# Biological Survey:
# Albany Ring Road

**Report prepared for**
**Main Roads Western Australia**
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FLORA | FAUNA | DIEBACK

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# 1 SUMMARY

Main Roads Great Southern Region are proposing to construct stage two and three of the Albany Ring Road Project. Southern Ecology was engaged to assess a broad project envelope (338 ha) for potential environmental constraints.

**FLORA**

- A total of 342 plant taxa from 65 families were recorded within and adjacent to 32 floristic quadrats established in the Survey Area.
- Populations of four Priority-listed flora were recorded: - *Synaphea incurva* (P1), *Boronia crassipes* (P3), *Andersonia* sp. Jamesii (J. Liddelow 84) (P4) and *Thysanotus isantherus* (P4). A previously recorded population of *Prasophyllum paulinae* (P1) is known from the Survey Area; the potential exists for it to re- emerge following fire.
- Five Declared Pests and/or Weeds of National Significance (WONS) were recorded: - Blackberry (**Rubus* species complex), Bridal Creeper (**Asparagus asparagoides*), Gorse (**Ulex europaeus*), Arum Lily (**Zantedeschia aethiopica*) and Lantana (**Lantana camara*).
- Vegetation condition graded from Completely Degraded to Excellent; Large areas of vegetation associated with shire reserves and intact wetlands on private property were classified as Excellent.
- Thirteen vegetation associations were described: - four occur exclusively in wetland habitats (*Homalospermum firmum/Callistemon glaucus* Peat Thicket, *Evandra aristata* Sedgeland, *Taxandria juniperina Closed Forest* and *Melaleuca preissiana* Low Woodland), three are associated with granite outcrops (*Taxandria marginata*, *Gastrolobium bilobum* and *Leucopogon assimilis* Shrublands) and six generally occur on uplands (*Hakea* spp. Shrubland/Woodland Complex, Jarrah/Marri/Sheoak Laterite Forest, Jarrah/Sheoak/*E. staeri* Sandy Woodland, Marri/Jarrah Coastal Hills Forest, Marri/Jarrah Forest/Peppermint Woodland and Peppermint Low Forest).
- Two Threatened and four Priority Ecological Communities occur in the vicinity; no vegetation in the Survey Area meets the requisite criteria for these communities. Several vegetation associations can be consigned as being significant due to their association with wetlands, granite refugia, low reservation status or low overall extent.

**FAUNA**

- Five significant fauna species were present within the Survey Area: - Carnaby's Cockatoo (*Calyptorhynchus latirostris*) (T-EN), Baudin's Cockatoo (*Calyptorhynchus baudinii*) (T-EN), Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) (T-VN), Western Ringtail Possum (*Pseudocheirus occidentalis*) (T-CR), and Southern Brown Bandicoot (*Isoodon obesulus* subsp. *fusciventer*) (P4).
- Western Ringtail Possum (WRP) scats were observed widely across the Survey Area, in multiple habitats of varying condition. *Core* and *supporting habitats* and *potential habitat linkages* were identified.
- Foraging and potential breeding habitat for three Black Cockatoo species occurred throughout the Survey Area, in all the Eucalypt Woodland/Forest habitats. Large areas of potential roosting sites were identified among both native and introduced tree species.
- No hollows were determined to be occupied or showed recent use by Cockatoo species. 60 trees contained hollows potentially suitable for the Carnaby's Cockatoo; 18 trees contained hollows potentially suitable for Forest Red-tailed Black Cockatoo and three trees contained hollows potentially suitable for Baudin's Cockatoo. In total, 662 potential breeding trees were recorded (DBH≥ 500mm, with or without hollows) comprising of four tree species.

# 2 INTRODUCTION

## 2.1 Project Background

Main Roads Great Southern Region are proposing to construct a heavy haulage route around the City of Albany for the transport of materials to the City's port, called the Albany Ring Road Project. The project is a staged development to support freight growth and long-term transport needs in the City of Albany in Western Australia. The project will connect Albany Highway, South Western Highway, Lower Denmark Road and Hanrahan Road allowing access to the Southern Ports Authority Albany Port (Figure 1). Stage one of the project, the construction and upgrade of Menang Drive to Chester Pass Road to Albany Highway was completed in 2017. Stages two and three are proposed.

Southern Ecology was engaged by Main Roads to assess the project envelope (the Survey Area) for potential constraints related to vegetation, flora, fauna or other environmentally sensitive sites. This report presents the results from survey effort from 2017 to 2019 for the project. The total Survey Area is 338 hectares (ha).

## 2.2 Scope and Objectives

The objective of the biological survey is to delineate key flora, fauna, soil, groundwater and surface water (wetlands) values within the Survey Area and to determine potential sensitivity to impact. The outcome of the survey and information supplied in the biological survey report will be used to inform the environmental assessment and approvals process. The scope of works included the following:

- Complete a desktop assessment of the survey area to identify:
    - Biological features and constraints which may be in or nearby the survey area.
    - Significant flora, vegetation/ecological communities, fauna, soil/land system, groundwater and surface water values and potential sensitivity to impact.
    - Likelihood of occurrence assessment for Threatened/Priority flora and fauna species that potentially occur.
    - Identify broad pre-European vegetation type(s).
- Conduct a detailed two-phase vegetation and flora survey to:
    - Verify and ground truth the desktop assessment findings.
    - Undertake vegetation association and condition mapping, including defining patches of planted and remnant native vegetation.
    - Identify and map the presence of any Threatened or Priority ecological communities (TECs or PECs).
    - Complete patch assessments for vegetation types which may potentially align with TECs against approved conservation advice.
    - Complete targeted searches to record the presence of any Threatened and Priority flora, Weeds of National Significance (WoNS) or Declared Pests, and map the extent of populations if encountered. Any Threatened flora to be mapped with a differential GPS.
    - Assess the flora species diversity, density, composition, structure and weed cover within marked quadrats.

- Conduct a Level 1 fauna survey, black cockatoo habitat and WRP assessments to:
    - Identify and map fauna habitat, including a summary of conservation significant fauna considered likely or possible to occur, or fauna recorded in each habitat type.
    - Map wetland habitat and riparian habitat if present.
    - Record native and non-native fauna within the Survey Area.
    - Identify and map of black cockatoo foraging habitat, roosting, potential breeding and actual breeding trees as per Commonwealth guidelines[1].
    - Identify and map Western Ringtail habitat as per Commonwealth guidelines.
- Provide a combined flora, vegetation, fauna and black cockatoo and western ringtail possum assessment report.

## 2.3 Local and Regional Context

### *2.3.1 Location and tenure*

The Survey Area is located within the Southern Jarrah Forest subregion of the Jarrah Forest Interim Biogeographic Regionalisation of Australia (IBRA) Region (Department of the Environment [DotE] 2014a). It intersects shire reserves, private property and road reserves mainly to the west of the City of Albany and is centred on Link Rd, South Coast Highway, George St, Lower Denmark Rd and Albany Port Rd (Figure 1).

The Survey Area includes one large City of Albany reserve with remnant vegetation (Res 28465, 28466 & 28467; corner of South Coast Highway and George St) that is vested for gravel extraction and rubbish purposes. Several smaller reserves within the Survey Area are vested for railway, drainage, public utilities or other purposes. One gazetted conservation reserve (Gledhow Nature Reserve) and one Public Park (Mt Melville) occur within the vicinity of the Survey Area (Appendix B).

### *2.3.2 Biological Environment*

The Survey Area occurs circles the western and southern interface between the urban and agricultural zones of Albany that was largely cleared for agricultural purposes in the 19th and 20th century. Three large patches of remnant vegetation remain within the Survey Area: Eucalypt and She-Oak Woodlands on George St Reserve (~30 ha), Forest and Granites on the lower southern slopes of Mt Melville (~12 ha) and a large wetland on Link Rd (6 ha). Other significant corridors of vegetation occur along Lower Denmark Rd and many narrow road reserves throughout the Survey Area continue to support native species. Large areas between Lower Denmark Rd and the Albany Port Rd have regenerated after clearing and/or have been planted with non-indigenous Eucalypts and Pine Trees.

Broad scale pre-European vegetation mapping (Shepherd *et al.* 2002) that overlies the Survey Area indicates the native vegetation is currently (or was previously) composed of three associations:

- Albany_3 - *"Forest. Mainly jarrah and marri Eucalyptus marginata, Corymbia calophylla.*"
- Albany_51 - *"Sedgeland. Cyperaceae, Restionaceae, Juncaceae.*"

[1] Biota undertook additional assessments of potential cockatoo breeding trees in 2019, which incorporated a reassessment of some trees (those occurring in the disturbance envelope) previously assessed by Southern Ecology in 2017, plus additional trees due to an expansion of the project footprint.

- Albany_978 - *"Low forest, woodland or low woodland with scattered trees Eucalyptus marginata, Banksia spp., Allocasuarina spp."*

The Survey Area also occurs within the zone mapped during the Albany Regional Vegetation Survey (Sandiford and Barrett 2010), which provides meso-scale vegetation information and provides a context for assessing the regional conservation significance of vegetation associations. Eleven mapping Units have previously been mapped within the Survey Area:

- *Evandra aristata* Sedgeland (Unit 46)
- *Gastrolobium bilobum/Hakea elliptica* Granite Shrubland/Yate Woodland (Unit 23)
- *Hakea* spp Shrubland/Woodland Complex (Unit 31)
- *Homalospermum firmum/Callistemon glaucus* Peat Thicket (Unit 47)
- Jarrah/Marri/Sheoak Laterite Forest (Unit 12)
- Jarrah/Sheoak/*E.staeri* Sandy Woodland (Unit 13)
- Marri/Jarrah Coastal Hills Forest (Unit 17)
- Marri/Jarrah Forest/Peppermint Woodland (Unit 10)
- Peppermint Low Forest (Unit 2)
- *Taxandria juniperina* Closed Forest (Unit 59)
- *Taxandria marginata* Granite Shrubland (Unit 24).

### *2.3.3 Surface Water and Hydrology*

The northern section of the Survey Area (Link Rd) intersects a broad drainage channel that supports a large area of seasonally wet or inundated wetland vegetation, which sheds water westward into Five Mile Creek and eventually into Lake Powell. The hydrology of the southern section of the Survey Area (Lower George St, Lower Denmark Rd) is largely altered by artificial channels installed early in the late 19$^{th}$ to make the peaty swaps more suitable for agriculture. These drains divert water south of the Survey Area into Robinson and eventually empty into Princess Royal Harbour.

Oyster Harbor represents the closest Nationally Important Wetland, with occurs 8 km east of the Survey Area and is hydrologically discrete. No Ramsar wetlands occur within the vicinity of the Survey Area.

### *2.3.4 Soil-Landscapes*

Seven soil-landscapes (Department of Agriculture and Food Western Australia [DAFWA] 2017) are mapped within the Survey Area:

- Collis yellow duplex - *"Gravelly yellow duplex soils; Jarrah-Marri forest."*
- Dempster crest - *"Sands and laterite on elongate crests; Jarrah-Albany Blackbutt-Marri forest."*
- Dempster slope - *"Sands and gravels on smooth slopes; Albany blackbutt-sheoak low forest."*
- Gardner granite - *"Granite outcrop."*
- Mattaband yellow duplex - *"Gravelly yellow and yellow duplex soils; Jarrah-Marri-Yellow Tingle forest."*
- Minor Valleys S7 slope - *"Broad valleys in sedimentary rocks; 30 m relief; smooth slopes. Deep sands and iron podzols on slopes; Albany Blackbutt-jarrah-sheoak woodland. Podzols and yellow duplex soils on floors; paperbark woodland, teatree heath."*
- Owingup Subsystem - *"Plains with swamps, lunettes and dunes. Yellow solonetzic soils, organic loams and diatomaceous earth. Wattle-Paperbark thickets, Teatree heath and reeds. Podzols on dunes; Banksia-Sheoak woodland."*

## 2.4 State and Commonwealth Conservation and Pest Categories

Commonwealth and State regulatory authorities maintain lists of vegetation, flora and fauna that are assigned into categories of conservation significance or pest status. An overview of the codes and categories used for conservation and pest status in Western Australia that are relevant to this biological survey are provided in Appendix A.


Figure 1. Survey Area location

# 3 METHODS

## 3.1 Personnel

The assessment was conducted by Damien Rathbone (botanist) and Dr Sandra Gilfillan (zoologist), with field assistance by Keith Smith, Anna de-Haan, Dylan Lehmann, Kirsty Vogel and Fin Pope-Gilby.

The flora survey (desktop and field assessment) was primarily conducted by Damien Rathbone (BScHons Plant Science, Scientific License 012382). Damien has over 14 years of experience conducting biological surveys in southern Western Australia. Within the South Coast region, he has previously undertaken Department of Biodiversity, Conservation and Attractions (DBCA) regional surveys (Albany Regional Vegetation Survey, Fitzgerald River National Park Flora Survey, Ravensthorpe Range Flora Survey), threatened species survey and recovery implementation, and has 10 scientific publications. Damien is also an accredited interpreter for dieback assessments on DBCA estate (Accreditation PDI-032).

Dr Sandra Gilfillan has worked extensively in the Great Southern and South Coast regions for the past 20 years. She has extensive experience in threatened species recovery planning, research and monitoring, including work on both Western Ringtail Possums (DBCA and Oyster Harbour Catchment Group) and Carnaby's Cockatoo (BirdLife Western Australia) and has a well-developed knowledge of the faunal ecology of the region.

## 3.2 Desktop Assessment

A desktop assessment of known or potential significant vegetation, flora and fauna within a 10 km radius of the Survey Area (the Study Area) was undertaken using the following sources:

- NatureMap (DBCA 2019a; results attached in Appendix H).
- Protected Matters Search Tool (PMST) (Department of the Environment and Energy [DotEE] 2019a; results attached in Appendix H).
- Threatened and Priority flora and fauna records from [DBCA] and/or the Western Australian Herbarium as supplied by Main Roads (16th July 2019) (mapped in Appendix B).
- PEC and TEC mapping from the Species and Communities Branch, DBCA, as supplied by Main Roads (16th July 2019) (mapped in Appendix B).

