and also contains a residence with numerous access tracks. Approximately two fifths of the Lot contains vineyards, two fifths contains remnant vegetation and the remaining fifth is cleared paddock with intermittent paddock trees. Stages two to six account for approximately half of the remnant vegetation within Lot 30.

3.1.3 Landforms, soils and climate

Soils within the study area are mapped as predominately Cowaramup Uplands System (216Co) 'Loamy gravels, duplex sandy gravels, semi-wet and wet soils' occurring on the 'Lateritic plateau with broad swampy depressions' landform. Wilyabrup Valleys System (216Wv) soils 'Loamy gravels, duplex sandy gravels and loamy earths' over the 'Major valleys landform', also occurs in the northern half of Stage 2 (DAFWA, 2004).

Local climate is classified as Warm Mediterranean, with winter dominant rainfall ranging between 600 and 1000mm annually (Environment Australia, 2000).

3.1.4 Important Bird Areas (IBA)

Important Bird Areas (IBAs) are sites of global bird conservation importance and are effective ways of identifying conservation priorities and are considered key sites for conservation (able to be conserved in their entirety and usually part of a protected-area network (Birdlife International, 2012)). They do one or more of three things:

- Identify areas where significant numbers of one or more globally threatened species occur
- Are one of a set of sites that together provide habitat for a suite of restricted-range species or biome-restricted species
- Identify areas where exceptionally large numbers of migratory or congregatory species occur

No IBAs occur in the immediate vicinity of the subject site.

3.2 ENVIRONMENTAL VALUES

3.2.1 Vegetation

Pre-European Vegetation at the subject site has been mapped at a broad scale by DAFWA (2005) adapted from 1:250,000 mapping carried out by J.S. Beard between the late 1960's to early 1980's (Beard 1975, 1980). The vegetation of the study area is part of the Chapman system mapped as Vegetation association Chapman 6; Medium woodland; Tuart and Jarrah.

The subject site also occurs within two Mattiske and Havel (1998) vegetation complexes, Cowaramup C2 and a small area of Wilyabrup W2 corresponding with the changes in soils type, over the northern half of stage 2. These are described below.

Cowaramup C2: Open forest of *Eucalyptus marginata subsp. marginata-Corymbia calophylla-Banksia grandis* on lateritic uplands in perhumid and humid zones.

Wilyabrup W2: Open forest of *Corymbia calophylla-Allocasuarina decussata-Agonis flexuosa* on deeply incised valleys in perhumid and humid zones.

3.2.2 Fauna

Fauna and habitats

A review of the Atlas of Living Australia (ALA 2012) shows a total of 79 animal species recorded within 10 km of the subject site (refer to updated list in Appendix C). This list is not exhaustive. From broad scale mapping and aerial photo interpretation, habitat at the subject site consists of areas of well connected woodland with cleared paddock and vineyards between. There appear to be connected vegetated drainage lines east and west of the study area, extending to north and south.

Ecotones between the woodland and vineyards also provide foraging opportunities for owls, raptors and some bats. The corridor widths (from 50 to several hundred metres) are likely to offer good habitat opportunities for a range of fauna, including larger species (mammals in particular), as well as dispersal at a landscape scale. Adjacent dams and creeks also offer similar opportunities for different species, for example Western Ringtail Possums may utilise the cooler drainage lines for dispersal and Rainbow Bee-eaters and bats often forage over dams.

Granite outcrops, dead wood and trees are essential habitat components for a variety of fauna. If present these resources provide shelter and the range of invertebrate, microbial and vertebrate species supported by decaying wood provides food for a number of other species.

Threatened species

The databases identified 17 vertebrate fauna species and four invertebrate species of conservation significance that have been recorded locally (Table 3-1). This includes eight bird species, four of which are threatened (one priority listed, two terrestrial migratory and one specially protected). Eight mammals have been observed locally (three threatened and five priority listed) along with a specially protected reptile. No fish or amphibians of any specific conservation significance are likely to occur at the site. A habitat evaluation table has been prepared for threatened fauna (Appendix A). While a number of invertebrates are listed and may occur locally they rely on wetland or sumplands which do not occur within Stages two to six. Waterbirds and marine species were not included.

Table 3-1 Threatened, migratory and priority listed fauna that may occur locally (**habitat may not necessarily be suitable at the subject site for all species**). Refer to Appendix A for conservation status descriptions and risk assessment.

Species Status* (State, Cth)
INVERTEBRATES
Austroassiminea letha (Cape Leeuwin Freshwater Snail) (T)
Engaewa reducta (Dunsborough Burrowing Crayfish) (T, CE)
Engaewa pseudoreducta (Margaret River Burrowing Crayfish) (T, CE)
Westralunio carteri (Carter's Freshwater Mussel) (P4,-)
VERTEBRATES
AMPHIBIA
-
AVES
Botaurus poiciloptilus (Australasian Bittern) (T, E)
Calyptorhynchus banksii subsp. naso (Forest Red-tailed Black Cockatoo)(T, V)
Calyptorhynchus baudinii (Baudin's Black Cockatoo) (T, V)
Calyptorhynchus latirostris (Carnaby's Black Cockatoo) (T, E)
Falcunculus frontatus subsp. leucogaster (Crested Shrike-tit western subspecies) (P4)
Falco peregrinus (Peregrine Falcon) (S, -)
Haliaeetus leucogaster White-bellied Sea eagle (-, M)
Merops ornatus (Rainbow Bee-eater)(-, M)
MAMMALIA
Dasyurus geoffroii (Western Quoll, Chudich)(T, V)
Falsistrellus mackenziei (Western False Pipistrelle)(P4, -)
Hydromys chrysogaster (Water-rat)(P4)
Isodon obesulus fusciventers (Southern Brown Bandicoot, Quenda) (P5, -)
Macropus irma (Western Brush Wallaby) (P4, -)

Species Status* (State, Cth)
Phascogale tapoatafa (Brush-tailed Phascogale, Wambenger)(T, V)
Pseudocheirus occidentalis (Western Ringtail Possum) (T, V)
Setonix brachyurus (Quokka)(T, V)
REPTILIA
Morelia spilota imbricata (Southern Carpet Python)(P4, -)
PISCES
-

3.2.3 DEC lands

The subject site is not located near any DEC lands. The closest is the coastal Leeuwin-Naturaliste National Park over four kilometres away to the west.

4 FIELDWORK RESULTS

4.1 FAUNA HABITAT

4.1.1 General habitat values

Fauna habitat within the study area consists of good quality Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) forest (Stages two to five). The understorey is generally in good condition with diverse native groundcover. The mid storey is generally open with Grass trees (*Xanthorrhoea spp*) and *Banksia spp* being some of the more common taxa. Although the study area has been logged in the past there are still many large trees (live and dead), some of which contain hollows. The overstorey contains a range of age classes and good recruitment of regrowth and large trees.

Generally Stage 5 is more open than Stage 4 with less mid storey. Stages 2 and 3 had been recently burnt and are subsequently without a midstorey and limited understorey. Large trees, including those with hollows, are still present.

Stage six has been cleared and grazed and is now restricted to mostly large and well established paddock trees (Jarrah, Marri and Peppermint). There are areas south of the dam where they are growing in clumps of up to two or more trees or where canopy connectivity has been maintained however in the most part they are isolated. The understorey is completely cleared over the entire study area due to past grazing. Some shrubs are starting to regenerate and offer some habitat opportunities, mainly for birds.

A large (0.3 ha) pile of rocks occurs on and outside of the southern boundary of Stage six. While this was artificially derived and isolated (not linked to any vegetation), it has the potential to provide refuge for reptiles. No other micro habitats are present within the study area (e.g. water courses, riparian vegetation, swamps, significant fallen timber).

Photos of the typical habitat are shown in Appendix B.

4.1.2 Corridor value

The study area offers a continuous corridor along the southern boundary of Lot 30, linking good quality vegetation around the perimeter of the property and more broadly, two creek systems off site. The width of the existing corridor is 80 m at its narrowest point (between Stages 3 and 4). It is highly likely that a range of fauna (including target species) are utilising this permanently for breeding and foraging habitat. Other more mobile species and those with larger home ranges such as the Western Quoll (*Dasyurus geoffroii)* and macropods may also use it periodically or pass through the study area when moving between larger patches but are unlikely to require it directly for foraging or breeding.

4.2 TREES

Habitat trees and hollows

There are numerous large trees of species suitable for developing hollows within the study area; 277 trees with a DBH greater than 50 cm; 30 of these have a DBH over 100 cm (see Appendix G). Smaller trees can also develop small hollows but were not recorded as it was outside of the scope of the survey. Thirteen trees with small hollows (less then 10cm DBH) were observed, though this is probably an underestimate of the actual number of hollow-bearing trees with small hollows across the site

Hollow-bearing tree surveys focussed on larger hollows that may be suitable for Black Cockatoo breeding. A total of 93 trees contained 109 medium or large hollows, with at least 6 hollows showing signs of active use (see Appendix G). Jarrah accounted for 36 trees, there were 42 Marri and only four stags (dead trees). The majority of trees with a DBH greater than 100 cm were Marri (18) followed by Jarrah (4). No active Black Cockatoo roosting sites were observed within the study area.

Hollows with characteristics suitable for Baudin's Black Cockatoo, Carnaby's Black Cockatoo and Forest Red-tail Black Cockatoo are shown in Table 4-1. Refer to **Error! Reference source not found.**for the locations of habitat trees and hollows. Baudin's Black Cockatoo usually nests in hollows with a large entrance diameter (30-40 cm) (DEC 2007), at considerable height above the ground (30-50 m above ground) (Jupp 2000). The study area exists within the species known breeding range (SEWPAC, 2012; Johnstone & Kirkby, undated). Carnaby's Black Cockatoo nests in hollows with medium to large entrance diameters (entrances greater than 10 cm) (Raana Scott, 2010) at a range of heights, including low to the ground (SPRAT 2010). Forest Red-tailed Black Cockatoos nest in mostly vertical hollows of Karri, Marri, Wandoo, Jarrah and Bullich with medium to large entrance diameters (12-41 cm) at heights of 8-14 m above ground. Spouts may be preferred. (DEC 2007; Johnstone & Kirkby, undated).

Table 4-1 Characteristics of hollows recorded in the subject site

Hollow type	Number of hollows	
Baudin's Black Cockatoo hollows	Hollows	Trees
Large hollows, >30m height	0	0
Carnaby's Black Cockatoo & Forest Red-tailed Black Cockatoo hollows	Hollows	Trees
Medium and large hollows, <10m height	36	27
Medium and large hollows, >10m height	73	66
Total no. hollows of medium to large size, any height	109	93
Total no. hollows recorded in the subject site (any size or height)	122	111

The raw habitat tree data is included in Appendix F.

4.2.2 Threatened, migratory or priority listed fauna

The following threatened, migratory or Priority listed fauna have potential to occur within the study area. For conservation status and risk assessment of each species, refer to Appendix A.

Carnaby's Black Cockatoo (Threatened WC Act, Endangered EPBC Act)

Carnaby's Black Cockatoo mainly occurs in or near eucalypt woodlands, especially those dominated by Wandoo or Salmon Gum, and is sometimes reported in forests of Marri, Jarrah, Karri and Tuart. On the Swan Coastal Plain most nests are in Tuart (SPRAT 2009) (Johnstone and Kirkby, undated). Nesting hollows may be located anywhere from 2 m to >10 m from the ground, mainly in the Wheatbelt (Cale 2003, SPRAT 2010, WA Museum 2010).

This species is a postnuptial nomad, tending to move west after breeding. E.g. most birds breeding in inland regions tend to move west after breeding into higher rainfall areas especially the nearcoastal Banksia scrubs (e.g. near Wanneroo) then many of these move further south onto the southern Swan Coastal Plain, southern Perth metropolitan area and Myalup areas. From breeding records in the Storr-Johnstone Bird Data Bank, this species is currently expanding its breeding range westward and south into the Jarrah-Marri forests of the Darling Scarp (e.g. Wungong Dam Catchment) and into the Tuart forests of the Swan Coastal Plain including near Bunbury, possibly due to climate change (Johnstone and Kirkby, undated).

Breeding success is dependent on suitable foraging habitat adjacent to the nest site to provide the necessary food for the survival of the chick. In the Bunbury, Ludlow and Whicher Range areas where breeding is recorded, there are areas of remnant vegetation, National Parks, Nature Reserves, State Forests, roadside verges and pine plantations that contain breeding and foraging habitat for Carnaby's Cockatoos (Johnstone and Kirkby, undated).