Prior to conducting the survey, the records returned from the database searches were assessed for their spatial accuracy. All valid species recorded were reviewed to determine key morphological characteristics, flowering times, habitat preferences and the likelihood and location of potentially suitable habitat within the Survey Area. This information was used to optimise the targeted flora and fauna surveys and the location of floristic quadrats (section 3.5, 3.6 and 3.9).

## 3.3 Likelihood of Occurrence Assessment

Following the field survey, all conservation significant flora and fauna species identified in the database searches that were not detected during the survey were assessed to determine their likelihood of occurrence in the Survey Area (post-survey likelihood of occurrence, Appendix F). Habitat suitability was determined from information in herbarium voucher labels, published descriptions, and knowledge from the authors. Survey effectiveness reflected the probability of detecting a particular species where

suitable habitat was present, which could be dependent on thoroughness of the survey, flowering period or timing of emergence (i.e. annuals or disturbance responsive species). Each species in the post-survey likelihood of occurrence (Appendix F) was assessed on a case by case basis according to the general categories summarized in Table 1.

Table 1. Matrix of habitat suitability and effectiveness of field surveys to determine the likely presence of conservation significant flora and fauna post survey.

| | | Survey Effectiveness | | |
|---|---|---|---|---|
| | | No survey limitations present that would have prevented detection; all habitats were thoroughly surveyed | Moderate survey limitations present (i.e. inconspicuous or cryptic species; dense vegetation) | Major survey limitations present (i.e. species is a post fire ephemeral and habitat are long unburnt; habitat inaccessible) |
| Habitat and Proximity | Species reliably recorded within close vicinity (<2 km) and suitable habitat present | Unlikely | Possible | Likely |
| | Species previously recorded within vicinity (2-10 km) but suitable habitat unknown | Unlikely | Possible | Possible |
| | Species previously recorded within vicinity (2-10 km) and suitable habitat present | Unlikely | Possible | Possible |
| | No suitable habitat appears to be present | Highly Unlikely | Unlikely | Possible |

## 3.4 Field Assessment

### *3.4.1 Field Survey Schedule and Type*

Various field surveys for vegetation, flora and fauna were undertaken over three years and included three spring seasons (October 2017 to October 2019) (Table 2). The majority of the Survey Area was assessed in 2017 and 2018; some minor additional areas were included in 2019 due to potential changes in the project envelope. Some key areas (such as the known population of *Prasophyllum paulinae*) were surveyed over repetitive seasons.

Surveys were conducted in accordance with the Environmental Protection Authority (EPA) Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016a), Technical Guidance - Sampling methods for Terrestrial Vertebrate Fauna Surveys (EPA and DEC 2010) and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) guidance for significant species (e.g. black cockatoos). Overall the survey effort comprised:

- Detailed flora and vegetation survey for the entire survey area.
- Targeted flora survey for *Prasophyllum paulinae* (including a targeted regional survey, see Appendix I).
- Level 1 fauna survey.
- Targeted fauna survey for Western Ringtail Possum.
- Targeted fauna survey for Black Cockatoos (Carnaby's Cockatoo (*Calyptorhynchus latirostris*) Baudin's Cockatoo (*Calyptorhynchus baudinii*); and Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*).

Survey effort derived from GPS tracklogs is shown on Map E, Appendix B.

Table 2. Field dates, survey type and approximate time expended.

| Date | Personnel | Survey Type | Area | Survey Effort (hours) |
|---|---|---|---|---|
| 24th October 2017 | Damien Rathbone, Sandra Gilfillan | Vegetation Mapping, Targeted flora survey of upland and granites. Targeted Fauna Survey, Fauna Habitat Assessment | Survey Area | 14 |
| 25-26th October 2017 | Sandra Gilfillan | Targeted Fauna Survey, Fauna Habitat Assessment and Cockatoo Tree Assessment | Survey Area | 6 |
| 31st October 2017 | Sandra Gilfillan and Dylan Lehmann | Targeted Fauna Survey, Fauna Habitat Assessment and Cockatoo Tree Assessment | Survey Area | 14 |
| 7th November 2017 | Damien Rathbone, Sandra Gilfillan and Dylan Lehmann | Targeted flora survey of wetlands. Targeted Fauna Survey, Fauna Habitat Assessment and Cockatoo Tree Assessment | Survey Area | 21 |
| 9th November 2017 | Damien Rathbone, Sandra Gilfillan | Vegetation Mapping, Targeted flora survey of wetlands. Targeted Fauna Survey, Fauna Habitat Assessment and Cockatoo Tree Assessment | Survey Area | 12.5 |
| 13th November 2017 | Sandra Gilfillan and Kirsty Vogel | Targeted Fauna Survey, Fauna Habitat Assessment and Cockatoo Tree Assessment | Survey Area | 14 |
| 15th November 2017 | Sandra Gilfillan and Kirsty Vogel | Targeted Fauna Survey, Fauna Habitat Assessment and Cockatoo Tree Assessment | Survey Area | 12 |
| 21st November 2017 | Sandra Gilfillan and Dylan Lehmann | Targeted Fauna Survey, Fauna Habitat Assessment and Cockatoo Tree Assessment | Survey Area | 10 |
| 22st November 2017 | Damien Rathbone and Fin Pope-Gilby | Floristic Quadrat Assessment | Survey Area | 10 |
| 23rd November 2017 | Damien Rathbone, Fin Pope-Gilby and Sandra Gilfillan | Floristic Quadrat Assessment, Targeted Fauna Survey and Fauna Habitat Assessment | Survey Area | 21 |
| 24st November 2017 | Damien Rathbone and Fin Pope-Gilby | Floristic Quadrat Assessment | Survey Area | 14 |
| 27st November 2017 | Damien Rathbone and Fin Pope-Gilby | Floristic Quadrat Assessment | Survey Area | 14 |
| 28th November 2017 | Damien Rathbone and Fin Pope-Gilby, Sandra Gilfillan | Floristic Quadrat Assessment, Targeted Fauna Survey and Fauna Habitat Assessment | Survey Area | 21 |
| 30th November 2017 | Damien Rathbone, Sandra Gilfillan and Dylan Lehmann | Targeted Flora Survey, Targeted Fauna Survey, Fauna Habitat Assessment and Cockatoo Tree Assessment | Survey Area | 10 |
| 7th December 2017 | Sandra Gilfillan | Targeted Fauna Survey and Fauna Habitat Assessment | Survey Area | 5 |
| 11th December 2017 | Sandra Gilfillan | Targeted Fauna Survey, Fauna Habitat Assessment and Cockatoo Tree Assessment | Survey Area | 3 |
| 13-14th December 2017 | Sandra Gilfillan | Targeted Fauna Survey, Fauna Habitat Assessment and Cockatoo Tree Assessment | Survey Area | 8 |
| 22nd January 2018 | Sandra Gilfillan | Targeted Fauna Survey and Fauna Habitat Assessment | Survey Area | 4 |
| 20th September 2018 | Damien Rathbone | Targeted Flora Survey of uplands and Granites | Survey Area | 7 |
| 17th October 2018 | Damien Rathbone | Targeted Flora Survey | Survey Area | 7 |
| 30th October 2018 | Damien Rathbone, Keith Smith, Anna de-Haan | Targeted Flora Survey for *Prasophyllum paulinae* | Survey Area | 15 |
| 21st November 2018 | Damien Rathbone | Targeted Flora Survey of Wetlands | Survey Area | 7 |
| 30th July 2019 | Damien Rathbone | Targeted Flora Survey | Survey Area | 7 |
| 2nd, 8th, 9th, 13th, 19th August 2019 | Damien Rathbone | Vegetation Mapping and Targeted Flora Survey | Survey Area and Additional 2019 Survey Areas | 24 |
| 12-13th August 2019 | Sandra Gilfillan | Targeted Fauna Survey and Fauna Habitat Assessment | Additional 2019 Survey Areas | 8 |
| 18th October 2019 | Damien Rathbone, Keith Smith | Targeted Flora Survey (including *Prasophyllum paulinae*) | Survey Area and Additional 2019 Survey Areas | 16 |
| | | | TOTAL: | 304.5 |

### *3.4.2 Weather*

Daily weather observations recorded from Albany were used to describe local rainfall and temperatures preceding the survey (Figure 2). Overall rainfall in the three-year survey period was below average, counteracted by a mean to above mean rainfall in the two months preceding spring in each year.

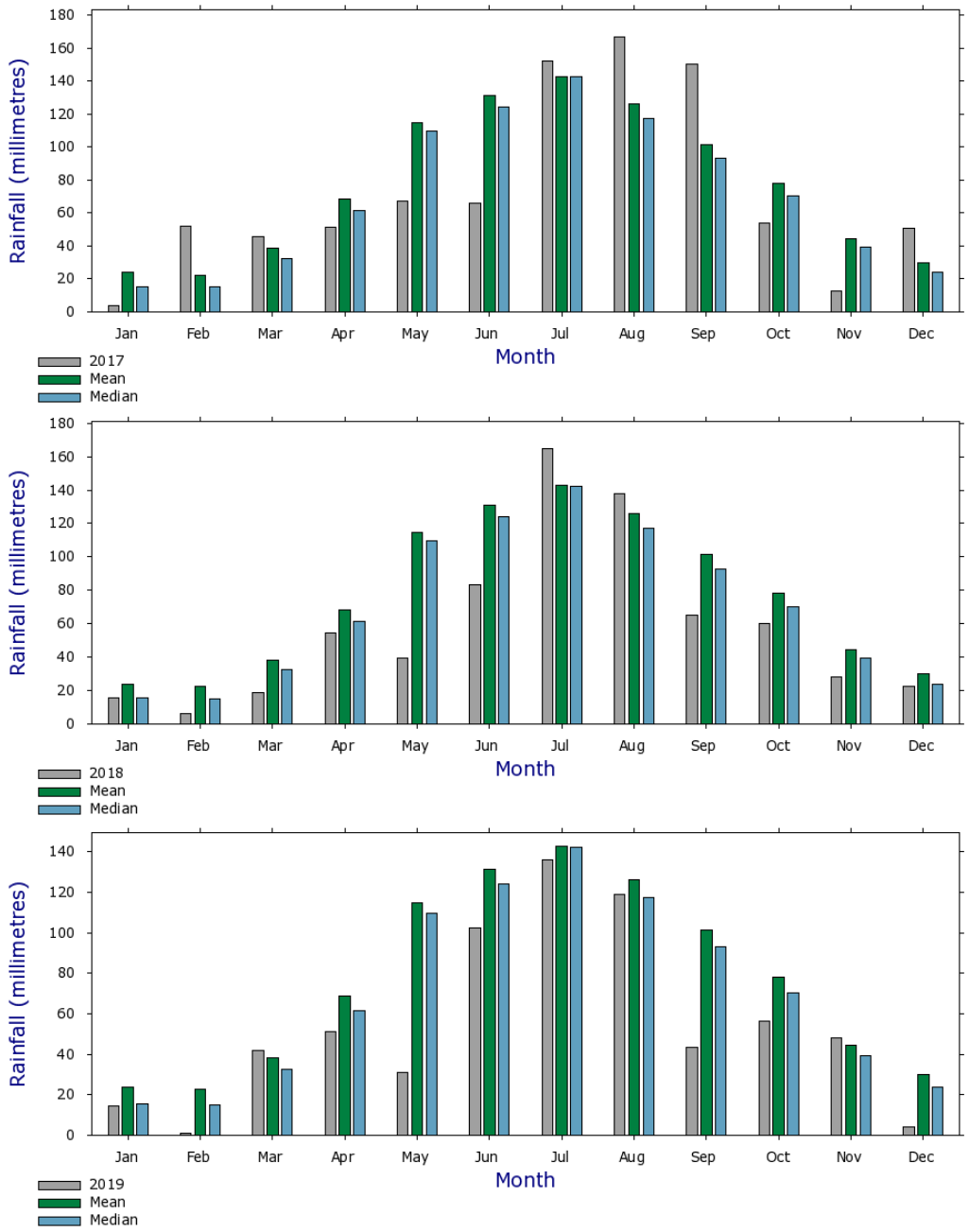


Figure 2. Rainfall statistics for 36 months that encompassed the assessment period compared with historical averages (all years available) from the nearest weather station (Albany 9500) (BOM 2019).

## 3.5 Vegetation Assessment

The vegetation and flora survey were undertaken in accordance with requirements of the EPA guidance document (EPA 2016a). Information acquired during the desktop review assisted in the design of the field survey. Pre-survey planning involved the examination of 1:5,000 scale orthophotos, soil and topography layers and existing records of conservation significant flora and vegetation.

The Survey Area was traversed by foot and vehicle and a vegetation assessment was conducted using floristic quadrats where the following attributes were recorded:

- Location and site description – GPS coordinate of NW corner using a handheld GPS (Garmin 64), other corners were measured using a vertex (Nikon 36) and compass. Quadrats dimensions are 10 m x 10 m unless stated. All four corners are marked with posts (temporarily) and UV stable flagging tape (3-5 years longevity).
- Species inventory – all vascular plant species present, including weed species. Species that were not confidently identified during the field survey were collected for identification in the Albany Regional Herbarium or Western Australian Herbarium.
- Foliar cover – the estimated percentage cover for each stratum and dominant species (up to three) within each stratum were noted. Vegetation structure was recorded in accordance with the National Vegetation Information System (Executive Steering Committee for Australian Vegetation Information [ESCAVI] 2003).
- Vegetation condition – according to the current vegetation condition classification (Table 3).
- Photographs – four photographs overlooking the quadrat were combined into a panorama.

The intensity of sampling with quadrats in each vegetation community varied depending on the area of extent, condition and species turnover. Regulatory guidance (EPA 2016a) indicates a minimum of three quadrats per vegetation type is recommended. In this survey, quadrats were specifically placed in vegetation with the highest apparent condition category and the number of quadrats was largely dependent on the total area of each community. Five associations were assessed by three or more quadrats (maximum of nine quadrats) and granite mosaics (included three associations as mosaics) were assessed in four quadrats. Three associations were assessed by less than three quadrats (*Taxandria juniperina* Closed Forest, *Evandra aristata* Sedgeland and Marri/Jarrah Coastal Hills Forest) due to a low overall extent or low extent in Good to Excellent condition. Two associations were not assessed by quadrats as were predominantly in Completely Degraded condition (assessed by opportunistic mapping sites only).