Breeding occurs mainly from early July to mid-December in the semi-arid and subhumid interior. The species is known to breed near Margaret River and the study area may be on the edge of this range (SEWPAC 2012). There has been an apparent shift in its breeding range further west and south since the middle of last century with a more rapid increase in the past 10–30 years into the Jarrah-Marri forests of the Darling Scarp and the Tuart forests of the Swan Coastal Plain (Johnstone and Kirkby, undated).

Although feed tree species are present, feed signs was not observed within the study area. The recovery plan for this species identifies the following critical habitat: *"remaining woodland breeding sites in the south west of Western Australia, and feeding and watering areas used during the breeding period [as well as] woodland sites known to have supported breeding in the past and which could be used in the future if new food resources are established"* (Cale 2003). The habitat in the study area appears to be outside of previously known breeding areas (SEWPaC 2012) and therefore may not constitute critical habitat for the Carnaby's Black Cockatoo.

Rainbow Bee-eater (Migratory EPBC Act)

Rainbow Bee-eaters *(Merops ornatus)* occupy a variety of habitats, and migrate to the south of the continent in summertime to breed. The species may use the sandy dam banks and cutting as breeding habitat, but only in the summer months. Rainbow Bee-eaters are migratory but populations are not considered to be under threat.

Peregrine Falcon (Specially protected WA)

The Peregrine Falcon *(Falco peregrinus)* occupies a range of habitat types, although they tend to nest either in stick-nests in high exposed branches or, more commonly, on cliff ledges. They breed between August and November. They have large home ranges (20-50 km^2) and occur at low density in the landscape (Schodde & Tidemann 2007). The diet of the Peregrine Falcon includes Australian Wood Duck *(Chenonetta jubata*), pigeons and doves, Galahs *(Eolophus roseicapilla)*, rosellas and cockatoos, starlings and larks (Olsen *et al.* 2006). Foraging habitat occurs in the study area and in surrounding forest areas. This species is loyal to a nest site using the same site over consecutive years. Nesting habitat could occur within exposed branches of some of the larger trees within the study area and there were a number of stick nests present within the study area.

Western False Pipistrelle (Priority 4)

The Western False Pipistrelle occurs in the high rainfall zones of Jarrah and Tuart forests. It has also been recorded in mixed Tuart-Jarrah tall woodlands on the adjacent coastal plain. Marri, Sheoak and Peppermint trees are often co-dominant at its collection localities (DEWHA, 2009). This species roosts in tree hollows (Phillips & Inwards 1985) in colonies of five to 30 bats (Aust Museum, 2009a). The species feeds on flying insects below the forest canopy.

Records occur south of Margaret River on the ALA website (2012). Further survey work with Anabat equipment (to records and analyse bats calls) would be required to determine if this species does utilise the vegetation within the study area, or roosts within the hollows contained therein.

4.3 SPECIES RECORDED

Eighteen fauna species, comprising 18 birds and three mammals, were detected during the short field survey; Baudin's Black Cockatoo, Red-tailed Black-Cockatoo and Western Ringtail Possum are target (conservation significant) species (marked in **bold**). Table 4-2 summarises the observation type and species detected.

Table 4-2 Opportunistic fauna records during the survey in the study areas (listed species marked in bold). Key to observation types given below the table.

Common name	Scientific name	Status	Observation type
AVES			
Acanthiza apicalis	Inland Thornbill		O
Acanthiza chrysorrhoa	Yellow-rumped Thornbill		O
Anthochaera carunculata	Red Wattlebird		O
Anthochaera lunulata	Western Wattlebird		O
Calyptorhynchus banksii	**Red-tailed Black-Cockatoo**	Rare or likely to become extinct (WC Act), Vulnerable (EPBC Act)	F
Calyptorhynchus baudinii	**Baudins Black-Cockatoo**	Rare or likely to become extinct (WC Act), Vulnerable (EPBC Act)	O
Chenonetta jubata	Australian Wood Duck		O
Coracina novaehollandiae	Black-faced Cuckoo-shrike		O
Cracticus tibicen	Australian Magpie		O

Common name	Scientific name	Status	Observation type
Dacelo novaeguineae	Laughing Kookaburra		O
Gerygone fusca	Western Gerygone		O
Malurus elegans	Red-winged Fairy-wren		O
Malurus splendens	Splendid Fairy-wren		O
Microeca fascinans	Jacky Winter		O
Phylidonyris novaehollandiae	New Holland Honeyeater		O
Rhipidura albiscapa	Grey Fantail		O
Rhipidura leucophrys	Willy Wagtail		O
MAMMALIA			
Macropus fuliginosus	Western Grey Kangaroo		O,S
Pseudocheirus occidentalis	**Western Ringtail Possum**	Rare or likely to become extinct (WC Act), Vulnerable (EPBC Act)	S
Trichosurus vulpecula	Common Brushtail Possum		S

Key to observation types

O	Observed	S	Scat
T	Tracks / scratchings	H	Heard call
F	Feed sign	A	Anecdotal

Baudin's Black Cockatoo (Threatened WC Act, Vulnerable EPBC Act)

Baudin's Black Cockatoo usually occurs in forest dominated by Marri and other *Eucalyptus* species, especially Karri and Jarrah, but may also occur in Wandoo woodland, and in orchards, and is occasionally recorded in farmland and grasslands (SPRAT 2010). It forages mostly on Marri gumnuts and blossoms (SPRAT 2010). When feeding in Marri, Baudin's Black Cockatoo extract seeds from their capsules by using its long, tapered upper mandible in a manner that causes little or no damage to the capsule itself (SPRAT 2010).

Preferred roosts are in areas with a dense canopy close to permanent sources of water (Johnstone & Kirkby 2008, in SPRAT 2010). During nesting season (August though to December) Baudin's Black Cockatoo is thought to be confined to areas of forest dominated by Karri (SPRAT 2010). The range of the species during the non-breeding season may be determined by the distribution of Marri dominated forest, its' favoured feed tree. It is known to nest in hollows of Eucalypts usually at some height (Pizzey and Knight 2007) mostly in tall wet sclerophyll forests such as the Karri forests south around Pemberton (DEC 2007). Nests are often 30-50 m above ground (Jupp 2000). The entrance diameter of breeding hollows are usually large - 30-40 cm, with large internal dimensions (>30 cm deep) (DEC 2007).

This species was observed foraging in Stage three and flying over and foraging in similar adjacent vegetation to the north. With the presence of Marri, the study area can be considered foraging habitat. The lack of large hollows greater than 30 m height (the trees on site were not 30m high) indicates that the site probably does not contain suitable breeding habitat for this species.

Forest Red-tailed Black Cockatoo (Threatened WC Act, Vulnerable EPBC Act)

The Forest Red-tailed Black Cockatoo inhabits the dense Jarrah (*Eucalyptus marginata)*, Karri (*E. diversicolor)* and Marri (*Corymbia calophylla)* forests receiving more than 600 mm average rainfall annually (Saunders & Ingram 1995 in SPRAT 2010). The Forest Red-tailed Black Cockatoo occurs within the same habitat as the Baudin's Cockatoo. They nest in large, mostly vertical, hollows of Karri, Marri, Wandoo, Jarrah and Bullich. Hollow height ranges 8-14 m above ground, entrance 12-41 cm and depth 1-5 m. Spouts may be preferred. They roost in Jarrah-Marri-Blackbutt habitat on road-sides, paddocks or forest blocks. Around 90% of the diet is made up of Marri and Jarrah seeds within its home range of 116-187 ha (Johnstone & Kirkby 1999; Johnstone & Storr 1998 in SPRAT 2010).

Critical habitat for Forest Red-tailed Black Cockatoo is considered to be any habitat where the species is known, or has potential, to occur (DEC 2007), whether suitable for foraging or breeding. Hollows in trees with entrance diameters suitable for use by Forest Red-tailed Black Cockatoo (12-41 centimetres) were present in the subject site, although it is not possible to assess suitability of the internal dimensions of the hollows as they were not inspected. Suitable foraging and breeding habitat occurs at the site, which based on the description above could be considered critical habitat.

Western Ringtail Possum (Threatened WC Act, Vulnerable EPBC Act)

WRP originally utilised a variety of habitats including Peppermint, Coastal Peppermint-Tuart, Jarrah-Marri associations, Sheoak woodland, and Eucalypt woodland and Mallee. Present populations mostly inhabit Peppermint and Peppermint -Tuart associations from Bunbury to Albany. Along the Swan Coastal Plain the highest densities occur in habitats with Peppermint as the dominant tree or as an understory component of Eucalypt forest or woodland (SPRAT 2010), but is also known to occur in adjacent woodland where Marri is dominant (pers. obs.). A range of nest types on or near the ground have been recorded where predators are absent, including low shrub thickets, sedges, rushes, and grass trees. Otherwise tree hollows and dreys in tree canopies are usually used.

In dense, coastal Peppermint forest, home ranges are about 0.5 ha to 1.5 ha and in Eucalypt forests about 2.5 ha. In the northern Jarrah forests, home ranges are larger and have been recorded to be at least 5.6 ha. Peppermint leaves form the basis of the WRP diet in coastal areas (between 79-100% based on a study of WRP near Busselton by Jones *et al.* 1994), but when unavailable, the dominant myrtaceous species are preferred. In the inland forest, Jarrah and Marri are the main food source. Garden plant varieties are also exploited in urban areas.

Records occur locally with highest abundances near Gracetown and in coastal areas (NatureMap 2012). A WRP scat was observed in the Peppermints along the drainage line between (but outside of) Stages five and six. Scats were also observed in lower abundances in Stage four within Marri woodland, some 500 m from the drainage line. From aerial photo analysis of remnant vegetation, creeks to the east and west link up with inland vegetation in the north and on to the coastal vegetation west of Caves Road. The importance of WRP and connective vegetation within the study area at a landscape scale (for genetic dispersal) is unknown. Further survey work would be required to determine WRP densities, if the WRP at the site are isolated, and if they are actually dispersing or moving along the drainage lines (and therefore determine the importance of remnant vegetation in Stages four, five and six).

5 POTENTIAL IMPACTS AND RECOMMENDATIONS

DIRECT IMPACTS

Direct impacts of the proposal are described below. Many of these can be mitigated through the recommendations included in Section 5.3.

Clearing of native vegetation

A total of 8.6 ha of remnant Marri and Jarrah woodland vegetation (Stages two to five) and a number of paddock trees (within Stage six), occur within the study area. Clearing and therefore impacts are yet to be proposed. Below ground biomass through clearing, such as seed banks, would also be destroyed.

The types of impacts associated with clearing native vegetation include (DECCW 2010):

- Loss of habitat.
- Loss of mature trees (provide more flowers, nectar, fruit, seeds, refuge and hollows than younger trees).
- Fragmentation of habitat and populations (discussed further below).
- Indirect impacts such as edge effects to surrounding vegetation, including opportunity for invasive species and changes to microclimatic conditions. Such changes may be important to vegetation structure and composition and fauna species such as bats.

Stages two to five provide good potential habitat for a range of common species and provide known habitat for at least three threatened species (potentially four), as well as three other conservation significant species (i.e. one Migratory, one Priority and one Specially Protected). Although Stages two and three were recently burnt these values will improve in time with regeneration.

Stage six of the study area consists of paddock trees with an exotic understorey. Other than the presence of hollows, Stage six has limited habitat value for the target species. Paddock trees do however play an important role for birds in particular and are recognised as important habitat features in over-cleared landscapes.

Loss of hollow-bearing trees

Tree hollows are cavities formed in the trunk or branches of a living or dead tree typically by wood fungi, assisted by termites and fire (Mawson and Long, 1994). Hollows are usually more common in older, mature trees. Hollows with large internal dimensions are the rarest (DECCW 2010).

There are numerous large trees suitable for Black Cockatoos within the study area; 277 trees with a DBH greater than 50 cm; 30 of these with a DBH over 100 cm. 111 of these trees contained hollows (122 hollows in total) (see Habitat trees in Appendix G). The types of impacts associated with clearing hollow-bearing trees (HBT) include (DECCW 2010):

- Loss of breeding and den habitat for mammals and birds.
- Loss of a slow-forming resource (large hollows may take over 200 years to form).
- Loss of HBT in a variety of landscape positions (fauna occupancy is related to landscape position, such as near riparian or dense habitats).