Quadrat information was used to define vegetation types that were manually aligned with Units described in the Albany Regional Vegetation Survey (Sandiford and Barrett 2010). Floristic similarity was assessed using two-way tables and field observations. Cladistics analysis was not conducted and was not considered necessary for alignment with these Units.

Table 3. Vegetation condition scale (EPA 2016a).

| Condition | Description |
|---|---|
| Pristine | Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement. |
| Excellent | Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks (dieback can be present in this category, but impacts are inconspicuous). |
| Very Good | Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing. |
| Good | Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing. |
| Degraded | Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing. |
| Completely Degraded | The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs. |

## 3.6 Targeted Flora Search

Targeted searches for potential Threatened and Priority flora identified from the desktop assessment were conducted over several field visits the Survey Area (details provided in Table 2). The searches were conducted in the appropriate season to detect most of the Threatened or Priority species considered possible to occur. The Survey Area was initially assessed to identify vegetation types and condition (see section 3.5). Vegetation and habitat types that were identified as potentially suitable for Threatened or Priority flora were surveyed by an intensive pattern of meandering transects. Where encountered, population census and site information of Threatened or Priority flora was recorded using a handheld GPS (Garmin 64) and in accordance with the Threatened and Priority Flora Report Form Field Manual (Department of Environment and Conservation [DEC] 2010). Population size was determined by either direct counts, or by estimation of plant density using transects or suitably sized quadrats. Additional regional targeted survey (outside the Survey Area) was conducted for *Prasophyllum paulinae* (P1), detailed in Appendix I.

## 3.7 Weeds

Cleared or pasture areas were not comprehensively surveyed, therefore not all weeds within the Survey were necessarily recorded. All weeds considered to be significant (Declared pests (DPIRD 2019) or Weeds of National Significance (WoNS) (DotEE 2019b)) or that were commonly encountered within remnant vegetation were recorded and/or mapped.

## 3.8 Fauna Habitat Assessment

A fauna habitat assessment was undertaken for conservation significant fauna that could potentially occur in the Survey Area determined from the desktop survey. The fauna habitat assessment primarily focused on the identification of fauna habitat based on vegetation type. Opportunistic recording of evidence (sightings, bird calls, tracks, scats, bones and feeding signs) of conservation significant fauna was also undertaken.

The likelihood of occurrence of significant fauna was determined by an assessment of the availability of potentially suitable habitat; its current know distribution and on any actual opportunistic sightings or signs of a species.

## 3.9 Targeted Fauna Search

Identification and quantification of habitat for Western Ringtail Possum and three species of Black Cockatoo (Carnaby's Cockatoo, Baudin's Cockatoo and the Forest Red-tailed Black Cockatoo) was specifically undertaken within the Survey Area, in accordance with EPBC Act guidelines (DEWHA 2009; DSEWPaC 2012). Habitat quality was categorised to identify important areas for each species.

### *3.9.1 Western Ringtail Possum (Pseudocheirus occidentalis) (T-CR)*

The EPBC Act Significant Impact Guidelines for the WRP pertain only to the population occurring on the southern Swan Coastal Plain (DEWHA 2009), and to date, no guidelines have been developed for the South Coast population, which can be defined as a significant population under the aforementioned guidelines.

The South Coast population of WRP differs from the Swan Coastal Plain population in terms of habitat preference, refuge types and possibly other aspects of their ecology. For example, the presence of Peppermint (*Agonis flexuosa*) is not necessary for the presence of the species; habitats with high densities are largely confined to Marri/Jarrah/Sheoak communities within 20 km of the coast; diets can be quite broad and a small percentage of individuals use refugia on the ground (Van Helden *et al.* 2018; Van Helden unpub. data; Van Helden and Close pers com.; Mathieson *et al.* in review; Gilfillan 2008 and S. Gilfillan pers. obs.). The EPBC Act Significant Impact Guidelines for the Swan Coastal Plain may therefore have limited application to the South Coast population.

The EPBC Act Significant Impact Guidelines categorised three areas as important for the WRP: *Core habitat, Primary corridors* and *Supporting habitat*. As these definitions in themselves are not specific to the Swan Coastal Plain they can potentially be used interchangeably. Using these habitat categories as a guide, plus current available data on Western Ringtail Possum ecology, habitat categories were defined for the South Coast population[2].

Habitat category definitions were defined for the South Coast population by:

1. Surveying for signs of the species within the Survey Area. Presence within a habitat patch was assessed by the observation of dreys and scats. All dreys seen were recorded. Absence of dreys, however, does not indicate absence of WRP (Gilfillan 2008). Scat searches were comprehensive, covering the entire remnant, therefore they provided an indication of the distribution of the species. The area of occupancy of WRP was based on the presence of scats or dreys. Where either of these signs were observed it was assumed that WRP would be using any continuous vegetation of similar habitat type extending from where the observations were made. Scat abundance is not an accurate measure of absolute abundance unless scat deposition and decay rates are known, but can be used as an indication of relative abundance (Wayne *et al.* 2006). In this survey the number of individual scat observations was used to aid the delineation of Western Ringtail Possum habitat.
2. Correlating available data on densities and home ranges of WRP with vegetation type. Data on densities was gathered from the following sources (Biota in prep; 2018; 2019: Gilfillan and Comer 2018: Van Helden *et al*. 2018: Van Helden pers. com.).

[2] NB: the defined categories should be considered draft (for details see Gilfillan 2019) and it is recommended they are presented to the Western Ringtail Possum Recovery Team for discussion and review.

3. Gathering expert opinion of what constitutes habitat categories. Western Ringtail Possum researchers from the University of Western Australia were consulted on this matter (Paul Close and Bronte Van Helden).

The habitat categories and their definitions are outlined in Table 4. The extent of these categories within the Survey Area was mapped (Appendix B). In addition, the habitat categories were mapped (desktop assessment only) within a 5 km buffer of the Survey Area to give a regional context (see Gilfillan and Rathbone 2019).

Table 4. Habitat categories of Western Ringtail Possums (adapted from DEWHA (2009)).

| Habitat Category | Areas mapped within the Survey Area. |
|---|---|
| Core<br>• likely contain sites necessary for breeding and dispersal, and support recruitment and population maintenance<br>• large remnants able to support multiple home ranges | • Any remnant patch >1ha with an established density of > 1/ha;<br>OR<br>• Any remnant patch with an established abundance of >50<br>• As a precautionary principal, any Jarrah, Marri or Sheoak forest or woodland, or Peppermint Low Forest remnant that is >50 ha in size until densities are established<br>• Urban areas with gardens generally having a > 30% canopy cover plus movement pathway such as fences and rooves |
| Supporting<br>• likely contain lower numbers of individuals and possibly survivorship<br>• likely provide an opportunity for an immigration source and emigration destination to allow for natural fluctuations in the species' fecundity<br>• may be breeding occurring or not<br>• can be native or non-native vegetation, including urban gardens | • any area with an established density of <1/ha, or established as individuals present (excluding linkages)<br>OR<br>• any area with an established abundance of <50, or established as individuals present (excluding linkages)<br>• As a precautionary principal, any Jarrah, Marri or Sheoak forest or woodland, or Peppermint Low Forest remnant that is < 50 ha in size until densities are established<br>• Urban areas with gardens generally having a < 30% canopy cover and less movement pathways |
| Linkage<br>• no resident individuals, movement of animals only<br>• do not need to be continuous, but can contain small gaps, as Western Ringtail Possums can come to the ground to move short distances<br>• any structure that allows movement of individuals at a small to medium scale (e.g. street-scape/road-side non-native plantings, wind-breaks, plantations, fence lines) | • Linkage; scats or record of ringtail<br>• Linkage likely; no evidence of WRP, however links two areas of occupied habitat<br>• Linkage possible; no evidence of WRP, but links areas of vegetation that are potential habitat for WRP |
| Primary Corridor<br>• provide major connectivity between areas of occupation<br>• regional scale<br>• containing multiple home ranges<br>• breeding occurring<br>• provides movements and habitat (residents) | • Coastal Corridor (from West Cape Howe NP to Cheyne's Beach – this may extend either east or west with new records) |

### 3.9.2 Black Cockatoo Species

***Black Cockatoos (Carnaby's Cockatoo (Calyptorhynchus latirostris) (T-EN); Baudin's Cockatoo (Calyptorhynchus baudinii) (T-EN); and Forest Red-tailed Black Cockatoo (Calyptorhynchus banksii subsp. naso) (T-VU)***

Breeding, foraging and roosting habitat was assessed in accordance with the EPBC Act Referral guidelines for the three threatened Black Cockatoo species (Table 5) (Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC 2012). This included recording the species, location, number and behaviour of any observed Black Cockatoos; recording the number, location and species of breeding trees above or equal to a diameter at breast height (DBH) of 500 mm and notes on whether trees contain hollows; the presence and extent of potential and known foraging habitat (identification of areas with known feeding species and observations of feeding evidence); and the presence and extent of potential roosting habitat. For Tuart (*Eucalyptus gomphocephala*) many trees branched well below breast height. In these cases, the diameter was measured below the first branch. For Pine (*Pinus radiata*) only an estimate of whether the DBH was greater than or less than 500 mm was taken, as the value of pines as a food source is not dependent on this threshold value. Pine saplings were recorded and specifically noted as such.

The survey timing potentially coincided with the use of hollows by nesting cockatoos, however the assessment was made only from ground level therefore limiting the detectability of active, or recently active hollows. Where a hollow was visible but an assessment of suitability or hollow entrance could not be made, the notation of 'possible' was made (a follow-up detailed assessment of breeding trees using a drone was undertaken by Biota (2019b).

Recording of feeding evidence by Black Cockatoos was not exhaustive, but a sufficient sample of records were taken for each habitat patch, in order to assist in characterising that patch as current feeding habitat. However, any area within the range of the black cockatoos that contains known food or plant species is considered to be potential foraging habitat for the species (DSEWPaC 2012).

Table 5. Habitat categories of Black Cockatoos (adapted from DEWHA (2009) and DSEWPaC (2012)).

| | |
|---|---|
| High quality foraging habitat (high_feed) | habitat patches consisting of a high coverage of feeding trees with a mature canopy. (NB: Pines not included in habitat assessment) |
| High quality breeding habitat (high_breed) | habitat patches consisting of a high number of potential breeding trees (≥500 mm DBH) |
| High quality roosting habitat (high_roost) | habitat patches consisting of a high number of potential roosting trees |
| Low quality foraging habitat (low_feed) | habitat patches consisting of a low coverage of feeding trees with a mature canopy |
| Low quality breeding habitat (low_breed) | habitat patches consisting of a low number of potential breeding trees (≥500 mm DBH) |
| Low quality roosting habitat (low_roost) | habitat patches consisting of a low number of potential roosting trees |

## 3.10 Regional Significance of Fauna Habitat

A regional perspective on the significance of fauna habitat within the Survey Area was determined by comparing the extent of vegetation associations suitable for significant species as a proportion of the total habitat within the Albany Regional Vegetation Survey Area (approximately 30 km radius around Albany) (Sandiford and Barrett 2010). Regional significance is also discussed with respect to the range of the conservation significant species.

## 3.11 Survey Limitations

In accordance with the EPA (2016a) document *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment* and EPA (2010) an assessment of potential survey limitations was undertaken (Table 6). No avoidable limitations were identified that can be expected to have affected the reliability of the results of the field survey.

Seasonal conditions preceding the field assessment have the potential to affect the emergence of annual species and the flowering of perennial species. The Survey Area occurs within a high rainfall zone and the assessment was conducted after close to average rainfall (Figure 3.1.2). Consequently, soil moisture conditions were not considered a major limitation for the emergence and flowering of Threatened or Priority flora species.

The information provided within this report is accurate and correct to the best of the author's knowledge. However, no liability is accepted for loss, damage or injury arising from its use. Plant populations can fluctuate over time, particularly after disturbance events such as fire and drought. Consequently, all mapping, vegetation descriptions and population estimates within this report should not be considered accurate indefinitely.