Construction environment

Construction, including clearing, would lead to a number of indirect impacts (see below) however there are risks of direct impacts such as injury and possibly death of reptiles, small mammals and birds that may be present within nests or hollows. Introduction of disease or pathogens as a result of clearing or ongoing farming activities (in particular adjacent areas of intact vegetation) may also have direct impacts, at a community level (*Phytophthora* dieback), or species level (amphibian Chytrid fungus).

Habitat connectivity

Some recognition of habitat connectivity has been given at the regional planning level. The South West Regional Ecological Linkages (SWREL) project (a partnership between WALGA and DEC) had the objective of improving recognition of ecological linkages in land use planning policy and procedures to contribute to the retention of native vegetation and fauna habitat and reduce the loss of biodiversity and key ecological functions across the South West project area (WALGA, 2012).

'Ecological linkages act as stepping stones of habitat which facilitate the maintenance of ecological processes and the movement of organisms within, and across, a landscape.'

Lot 30 is not recognised as a core linkage on the SWREL project axis lines. It is however within 100 m or within an edge touching <100 m of a linkage. SWREL describes that *while gaps in vegetation will, to some degree, compromise the capacity of flora and fauna species to persist, where the cleared gap between patches is <100 m those impacts will be limited in that such a gap does not bring about a significant barrier to the dispersal of many fauna species, seed and other genetic material. Further, a gap of <100 m provides an excellent opportunity to connect patches through revegetation and management activities, thereby improving overall landscape viability.*

At a local scale and certainly within and around Lot 30, Stages two to five do provide good habitat connectivity. Paddock trees (such as those in Stage six) have been shown to have the potential to enhance landscape connectivity by acting as stepping stones to assist bird movement (Fischer and Lindenmayer, 2001) and as important for general ecological function at a landscape scale (Manning et al, 2006). They may provide:

- increased landscape-scale tree cover;
- increased connectivity for fauna;
- increased genetic connectivity for tree populations; and
- provision of genetic material and focal points for future large-scale ecosystem restoration.

5.2 INDIRECT IMPACTS

Indirect impacts would mostly be associated with the construction period, and may involve factors such as accidental clearing or disturbance of native vegetation surrounding the site, noise, dust and vibration. This may be of particular concern if construction disrupts breeding cycles of threatened species.

The removal of remnant vegetation (Stages two to five) would depend on the amount and location proposed to be removed but would have direct impacts described above. Indirect impacts (on adjacent areas to be retained) may include increased negative edge effects such the ingress of weeds, changes to microhabitat and increased access for invasive predators such as foxes and cats. The removal of paddock trees in Stage six are unlikely to significantly alter the use of that area by threatened fauna but it may affect a range of non-threatened species, in particular birds.

The introduction of *Phytophthora* dieback during construction is also possible, and would be an issue if parts of the study area (Stages two to five) are to be retained. Localised dieback could have a major impact on vegetation at the study area due to the susceptibility of Jarrah, Banksia and other species to *Phytophthora* disease.

Phytophthora dieback surveys have not been carried out nor were they included within the scope of this report. However, dieback status at the site should be assessed if vegetation is to be retained given its relevance to Black Cockatoo habitat (both habitat trees and feed species are vulnerable to dieback).

5.3 RECOMMENDATIONS

As this assessment was carried out to identify fauna values within the study area, impact extents have not yet been proposed.

Black Cockatoos

The study area contains approximately 8.6 ha of foraging habitat (not counting the paddock trees in Stage six which are also foraging habitat), plus 277 habitat trees greater than 50 cm DHB. Ninety-three trees contained 109 medium or large hollows, potentially suitable for Carnaby's and Forest Red-tailed Black Cockatoos. Baudin's Black Cockatoo is unlikely to breed at the site due to the lack of suitable nesting sites. Although the study area may not contain critical habitat (as identified by the Carnaby's Black Cockatoo recovery plan) it still contains potential breeding habitat (critical habitat) for Forest Red-tailed Cockatoos. It is not clear whether any of the hollows are actively being used by fauna, or if they are actually suitable (i.e. adequate depth) for Black Cockatoo breeding. Nonetheless, good quality foraging habitat for all Black Cockatoo species is present across the entire site.

The Black Cockatoo Referral guidelines recommend the following as potentially incurring significant impact and therefore requiring referral to SEWPAC:

- *Clearing of any known nesting tree* (presence unknown).
- *Clearing or degradation of any part of a vegetation community known to contain breeding habitat* (**present**).
- *Clearing of more than 1 ha of quality foraging habitat* (**present but extent will depend on the proposed clearing extent**).
- *Clearing or degradation (including pruning the top canopy) of a known night roosting site* (not present)
- *Creating a gap of greater than 4 km between patches of black cockatoo habitat (breeding, foraging or roosting)* (not likely to occur).

Western Ringtail Possum

The study area is not located within the area under the SEWPaC "Significant impact guidelines for the vulnerable western ringtail possum (*Pseudocheirus occidentalis*) in the southern Swan Coastal Plain, Western Australia Nationally threatened species and ecological communities, EPBC Act policy statement 3.10" ('WRP guidelines'), nor is the study area bound by the referral triggers suggested in that document. Given that higher quality WRP habitat was present within the drainage line, and that WRP would be using the Jarrah/Marri woodland in low abundances, clearing in Stages 2-6 is unlikely to result in a significant impact to this species. EPBC Act referral is therefore unlikely to be required specifically for WRP. However, it is recommended that if the project is referred that SEWPaC are made aware of the presence of WRP.

5.3.2 Recommended safeguards

Adoption of the following measures would assist to minimise the risk posed by the proposal to biodiversity values within the study area:

1. **Large hollow-bearing trees should be retained wherever possible.**

Suitable breeding hollows for the (large) Black Cockatoos may take several hundred to thousands of years to form. For example a study by Mawson et al (1994) found that hollows utilised by the medium sized Long-billed Corella (which can utilise smaller hollows than Black Cockatoos) may take on average around 450 years to form in Marri and over 1000 years in Jarrah.

2. **Where removal of large or hollow-bearing trees is proposed this should be undertaken in accordance with nghenvironmental's tree removal recommendations (Appendix D), with a qualified/licensed fauna spotter on site (to keep records, handle threatened fauna and prevent injury to fauna during clearing).**
3. **The areas adjacent to the drainage line (between Stages 5 and 6, and possibly the southern part of Stage six) could be revegetated with a variety of local provenance and endemic species, including understory species, if clearing is carried out elsewhere. Peppermint (*Agonis flexuosa*) should be planted heavily in this mix.**
4. **If clearing is required within Stages two to five, this should be minimised and a vegetated corridor retained where possible linking to the creekline between Stages 5 and 6. The wider this corridor the more valuable it will be (minimum 20 m wide, preferably 40 m). It should also be fenced.**

Generally the wider the corridor the better, particularly in terms of maximising its long term value to birds and mammals and reducing existing edge effects. It is generally accepted that there is a significant relationship between the edge to area ratio of remnants and their habitat value (May and Norton 1996). The value of areas with lots of edges and little area (such as a narrow linear corridor) become degraded by the impacts of edge effect, to the point where they may no longer be suitable for a range of species (Lindenmayer & Fischer 2006).

Edge effects may include:

- Changes in microclimate – usually brighter and drier conditions; leading to a change in flora species composition and abundance. This in turn could create a shift in the vegetation community present and affect the type of habitat available for both flora and fauna species.
- Ingress of weeds (Lindemayer & Fischer 2006).
- Ingress of predators or increased foraging opportunities.
- Habitat loss and degradation.

Corridor width has been shown to be important in studies of birds and mammals, but not all animal groups (Lindenmayer and Nix 1993). Lindenmayer and Nix (1993) found that arboreal animals (such as WRP) that forage on leaves rather than widely dispersed resources such as nectar, insects, etc., were less affected by narrow corridor widths, probably because they do not need to forage over such a large area. Based on personal observations of WRP persisting in highly fragmented environments, and given that the species is an arboreal species that feeds on leaves, it is probable that WRP would utilise any reasonable width corridors retained within Stages two to five. Stands of young secondary regrowth (such as any revegetation proposed) **do not** provide suitable habitat for arboreal marsupials but as the vegetation

matures over a period of 40-200 years, may be recolonised by such animals (Lindenmayer, 1992). Thus, WRP may re-colonise revegetated areas along the drainage line over the long term once a connective canopy is established. They would still forage on suitable regrowth species in the short term.

5. Schedule clearing outside of key breeding periods

Fauna are generally most sensitive to disturbance during breeding periods. This is a particularly important consideration for threatened species. Key breeding periods for the relevant species are given below (Table 5-1), and works should be scheduled with these periods in mind.

Birds disturbed from the nest (for example, from excessive noise or changes to light) may disrupt incubation or cease to feed their young (Webster 1999). Marsupials under stress may eject pouch young or change their nesting behaviour (Rhind 2003). Stress may occur for a range of reasons including environmental factors such as drought as well as from anthropogenic habitat disturbance. Many marsupials display a strong fidelity to their territory (Rhind 2003), and therefore disturbance can cause stress. An example of a stress factor may include loss of foraging resources (such as through clearing), thereby necessitating an increase in foraging effort, potential for loss of physical condition and potential for neglect or ejection of young.

Table 5-1 gives a range of time based on information in recovery plans and species profiles and can be considered approximate only, as many Australian species will vary their breeding season depending on seasonal and habitat conditions. Clearing should be scheduled with these periods in mind.

Table 5-1 Approximate breeding periods are shown as a guideline for fauna where breeding may be affected by disturbance.

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Carnaby's Black Cockatoo												
Baudin's Black Cockatoo												
Forest Red-tailed Black Cockatoo												
Rainbow Bee-eater												
Peregrine Falcon												
Key												
Eggs/pouch												
Dependent young in nest/burrow												

Western Ringtail Possum is not included above given that breeding occurs throughout the year. Bats (Western False Pipistrelle) are unlikely to leave the tree if they are inside during clearing. Hollows should therefore be inspected once clearing has taken place by a licensed 'fauna spotter', so that individuals can be collected.

6 CONCLUSION

The study area contains 8.6 ha of good quality fauna habitat (Stages two to five), and a number of habitat trees and patches within Stage six. The entire site contains foraging habitat for the threatened Black Cockatoos, including the paddock trees. Forest Red-tailed Black Cockatoo feed signs were observed widely over the site and Baudin's Black Cockatoo was sighted. WRP were present in the drainage line vegetation between Stages five and six and in lower abundances in Stages three to five. Additional target species such as Peregrine Falcon, Rainbow Bee-eater and Western False Pipistrelle may also be impacted by clearing.

There are numerous large trees of species suitable for developing hollows within the study area; 277 trees with a DBH greater than 50 cm; 30 of these with a DBH over 100 cm. A total of 93 trees contained 109 medium or large hollows, with at least 6 hollows showing signs of active use. It is not clear whether these are actually suitable (i.e. depth) for Black Cockatoo breeding. No Black Cockatoo roosting sites were observed within the study area.

Depending on the scale of clearing there may be a need for a Referral under the EPBC Act, given the potential for a significant impact on Forest Red-tailed Black Cockatoos but also potentially Baudin's and Carnaby's Black Cockatoo. SEWPaC should also be made aware of the presence of WRP if the project is referred. It is the responsibility of the proponent to refer the proposal (the Black Cockatoo referral guidelines are available here: http://www.environment.gov.au/epbc/publications/wa-black-cockatoos.html).

The environmental management and the recommendations described in Section 5.3 may reduce the impacts proposed to fauna, but would require the retention of a reasonable corridor through Stages two to five.

7 REFERENCES

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APPENDIX A THREATENED FAUNA EVALUATION

This table provides an evaluation of the presence of habitat for listed species, and the likelihood of occurrence for each species. The latter is based on the nearby records, habitat in the subject site and information from literature, database searches (Naturemap and EPBC protected Matters search tool) and expert consultation. The potential to be impacted depends on the nature of the proposal, habitat utilisation by the subject species and the likelihood of occurrence. Marine, marine migratory and wetland specialist species have been excluded from the list as have those species considered to be regionally extinct.

Species Status* (State, Cth)	Ecology	Presence of habitat	Likelihood of occurrence	Potential to be impacted?
INVERTEBRATES				
Austroassiminea letha (Cape Leeuwin Freshwater Snail) T	Species of minute salt marsh snails with an operculum, aquatic gastropod mollusks, or micromollusks in the family Assimineidae.	None	Unlikely	None
Engaewa reducta (Dunsborough Burrowing Crayfish) T, CE	The Dunsborough Burrowing Crayfish is endemic to south-western Western Australia and is known from an area between Dunsborough and the Margaret River, approximately 250 km south of Perth. The Dunsborough Burrowing Crayfish uses a variety of habitats that provide moist sandy/loamy soils and an accessible watertable. These include vegetated seepages, swamp plains and swampy headwaters of streams.	None, marginal between Stages 5 and 6 but outside of the study area.	Unlikely	None
Engaewa pseudoreducta (Margaret River Burrowing Crayfish) T, CE	The Margaret River Burrowing Crayfish is endemic to south-western Western Australia. The species is known only from only two populations in swampy headwaters of a tributary of the Margaret River, near Osmington, 250 km south of Perth. One of these populations, from which the species was first collected, is presumed extinct. The Margaret River Burrowing Crayfish lives in the narrow, creek tributaries of the Margaret River in areas of dense vegetation that includes tea-trees (Melaleuca spp.) and eucalypts (Eucalyptus spp.). Soils are heavy grey-yellow clays (TSSC 2009h).	None	Unlikely	None

Species Status* (State, Cth)	Ecology	Presence of habitat	Likelihood of occurrence	Potential to be impacted?
Westralunio carteri (Carter's Freshwater Mussel) P4	*Westralunio carteri* is the only freshwater mussel found in southwest WA however very little is known about it. It is a bivalve found in freshwater streams, rivers, billabongs, ponds, wetlands and lakes inland from the coast mostly areas with muddy, silty and sandy bottoms and flowing permanent water. Tracks can be seen along banks and sandy/muddy patches of stream bed. Environmental tolerances of *W. carteri* are not precisely known but they can be found where water temperatures range from 4°C to over 30°C (http://www.musselwatchwa.com).	None	Unlikely	None
VERTEBRATES				
AMPHIBIA				
-	-	-	-	-
AVES				
Botaurus poiciloptilus (Australasian Bittern) T, E	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleocharis* spp.). Hides during the day amongst dense reeds or rushes and feed mainly at night on frogs, fish, yabbies, spiders, insects and snails.	None	Unlikely	None
Calyptorhynchus banksii subsp. naso (Forest Red-tailed Black Cockatoo) T, V	The Forest Red-tailed Black Cockatoo (FRTBC) inhabits the dense Jarrah (*Eucalyptus marginata)*, Karri (*E. diversicolor)* and Marri (*Corymbia calophylla)* forests receiving more than 600 mm average rainfall annually (Saunders & Ingram 1995 in SPRAT 2009). The Forest Red-tailed Black Cockatoo occurs within the same habitat as the Baudin's Cockatoo. They nest in large, mostly vertical, hollows of Karri, Marri, Wandoo, Jarrah and Bullich. Hollow height ranges 8-14m above ground, entrance 12-41cm and depth 1-5m. Spouts may be preferred. They roost in Jarrah-Marri-Blackbutt habitat on road-sides, paddocks or forest blocks. Around 90% of the diet is made up of Marri and Jarrah seeds within its home range of 116-187 ha (Johnstone & Kirkby 1999; Johnstone & Storr 1998 in SPRAT 2009).	Present	Probable	Yes

Species Status* (State, Cth)	Ecology	Presence of habitat	Likelihood of occurrence	Potential to be impacted?
Calyptorhynchus baudinii (Baudin's Black Cockatoo) T, V	Baudin's Black Cockatoo occurs in forest dominated by *Corymbia calophylla* (Marri) and *Eucalyptus* species, especially *E. diversicolor* (Karri) and *E. marginata* (Jarrah) but may occur in *E. wandoo* (Wandoo) woodland, and in orchards, and is occasionally recorded in farmland and grasslands (SPRAT 2010). It forages mostly on Marri gumnuts and blossoms (SPRAT 2010). When feeding in Marri, Baudin's Black Cockatoo extract seeds from their capsules by using its long, tapered upper mandible in a manner that causes little or no damage to the capsule itself. Preferred roosts are in areas with a dense canopy close to permanent sources of water (Johnstone & Kirkby 2008, in SPRAT 2010). The range of the species during the non-breeding season (breeds in August though to December) may be determined by the distribution of Marri, and that nesting might be confined to areas in which Karri occurs (SPRAT 2010). It is known to nest in hollows of Eucalypts usually at some height (Pizzey and Knight 2007). Often nest 30-50m above ground (Jupp 2000). Tree hollows usually entrance of 30-40cm, >30cm deep (DEC 2007a).	Present	Present	Yes

Species Status* (State, Cth)	Ecology	Presence of habitat	Likelihood of occurrence	Potential to be impacted?
Calyptorhynchus latirostris (Carnaby's Black Cockatoo) T, E	This species is a postnuptial nomad, tending to move west after breeding. Carnaby's Black Cockatoo mainly occurs in or near eucalypt woodlands, especially those dominated by Wandoo or Salmon Gum, and sometimes reported in forests of Marri, Jarrah, Karri and Tuart. On the Swan Coastal Plain most nests are in Tuart (SPRAT 2009) (Johnstone and Kirkby, undated). Nesting hollows may be located anywhere from 2 m to >10 m from ground, mainly in the Wheatbelt (Cale 2003, SPRAT 2009, WA Museum 2010). From breeding records in the Storr-Johnstone Bird Data Bank, this species is currently expanding its breeding range westward and south into the Jarrah-Marri forests of the Darling Scarp (e.g. Wungong Dam Catchment) and into the Tuart forests of the Swan Coastal Plain, possibly due to climate change (Johnstone and Kirkby, undated). Breeding success is dependent on suitable foraging habitat adjacent to the nest site to provide the necessary food for the survival of the chick. In the Bunbury, Ludlow and Whicher Range areas where breeding is recorded, there are areas of remnant vegetation, National Parks, Nature Reserves, State Forests, roadside verges and pine plantations that contain breeding and foraging habitat for Carnaby's Cockatoos (Johnstone and Kirkby, undated). Breeding occurs mainly from early July to mid-December in the semiarid and subhumid interior from the Three Springs district south to the Stirling Range, west to Cockleshell Gully, Cataby, Regans Ford, Gingin, near mouth of Moore River, Yanchep, Serpentine, Mandurah, Lake Clifton, Bunbury, Nannup and Tone River and east to Manmanning, Kellerberrin, Woolundra, Lake Cronin, Hatters Hill and near Ravensthorpe. There has been an apparent shift in its breeding range further west and south since the middle of last century with a more rapid increase in the past 10–30 years into the Jarrah-Marri forests of the Darling Scarp and the Tuart forests of the Swan Coastal Plain (Johnstone and Kirkby, undated).	Present	Possible	Yes

Species Status* (State, Cth)	Ecology	Presence of habitat	Likelihood of occurrence	Potential to be impacted?
Falcunculus frontatus subsp. leucogaster (Crested Shrike-tit western subspecies) P4	The Crested Shrike-tit is found in eucalypt forests and woodlands, forested gullies also acacia, coastal tea-tree, banksia, orchards parks and gardens (Aust Museum 2009) (Pizzey and Knight 2007). Subspecies Leucogaster is confined to southwestern WA, where it nests in a deep cup of lichen or spider web decorated with lichen and lined with grass in vertical stems of eucalypt foliage 5-25m high (Pizzey and Knight 2007). It is an insectivore but will also feed on fruit or seeds and is not present on the Swan Coastal Plain (Pizzey and Knight 2007). Nearest records are over 30km south near Augusta and Nannup (Naturemap website, accessed 08.01.2012).	Present	Possible but unlikely	Unlikely
Falco peregrinus (Peregrine Falcon) S, -	Peregrine Falcons tend to breed either in stick-nests in trees or nest on cliff ledges. It appears that stick-nests may be used where cliff ledges are limited. Cliff sites are chosen for protection from dominant weather direction and in well drained areas. Where good habitat occurs and the density of Peregrine Falcons is high, active nests may occur within 2.5km of each other. The diet of the Peregrine Falcon includes wood duck, pigeons and doves, galahs, rosellas and cockatoo, starlings and larks (Olsen *et al.*. 2006). Breeds Aug-Nov.	Present	Possible	Possible
Haliaeetus leucogaster White-bellied Sea eagle -, M	This species occurs around coastal areas, islands and estuaries, but is also found in inland areas where it is known from large rivers, wetlands and reservoirs (DECC, 2009). Usually forages, perches and roosts around waterways and nests in a huge nest of sticks in a tall live tree near water (Schodde and Tidemann, 2007) (Pizzey and Knight 2007).	Marginal	Unlikely	Unlikely
Merops ornatus (Rainbow Bee-eater) -, M	This species occupies a wide range of habitats including mangroves, heathland, vine thickets and open woodland on sandy soils, throughout Australia (Pizzey and Knight 2007). *M. ornatus* lay eggs in a burrow or sandy bank or cutting. The southern populations migrate north over winter to northern Australia, Papua New Guinea and eastern Indonesia (DEWHA 2009).	Present	Possible	Unlikely, wide ranging
MAMMALIA				

Species Status* (State, Cth)	Ecology	Presence of habitat	Likelihood of occurrence	Potential to be impacted?
Dasyurus geoffroii (Western Quoll, Chudich) T, V	Quolls may occupy a range of habitats including forest, woodland and desert, though in the SW they are largely restricted to Jarrah forest or scattered through the southern and eastern wheat belt (DEC 2010). Current records indicated that this only represents approximately 5% of their former range. In the Jarrah forest populations occur in both moist, densely vegetated, steeply sloping forest and drier, open, gently sloping forest, with higher densities in riparian areas. Habitat attributes which are likely to be critical to the life cycle for the Western Quoll are large areas of undisturbed habitat which a sufficient variety of key food and other resources such as large hollow logs, burrows or small caves at ground level for denning. To be suitable as den sites, logs must have a diameter of at least 30 cm but usually greater than 50 cm, a hollow diameter of 7–20 cm and generally 1m long (Orell & Morris 1994). Annually, an adult female Chuditch will utilise an estimated average of 66 logs and 110 burrows within her home range. A large amount of den sites are required for both sexes. They occupy relatively large home ranges, with males utilising over 15 km^2 and females 3-4 km^2 (Orell & Morris 1994).	Marginal, corridor	Unlikely	Unlikely
Falsistrellus mackenziei (Western False Pipistrelle) P4, -	It occurs in wet sclerophyll forest dominated by Karri (*Eucalyptus diversicolor*), and in the high rainfall zones of the Jarrah (*E. marginata*) and Tuart (*E. gomphocephala*) forests. It has also been recorded in mixed Tuart-Jarrah tall woodlands on the adjacent coastal plain. Marri (*E. calophylla*), Sheoak (*Casuarina heugeliana*) and Peppermint (*Agonis flexuosa*) trees are often co-dominant at its collection localities (DEWHA, 2009). This species roosts in tree hollows (Phillips & Inwards 1985) in colonies of 5 to 30 bats (Aust Museum, 2009a). The species feed on flying insects between below the forest canopy.	Marginal but still present	Possible	Possible
Hydromys chrysogaster (Water-rat) P4	The Water-rat is usually found in permanent fresh or brackish water but can be found in marine environments. Fresh water habitats include swamps, lakes, dams even urban drainage swamps.	None	Unlikely	None

Species Status* (State, Cth)	Ecology	Presence of habitat	Likelihood of occurrence	Potential to be impacted?
Isodon obesulus fusciventers (Southern Brown Bandicoot, Quenda) P5, -	Quenda's habitat consists of dense scrubby, often swampy vegetation with a dense cover up to one metre high particularly near watercourses and wetlands. It often feeds in adjacent forest (Jarrah and Wandoo) and woodlands that are burnt on a regular basis. Nests can be concealed next to or under old logs, shrubs or piles of debris and are made up of ground litter piled up over a shallow depression providing internal chambers. Home ranges vary with population density, and range from 5-8.6 ha for males and 1-6 ha for females (DEC 2010). Feed on a variety of ground-dwelling invertebrates and the fruit-bodies of hypogeous fungi. Their searches for food often create distinctive conical holes in the soil (DECCW 2010).	Marginal as adjacent foraging habitat, potential between Stages 5 and 6 but this is outside of the study area.	Possible but unlikely	Unlikely
Macropus irma (Western Brush Wallaby) P4, -	Optimum habitat for the Western Brush Wallaby includes open Jarrah forest or woodland and seasonally wet flats with low grasses and scrubby thickets, but also areas of mallee and heathland. Common dietary flora includes *Carpobrotus edulis, Cynodon dactylon* and *Nuytsia floribunda* (DEC, 2008).	Marginal	Unlikely	Unlikely
Phascogale tapoatafa (Brush-tailed Phascogale, Wambenger) T, V	This arboreal species is found in a variety of forest types. Ideal habitat for this species consists of dry sclerophyll forest and open woodland (Jarrah, Marri, and mixed Jarrah Karri) that contain hollow bearing trees and sparse ground cover (CALM, 2003). Their many nesting sites include hollow tree limbs, rotten stumps and even birds' nests. Lactating females prefer a large tree cavity with a small entrance with a nest made of bark, feathers and fur. A female's home range covers 20 to 70 hectares, a male's home ranges over laps females and increases during breeding season. (DEC, 2008). It is predominantly carnivorous, foraging on arthropods, invertebrates, small vertebrates and nectar (Strahan 1995).	Present but patch may not be large enough.	Possible but unlikely	Possible but unlikely