Table 6. Assessment of potential survey limitations for flora and fauna.

| Potential for limitation | Assessment |
|---|---|
| Availability of contextual information | Flora: Regional vegetation mapping (Sandiford and Barrett 2010) and flora records from the DBCA were available to allow for an appropriate level of contextual information prior to the field survey. Due to the proximity to Albany the environmental values within the survey area are considerably to be well documented.<br><br>Fauna: There has been no comprehensive classification of fauna habitats across the region, so it was necessary to base fauna habitats on ARVS vegetation units. No regional biological (fauna) survey has been carried out for the region. Local assessments for Western Ringtail Possum were considered during the assessment (Oyster Harbour Catchment Group surveys (Mt Melville and Mt Adelaide/Clarence)). |
| Personnel experience | Flora and fauna: The senior ecologists conducting the assessments are competent with extensive experience (>10 years) in surveying south coast biota. |
| Proportion of flora and fauna recorded or identification issues | Flora: All specimens collected were identified to species level. The survey intensity (including surveys from 2017 to 2019) is considered sufficient to have recorded all or most of the native species present in the Survey Area.<br><br>Fauna: Five out of 14 species potentially occurring were identified in the field (by signs only): three species of Black Cockatoo (feeding signs only); Western Ringtail Possum (scats and dreys); Quenda (diggings). For non-targeted fauna species only opportunistic sampling was undertaken, thus this was biased toward species that can easily be detected by sightings or by prominent signs such as scats or diggings. For example, Quenda diggings are easily detected and therefore the distribution of Quenda determined by the survey is likely to be a close approximation of its true distribution. Nocturnal, cryptic, less common species or seasonal visitors were not likely to have been identified during the survey. For example, the Brush-tailed Phascogale is a nocturnal species and is very difficult to detect by signs and requires trapping to determine presence. For these reasons the focus in this survey was on identifying potential suitable habitat rather than presence of these species. |
| Extent of survey and site access | Flora: The area of survey is relatively large, however is mainly non-native vegetation. The areas of intact native vegetation were adequately surveyed and no major access restrictions were present. The survey intensity (including surveys in 2017, 2018 and 2019) is considered sufficient to have recorded most of the native species present in the Survey Area.<br><br>Fauna: The intensity of the targeted fauna surveys was adequate; all areas of remnant vegetation were surveyed completely. Access was generally not hindered, traversing the wetlands on Link Rd is challenging and at times impossible due to very thick vegetation and blackberry infestations. |
| Timing/weather/season/cycle | Flora: The survey timing was undertaken specifically to target potential significant flora determined from the desktop assessment. Surveys were stratified from early to late Spring over multiple years, which therefore captured a wide breadth of flowering times. Within the southern Jarrah forest region September and October is appropriate for botanical surveys in upland areas; November to January is appropriate for lowland/wetland areas.<br><br>Whilst below average rainfall occurred in all three years, this was counteracted by high rainfall preceding the spring surveys, such that the seasonal conditions were considered appropriate for recording the flora values present.<br><br>Fauna: Timing of surveys may not have been within the breeding season of the Forest Red-tailed Black Cockatoo (breeding can occur at any time of year depending on resource availability). |
| Disturbances (e.g. fire, flood, accidental human intervention etc.) which affected results of survey | Flora: Large areas of Survey Area on Lower Denmark road adjacent to the railway line were slashed in 2019, therefore may change the short-term structure and floristics of those areas. Most of the fire ages present were estimated to be > 5 years, therefore the previous fire regime is not expected to affect the recording of the flora values present. Some long unburnt areas may have reduced to ability to detect some fire ephemeral species (see desktop assessment for more details).<br><br>Fauna: No disturbances were likely to have affected the fauna survey results. |

# 4 FLORA RESULTS

## 4.1 Desktop Assessment

### *4.1.1 Flora*

The desktop assessment identified that 70 conservation significant flora have previously been recorded in the vicinity (<10 km) of the Survey Area (mapped in Appendix B). A post-survey likelihood of occurrence assessment of conservation significant flora (Appendix E) was undertaken following the field visits to determine the suitability of habitats encountered and the effectiveness of the survey effort and timing. The assessment determined the following conclusions:

- Five species identified in the desktop assessment were recorded in the Survey Area.
- Suitable or potentially suitable habitat for 38 conservation significant flora was present in the Survey Area, based on general soil and landform characteristics. However, none of these species were recorded during the survey. No survey limitations (i.e. flowering time, absence of disturbance) were identified for any of these species that would have prevented their detection during the survey, therefore they are considered unlikely to be present.
- One threatened orchid, *Caladenia harringtoniae* (T) was considered to potentially occur associated with granite on Mt Melville. Targeted surveys were conducted at the appropriate time of year and no individuals were detected. However, there remains the possibility for this species to emerge after fire.
- Four Priority-listed annual taxa that occur in wetlands/damplands were considered possible to occur within the Survey Area: *Drosera paleacea* (P1), *Gonocarpus simplex* (P4), *Microtis pulchella* (P4) and *Microtis quadrata* (P4). These taxa flower in summer and are most prolific after fire, therefore would have been difficult or impossible to detect during the survey (fire has been absent from the majority of the Survey Area for >10 years).
- Two Priority-listed species are inconspicuous and may not have been flowering during the surveys, therefore may have been difficult to detect if in low numbers (*Schoenus* sp. Grassy (E. Gude & J. Harvey 250) (P2) and *Laxmannia jamesii* (P4)).
- Fourteen species were considered 'Unlikely' to occur as no (or very limited) suitable habitat was present in the Survey Area.
- Five species were considered 'Unlikely' to occur as the Survey Area is outside their known range (records in the study area are geo-spatial errors).

### *4.1.2 Vegetation*

The desktop assessment determined that two TECs may occur within the Survey Area: "*Subtropical and temperate saltmarsh"* (Vulnerable) and "*Proteaceae Dominated Kwongkan Shrublands*" (Endangered) (DotEE 2019a) (Mapped in Appendix B). The "*Subtropical and temperate saltmarsh"* community is confined to the saline tidal margins of Princess Royal Harbour and Torbay inlet and is considered highly unlikely to occur with the Survey Area. The "*Proteaceae Dominated Kwongkan Shrublands"* only applies to vegetation within the Southeast Coastal Floristic Province, therefore cannot be applied within the Survey Area.

Four PECs occur directly adjacent to the Survey Area (DPaW 2019b, Appendix B). *Banksia coccinea* Thicket (P1), Coastal *Melaleuca incana/Taxandria juniperina* (P1), *Banksia littoralis/Melaleuca incana* (P1) and *Astartea scoparia* Swamp Thicket (P1). All of these communities were considered during the field assessment.

## 4.2 Field Assessment

### *4.2.1 Vegetation*

Thirteen native vegetation associations were described from the Survey Area: - four occur exclusively in wetland habitats, three are associated with granite outcrops and six generally occur on uplands of sand or predominantly laterite. Three granite shrublands/woodland combinations occurred that varied below the resolution of mapping used in this assessment 1:5000, therefore were mapped as mosaics (all mosaics represent 50% proportions of each association) (Table 7).

Remnant vegetation covered a total of 80.7 ha (24%) of the 338 ha Survey Area and was represented in condition scales grading from Completely Degraded (native understory very sparse or absent) to Excellent (no obvious disturbance). The condition of the majority of the remnant vegetation (61%) was classified as Very Good or Excellent.

Remaining areas were mainly comprised of roads, tracks, commercial or residential areas and pasture. Five additional non-native vegetation types were mapped (total of 98.99 ha), comprised of weeds, revegetation or plantations.

Vegetation descriptions for native and non-native vegetation is provided below; mapping is provided in Appendix B.

Table 7. Extent (ha) and condition of remnant and non-native vegetation in the Survey Area.

| Vegetation Association (ARVS Unit) | Condition | | | | | Total: |
|---|---|---|---|---|---|---|
| | Completely Degraded | Degraded | Good | Very Good | Excellent | |
| Uplands | | | | | | |
| *Hakea* spp. Shrubland/Woodland Complex (31) | | 1.72 | | 0.47 | 2.52 | 4.71 |
| Jarrah/Marri/Sheoak Laterite Forest (12a) | 2.50 | 7.21 | 0.14 | 2.76 | 19.90 | 32.51 |
| Jarrah/Sheoak/*E. staeri* Sandy Woodland (13) | | 0.94 | | | 3.29 | 4.24 |
| Marri/Jarrah Coastal Hills Forest (17) | | | | | 2.13 | 2.13 |
| Marri/Jarrah Forest/Peppermint Woodland (10) | 0.70 | 3.61 | 1.17 | 5.59 | | 11.07 |
| Peppermint Low Forest (2) | 1.42 | | | | | 1.42 |
| Granites | | | | | | |
| *Taxandria marginata* Granite Shrubland (24) | | 0.85 | | 0.42 | 0.58 | 1.85 |
| *Gastrolobium bilobum* Granite Shrubland/Yate Woodland (23) | 0.14 | 0.56 | | 0.42 | 0.23 | 1.35 |
| *Leucopogon assimilis* Granite Shrubland (25) | | | | | 0.35 | 0.35 |
| Wetlands | | | | | | |
| *Evandra aristata* Sedgeland (46) | | | | 0.64 | | 0.64 |
| *Homalospermum firmum*/*Callistemon glaucus* Peat Thicket (47) | 1.93 | 1.68 | | 1.96 | 4.96 | 10.53 |
| *Melaleuca preissiana* Low Woodland (49) | 1.12 | | | 0.06 | | 1.18 |
| *Taxandria juniperina* Closed Forest (59) | 4.44 | 1.48 | 0.05 | 2.75 | | 8.72 |
| Sub-total: | 12.25 | 18.05 | 1.36 | 15.07 | 33.96 | 80.70 |
| Non-native Vegetation | | | | | | |
| *Mature Planted Trees (Iron Barks, Blue Gum, Tuart, other Eucalypts and Peppermint generally > 10 years old)* | | | | | | 74.51 |
| *Woody Weeds (Victorian Tea Tree, Taylorina, Sydney Wattle, Kangaroo Acacia or Bamboo with isolated native plants)* | | | | | | *7.14* |
| *Other Weeds (Watsonia, Bracken Fern or Blackberry with isolated native plants)* | | | | | | *2.16* |
| *Revegetation (mixed shrubs and trees generally <10 years old)* | | | | | | 5.58 |
| *Isolated Plants (Pasture and herbaceous weeds with isolated native plants)* | | | | | | 9.60 |
| Completely Cleared | | | | | | 158.63 |
| | | | | | Grand Total: | 338.32 |

*Hakea* spp. Shrubland/Woodland Complex:
Soil: White sand with heavy laterite gravel and rocks (<30mm)
Landform: Hill crest
Represented in quadrat 1, 2, 3 & 32
Total of 4.71 ha, Degraded to Excellent Condition
Concordant with Unit 31(Sandiford and Barrett 2010)

| Lifeform | % Cover | Dominant taxa |
|---|---|---|
| Mallee <10m | 10-30% | *Eucalyptus marginata, Eucalyptus staeri, Allocasuarina fraseriana* |
| Shrubs >2m | 10-70% | *Hakea ferruginea, Hakea lasiantha, Hakea ceratophylla, Hakea trifurcata, Hakea lasiantha* |
| Shrubs 1-2m | 10-30% | *Acacia browniana* var. *browniana, Acacia myrtifolia, Agonis theiformis, Allocasuarina humilis, Beaufortia decussata, Petrophile diversifolia, Leucopogon verticillatus, Leucopogon obovatus* subsp. *obovatus* |
| Shrubs <1m | 10-30% | *Hibbertia microphylla, Hovea trisperma, Dasypogon bromeliifolius, Synaphea gracillima, Xanthorrhoea platyphylla, Sphaerolobium grandiflorum, Sphenotoma capitata, Pultenaea verruculosa, Andersonia* sp. Jamesii (J. Liddelow 84) |
| Sedges | <10% | *Lepidosperma drummondii, Lepyrodia hermaphrodita, Anarthria gracilis, Anarthria prolifera, Mesomelaena tetragona, Tetraria octandra* |

Jarrah/Marri/Sheoak Laterite Forest:
Soil: Grey sand with laterite gravel
Landform: Middle to upper hill-slopes
Represented in quadrat 4, 5, 6 & 7
Total of 32.51 ha, Completely Degraded to Excellent condition
Concordant with Unit 12a (Sandiford and Barrett 2010)

| Lifeform | % Cover | Dominant taxa |
|---|---|---|
| Tree >10m | 30-70% | *Eucalyptus marginata, Corymbia calophylla, Allocasuarina fraseriana* |
| Shrubs >2m | 10-30% | *Banksia grandis, Persoonia longifolia (dieback free areas only), Hakea amplexicaulis* |
| Shrubs 1-2m | 10-30% | *Beaufortia decussata, Bossiaea linophylla, Agonis theiformis, Xanthorrhoea platyphylla, Leucopogon verticillatus* |
| Shrubs <1m | 10-30% | *Acacia browniana* var. *browniana, Dasypogon bromeliifolius, Hibbertia cunninghamii, Logania serpyllifolia* subsp. *serpyllifolia* |
| Sedges | 30/70 % | *Patersonia umbrosa* var. *umbrosa, Desmocladus fasciculatus, Tetraria octandra, Lomandra pauciflora, Tetraria* sp. Jarrah Forest (R. Davis 7391) |

Jarrah/Sheoak/*E. staeri* Sandy Woodland:
Soil: Grey sand
Landform: Middle hill-slopes
Represented in quadrat 8, 21 & 25
Total 4.23 ha, Degraded to Excellent condition
Concordant with Unit 13 (Sandiford and Barrett 2010)

| Lifeform | % Cover | Dominant taxa |
|---|---|---|
| Tree >10m | 30-70% | *Eucalyptus marginata, Eucalyptus staeri, Allocasuarina fraseriana, Corymbia calophylla* |
| Shrubs >2m | 10-30% | *Banksia grandis* (dieback free areas only) |
| Shrubs 1-2m | 10-30% | *Bossiaea linophylla, Agonis theiformis, Xanthorrhoea platyphylla, Leucopogon verticillatus, Hakea ruscifolia, Leucopogon obovatus* subsp. *obovatus* |
| Shrubs <1m | 10-30% | *Acacia browniana* var. *browniana, Dasypogon bromeliifolius, Hibbertia cunninghamii, Xanthosia rotundifolia. Opercularia hispidula, Hibbertia cuneiformis* |
| Sedges | 30/70 % | *Anarthria scabra, Patersonia umbrosa* var. *umbrosa, Tetraria octandra, Tetraria* sp. Jarrah Forest (R. Davis 7391), *Johnsonia lupulina* |

Marri/Jarrah Coastal Hills Forest:
Soil: Brown loamy sand, granite boulders
Landform: Middle - upper hill-slopes
Represented in quadrat 11 & 12
Total 2.13 ha, Excellent condition
Concordant with Unit 17 (Sandiford and Barrett 2010)

| Lifeform | % Cover | Dominant taxa |
|---|---|---|
| Tree >10m | 30-70% | *Corymbia calophylla, Eucalyptus cornuta, Agonis flexuosa* |
| Shrubs >2m | <10% | *Bossiaea linophylla, Gastrolobium bilobum* |
| Shrubs 1-2m | 10-30% | *Hovea elliptica, Leucopogon obovatus* subsp. *obovatus* |
| Shrubs <1m | 10-30% | *Tremandra stelligera, Opercularia hispidula, Hibbertia cuneiformis, Hibbertia furfuracea,* |
| Sedges/Grasses | 10-30% | *Loxocarya cinerea, Microlaena stipoides, Poa porphyroclados, Stypandra glauca, Tetrarrhena laevis, Tetraria octandra, Lepidosperma tenue* |

Marri/Jarrah Forest/Peppermint Woodland:
Soil: Brown or grey sand, sometimes granite boulders
Landform: Middle - lower hill-slopes
Represented in quadrat 9, 15 & 20
Total 11.07 ha, Completely Degraded to Excellent condition
Concordant with Unit 10 (Sandiford and Barrett 2010)

| Lifeform | % Cover | Dominant taxa |
|---|---|---|
| Tree >10m | 30-70% | *Corymbia calophylla, Eucalyptus marginata, Eucalyptus cornuta, Agonis flexuosa* |
| Shrubs >2m | <10% | *Bossiaea linophylla, Hovea elliptica, Agonis theiformis* |
| Shrubs 1-2m | 10-30% | *Hovea elliptica, Leucopogon obovatus* subsp. *obovatus* |
| Shrubs <1m | 10-30% | *Pteridium esculentum, Tremandra stelligera, Opercularia hispidula, Hibbertia furfuracea, Hibbertia cuneiformis, Xanthosia rotundifolia* |
| Sedges/Grasses | 30-70% | *Loxocarya cinerea, Tetrarrhena laevis, Tetraria octandra* |

Peppermint Low Forest:
Soil: White sand
Landform: Lower hill-slopes, dunes
Not represented in quadrats
Total 1.42 ha, Completely Degraded condition
Concordant with Unit 2 (Sandiford and Barrett 2010)

| Lifeform | % Cover | Dominant taxa |
|---|---|---|
| Tree >10m | 30-70% | *Agonis flexuosa* |
| Ground | <10% | **Aira caryophyllea, *Anthoxanthum odoratum, *Briza minor* |

*Taxandria marginata* Granite Shrubland:
Soil: Shallow brown loam or sand
Landform: Granite outcrop
Represented in quadrat 10 and 19
Total 1.85 ha, Degraded to Excellent condition
Concordant with Unit 24 (Sandiford and Barrett 2010)

| Lifeform | % Cover | Dominant taxa |
|---|---|---|
| Shrubs >2m | 10-30% | *Taxandria marginata, Anthocercis viscosa, Dodonaea ceratocarpa, Acacia crassiuscula* |
| Sedges/Grasses | 10-30% | *Lepidosperma hopperi, Lepidosperma tenue, Patersonia limbata, Stypandra glauca* |

*Gastrolobium bilobum* Granite Shrubland/Yate Woodland:
Soil: Shallow brown loam or sand
Landform: Granite outcrop
Represented in quadrat 14
Total in mosaic 1.35 ha, Completely Degraded to Excellent condition
Concordant with Unit 23 (Sandiford and Barrett 2010)

| Lifeform | % Cover | Dominant taxa |
|---|---|---|
| Tree >10m | <10% | *Eucalyptus cornuta* |
| Shrubs 1-2m | 10-30% | *Gastrolobium bilobum, Dodonaea ceratocarpa Hibbertia furfuracea, Leucopogon obovatus* subsp. *obovatus, Pimelea rosea* subsp. *rosea* |
| Sedges/Grasses | 30-70% | *Lepidosperma hopperi, Lepidosperma tenue, Stypandra glauca, Loxocarya cinereal* |

*Leucopogon assimilis* Granite Shrubland:
Soil: Shallow brown loam or sand
Landform: Granite outcrop
Represented in quadrat 13
Total in mosaic 0.35 ha, Excellent condition
Concordant with Unit 25 (Sandiford and Barrett 2010)

| Lifeform | % Cover | Dominant taxa |
|---|---|---|
| Tree >10m | <10% | *Eucalyptus cornuta* |
| Shrubs >2m | 30-70% | *Gastrolobium bilobum, Dodonaea ceratocarpa* |
| Shrubs <1m | 10-30% | *Leucopogon assimilis, Leucopogon obovatus* subsp. *obovatus, Hibbertia diamesogenos, Leucopogon pendulus, Verticordia plumosa, Andersonia sprengelioides* |
| Sedges/Grasses/Herbs | 30-70% | *Borya sphaerocephala, Stypandra glauca, Loxocarya cinerea, Microlaena stipoides, Neurachne alopecuroidea* |

*Evandra aristata* Sedgeland:
Soil: Grey sand
Landform: Wetland/valley floor
Represented in quadrat 18
Total 0.64 ha, Very Good condition
Concordant with Unit 46 (Sandiford and Barrett 2010)

| Lifeform | % Cover | Dominant taxa |
|---|---|---|
| Tree <10m | <10% | *Nuytsia floribunda* |
| Shrubs 1-2m | 10-30% | *Beaufortia sparsa, Adenanthos obovatus, Jacksonia horrida, Melaleuca thymoides, Taxandria parviceps* |
| Shrubs <1m | 10-30% | *Hypocalymma strictum, Boronia crenulata, Boronia spathulata, Dampiera linearis, Dasypogon bromeliifolius* |
| Sedges/Grasses/Herbs | 30-70% | *Evandra aristata, Gymnoschoenus anceps, Anarthria laevis, Anarthria prolifera, Anarthria scabra, Xyris lanata* |

*Homalospermum firmum*/*Callistemon glaucus* Peat Thicket:
Soil: Grey sand, with peat
Landform: Wetland/valley floor
Represented in quadrat 16, 17, 22, 23, 24, 26, 27, 28, 29
Total 10.53 ha, Degraded to Excellent
Concordant with Unit 47 (Sandiford and Barrett 2010)

| Lifeform | % Cover | Dominant taxa |
|---|---|---|
| Shrubs 1-2m | 30-70% | *Callistemon glaucus, Homalospermum firmum, Taxandria linearifolia, Boronia crassipes, Hakea linearis, Sphaerolobium vimineum* |
| Sedges | >70% | *Empodisma gracillimum, Gymnoschoenus anceps, Leptocarpus tenax, Schoenus multiglumis, Xyris lanata* |

*Melaleuca preissiana* Low Woodland:
Soil: Sand
Landform: Wetland/valley floor
Not represented in quadrats
Total 1.18 ha, Completely Degraded to Very Good condition
Concordant with Unit 49 (Sandiford and Barrett 2010)

| Lifeform | % Cover | Dominant taxa |
|---|---|---|
| Shrubs >2m | 30-70% | *Melaleuca preissiana, Melaleuca rhaphiophylla* |
| Ground | >70% | **Holcus lanatus, *Anthoxanthum odoratum, Baumea species, Centella asiatica* |

*Taxandria juniperina* CIosed Forest:
Soil: Sand
Landform: Wetland/valley floor
Represented in quadrat 30 & 31
Total 8.72 ha, Completely Degraded to Excellent condition
Concordant with Unit 59 (Sandiford and Barrett 2010)

| Lifeform | % Cover | Dominant taxa |
|---|---|---|
| Shrubs >2m | >70% | *Taxandria juniperina, Homalospermum firmum, Astartea species* |
| Grasses | >10% | *Leptocarpus scariosus, Baumea acuta, Lepidosperma striatum* |

Non-native Vegetation

Mature Planted Trees (Iron Barks, Blue Gum, Tuart, other Eucalypts and Peppermint generally > 10 years old)

Woody Weeds (Victorian Tea Tree, Taylorina, Sydney Wattle, Kangaroo Acacia or Bamboo with isolated native plants)

Other Weeds (Watsonia, Bracken Fern or Blackberry with isolated native plants)

| | |
|---|---|
| Revegetation (mixed shrubs and trees generally <10 years old) |  |
| Isolated Plants (Pasture and herbaceous weeds with isolated native plants) |  |

### *4.2.2 Regional and Local Significance of Vegetation*

Four vegetation types described from the Survey Area are considered wetland habitats as they are dependent on surface or subsurface expression of ground water (*Homalospermum firmum/Callistemon glaucus* Peat Thicket, *Evandra aristata* Sedgeland, *Taxandria juniperina Closed Forest* and *Melaleuca preissiana* Low Woodland). Three vegetation types are associated with granite outcrops, which are considered to be significant due to their restricted distribution, high number of conservation significant taxa and their role as climate refugia (*Taxandria marginata*, *Gastrolobium bilobum* and *Leucopogon assimilis* Shrublands).

Within the local region, there is approximately 35% total remnant vegetation, of which 19% and 39% occur in IUCN or Crown reserves, respectively (includes Albany Regional Vegetation Survey Area of 125,415 ha) (Sandiford and Barrett 2010). The current extent of pre-European vegetation associations in the Survey Area are above 30% at state and local government jurisdictions (Table 8). When aligned with mapping Units in the Albany Regional Vegetation Survey, eight of the 13 associations from the Survey Area have very low overall extent or low representation in reserves or (Table 9). Conservation criteria applied in the Albany Regional Vegetation Survey defines that six of the association are rare (<1,500 ha in total) and five are poorly represented in the conservation estate (<10% in IUCN reserves).

Table 8. Extent (ha) of pre-European vegetation associations from the Survey Area (Government of Western Australia [GoWA] 2019).

| Vegetation Association | Western Australia | | | City of Albany (LGA) | | |
|---|---|---|---|---|---|---|
| | Pre-European Extent | Current Extent | % Remaining | Pre-European Extent | Current Extent | % Remaining |
| 3 - Medium forest; jarrah-marri | 2,661,405 | 1,803,437 | 68 | 50,509 | 16,025 | 32 |
| 51 - Sedgeland; reed swamps, occasionally with heath | 59,085 | 33,058 | 56 | 17,586 | 5,751 | 33 |
| 978 - Low forest; jarrah, *Eucalyptus staeri* & *Allocasuarina fraseriana* | 53,231 | 18,856 | 36 | 52,154 | 18,720 | 36 |

Table 9. Overall extent and reservation status of vegetation associations from the Survey Area and local status derived from the Albany Regional Vegetation Survey (Sandiford and Barrett 2010). Includes IUCN I-IV reserves with Albany Region (<35 km radius).

| Vegetation Type | Current Extent | | Reserve IUCN I-IV | |
|---|---|---|---|---|
| | ha | % | ha | % |
| *Leucopogon assimilis* Granite Shrubland | 17 | 0.1 | 8 | 50 |
| *Taxandria marginata* Granite Shrubland | 109 | 0.2 | 21 | 19.1 |
| *Gastrolobium bilobum* Granite Shrubland/Yate Woodland | 163 | 0.4 | 2 | 1.3 |
| *Melaleuca preissiana* Low Woodland | 679 | 1.5 | 53 | 7.7 |
| *Taxandria juniperina* Closed Forest | 779 | 1.8 | 77 | 9.9 |
| Peppermint Low Forest | 1,232 | 2.8 | 281 | 22.8 |
| Marri/Jarrah Coastal Hills Forest (17) | 1,238 | 2.8 | 625 | 50.5 |
| Marri/Jarrah Forest/Peppermint Woodland | 1,597 | 3.6 | 107 | 6.7 |
| *Evandra aristata* Sedgeland (46) | 1,747 | 4 | 219 | 12.5 |
| *Homalospermum firmum/Callistemon glaucus* Peat Thicket (47) | 2,083 | 4.7 | 263 | 12.6 |
| Hakea spp. Shrubland/Woodland Complex (31) | 2,366 | 5.4 | 1073 | 45.4 |
| Jarrah/Sheoak/*E. staeri* Sandy Woodland (13) | 5,148 | 11.7 | 1334 | 25.9 |
| Jarrah/Marri/Sheoak Laterite Forest | 13,144 | 29.8 | 1,273 | 9.8 |

Two TECs are known in the vicinity the Survey Area; no vegetation meets the requisite criteria for either community. *Subtropical and Temperate Coastal Saltmarsh* TEC (Vulnerable) occurs approximately 100m from the Survey Area on the margin of Princess Royal Harbor and is confined to marine saline habitats (DotE 2013). The Survey Area falls outside (~6 km) the South East Coastal Botanical Provence, therefore the Proteaceae Dominated Kwongkan Shrubland TEC (Endangered) is not applicable to vegetation within the Survey Area (DotE 2014b).

Four PECs occur directly adjacent to the Survey Area (DBCA 2019b, Appendix B). *Banksia coccinea* Thicket (P1), Coastal *Melaleuca incana/Taxandria juniperina* (P1) and *Banksia littoralis/Melaleuca incana* (P1) have distinctive dominant species that are absent from the Survey Area. *Astartea scoparia* Swamp Thicket (P1) may have previously occurred in the wetland areas on Lower Denmark Road that is now obscured by a high level of disturbance and altered drainage. No PECs were recorded in the Survey Area.

### 4.2.3 Flora

Thirty-two floristic quadrats were established within the Survey Area (Appendix D). A total of 342 taxa from 65 families, including 61 weeds were recorded from the Survey Area (including opportunistic observations; Appendix C). The plant families most represented were Myrtaceae (40 taxa), Fabaceae (38), Cyperaceae (27) and Proteaceae (25). Quadrat diversity varied from nine to 51 taxa per quadrat, with an average of 23.3. The most species rich vegetation was *Hakea* spp. Shrubland/Woodland Complex (average 36.5 taxa per quadrat) and the lowest was *Taxandria juniperina* Closed Forest (average 13 taxa per quadrat).

### 4.2.4 Conservation Significant Flora

Habitat or populations of five significant flora were recorded or are previously known from the Survey Area that are mapped (Appendix B) and discussed below. Population and location data are provided in Appendix F and Threatened and Priority Flora forms are provided in Appendix G.

***Prasophyllum paulinae* (P1)**

*Prasophyllum paulinae* is a Priority 1 taxon from the Orchidaceae family, known only from two wetland habitats in the vicinity of Albany, both recorded following fire. The first voucher and type specimen were collected in 1988 and 1993, respectively, from a regenerating swamp on private property (P222501) that occurs within the Survey Area. The taxon was named in dedication to the late Pauline Herberle (Jones and Clements 1996), the family of who still own the property. The precise location of the early collections is uncertain due to inaccurate geo-tags, but was noted to be locally frequent within a degraded swamp with black, peaty, alkaline soil on the Heberle's property, Frederick Street, Gledhow (Western Australian Herbarium Accession no. 04514238).