Species Status* (State, Cth)	Ecology	Presence of habitat	Likelihood of occurrence	Potential to be impacted?
Pseudocheirus occidentalis (Western Ringtail Possum) T, V	The Western Ringtail Possum (WRP) originally utilised a variety of habitats including Peppermint (*Agonis flexuosa*), Coastal Peppermint-Tuart, Jarrah-Marri associations, Sheoak woodland, and Eucalypt woodland and mallee. Present populations mostly inhabit Peppermint and Peppermint -Tuart associations from Bunbury to Albany. Along the Swan Coastal Plain the highest densities occur in habitats with Peppermint as the dominant tree or as an understory component of *Eucalypt* forest or woodland (SPRAT 2009). Only two sites have been recorded where Peppermint was absent (SPRAT 2009). A range of nest types on or near the ground have been recorded where predators are absent, including low shrub thickets, sedges, rushes, and grass trees. Otherwise tree hollows and dreys in tree canopies are usually used. In dense, coastal Peppermint forest, home ranges are about 0.5 hectares to 1.5ha and in eucalypt forests about 2.5ha. In the northern jarrah forests, home ranges are larger and have been recorded to at least 5.6ha. Peppermint leaves form the basis of the WRP diet in coastal areas (between 79-100% based on a study of WRP near Busselton by Jones *et al.* 1994), but when unavailable, the dominant myrtaceous species are preferred. In the inland forest, Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) are the main food source. Garden plant varieties are also exploited in urban areas.	Present	Present	Yes
Setonix brachyurus (Quokka) T, V	The current distribution of the quokka includes Rottnest and Bald Islands, and at least 25 sites on the mainland, including several National Parks and swamp/creek areas through the south-west forests from Jarrahdale to Walpole. The mainland quokka lives in the Darling Range and south-west regions of WA, mostly inhabiting densely vegetated swamps and sometimes tea-tree thickets on sandy soils along creek systems and dense heath on slopes (DEC, 2008).	None	Unlikely	None
REPTILIA				

Species Status* (State, Cth)	Ecology	Presence of habitat	Likelihood of occurrence	Potential to be impacted?
Morelia spilota imbricata (Southern Carpet Python) P4, -	It may shelter in burrows made by other animals, hollow tree limbs or logs (especially 150mm approx diameter hollows extending at least to 1m deep), or rock crevices. It commonly uses hollow logs for shelter (Wilson and Swan, 2008). This subspecies has been recorded from semi-arid coastal and inland habitats, *Banksia* woodland, eucalypt woodlands, and grasslands (DEC, 2009).	Marginal, corridor	Unlikely	Unlikely
PISCES				
-	-			

*Status

T: Rare or likely to become extinct

This status criterion has been set by the *Wildlife Conservation Act 1950.*

V: Vulnerable EPBC
E: Endangered EPBC
CE: Critically Endangered

These status criterions have been set by the *Environmental Protection and Biodiversity Conservation Act 1999*.

Priority Fauna
P 1: Taxa with few, poorly known populations on threatened lands.
P 2: Taxa with few, poorly known populations on conservation lands.
P 3: Taxa with several, poorly known populations, some on conservation lands.
P 4: Taxa in need of monitoring.
P 5: Taxa in need of monitoring.

These status criterions have been set by the WA Department of Environment and Conservation.

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APPENDIX B HABITAT PLOTS

The following habitat descriptions were based on two habitat survey plots undertaken at each Stage, and a general appraisal of the Stage. Due to past management regimes and the small size of each Stage, habitat within each Stage was homogenous. No creeks or other features were present that may have created localised habitat differences between Stages two to five. Stage six was more variable given that an anthropogenically derived rocky outcrop was present.

Stage:	2
Habitat summary, connectivity:	Marri - Jarrah regenerating woodland, separated from the east west corridor in the south by a road and from remnant vegetation in the north by the recently cleared Stage 1. Mid slope, skeletal pea gravel soils.
Disturbance and weeds	Recently burnt. Some regeneration of both native and weed ground cover.
Habitat structure	Ground: intact litter layer (60% cover), some fallen timber present although none hollow. Rock and bare ground also present (10% coverage each). Some regeneration of ground cover, 50% exotic. Midstorey: None. Overstorey: Dominated by dense regrowth Marri/Jarrah up to 20m tall, DBH average 20cm.
Foraging and breeding resources	Foraging: No cover for nesting and roosting habitat, due to fire. Some mature and hollow-bearing trees scattered throughout but in lower densities to other Stages. No termite mounds. Still being utilised by birds and macropods.
Overall habitat quality	Poor (due to recent burn).

Stage:	3
Habitat summary, connectivity:	Marri - Jarrah regenerating woodland, joining intact remnant vegetation in Stage 4 to a corridor in the northwest. Ridge, low slope with clayish loam, pea gravelly soils and rock.
Disturbance and weeds	Very recently burnt. No regeneration of vegetation present.
Habitat structure	Ground: intact litter layer (50% cover), some fallen timber present as a result of fire but generally sparse and not hollow bearing. Rock (5%) and bare ground (45%). Midstorey: None. Overstorey: Dominated by regrowth Marri/Jarrah up to 20m tall, DBH average 30cm with some much larger trees and stags.
Foraging and breeding resources	Foraging: No cover for nesting and roosting habitat, due to fire. Several mature and hollow-bearing trees scattered throughout. No termite mounds. Still being utilised by birds and macropods.
Overall habitat quality	Poor (due to recent burn). Likely to moderate once regeneration occurs.

Stage:	4, 5
Habitat summary, connectivity:	Intact Marri - Jarrah forest, joining intact remnant vegetation in Stage 5 to the brunt area in Stage 3, forms an east west corridor. Ridge, pea gravelly soils and shallow loam.
Disturbance and weeds	Logged in distant the past, hasn't been burnt for a long time.
Habitat structure	Ground: intact litter layer (60% cover), some fallen timber (10%) with some sparse hollows. Rock (5%) and native ground cover (25%). Midstorey: Intact variable midstorey, mostly lower understorey plants and few shrubs (open). Some Banksia. Overstorey: Variable age class, fairly dense Marri/Jarrah up to and greater than 20m tall, DBH average 50cm with many larger trees and stags. Stage 5 is more open than stage 4 with slightly more disturbance, probably more heavily logged.
Foraging and breeding resources	Foraging: Excellent habitat opportunities, with variable intact structure and hollow-bearing trees scattered throughout. No termite mounds. Abundant bird activity.
Overall habitat quality	Good.

Stage:	6
Habitat summary, connectivity:	Primarily paddock trees, Marri, Jarrah and Peppermint (or isolated clumps of up to 3-4 trees).
Disturbance and weeds	Recently grazed.
Habitat structure	Ground: Weedy, exotic grasses. No fallen timber. Very large rocky outcrop (not natural) where rocks have been piled. Midstorey: Isolated shrub regrowth, but mostly clear. Overstorey: Mostly large Marri/Jarrah/Peppermint paddock trees less than 20m tall, DBH average 70cm.
Foraging and breeding resources	Foraging: Generally poor habitat opportunities for target species, but useful as stepping stones for birds between patches and hollows may provide nesting opportunities for birds. WRP may utilise some of the large trees to the south of the dam though sign was not observed. Rocky piles would provide reptile refuge and habitat.
Overall habitat quality	Poor.

APPENDIX C UPDATED SPECIES LIST

The following list is a database extract from from Atlas of Living Australia, (ALA), (2012), within 10 km of the study area (http://regions.ala.org.au/ accessed 10.12.2012). Target species are listed in **Bold**. Field observations are noted and the list has been updated where additional species were observed. This database list is not exhaustive and not all species are likely to occur at the site.

Scientific name	*Vernacular name*	*Class*	*Observed*
Crinia glauerti	Clicking Froglet	AMPHIBIA	
Crinia pseudinsignifera	False Western Froglet	AMPHIBIA	
Litoria adelaidensis	Slender Tree Frog	AMPHIBIA	
Litoria moorei	Motorbike Frog	AMPHIBIA	
Acanthiza apicalis	Inland Thornbill	AVES	x
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	AVES	x
Acanthiza inornata	Western Thornbill	AVES	
Acanthorhynchus superciliosus	Western Spinebill	AVES	
Accipiter cirrocephalus	Collared Sparrowhawk	AVES	
Accipiter fasciatus	Brown Goshawk	AVES	
Anas gracilis	Grey Teal	AVES	
Anas superciliosa	Pacific Black Duck	AVES	
Anthochaera carunculata	Red Wattlebird	AVES	x
Anthochaera lunulata	Western Wattlebird	AVES	x
Ardea pacifica	White-necked Heron	AVES	
Barnardius zonarius	Australian Ringneck	AVES	x
Barnardius zonarius	Port Lincoln Parrot	AVES	
Cacomantis flabelliformis	Fan-tailed Cuckoo	AVES	
Calyptorhynchus banksii	**Red-tailed Black-Cockatoo**	AVES	x
Calyptorhynchus baudinii	**Baudins Black-Cockatoo**	AVES	x
Chalcites lucidus	Shining Bronze-Cuckoo	AVES	
Chenonetta jubata	Australian Wood Duck	AVES	x
Chroicocephalus novaehollandiae	Silver Gull	AVES	
Colluricincla harmonica	Grey Shrike-thrush	AVES	
Coracina novaehollandiae	Black-faced Cuckoo-shrike	AVES	x
Corvus coronoides	Australian Raven	AVES	
Cracticus tibicen	Australian Magpie	AVES	x
Cracticus torquatus	Grey Butcherbird	AVES	
Dacelo novaeguineae	Laughing Kookaburra	AVES	x
Daphoenositta chrysoptera	Varied Sittella	AVES	
Diomedea exulans	Wandering Albatross	AVES	
Egretta novaehollandiae	White-faced Heron	AVES	
Eopsaltria georgiana	White-breasted Robin	AVES	
Epthianura albifrons	White-fronted Chat	AVES	
Falco berigora	Brown Falcon	AVES	
Falco cenchroides	Nankeen Kestrel	AVES	

Scientific name	*Vernacular name*	*Class*	*Observed*
Falco peregrinus	**Peregrine Falcon**	**AVES**	
Gerygone fusca	Western Gerygone	AVES	x
Grallina cyanoleuca	Magpie-lark	AVES	
Haematopus fuliginosus	Sooty Oystercatcher	AVES	
Haliastur sphenurus	Whistling Kite	AVES	
Hirundo neoxena	Welcome Swallow	AVES	
Lichmera indistincta	Brown Honeyeater	AVES	
Malurus elegans	Red-winged Fairy-wren	AVES	x
Malurus splendens	Splendid Fairy-wren	AVES	x
Merops ornatus	**Rainbow Bee-eater**	AVES	
Microcarbo melanoleucos	Little Pied Cormorant	AVES	
Microeca fascinans	Jacky Winter	AVES	x
Morus serrator	Australasian Gannet	AVES	
Ninox novaeseelandiae	Southern Boobook	AVES	
Pachycephala pectoralis	Golden Whistler	AVES	
Pandion cristatus	Eastern Osprey	AVES	
Pardalotus punctatus	Spotted Pardalote	AVES	
Pardalotus striatus	Striated Pardalote	AVES	
Petrochelidon nigricans	Tree Martin	AVES	
Petroica boodang	Scarlet Robin	AVES	
Phalacrocorax carbo	Great Cormorant	AVES	
Phalacrocorax sulcirostris	Little Black Cormorant	AVES	
Phaps chalcoptera	Common Bronzewing	AVES	
Phaps elegans	Brush Bronzewing	AVES	
Phylidonyris novaehollandiae	New Holland Honeyeater	AVES	x
Platycercus icterotis	Western Rosella	AVES	
Porphyrio porphyrio	Purple Swamphen	AVES	
Purpureicephalus spurius	Red-capped Parrot	AVES	
Rhipidura albiscapa	Grey Fantail	AVES	x
Rhipidura leucophrys	Willy Wagtail	AVES	x
Sericornis frontalis	White-browed Scrubwren	AVES	
Stipiturus malachurus	Southern Emu-wren	AVES	
Thalassarche chlororhynchos	Yellow-nosed Albatross	AVES	
Thalasseus bergii	Crested Tern	AVES	
Thinornis rubricollis	Hooded Plover	AVES	
Tyto javanica	Eastern Barn Owl	AVES	
Zosterops lateralis	Silvereye	AVES	
Lottia onychitis	Lottia onychitis	GASTROPODA	
Onthophagus haagi Harold, 1867	Onthophagus haagi Harold, 1867	INSECTA	
Macropus fuliginosus	Western Grey Kangaroo	MAMMALIA	x
Pseudocheirus occidentalis	**Western Ringtail Possum**	**MAMMALIA**	x
Trichosurus vulpecula	Common Brushtail Possum	MAMMALIA	x
Acritoscincus trilineatus	Western three-lined skink	REPTILIA	
Diplodactylus granariensis Storr, 1979	Wheat-belt Stone Gecko	REPTILIA	

Scientific name	*Vernacular name*	*Class*	*Observed*
Egernia richardi	Bright Crevice-skink	REPTILIA	
Morethia lineoocellata	West Coast Morethia	REPTILIA	
Pseudonaja affinis affinis	Dugite	REPTILIA	

APPENDIX D TREE REMOVAL RECOMMENDATIONS

nghenvironmental recommends that the clearing of native vegetation and the removal of hollow bearing trees (HBT) and branches should be avoided where possible. However, where the removal of native vegetation and/or habitat trees must take place, the following guidelines are recommended:

General Guidelines

- Non-hollow bearing vegetation should only be removed between May and July to avoid the breeding seasons of most forest fauna.
- Where threatened species may be present (Western Ringtail Possum habitat or hollow bearing trees in particular) a licensed fauna spotter should be onsite for preclearance surveys. This is usually a clearing permit condition.
- Check for animals in the zone of disturbance before clearing and scare or remove them before beginning operations where possible. Re-check after clearing to ensure no animals have become trapped or injured during clearing operations.
- Clearly mark the limits of the vegetation to be removed and retained by differentiating with coloured flagging tape. Take care when moving near native vegetation to be retained.
- Fell trees into the zone of disturbance to avoid damaging adjacent vegetation; do not push felled vegetation into areas to be retained.
- Retain tree hollows where practical when pruning branches.
- Mulch rather than burn cleared native vegetation. Where possible, consider distributing some logs from the felled trees into areas of vegetation to be retained where it would not be considered a fire hazard. This would provide additional habitat for ground dwelling fauna such as reptiles and small mammals

Clearing Hollow Bearing Vegetation

- HBT removal should ideally be conducted between January to March to avoid the breeding seasons of bats, birds and many hollow-bearing dependant fauna.
- Ensure a suitably qualified and licensed fauna spotter is onsite during the removal of HBT and branches to check for the presence of fauna before, during and after tree or branch removal. This person should ensure that any fauna found is safely located to nearby habitat.
- Clearly mark the HBT to be removed and/or retained by differentiating with coloured flagging tape. Remove all non-hollow bearing vegetation prior to the removal of HBT.
- Where possible, leave HBT standing for at least one night after other clearing to allow any fauna the opportunity to remove themselves after site disturbance.
- Before felling HBT, tap along trunk using an excavator or loader to scare animals from the hollows. Repeat several times. The aim of this is to 'substantially' shake the tree. The majority of fauna will exit the tree during this process.
- If taking the HBT tree down in stages, the non-hollow-bearing branches should be removed before the hollow-bearing branches are removed.

APPENDIX E DATABASE SEARCHES

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 10/12/2012

Kingdom Animalia
Conservation Status Conservation Taxon (T, X, IA, S, P1-P5)
Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 115°03' 05" E,33°48' 33" S
Buffer 10km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	41323	*Actitis hypoleucos (Common Sandpiper)*		IA	
2.	34110	*Austroassiminea letha (Cape Leeuwin Freshwater Snail)*		T	
3.	24733	*Calyptorhynchus baudinii (Baudin's Cockatoo (long-billed black-cockatoo))*		T	
4.	24734	*Calyptorhynchus latirostris (Carnaby's Cockatoo (short-billed black-cockatoo))*		T	
5.	25335	*Caretta caretta (Loggerhead Turtle)*		T	
6.	25575	*Charadrius leschenaultii (Greater Sand Plover)*		IA	
7.	24376	*Charadrius rubricollis (Hooded Plover)*		P4	
8.	24092	*Dasyurus geoffroii (Chuditch, Western Quoll)*		T	
9.	33946	*Engaewa reducta (Dunsborough Burrowing Crayfish)*		T	
10.	25624	*Falco peregrinus (Peregrine Falcon)*		S	
11.	24189	*Falsistrellus mackenziei (Western False Pipistrelle)*		P4	
12.	24215	*Hydromys chrysogaster (Water-rat)*		P4	
13.	24153	*Isoodon obesulus subsp. fusciventer (Quenda, Southern Brown Bandicoot)*		P5	
14.	24133	*Macropus irma (Western Brush Wallaby)*		P4	
15.	24168	*Macrotis lagotis (Bilby)*		T	
16.	24598	*Merops ornatus (Rainbow Bee-eater)*		IA	
17.	25240	*Morelia spilota subsp. imbricata (Carpet Python)*		S	
18.	24099	*Phascogale tapoatafa subsp. tapoatafa (Southern Brush-tailed Phascogale, Wambenger)*		T	
19.	24166	*Pseudocheirus occidentalis (Western Ringtail Possum)*		T	
20.	24145	*Setonix brachyurus (Quokka)*		T	
21.	34113	*Westralunio carteri (Carter's Freshwater Mussel)*		P4	

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

Australian Government

Department of Sustainability, Environment, Water, Population and Communities

EPBC Act Protected Matters Report

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

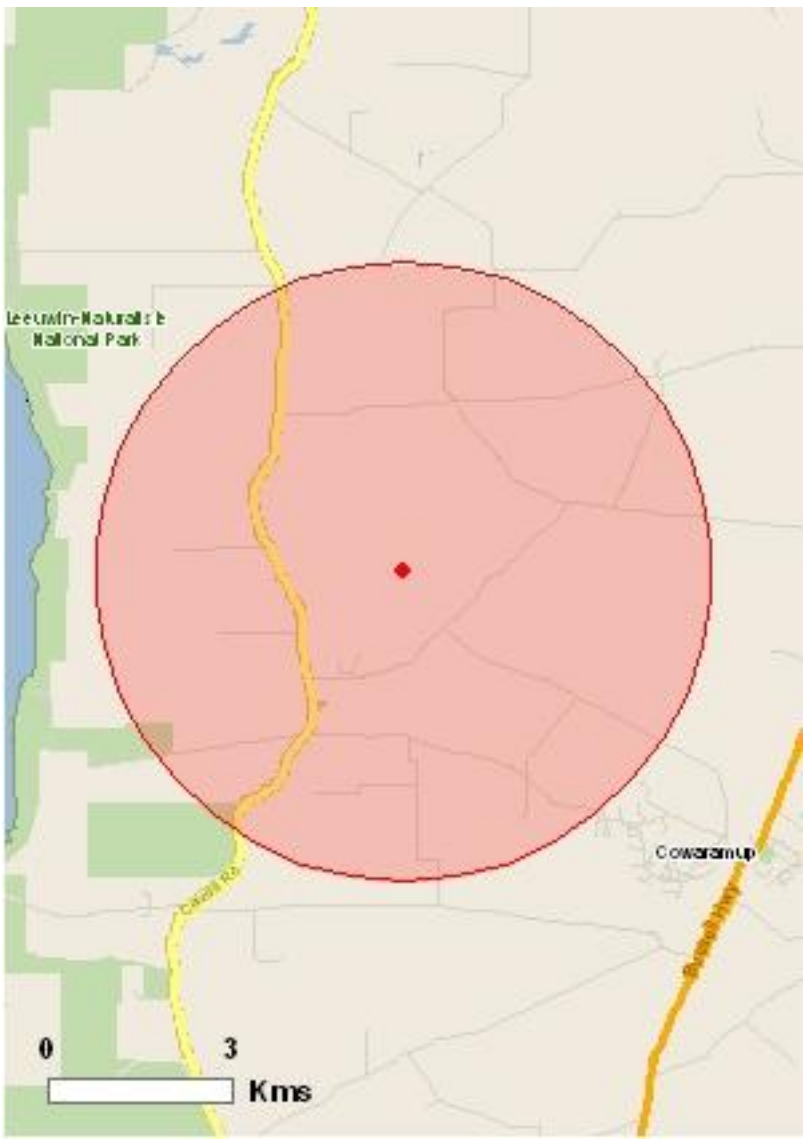
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

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

Report created: 10/12/12 12:40:58

Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

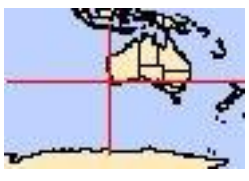
Caveat
Acknowledgements



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

Coordinates

Buffer: 5.0Km



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Areas:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	14
Listed Migratory Species:	8

Other Matters Protected by the EPBC Act

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

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

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

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

Commonwealth Land:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	5
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 nominated.

Place on the RNE:	1
State and Territory Reserves:	1
Regional Forest Agreements:	1
Invasive Species:	11
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
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 baudinii		
Baudin's Black-Cockatoo, Long-billed Black-Cockatoo [769]	Vulnerable	Breeding known to occur within area
Calyptorhynchus latirostris		
Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding likely to occur within area
Leipoa ocellata		
Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Crustaceans		
Engaewa reducta		
Dunsborough Burrowing Crayfish [82675]	Critically Endangered	Species or species habitat likely to occur within area
Mammals		
Dasyurus geoffroii		
Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Pseudocheirus occidentalis		
Western Ringtail Possum [25911]	Vulnerable	Species or species habitat likely to occur within area
Plants		
Banksia nivea subsp. uliginosa		
Swamp Honeypot [82766]	Endangered	Species or species habitat may occur within area

Name	Status	Type of Presence
Banksia squarrosa subsp. argillacea		
Whicher Range Dryandra [82769]	Vulnerable	Species or species habitat may occur within area
Caladenia excelsa		
Giant Spider-orchid [56717]	Endangered	Species or species habitat likely to occur within area
Centrolepis caespitosa		
[6393]	Endangered	Species or species habitat likely to occur within area
Drosera fimbriata		
Manypeaks Sundew [18749]	Vulnerable	Species or species habitat known to occur within area
Gastrolobium papilio		
Butterfly-leaved Gastrolobium [78415]	Endangered	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

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

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
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

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

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

Name
Commonwealth Land -

Listed Marine Species [Resource Information]

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

Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat 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

Extra Information

Places on the RNE [Resource Information]

Note that not all Indigenous sites may be listed.

Name	State	Status
Natural		
Leeuwin - Naturaliste Ridge Area	WA	Registered

State and Territory Reserves [Resource Information]

Name	State
Leeuwin-Naturaliste	WA

Regional Forest Agreements [Resource Information]

Note that all areas with completed RFAs have been included.