Extensive survey was undertaken of the Herberle's property (in the Survey Area) over several days in spring 2017, 2018 and 2019. All suitable habitat was occupied by a common congener, *Prasophyllum macrostachyum* (Plate 1), and no individuals concordant with the description of *P. paulinae* were detected. A large area of regenerating wetland vegetation and seasonally inundated firebreaks occur at the southern end of the Herberle's property, which is considered the most likely location of the early collections of *P. paulinae*. Currently the area is composed of a tall, long unburnt (>20 years) closed forest of *Taxandria juniperina* and *Homalospermum firmum* (Plate 2). This area has been defined as a known population location for *P. paulinae* (Appendix B). The failure to detect *P. paulinae* during the surveys does not exclude its presence from the previously known habitat or its potential to emerge in future years, particularly after fire.

*Prasophyllum paulinae* is also known from one other population in a peat wetland at Two Peoples Bay, east of Albany. Population monitoring after a fire in 2010, indicates it co-occurred with other *Prasophyllum* species and that numbers peaked (over 100 individuals) two years after the fire, then declined thereafter. The last plants (23 individuals) were seen in 2015 (Anna de Haan pers. comm.).

Suitable habitat for *Prasophyllum paulinae* is considered to be recently burnt *Homalospermum firmum/Callistemon glaucus* Peat Thicket and *Taxandria juniperina* Closed Forest. A total of 19.25 ha of these Units occurs within the Survey Area that are long unburnt (mapped in Appendix B). Targeted survey for *Prasophyllum paulinae* in these areas over consecutive springs has not detected any individuals. However, the potential exists for it to emerge following fire within this habitat.

Regional surveys for *Prasophyllum paulinae* were undertaken by Southern Ecology in spring 2019, which successfully detected some individuals (outside the Survey Area) that meet the taxonomic

description of the taxon. The details of these surveys are presented in a separate report (Rathbone 2020).

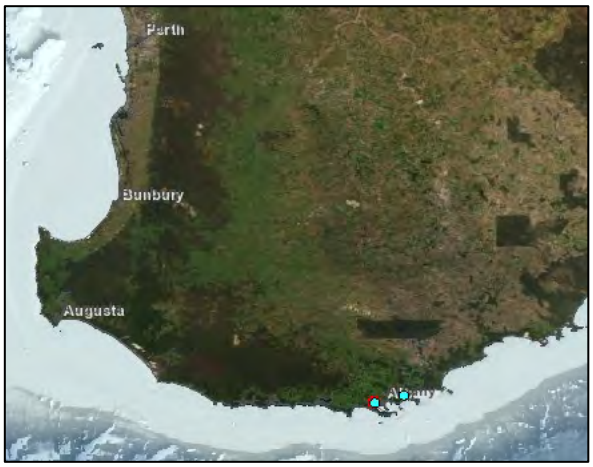


Plate 1 and 2. *Prasophyllum macrostachyum*, the common congener of *P. paulinae* (P1) found within the Survey Area and the regional distribution of *P. paulinae* (DPaW 2019a).

***Synaphea incurva* (P3)**

*Synaphea incurva* is a Priority 3 taxon from the Proteaceae family, known from a very narrow range between Redmond State Forest and Hassel National Park (Plate 4). It is commonly associated with heath or woodlands with laterite gravel and sand. Two populations, totalling eight individuals were recorded on road verges in the Survey Area (Plate 3).


Plate 3 and 4. *Synaphea incurva* (P3) and regional distribution (DPaW 2019a).

***Boronia crassipes* (P3)**

*Boronia crassipes* is a Priority 3 taxon from the Rutaceae family, known from wetlands between Albany and Walpole (Plate 6). It is commonly associated with *Homalospermum firmum* and *Empodisma gracillimum* on peat and sand. Several large populations are known within the vicinity of Albany. In the Survey Area, one population with 1,018 individuals was recorded in the broad drainage channel on Link Rd (Plate 5).

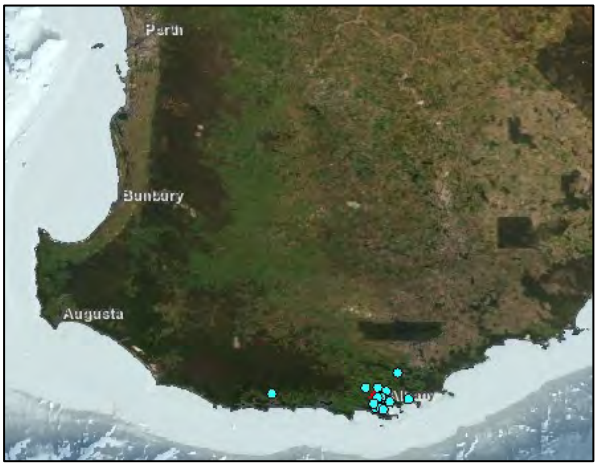


Plate 5 and 6. *Boronia crassipes* (P3) and regional distribution (DPaW 2019a).

***Andersonia* sp. Jamesii (J. Liddelow 84) (P4)**

*Andersonia* sp. Jamesii (J. Liddelow 84) is a Priority 4 taxon from the Ericaceae family, known from a relatively narrow range around Albany (Plate 8). It is commonly associated with poorly drained lateritic areas, often on hill crests in *Eucalyptus marginata*/*E. staeri* woodlands. In the Survey Area, a population of 22 individuals was recorded in the large City of Albany Reserve on George St and one individual was recorded on Albany Highway (Plate 7).


Plate 7 and 8. *Andersonia* sp. Jamesii (J. Liddelow 84) (P4) and regional distribution (DPaW 2019a).

***Thysanotus isantherus* (P4)**

*Thysanotus isantherus* is a Priority 4 taxon known from several coastal granite outcrops between Betty's Beach and Walpole and a disjunct occurrence near Cape Leeuwin (Plate 10). It is commonly associated with shallow soil herblands on the margin of granite sheets. It is inconspicuous due to its small size (<15 cm), its dull pink flowers and its leaves that wither to an underground tuber during dry periods. Two individuals were recorded on the western slopes of Mt Melville (Plate 9).


Plate 9 and 10. *Thysanotus isantherus* (P4) and regional distribution (DPaW 2019a).

### *4.2.5 Weeds*

A total of sixty-one weeds were recorded from areas of remnant vegetation. Five significant weeds were recorded and mapped within the Survey Area (Appendix B): Blackberry (**Rubus* species complex, WoNS, Declared Pest) and Bridal Creeper (**Asparagus asparagoides*, WoNS, Declared Pest) were frequently observed in multiple habitats; Gorse (**Ulex europaeus*, WoNS, Declared Pest), Arum Lily (**Zantedeschia aethiopica,* Declared Pest) and Lantana (**Lantana camara,* WoNS, Declared Pest) were recorded as isolated occurrences. Other large woody weeds recorded widely in remnant vegetation, that are of concern to the City of Albany include **Acacia longifolia, *Psoralea pinnata* and **Dipogon lignosus.* A variety of other agricultural weeds occurred under planted vegetation, or adjacent to pasture areas (see Appendix C). The survey of these agricultural areas was not extensive and it is possible more weeds occur in these areas.

# 5 FAUNA RESULTS

## 5.1 Desktop Assessment

The likelihood of occurrence assessment of conservation significant fauna identified for the Survey Area is included in Appendix E. Field assessments confirmed that habitats within the Survey Area are currently being utilised by five conservation significant fauna species; Carnaby's Cockatoo (*Calyptorhynchus latirostris*) (T-EN), Baudin's Cockatoo (*Calyptorhynchus baudinii*) (T-EN), Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) (T-VN), Western Ringtail Possum (*Pseudocheirus occidentalis*) (T-CR), and Southern Brown Bandicoot (*Isoodon obesulus* subsp. *fusciventer*) (P4). One significant fauna species was considered likely to occur in the Survey Area - Water Rat (*Hydromys chrysogaster*) (P4), and seven conservation significant fauna species were considered to possibly occur in the Survey Area: - Carter's Freshwater Mussel (*Westralunio carteri*) (VU), South-western Brush-tailed Phascogale (*Phascogale tapoatafa wambenger*) (CD), Masked Owl (*Tyto novaehollandiae* subsp. *novaehollandiae*) (P3), Peregrine Falcon (*Falco peregrinus*) (OS), Fork-tailed Swift (*Apus pacificus*) (IA), Short-nosed Snake (*Elapognathus minor*) (P2) and the Woollybush bee (*Hylaeus globuliferus*) (P3).

## 5.2 Fauna Habitat

The vegetation types identified in Section 4.2 can be used to categorise general fauna habitats. The known or potential vegetation types associated with significant fauna in the Survey Area is presented in Table 10. There was a variety of fauna habitats identified within the Survey Area, from lowland wetlands to Eucalypt forest woodlands and shrublands on the western slopes of Mt. Melville. Planted Eucalypts also provide some habitat for fauna as do some highly altered vegetation with high percentages of weeds.

Some vegetation associations are mapped (Appendix B) that are not indicated as suitable habitat in Table 10. For example, *Evandra aristata* Sedgeland and *Hakea* spp. Shrubland/Woodland Complex are not considered suitable for Baudin's and Forest Red-tailed Black Cockatoos. However, in some instances have been mapped as habitat due to the presence of potentially suitable night roosting trees.

Some non-remnant vegetation, such as Bluegum and pine plantations, scattered trees over pasture grasses, or revegetation provide a habitat for some significant species. These are included in Table 10 and discussed further in the following sections.

Table 10. Conservation significant fauna and known (x) or potentially (?) associated vegetation within the Survey Area compared to the larger Albany Regional Vegetation Survey Area (Sandiford and Barrett 2010). Information is not sufficient to determine the habitat of the Recherche Cape Barren Goose (VU), Short-nosed Snake (P2) and Woollybush Bee (P3).

| Fauna Habitat and associated Vegetation Associations (ARVS Unit no.) | Ha within Survey Area | Carnaby's Cockatoo (EN) | Baudin's Cockatoo (EN) | Forest Red-tailed Black-Cockatoo (VU) | Western Ringtail Possum (CR) | Quenda (P4) | Brush-tailed Phascogale (CD) | Masked Owl (P3) | Water Rat (P4)) | Peregrine Falcon (OS) | Carters Freshwater Mussel (VU) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Eucalypt (Jarrah/Marri) Woodland/Forest | | | | | | | | | | | |
| Jarrah/Marri/Sheoak Laterite Forest (12) | 32.51 | x | x | x | x | x | ? | ? | | ? | |
| Jarrah/Sheoak/*Eucalyptus staeri* Sandy Woodland (13) | 4.24 | x | x | x | x | x | ? | | | ? | |
| Marri/Jarrah Coastal Hills Forest (17) | 2.13 | x | x | x | x | x | ? | ? | | ? | |
| Marri/Jarrah Forest/Peppermint Woodland (10) | 11.07 | x | x | x | x | x | ? | | | ? | |
| Non-Eucalypt Woodland /Forest | | | | | | | | | | | |
| *Taxandria juniperina* Closed Forest (59) | 8.72 | x | x | x | x | x | | | | | |
| *Melaleuca preissiana* Low Woodland (49) | 1.18 | | | | x | x | | | | | |
| Peppermint Low Forest (2) | 1.42 | | | | x | | | | | | |
| Shrubland/woodland | | | | | | | | | | | |
| *Hakea spp.* Shrubland/Woodland Complex (31) | 4.71 | x | | | x | | | | | | |
| *Mosaic Taxandria marginata/Gastrolobium bilobum* Granite Shrubland/Yate Woodland (23/24) | 2.57 | x | | x | x | x | | | | | |
| Shrubland | | | | | | | | | | | |
| Mosaic *Taxandria marginata/Leucopogon assimilis* Granite Shrubland (24/25) | 0.98 | | | | x | x | | | | | |
| Wetland | | | | | | | | | | | |
| *Evandra aristata* Sedgeland (46) | 0.64 | x | | | x | x | | | ? | | |
| *Homalospermum firmum /Callistemon glaucus* Peat Thicket (47) | 10.53 | x | | | x | x | | | ? | | ? |
| Non-remnant vegetation | | | | | | | | | | | |
| *Mature Planted Trees (Iron Barks, Blue Gum, Tuart, other Eucalypts and Peppermint generally > 10 years old)* | 74.51 | x | x | x | | | | | | | |
| *Woody Weeds (Victorian Tea Tree, Taylorina, Sydney Wattle, Kangaroo Acacia or Bamboo with isolated native plants)* | 7.14 | | | | x | x | | | | | |
| *Other Weeds (Watsonia, Bracken Fern or Blackberry with isolated native plants)* | 2.16 | | | | | x | | | | | |
| *Revegetation (mixed shrubs and trees generally <10 years old)* | 5.58 | | | | | ? | | | | | |
| *Isolated Plants (Pasture and herbaceous weeds with isolated native plants)* | 9.60 | | | | | | | | | | |
| Total extent (ha) in Survey Area (excluding non-remnant vegetation) | 80.7 | 77.12 | 58.67 | 61.24 | 80.7 | 74.57 | 49.95 | 34.64 | 11.17 | 49.95 | 10.53 |
| Extent in Survey Area as proportion (%) of the total potential habitat in the ARVS Survey Area (DPaW 2013b) | | 0.18 | 0.20 | 0.25 | 0.19 | 0.18 | 0.36 | 0.21 | 0.17 | NA | NA |

## 5.3 Targeted Conservation Significant Fauna

### *5.3.1 Western Ringtail Possum (Pseudocheirus occidentalis) (T-CR)*

Preferred habitat for the WRP on the south coast of Western Australia is not well understood. The species has been recorded in coastal heath, Jarrah/Marri woodland and forest, Jarrah/Sheoak woodland, peppermint woodlands, myrtaceous heaths and shrublands, Bullich (*Eucalyptus megacarpa*) dominated riparian zones and Karri forest (*Eucalyptus diversifolia*). In the vegetation associations mapped in the Albany Region (35 km radius from Albany in Sandiford and Barrett (2010)), most ringtail records were from *Coastal limestone heath vegetation* unit 5b (DPaW 2014). Recent spotlight surveys have found high numbers in *Coastal Hills Forest, Jarrah Woodland* and *Marri/Jarrah Forest/Peppermint Woodland* on Mt Clarence/Adelaide and Mt Melville within the Albany town site (S. Gilfillan unpubl. data). Recent radio collaring of individuals determined home ranges of 0.88 ± 0.12 ha (mean ± SE), and were commonly associated at night with Marri and Jarrah, suggesting a preference for these species as foraging trees. Daytime refuges included dreys, large trees, tree hollows (Marri only) and thick ground cover (Van Helden *et al.* 2017).