Name	State
South West WA RFA	Western Australia

Invasive Species [Resource Information]

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

Name	Status	Type of Presence
Mammals		

Name	Status	Type of Presence
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
Sus scrofa Pig [6]		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
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		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
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

-33.80907 115.05171

Caveat

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Acknowledgements

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

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

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

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

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APPENDIX F HABITAT TREE DATASHEET

GPS	Easting	Northing	Tree_height	Species	DBH_cms	Spout	Hollow_height	Hollow_diam	Notes
1	319982	6257320	Less than 10m	Jarrah	50-75cm				
3	320074	6257370	Less than 10m	Jarrah	50-75cm				
4	320117	6257313	Less than 10m	Jarrah	50-75cm				
5	320141	6257287	11-20m	Marri	100cm plus		Less than 10m	10-20cm	Marginal
5	320141	6257287	11-20m	Marri	100cm plus		Less than 10m	10-20cm	
5	320141	6257287	11-20m	Marri	100cm plus	Spout	11-20m	10-20cm	
6	320173	6257298	11-20m	Jarrah	50-75cm				
7	320162	6257194	Less than 10m	Jarrah	75-100cm				
8	320132	6257226	Less than 10m	Jarrah	50-75cm				
9	320065	6257123	11-20m	Jarrah	75-100cm	Spout	11-20m	20cm plus	
10	320040	6257108	11-20m	Marri	75-100cm				
11	320028	6257112	20m plus	Marri	100cm plus		11-20m	10-20cm	Marginal
12	319999	6257131	11-20m	Marri	100cm plus		11-20m	10-20cm	
12	319999	6257131	11-20m	Marri	100cm plus		11-20m	10-20cm	
13	320022	6257067	11-20m	Marri	75-100cm				
14	320021	6257068	20m plus	Marri	100cm plus	Spout	11-20m	10-20cm	
15	320042	6257065	11-20m	Marri	100cm plus				
16	320036	6257061	11-20m	Marri	75-100cm				
17	319967	6257073	Less than 10m	Marri	50-75cm				
18	319950	6257074	11-20m	Marri	75-100cm		11-20m	10-20cm	Marginal
19	319949	6257038	Less than 10m	Marri	75-100cm				
20	319924	6257038	11-20m	Marri	100cm plus	Spout	Less than 10m	10-20cm	Marginal
21	319971	6257016	Less than 10m	Marri	50-75cm				
23	319862	6257058	11-20m	Marri	50-75cm				
24	319875	6257066	11-20m	Marri	50-75cm				
25	319911	6257072	11-20m	Marri	50-75cm				
26	319911	6257062	11-20m	Marri	50-75cm				
27	320008	6257155	11-20m	Marri	50-75cm				
28	320009	6257156	11-20m	Marri	50-75cm				
29	320008	6257169	11-20m	Marri	100cm plus				
30	319985	6257216	11-20m	Marri	100cm plus	Spout	Less than 10m	10-20cm	Marginal
31	320004	6257230	Less than 10m	Marri	50-75cm				
32	319992	6257259	11-20m	Marri	50-75cm				
33	319992	6257261	11-20m	Marri	75-100cm				
34	319952	6257222	11-20m	Jarrah	50-75cm				
35	319948	6257214	11-20m	Marri	50-75cm				
36	319949	6257213	11-20m	Marri	50-75cm				
37	319951	6257209	11-20m	Jarrah	50-75cm	Spout	Less than 10m	5-10cm	
47	319454	6257080	11-20m	Marri	50-75cm				
48	319448	6257094	11-20m	Marri	50-75cm	Spout	11-20m	10-20cm	Marginal

GPS	Easting	Northing	Tree_height	Species	DBH_cms	Spout	Hollow_height	Hollow_diam	Notes
49	319432	6257082	11-20m	Marri	75-100cm				
50	319419	6257138	20m plus	Marri	50-75cm				
51	319407	6257094	11-20m	Jarrah	50-75cm				
53	319377	6257169	11-20m	Jarrah	50-75cm	Spout	11-20m	10-20cm	
54	319381	6257162	11-20m	Jarrah	Less than 50cm	Spout	11-20m	5-10cm	
55	319371	6257127	11-20m	Jarrah	50-75cm				
56	319373	6257121	11-20m	Jarrah	50-75cm				
57	319375	6257113	11-20m	Marri	75-100cm		11-20m	10-20cm	Bees
57	319375	6257113	11-20m	Marri	75-100cm	Spout	11-20m	20cm plus	
58	319363	6257134	Less than 10m	Stag	Less than 50cm	Vertical	Less than 10m	10-20cm	
59	319356	6257146	11-20m	Marri	50-75cm		Less than 10m	5-10cm	Bees
60	319354	6257164	Less than 10m	Marri	50-75cm				
61	319341	6257161	11-20m	Jarrah	50-75cm				
62	319334	6257156	11-20m	Marri	75-100cm				
63	319323	6257150	11-20m	Jarrah	50-75cm				
64	319336	6257146	11-20m	Marri	50-75cm	Vertical	11-20m	20cm plus	
65	319348	6257139	11-20m	Marri	50-75cm				
66	319341	6257132	11-20m	Marri	75-100cm		11-20m	10-20cm	Marginal
67	319303	6257129	11-20m	Jarrah	50-75cm	Spout	11-20m	10-20cm	
67	319303	6257129	11-20m	Jarrah	50-75cm	Spout	11-20m	10-20cm	
67	319303	6257129	11-20m	Jarrah	50-75cm	Spout	11-20m	10-20cm	
68	319296	6257123	11-20m	Jarrah	50-75cm	Spout	11-20m	10-20cm	
69	319304	6257109	11-20m	Jarrah	50-75cm	Spout	11-20m	10-20cm	
69	319304	6257109	11-20m	Jarrah	50-75cm	Spout	11-20m	10-20cm	
70	319302	6257092	11-20m	Jarrah	50-75cm				
71	319303	6257086	11-20m	Jarrah	50-75cm		11-20m	10-20cm	
72	319329	6257001	11-20m	Jarrah	50-75cm				
73	319323	6256994	11-20m	Marri	50-75cm				
74	319348	6256979	11-20m	Marri	50-75cm	Spout	11-20m	10-20cm	
75	319356	6256984	Less than 10m	Jarrah	50-75cm	Vertical	Less than 10m	10-20cm	
76	319374	6256997	11-20m	Marri	50-75cm	Spout	11-20m	10-20cm	
76	319374	6256997	11-20m	Marri	50-75cm	Spout	11-20m	10-20cm	
77	319390	6256995	11-20m	Marri	50-75cm				
78	319374	6257012	11-20m	Jarrah	50-75cm	Spout	11-20m	10-20cm	
79	319376	6257017	11-20m	Jarrah	50-75cm				
80	319389	6257015	11-20m	Jarrah	75-100cm		11-20m	10-20cm	
81	319372	6257023	11-20m	Marri	100cm plus		Less than 10m	20cm plus	Marginal
82	319352	6257041	11-20m	Jarrah	100cm plus				
83	319355	6257058	11-20m	Jarrah	50-75cm		Less than 10m	10-20cm	
84	319386	6257072	11-20m	Marri	50-75cm		11-20m	10-20cm	
85	319396	6257056	11-20m	Jarrah	50-75cm				
86	319395	6257042	11-20m	Jarrah	50-75cm				
87	319418	6257021	11-20m	Jarrah	50-75cm				
88	319423	6257011	11-20m	Jarrah	75-100cm	Spout	11-20m	10-20cm	

GPS	Easting	Northing	Tree_height	Species	DBH_cms	Spout	Hollow_height	Hollow_diam	Notes
88	319423	6257011	11-20m	Jarrah	75-100cm	Spout	11-20m	10-20cm	
88	319423	6257011	11-20m	Jarrah	75-100cm	Spout	11-20m	10-20cm	
89	319432	6257013	11-20m	Jarrah	50-75cm				
90	319421	6257003	11-20m	Jarrah	50-75cm				
91	319422	6257002	11-20m	Jarrah	50-75cm				
92	319431	6256980	11-20m	Marri	50-75cm				
93	319470	6257028	20m plus	Stag	50-75cm	Spout	Less than 10m	10-20cm	Bees
93	319470	6257028	20m plus	Stag	50-75cm	Spout	11-20m	10-20cm	
94	319479	6256979	11-20m	Marri	50-75cm				
95	319446	6257002	Less than 10m	Jarrah	50-75cm		Less than 10m	5-10cm	
96	319425	6257073	11-20m	Jarrah	50-75cm				
97	319424	6257062	11-20m	Marri	75-100cm				
98	319478	6257055	11-20m	Jarrah	50-75cm				
99	319485	6257042	11-20m	Jarrah	50-75cm				
100	319484	6257015	11-20m	Stag	75-100cm	Spout	11-20m	20cm plus	
101	319491	6257001	11-20m	Jarrah	75-100cm	Spout	11-20m	10-20cm	Marginal
101	319491	6257001	11-20m	Jarrah	75-100cm		11-20m	10-20cm	Marginal
102	319500	6256989	11-20m	Jarrah	50-75cm		11-20m	10-20cm	
103	319506	6256980	11-20m	Jarrah	100cm plus		11-20m	10-20cm	
104	319528	6256991	11-20m	Jarrah	50-75cm		11-20m	10-20cm	
104	319528	6256991	11-20m	Jarrah	50-75cm		11-20m	10-20cm	
105	319526	6256991	11-20m	Jarrah	75-100cm				
106	319532	6256996	11-20m	Jarrah	50-75cm				
107	319503	6257040	11-20m	Jarrah	100cm plus		11-20m	10-20cm	
108	319510	6257058	11-20m	Jarrah	50-75cm				
109	319515	6257045	11-20m	Jarrah	50-75cm		11-20m	10-20cm	
109	319515	6257045	11-20m	Jarrah	50-75cm		11-20m	10-20cm	
110	319521	6257053	11-20m	Marri	75-100cm		11-20m	10-20cm	
111	319518	6257042	11-20m	Marri	50-75cm		Less than 10m	5-10cm	Marginal
112	319518	6257032	11-20m	Marri	75-100cm				
113	319523	6257028	11-20m	Jarrah	50-75cm				
114	319533	6257030	11-20m	Jarrah	50-75cm				
115	319537	6257041	11-20m	Jarrah	50-75cm				
116	319547	6257050	11-20m	Marri	50-75cm				
117	319548	6257045	11-20m	Jarrah	50-75cm				
118	319547	6257007	11-20m	Jarrah	50-75cm				
119	319541	6256998	11-20m	Jarrah	50-75cm				
120	319551	6256987	11-20m	Jarrah	50-75cm				
121	319539	6256978	11-20m	Marri	75-100cm		Less than 10m	10-20cm	Marginal
122	319543	6256983	11-20m	Marri	50-75cm		11-20m	10-20cm	Marginal
123	319557	6256987	11-20m	Marri	75-100cm				
124	319566	6256984	11-20m	Jarrah	50-75cm				
125	319564	6256992	11-20m	Jarrah	100cm plus	Spout	11-20m	10-20cm	
126	319571	6256990	11-20m	Marri	100cm plus	Spout	11-20m	20cm plus	

GPS	Easting	Northing	Tree_height	Species	DBH_cms	Spout	Hollow_height	Hollow_diam	Notes
127	319566	6257010	11-20m	Jarrah	50-75cm	Spout	11-20m	10-20cm	
128	319563	6257026	11-20m	Marri	50-75cm		11-20m	10-20cm	Marginal
129	319564	6257038	11-20m	Marri	50-75cm				
130	319566	6257048	11-20m	Marri	50-75cm				
131	319597	6257040	11-20m	Jarrah	50-75cm				
132	319583	6257035	11-20m	Jarrah	75-100cm				
133	319601	6257018	11-20m	Jarrah	100cm plus		11-20m	5-10cm	
134	319586	6256994	11-20m	Jarrah	50-75cm	Vertical	Less than 10m	10-20cm	
135	319606	6256989	11-20m	Marri	50-75cm				
136	319592	6257080	Less than 10m	Marri	100cm plus				
137	319607	6257070	11-20m	Jarrah	50-75cm				
138	319608	6257063	11-20m	Marri	50-75cm		11-20m	10-20cm	
139	319617	6257064	11-20m	Jarrah	50-75cm		11-20m	10-20cm	
140	319599	6257056	11-20m	Jarrah	50-75cm	Spout	11-20m	10-20cm	
144	319623	6257028	11-20m	Marri	75-100cm	Vertical	11-20m	10-20cm	Marginal
145	319622	6257021	11-20m	Marri	50-75cm				
146	319607	6257007	11-20m	Marri	50-75cm		Less than 10m	10-20cm	Marginal
147	319605	6257006	11-20m	Marri	50-75cm				
148	319617	6256993	11-20m	Jarrah	50-75cm				
149	319628	6256979	11-20m	Marri	75-100cm				
150	319627	6257000	11-20m	Marri	75-100cm				
151	319638	6257001	11-20m	Jarrah	50-75cm		Less than 10m	10-20cm	
151	319638	6257001	11-20m	Jarrah	50-75cm	Spout	11-20m	5-10cm	
152	319646	6257002	11-20m	Jarrah	50-75cm				
153	319656	6256999	11-20m	Marri	50-75cm				
154	319668	6257000	11-20m	Jarrah	50-75cm				
155	319665	6257017	11-20m	Jarrah	50-75cm				
156	319667	6257021	11-20m	Jarrah	50-75cm				
157	319662	6257018	11-20m	Marri	75-100cm				
158	319652	6257017	11-20m	Jarrah	50-75cm				
159	319650	6257012	11-20m	Jarrah	50-75cm				
160	319636	6257018	11-20m	Jarrah	50-75cm				
161	319638	6257019	11-20m	Marri	75-100cm				
162	319627	6257028	11-20m	Marri	75-100cm				
163	319639	6257031	11-20m	Marri	50-75cm				
164	319640	6257040	11-20m	Marri	75-100cm				
165	319651	6257040	11-20m	Marri	50-75cm		Less than 10m	10-20cm	
165	319651	6257040	11-20m	Marri	50-75cm		Less than 10m	10-20cm	
165	319651	6257040	11-20m	Marri	50-75cm		11-20m	10-20cm	
166	319655	6257039	11-20m	Jarrah	50-75cm				
167	319655	6257039	11-20m	Jarrah	50-75cm				
168	319667	6257039	11-20m	Jarrah	50-75cm				
169	319654	6257048	11-20m	Marri	75-100cm				
170	319647	6257052	11-20m	Marri	50-75cm				