The field assessment determined that the Western Ringtail Possum occupied 111.5 ha (approximately 33%) of the Survey Area (Appendix B, Table 11). A wide range of vegetation types in various levels of condition were utilised (Jarrah, Marri and Sheoak woodlands, Jarrah/Marri Forest, *Taxandria juniperina* Woodland) that varied in condition from Degraded to Excellent.

Non-native vegetation was also utilised such as exotic Eucalypt species plantations, particularly where the weed species Sydney Golden Wattle (*Acacia longifolia*) and Victorian Tea Tree (*Leptospermum laevigatum*) provide patches of thick mid-storey (where dreys were frequently found). Western Ringtail Possum scats were also found at the base of many pine trees.

Table 11. Extent of Western Ringtail Possum habitat in the Survey Area

| | Area (ha) |
|---|---|
| Core | 10.2 |
| Supporting | 100.2 |
| Core (Urban) | 1.1 |
| Supporting (Urban) | Not present |
| Total | 111.5 |

#### 5.3.1.1 Core habitat

A total of 11.3 ha of core habitat occurs within the Survey Area with 1.1 ha within urban areas. Core habitat was concentrated at the southern end of the Survey Area and is contiguous with core habitat on Mt Melville. No other core habitat exists within the Survey Area. In preliminary surveys (Rathbone and Gilfillan 2018) the City of Albany Reserve on the corner of George St and South Coast Hwy was considered core habitat. However, the updated data used to define core habitat (any area with an established density of <1/ha) precludes this from being assigned core status with a density of only 0.14/ha (Biota 2018). Core habitat was only a small percentage of estimated core habitat within the 5 km buffer (<0.5%) (Table 11).

#### 5.3.1.2 Supporting habitat

A total of 100.2 ha of supporting habitat occurs within the Survey Area. Supporting habitat is distributed throughout the Survey Area, with the George St Reserve providing the largest native remnant of suitable supporting habitat. Mature planted trees in the east of the Survey Area also constituted supporting habitat. These were planted tree assemblages with a varying density of largely non-native mid-storey species (from very spare to dense thickets of, particularly, Victorian Tea Tree and Sydney Golden Wattle). The two patches of *Homalospermum firmum/Callistemon glaucus* Peat Thicket (ARVS Unit 47) on Link Rd are considered supporting habitat. Very limited scat searches were performed here due the thick nature of the vegetation and no scats were observed. However, the presence of Western Ringtail Possums in the adjoining Eucalypt woodland to the north suggests this habitat is likely to be used, particularly due to the thick vegetation providing many opportunities for refuge. Supporting habitat within the Survey Area was fairly continuous along Lower Denmark Rd.

#### 5.3.1.3 Linkages

Three linkage types were mapped within the Survey Area (Table 12). The number of linkages is a more useful measure than area as the number reflects the degree of opportunity for individuals to move through the landscape. A rectangle, for example, of linkage habitat will provide less distance for movement than the same area covering a narrow linear linkage.

Table 12. Western Ringtail Possum Linkages within the Survey Area.

| | Survey Area | |
|---|---|---|
| Linkage Type | No. of Linkages | Area |
| Linkage | 28 | 43.7 |
| Linkage_likely | 18 | 10.9 |
| Linkage_possible | 20 | 11.1 |

An important *Potential habitat linkage* occurs along the rail reserve, adjacent to both sides of Lower Denmark Rd, forming a partial link between the core habitats of the eastern edge of the Survey Area and the large are of supporting habitat in the George St Reserve. Small, narrow *Habitat linkages* also occur in patches of roadside vegetation, along Link Rd, south of Lancaster Rd and on George St.

#### 5.3.1.4 Primary Corridors

There are three primary corridors within the South Coast Population:

- King River
- Kalgan River
- Coastal Corridor (from West Cape Howe NP to Cheyne's Beach – this may extend either east or west with new records)

On a regional scale, the southern section for the Survey Area covering the intersection of the Hanrahan Rd/Frenchman's Bay Road and Princess Royal Drive forms part of the Costal Corridor within the South Coast Macro Corridor Network. This Corridor Network was developed as a strategic planning tool to

provide guidance at a regional level as to where protection and enhancement of major corridor linkages should be targeted (Wilkins *et al.* 2006). The Coastal Corridor (Forest to Two Peoples Bay Corridor) is a Priority 1 Corridor which is defined as one that links two or more *very high nature conservation value* areas (Forest Region and Two People Bay NR). On a local scale the Survey Area is within Strategic Zone B of the Coastal Corridor.

### *5.3.2 Black Cockatoo Species*

***Black Cockatoos (Carnaby's Cockatoo (Calyptorhynchus latirostris) (T-EN); Baudin's Cockatoo (Calyptorhynchus baudinii) (T-EN); and Forest Red-tailed Black Cockatoo (Calyptorhynchus banksii subsp. naso) (T-VU)***

**Carnaby's Cockatoo (*Calyptorhynchus latirostris*) (T-EN)**

Habitats considered suitable for this species are uncleared or remnant native Eucalypt woodlands or forests containing Marri, Jarrah or Karri and shrublands or Kwongkan heathland dominated by *Hakea, Dryandra, Banksia* and *Grevillea* (DSEWPaC 2012). On the south coast they feed on Jarrah and Marri seeds and a wide variety of mainly proteaceous species. Breeding hollows occur in Jarrah and Marri and generally have an entrance diameter >200 mm and occur in trees that are 120–150 years old. Trees approaching 680 mm DBH are close to developing suitable hollows (Pittman *et. al*. 2007, Whitford and William 2002, DPaW 2013a).

Communal night roosting occurs at different sites throughout the year. Groups of birds will roost in a suitable tree or group of tall trees, usually close to a water source (known to drink at dams and farm troughs) and within an area of quality foraging habitat. The cockatoos fly to feeding areas each day before returning to the night roost, however, use of a particular night roost site may vary from daily to weekly. Night roosts are generally located in the tallest trees in an area; on the south coast potential roost trees include Marri, Karri, Blackbutt, *Taxandria juniperina*, Tuart (planted), introduced Eucalypts (for example Blue Gum) and introduced pines (DSEWPaC 2012).

**Baudin's Cockatoo (*Calyptorhynchus baudinii*) (T-EN)**

Baudin's Cockatoo occurs in high-rainfall areas, usually at sites that are heavily forested and dominated by Marri, Jarrah and Karri. It also occurs in woodlands of Wandoo (*E. wandoo*), Blackbutt (*E. patens*), Flooded Gum (*E. rudis*), and Yate (*E. cornuta*) (DSEWPaC, 2012). Baudin's cockatoo feeds mainly on the seeds of Marri, but may also feed on the seed of *Banksia* spp., *Hakea* spp. and *Erodium botrys*. Additionally, Baudin's Cockatoo feeds on invertebrate larvae and on apple, pear and persimmon in domestic and commercial fruit orchards (Chapman 2008). There is very little breeding information and the breeding biology of this species remains poorly known (Johnstone and Kirkby 2008). Known breeding trees include Karri, Marri, Wandoo and Tuart. Hollows suitable for Baudin's Cockatoo are likely to be in trees 500 mm or greater DBH and suitable hollows usually have a diameter of 300-400 mm (Johnstone & Storr 1998; Higgins 1999; Saunders 1974, 1979).

**Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii subsp. naso*) (T-VN)**

Forest Red-tailed Black Cockatoo commonly occur in Jarrah, Karri and Marri forests and also in a range of other forest and woodland types, including Blackbutt, Wandoo and Tuart (*E. gomphocephala*), Albany Blackbutt, Yate and Flooded Gum (DSEWPaC, 2012). Ninety percent of the Forest Red-tailed Black Cockatoo total diet consists of Marri and Jarrah seeds (Johnstone & Kirkby 1999), and it depends on both feed trees during breeding periods (Johnstone *et al.* 2013). Other feed trees include Blackbutt, Albany Blackbutt, Forest Sheoak (*Allocasuarina torulosa*), Snottygobble (*Persoonia* spp.) and Karri.

Breeding occurs almost exclusively in Marri. Johnson *et al.* (2013) found by measuring 128 breeding trees that mean DBH was 2790 mm, mean estimated age was 222 years, and mean hollow entrance size was 300 mm x 340 mm. However, Whitford *et al.* (2015) state a more realistic minimum age for trees bearing suitable hollows is approximately 120–150 years (tree diameters of 500–600 mm) and most nest hollows occurred in intermediate-sized trees.

***Black Cockatoo Breeding Habitat***

The Survey Area occurs within the known distribution and predicted breeding range of Carnaby's Cockatoo and Baudin's Cockatoo. Forest Red-tailed Black Cockatoo are known to occur and may breed in suitable trees anywhere within their range of occurrence (DSEWPaC 2012). There are no confirmed breeding sites for any of the three Cockatoo species within 10 km of the Survey Area.

Potential breeding habitat for all three black Cockatoo species (Table 14) considered to be of high quality occurs in two large areas of Eucalypt Woodland/Forest on the southern slopes of Mt Melville and George St Reserve; several smaller patches are distributed throughout the Survey Area (total of 43.63 ha). Lower quality potential breeding habitat occurs in some of the narrow strips of roadside Eucalypt Woodland/Forest vegetation on Link Rd, George St (8.08 ha) and in areas of *Eucalyptus gomphocephala* (5.35 ha). *Eucalyptus gomphocephala* is restricted to the swan coastal plain and all occurrences within the Survey Area due to ornamental planting (approximately 70 years old). Many of the tree were ≥ 500 mm DBH, although none contained hollows at present.

No trees within the Survey Area contain hollows that were currently occupied or showed recent use by Cockatoo species. A total of 175 hollows with an entrance estimated to be greater than 100 mm were recorded within 120 alive and dead trees of *Corymbia calophylla* and *Eucalyptus marginata* (Table 13). Based on suitability of host species and current entrance size, 60 trees contained hollows potentially suitable for Carnaby's Cockatoo (*Eucalyptus marginata* or *Corymbia calophylla* with hollow entrance ≥ 200 mm), 18 trees contained hollows potentially suitable for Forest Red-tailed Black Cockatoo (*Corymbia calophylla* with hollow entrance ≥ 200 mm) and three trees contained hollows potentially suitable for Baudin's Cockatoo (*Corymbia calophylla* with hollow entrance ≥ 300 mm). Additional assessments using a drone (Biota 2019b) of all potential breeding trees within the disturbance envelope of the project were determined to be currently unsuitable for breeding.

In total, 662 potential breeding trees were recorded (DBH≥ 500 mm, with or without hollows) comprising of the tree species *Corymbia calophylla* (287), *Eucalyptus marginata* (279), planted *Eucalyptus gomphocephala* (62), dead stags of *Eucalyptus marginata*/*Corymbia calophylla* (29) and *E. staeri* (5).

Table 13. Count of hollows with an entrance size greater than 100 mm in potential breeding trees for Black Cockatoo species.

| | Hollow entrance (mm) | | |
|---|---|---|---|
| Tree Species | 100-199 | 200-299 | ≥300 |
| *Corymbia calophylla* | 18 | 16 | 3 |
| *Eucalyptus marginata* | 69 | 34 | 14 |
| Dead Stag of *Eucalyptus marginata* or *Corymbia calophylla* | 11 | 4 | 6 |

***Black Cockatoo Breeding Feeding Habitat***

Evidence of feeding was widely overserved for all three species across the Survey Area (mapped in Appendix B, Table 14). Diagnostic evidence of feeding on fruits of *Corymbia calophylla*, *Eucalyptus marginata* and *E. staeri* of all three Black Cockatoo species was observed and on planted Pine tree by Carnaby's Cockatoo.

High quality feeding habitat for all three species of Black Cockatoo was mapped in all the large Eucalypt Woodland and Forest remnants (43.63 ha). Lower quality potential feeding habitat occurred in some degraded Eucalypt remnants (8.08 ha) with *Allocasuarina* and *Hakea* an in isolated patches and narrow roadside corridors (3.40 ha). Wetland areas that contained frequent *Callistemon glaucus* were also mapped as low-quality feeding habitat for Carnaby's Cockatoo (6.51 ha), which is considered a minor food source for this species (Johnston 2013).

***Black Cockatoo Roosting Habitat***

Confirmed roost sites for Carnaby's Cockatoo occur in Marri Jarrah Forest/Peppermint Woodland on Mt Melville, only 350 m from the eastern edge of the Survey Area and in tall *Taxandria juniperina* trees at Lake Seppings (4.8 km from the Survey Area). There are no confirmed roosting sites within 10 km for Baudin's Cockatoos or Forest Red-tailed Black Cockatoo. However, some Black cockatoo flocks around Albany are mixed flocks comprising both Carnaby's and Baudin's Cockatoos and thus the confirmed roosting sites for Carnaby's Cockatoos may contain some Baudin's individuals (Sarah Comer, South Coast Regional Ecologist, DCBA, *pers.com*.)