GPS	Easting	Northing	Tree_height	Species	DBH_cms	Spout	Hollow_height	Hollow_diam	Notes
171	319632	6257054	11-20m	Marri	50-75cm				
172	319630	6257071	11-20m	Marri	50-75cm				
173	319628	6257076	11-20m	Marri	50-75cm				
174	319637	6257079	11-20m	Jarrah	50-75cm				
175	319631	6257084	11-20m	Jarrah	50-75cm		11-20m	10-20cm	
175	319631	6257084	11-20m	Jarrah	50-75cm		11-20m	5-10cm	
176	319626	6257092	11-20m	Marri	50-75cm				
177	319627	6257101	11-20m	Jarrah	50-75cm		11-20m	10-20cm	Marginal
178	319636	6257101	11-20m	Jarrah	50-75cm				
179	319641	6257103	11-20m	Jarrah	50-75cm				
180	319655	6257084	11-20m	Jarrah	50-75cm				
181	319652	6257075	11-20m	Jarrah	50-75cm				
182	319661	6257074	11-20m	Marri	75-100cm				
183	319675	6257065	11-20m	Stag	50-75cm				
184	319676	6256994	11-20m	Stag	50-75cm				
185	319686	6256982	11-20m	Marri	75-100cm	Vertical	11-20m	10-20cm	
186	319670	6256984	11-20m	Marri	50-75cm				
187	319700	6256983	11-20m	Jarrah	50-75cm				
188	319703	6256987	11-20m	Marri	100cm plus	Spout	11-20m	10-20cm	
188	319703	6256987	11-20m	Marri	100cm plus		11-20m	10-20cm	
189	319716	6256990	11-20m	Marri	50-75cm				
190	319716	6256991	11-20m	Marri	75-100cm				
191	319708	6257017	11-20m	Jarrah	50-75cm				
192	319708	6257024	11-20m	Jarrah	50-75cm				
193	319711	6257023	11-20m	Marri	75-100cm				
194	319714	6257032	11-20m	Marri	50-75cm				
195	319714	6257044	11-20m	Jarrah	50-75cm				
196	319706	6257045	11-20m	Marri	50-75cm				
197	319710	6257051	11-20m	Jarrah	50-75cm				
198	319711	6257060	11-20m	Jarrah	75-100cm	Spout	Less than 10m	10-20cm	
199	319727	6257050	11-20m	Jarrah	50-75cm				
200	319724	6257054	11-20m	Jarrah	75-100cm	Vertical	Less than 10m	20cm plus	
201	319719	6257058	11-20m	Marri	75-100cm				
202	319722	6257075	11-20m	Marri	50-75cm				
203	319720	6257080	11-20m	Marri	75-100cm	Vertical	Less than 10m	20cm plus	Marginal
204	319714	6257085	11-20m	Jarrah	50-75cm				
205	319719	6257111	11-20m	Jarrah	50-75cm		Less than 10m	5-10cm	
206	319724	6257109	11-20m	Marri	50-75cm				
207	319734	6257096	11-20m	Jarrah	50-75cm				
208	319742	6257088	11-20m	Jarrah	50-75cm				
209	319754	6257074	11-20m	Jarrah	75-100cm				
210	319752	6257064	11-20m	Marri	75-100cm	Spout	11-20m	10-20cm	
211	319751	6257045	11-20m	Jarrah	50-75cm				
212	319744	6257043	11-20m	Jarrah	50-75cm				

GPS	Easting	Northing	Tree_height	Species	DBH_cms	Spout	Hollow_height	Hollow_diam	Notes
213	319740	6257046	11-20m	Jarrah	50-75cm				
214	319734	6257033	11-20m	Jarrah	50-75cm				
215	319740	6257021	11-20m	Marri	50-75cm				
216	319746	6257014	11-20m	Jarrah	50-75cm				
217	319728	6257003	11-20m	Marri	100cm plus	Spout	11-20m	10-20cm	
218	319731	6256990	11-20m	Marri	75-100cm				
219	319748	6256991	11-20m	Marri	75-100cm				
220	319758	6256985	11-20m	Marri	50-75cm				
221	319779	6256982	11-20m	Marri	100cm plus				
222	319773	6256992	11-20m	Jarrah	50-75cm				
223	319761	6257027	11-20m	Marri	50-75cm				
224	319770	6257037	11-20m	Jarrah	50-75cm				
225	319758	6257119	11-20m	Jarrah	50-75cm				
226	319739	6257125	11-20m	Marri	100cm plus		Less than 10m	10-20cm	
226	319739	6257125	11-20m	Marri	100cm plus		11-20m	10-20cm	
226	319739	6257125	11-20m	Marri	100cm plus		11-20m	10-20cm	
227	319724	6257147	11-20m	Marri	75-100cm	Vertical	11-20m	5-10cm	
228	319719	6257150	11-20m	Jarrah	50-75cm				
229	319751	6257175	11-20m	Marri	75-100cm	Spout	Less than 10m	10-20cm	Marginal
231	319766	6257145	11-20m	Jarrah	50-75cm				
232	319774	6257141	11-20m	Marri	50-75cm				
233	319786	6257128	Less than 10m	Marri	100cm plus				
234	319783	6257113	Less than 10m	Marri	75-100cm	Spout	Less than 10m	10-20cm	Marginal
235	319778	6257103	11-20m	Marri	75-100cm	Spout	Less than 10m	10-20cm	Marginal
235	319778	6257103	11-20m	Marri	75-100cm		11-20m	10-20cm	
236	319776	6257086	11-20m	Marri	75-100cm				
237	319785	6257090	11-20m	Marri	75-100cm				
238	319789	6257078	11-20m	Marri	50-75cm				
239	319773	6257074	Less than 10m	Jarrah	50-75cm	Vertical	11-20m	20cm plus	Marginal
240	319775	6257072	11-20m	Marri	75-100cm		11-20m	10-20cm	
240	319775	6257072	11-20m	Marri	75-100cm		11-20m	10-20cm	
241	319781	6257050	11-20m	Marri	100cm plus	Spout	11-20m	10-20cm	Bees
241	319781	6257050	11-20m	Marri	100cm plus		Less than 10m	20cm plus	
242	319783	6257046	11-20m	Jarrah	50-75cm	Vertical	Less than 10m	20cm plus	
243	319782	6257036	11-20m	Marri	75-100cm				
244	319775	6257033	11-20m	Jarrah	50-75cm				
245	319794	6257017	11-20m	Marri	50-75cm				
246	319790	6257007	11-20m	Jarrah	50-75cm				
247	319785	6256991	11-20m	Jarrah	50-75cm				
248	319809	6256992	11-20m	Marri	50-75cm	Spout	11-20m	10-20cm	
249	319809	6256992	11-20m	Jarrah	50-75cm		Less than 10m	10-20cm	
250	319809	6256991	11-20m	Jarrah	50-75cm				
251	319809	6256991	11-20m	Jarrah	50-75cm				
252	319820	6257015	11-20m	Jarrah	50-75cm				

GPS	Easting	Northing	Tree_height	Species	DBH_cms	Spout	Hollow_height	Hollow_diam	Notes
253	319822	6257021	11-20m	Jarrah	50-75cm				
254	319804	6257037	11-20m	Jarrah	50-75cm				
255	319804	6257041	11-20m	Marri	75-100cm				
256	319792	6257041	11-20m	Jarrah	50-75cm				
257	319797	6257050	11-20m	Jarrah	50-75cm				
258	319798	6257067	11-20m	Jarrah	50-75cm	Spout	11-20m	10-20cm	
259	319802	6257073	11-20m	Jarrah	50-75cm		11-20m	10-20cm	
260	319800	6257092	Less than 10m	Marri	50-75cm				
261	319811	6257119	11-20m	Jarrah	50-75cm		Less than 10m	5-10cm	
261	319811	6257119	11-20m	Jarrah	50-75cm				
262	319807	6257118	11-20m	Jarrah	50-75cm	Spout	11-20m	5-10cm	
263	319807	6257129	11-20m	Marri	100cm plus	Spout	11-20m	10-20cm	Marginal
264	319811	6257147	11-20m	Jarrah	50-75cm	Spout	11-20m	10-20cm	Marginal
265	319796	6257149	Less than 10m	Marri	75-100cm	Spout	11-20m	20cm plus	Marginal
266	319779	6257154	11-20m	Marri	50-75cm				
267	319770	6257156	11-20m	Marri	50-75cm		Less than 10m	5-10cm	Bees
268	319767	6257169	11-20m	Jarrah	50-75cm				
269	319764	6257170	Less than 10m	Stag	50-75cm	Spout	Less than 10m	10-20cm	
269	319764	6257170	Less than 10m	Stag	50-75cm	Spout	Less than 10m	10-20cm	
270	319779	6257180	Less than 10m	Marri	50-75cm	Spout	Less than 10m	10-20cm	
271	319786	6257193	11-20m	Jarrah	50-75cm				
272	319808	6257173	Less than 10m	Jarrah	50-75cm	Spout	Less than 10m	10-20cm	
272	319808	6257173	Less than 10m	Jarrah	50-75cm	Spout	Less than 10m	10-20cm	
272	319808	6257173	Less than 10m	Jarrah	50-75cm		Less than 10m	10-20cm	
272	319808	6257173	Less than 10m	Jarrah	50-75cm		Less than 10m	10-20cm	
273	319812	6257184	Less than 10m	Jarrah	50-75cm				
274	319825	6257157	11-20m	Marri	75-100cm	Vertical	11-20m	20cm plus	Marginal
275	319823	6257185	11-20m	Jarrah	50-75cm				
276	319815	6257205	11-20m	Marri	50-75cm		Less than 10m	10-20cm	
277	319830	6257212	11-20m	Jarrah	50-75cm				
278	319836	6257207	11-20m	Marri	50-75cm				
279	319843	6257214	11-20m	Marri	50-75cm				
280	319859	6257231	11-20m	Marri	75-100cm				
281	319863	6257228	11-20m	Jarrah	50-75cm	Spout	11-20m	10-20cm	
282	319858	6257214	11-20m	Jarrah	50-75cm				
283	319848	6257205	11-20m	Marri	50-75cm	Spout	Less than 10m	10-20cm	
283	319848	6257205	11-20m	Marri	50-75cm	Vertical	Less than 10m	10-20cm	
284	319840	6257194	11-20m	Jarrah	50-75cm				
285	319823	6257200	11-20m	Jarrah	50-75cm				
286	319829	6257180	11-20m	Marri	50-75cm				
287	319838	6257171	11-20m	Marri	50-75cm	Vertical			
288	319834	6257141	11-20m	Jarrah	50-75cm				
289	319831	6257098	11-20m	Jarrah	50-75cm		Less than 10m	10-20cm	
290	319823	6257064	11-20m	Marri	50-75cm				

GPS	Easting	Northing	Tree_height	Species	DBH_cms	Spout	Hollow_height	Hollow_diam	Notes
291	319816	6257053	11-20m	Jarrah	50-75cm				
292	319833	6257021	11-20m	Marri	75-100cm				
293	319826	6257015	11-20m	Marri	50-75cm				
294	319817	6257020	11-20m	Jarrah	50-75cm				
295	319825	6257002	11-20m	Jarrah	50-75cm				

APPENDIX G MAPS