Potential roosting habitat for all three species of Black Cockatoo occurred throughout the Survey Area (Appendix B, Table 14). As there were numerous water sources within the Survey Area (including dams, man-made pools and farm water troughs) all areas with tall trees suitable for roost sites are considered potential roosting areas. They include native Eucalypt Woodland/Forests, *Taxandria juniperina* woodlands, exotic Eucalypt plantations and introduced pine trees (67.3 ha). Other areas of low-quality potential roosting habitat occur in Sedgelands with patches of **Leptospermum laevigatum*, **Acacia longifolia* and occasional **Eucalyptus globulus.*

Table 14. Summary of breeding, feeding and roosting habitat for three species of Black Cockatoo in the Survey Area.

| Habitat Type | Description | **Carnaby's** Cockatoo | Baudin's Cockatoo | Forest Red-tailed Black Cockatoo | Total |
|---|---|---|---|---|---|
| High quality feeding and potential breeding and roosting | Eucalypt Woodland or Forest | + | + | + | 43.63 |
| Low quality feeding and potential breeding and roosting | Degraded Eucalypt Woodland with *Allocasuarina* and *Hakea* Shrubland | + | + | + | 8.08 |
| High quality potential roosting habitat | Mature Planted Trees and tall Taxandria Forest | + | + | + | 67.30 |
| Low quality potential roosting habitat | Sedgeland with **Leptospermum laevigatum*, **Acacia longifolia* and occasional **Eucalyptus globulus* | + | + | + | 9.08 |
| Low quality feeding habitat | Degraded/isolated remnants Eucalypt Woodland or Forest with *Allocasuarina* and *Hakea* Shrubland | + | + | + | 3.40 |
| Low quality feeding habitat | Wetlands with *Callistemon glaucus* | + | | | 6.51 |
| Low quality potential breeding habitat | Planted *Eucalyptus gomphocephala* | + | + | + | 5.35 |
| | | | | Total: | 143.36 |

## 5.4 Other Conservation Significant Fauna

**Quenda *(Isoodon obesulus* subsp*. fusciventer)* (P4)**
The Quenda occurs in wet or dry sclerophyll forest through to open woodland and scrubby, dense vegetation on sandy soils. The species often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover (Paull 2008).

Characteristic diggings of this species were observed throughout the Survey Area in all vegetation types from Degraded to Excellent condition. Diggings were also observed in some plantation areas and areas dominated by weeds (Appendix B). One roadkill was observed on the Old Denmark Rd, near the corner of George St and a skull and lower jaw bones were found in the small roadside remnant east on Albany Hwy.

**Carter's Freshwater Mussel (*Westralunio carteri*) (VU)**
The current distribution of the Carter's Freshwater Mussel is restricted to freshwater streams, rivers, reservoirs and lakes within 50-100 km of the coast with mean salinity <1.6 ppt. Patchy distribution occurs in sandy/muddy sediments with greatest densities associated with exposed submerged tree roots (*Eucalyptus rudis*, *Melaleuca* spp. and others), woody debris and overhanging riparian vegetation near stream banks and edges of lakes/dams. Precise habitat requirements and quantification of density within habitat types are in the early stages of study for this species; juveniles may require specific micro-habitats and are difficult to locate in the wild. The species is semi-parasitic, therefore requires presence of host fish species (SWCC date unknown).

Potentially suitable habitat exists within an artificial dam in the Link Road wetland. It is not known if this habitat provides specific requirements such as suitable micro-habitat for juveniles or presence of host fish species.

**South-western Brush-tailed Phascogale, Wambenger (*Phascogale tapoatafa wambenger*) (CD)**
The Brush-tailed Phascogale in south-west WA inhabits Eucalypt woodland and open forests, and is found less commonly in wetter forests. The species has an arboreal foraging habit and a preference for mature trees for nesting hollows, although sometimes smaller trees have the potential to provide these (Abbott and Whitford 2001). Rees *et al.* (2006) found that suitable hollows for this species in Victoria ranged in diameter at breast height (DBH) from 25 to 171 cm, with a mean DBH for the trees used by each individual phascogale of >80 cm. Hollow entrance sizes for Brush-tailed Phascogales are small, > 5 cm diameter, with large hollow chamber size. This species was not directly observed during the survey.

A confirmed record of the South-western Brush-tailed Phascogale in Mira Mar (an Albany suburb approximately 4 km from the Survey Area) in March 2017 indicates they possibly occur within the Albany area. This species was targeted in a community fauna survey of Mt. Melville Reserve (bounding the eastern edge of the Survey Area) in 2014/15 by the installation of nest boxes. After one year no Brush-tailed Phascogales were found to be using the nest boxes. Spotlighting was also carried out during the survey and no Brush-tailed Phascogale were observed (Gilfillan and Maciejewski 2015). However, targeted trapping for this species was not carried out. Potentially suitable habitat exists in the Marri and Jarrah woodland and forest vegetation types within the Survey Area (Table 10).

**Fork-tailed Swift, Pacific Swift (*Apus pacificus*) (1A)**
The Fork-tailed Swift is almost exclusively aerial, flying from less than 1 m to at least 300 m above the ground. It does not breed in Australia, and therefore breeding habitat is not required. This species was

not observed during the survey. Habitats that provide a source of insects would most likely comprise all the vegetation types present within the Survey Area.

**Short-nosed Snake (*Elapognathus minor*) (P2)**
There are only a few records for this species on the South Coast and therefore its habitat is not well known. This species was not observed during the survey. As the habitat is not well known, it is possible that suitable habitat may exist within the Survey Area, however the vegetation types cannot be confirmed.

**Masked Owl (southern subsp.) (*Tyto novaehollandiae* subsp. *novaehollandiae*) (P3)**
The Masked Owl inhabits forests, woodlands, timbered waterways and open country on the fringe of these areas and require tall Eucalypts with suitable hollows for nesting and roosting and adjacent areas for foraging that support an abundance of principally terrestrial mammals, although arboreal mammals can also be taken. They may also use caves for nesting. Masked Owls are territorial, and pairs remain in or near the territory all year round (Garnett 2000).

This species was not observed during the survey. It possibly occurs as hollows suitable for nesting are present within the Eucalypt woodland/forest vegetation types and prey in the form of terrestrial mammals (Quenda, rabbits) are also present within the Survey Area.

Spotlighting during a fauna survey of Mt. Melville Reserve (bounding the eastern edge of the Survey Area) in 2014/15 (Gilfillan and Maciejewski 2015) did not observe and Masked Owls and none were heard, however no targeted playback for the species was carried out.

**Woollybush Bee (*Hylaeus globuliferus*) (P3)**
*Hylaeus* are typically small to medium-sized bees with black, relatively hairless bodies and most species have characteristic white, cream or yellow marks on the face and thorax. Vacated borer holes in tree trunks and dead branches, hollow pithy stems and the vacated burrows of other bees or wasps are commonly used (WAM 2018).

This species was not observed during the survey**.** Only the type specimen (1929) is known from the Albany area. Its habitat within the South Coast is not known, therefore the species may possibly occur. However, the vegetation types cannot be identified at this point in time.

**Water-rat, Rakali (*Hydromys chrysogaster*) (P4)**
Rivers, estuaries, swamps, lakes, dams/reservoirs, creeks, damplands, floodplains, sumpland, protected coastal beaches and islands (Olsen 2008). In Western Australia, Rakali are the only aquatic mammal in freshwater ecosystems. They require prey such as flat feeding sites such as logs, rocks or sheltered areas on the river bank to consume prey and a suitable substrate to dig burrows (Olsen 2008; Trocini *et al.* 2015). At Two Peoples Bay individuals preferentially utilised wetland habitats characterised by dense, low-lying vegetation (0–30 cm from ground), low-density canopy cover and shallow, narrow water bodies (Speldewinde *et al*. 2013). Evidence of rakali has been found at sites with relatively poor habitat and other studies in the eastern states have identified Rakali populations in less than optimal habitats, such as irrigation drainage channels and polluted urban water-bodies (Scott and Grant 1997)

No signs of this species were found; however, it is known to occur in Lake Powell which is connected to the natural broad drainage channel that intersects the Survey Area north of South Coast Highway that flows west into Five Mile Creek and eventually into Lake Powell. In addition, farm dams, and roadside drainage channels particularly along Lower Denmark Rd, may provide habitat for this species.

**Peregrine Falcon (*Falco peregrinus*) (OS)**

Peregrine Falcon occur in a variety of habitats from woodlands to open grasslands and coastal cliffs. Prey consists of other birds. It requires abundant prey and secure nest sites, and prefers coastal and inland cliffs or open woodlands near water. Suitable habitat exists for this species (all forest/woodland vegetation communities) however this species is not common and therefore may only be encountered occasionally.

## 5.5 Regional Significance of Fauna Habitats

Habitat for all significant fauna species known or potentially occurring within the Survey Area (for which data is available) is represented outside of the Survey Area (Table 10). All of the fauna species for which ranges are well known are wide ranging, and thus the Survey Area represents only a small area of their total range. It should be noted, however that the Western Ringtail Possum South Coast population may be an isolated sub-population and is considered a separate management unit (DPaW 2014). Thus, when considering range for this species, the South Coast range is the most appropriate scale.

Ranges of the Short-nosed snake and Woollybush Bee are not well known, therefore the regional context of their ranges cannot be discussed. In addition, the Survey Area is situated at the eastern edge of the range of the Brush-tailed Phascogale and Baudin's Cockatoo's predicted breeding range, and possibly the Short-nosed Snake (from current known records).

In terms of regional connectivity, the southern section of the Survey Area (in the area of the Hanrahan Rd and Frenchman's Bay Rd. intersection) serves as an important link between the central Albany area of Western Ringtail Possum core habitat and that to the south west (Robinson, Big Grove and the Torndirrup Peninsula).

# 6 CONCLUSIONS

Southern Ecology conducted primary flora and fauna assessments in the Survey Area in 2017 that were followed up with assessments in 2018 and 2019 to address changes in the project design and to consolidate the biological information. The surveys have included a Detailed and Targeted Flora Assessment (covering a range from July to November) and Level 1 Fauna, Black Cockatoo and Western Ringtail Possum Assessment and a regional Targeted Survey for *Prasophyllum paulinae* (P1).

A wide range of vegetation types were recorded from wetlands, granite outcrops and lateritic uplands and quartzitic sands that were primarily in Very Good or Excellent condition. The vegetation described constitutes 0.18% of the 35% remnant vegetation that remains within the region (Albany Regional Vegetation Area), which reflects the long history of European occupation in Albany and the utilisation of land suitable for agriculture. Of the thirteen associations described, six are recognised as locally rare (<1,500 ha in total), five are poorly represented in the conservation estate (<10% in IUCN reserves), four are considered wetland vegetation recognised under State acts.

A total of 342 taxa were recorded in 32 floristic quadrats with an average of 23.3 species per quadrat. The species assemblages were typical of the local region and the vegetation types encountered. However, overall species richness was reduced due to weed infestation of granite communities, the long unburnt condition of the wetlands and the impacts of *Phytophthora* Dieback in the upland lateritic areas. Four Priority-listed flora were recorded (*Synaphea incurva* (P3), *Boronia crassipes* (P3), *Andersonia* sp. Jamesii (J. Liddelow 84) (P4) and *Thysanotus isantherus* (P4)) and one previously known population of *Prasophyllum paulinae* (P1) is known from the Survey Area.

Targeted surveys for *Prasophyllum paulinae* within two wetland vegetation associations in the Survey Area (total of 19.25 ha) did not detected any individuals. However, the potential exists for it to emerge following fire within this habitat. Regional Targeted Surveys were conducted that targeted recently burnt areas of suitable habitat, which identified a new population estimated to comprise 50 plants outside the Survey Area.

Survey limitations did not generally affect the confidence of the survey results. However, the absence of fire or other disturbance may have impeded the detection of five conservation significant flora that generally occur in wetland areas or granite refuges.

Five significant fauna species were present within the Survey Area: - Carnaby's Cockatoo (*Calyptorhynchus latirostris*) (T-EN), Baudin's Cockatoo (*Calyptorhynchus baudinii*) (T-EN), Forest Red-tailed Black Cockatoo (*Calyptorhynchus banksii naso*) (T-VN), Western Ringtail Possum (*Pseudocheirus occidentalis*) (T-CR), and Southern Brown Bandicoot (*Isoodon obesulus* subsp. *fusciventer*) (P4).

Western Ringtail Possums scats and dreys were observed widely across the Survey Area, in multiple native and non-native habitats of varying condition. Albany occurs in the centre of the south coast population of WRP, which has been poorly understood until recently. As part of this assessment the EPBC Act Significant Impact Guidelines categories were adapted south coast population and *core* and *supporting habitats* and *potential habitat linkages* were identified for the Survey Area.

Foraging and potential breeding habitat for three Black Cockatoo species occurred throughout the Survey Area, in all the Eucalypt Woodland/Forest habitats. Large areas of potential roosting sites were identified among both native and introduced tree species. No trees within the Survey Area contain hollows that were currently occupied or showed recent use by Cockatoo species. However, based on suitability of host species and current entrance size, up to 60 trees contained hollows potentially suitable for Black Cockatoo species.

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# 8 APPENDIX A - Conservation Status Definitions

Table A1. Acts relevant to environmental impact assessment.

| | |
|---|---|
| *Environment Protection and Biodiversity Conservation* [EPBC] *Act 1999* | https://www.legislation.gov.au/Details/C2016C00777 |
| *Environmental Protection* [EP] *Act 1986* | https://www.slp.wa.gov.au/legislation/statutes.nsf/law_a252.html |
| *Biodiversity Conservation* [BC] *Act 2016* | https://www.slp.wa.gov.au/legislation/statutes.nsf/law_a147120.html |

Table A2. The categories for flora and fauna listed as Threatened or specially protected. Taxa can be recognised as Threatened (T) or Conservation Dependent under Commonwealth (EPBC) and / or State (BC) Acts.

| Threat category | Definition |
|---|---|
| Threatened - Critically Endangered (T-CR) | Considered to be facing an extremely high risk of extinction in the wild |
| Threatened – Endangered (T-EN) | Considered to be facing a very high risk of extinction in the wild |
| Threatened – Vulnerable (T-VN) | Considered to be facing a high risk of extinction in the wild |
| Threatened - Presumed extinct (T-EX) | Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. |
| Conservation dependant (CD) | Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened |
| Migratory birds protected under international agreement (IA) | Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds |
| Other specially protected fauna (OS) | Fauna otherwise in need of special protection to ensure their conservation |

Table A3. Flora or fauna that are potentially threatened but do not meet the survey criteria or are otherwise data deficient are listed under Priority categories with the Department of Biodiversity, Conservation and Attractions.

| Category | Description |
|---|---|
| Priority One (P1) | Known from few locations (generally <5), small populations and/or occurring on land with insecure tenure |
| Priority Two (P2) | Known from few locations (generally <5), small populations with some occurring on land with secure tenure |
| Priority Three (P3) | Known from several locations with habitat not under imminent threat |
| Priority Four (P4) | (a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy |

Table A4. Categories for ecological communities listed as Threatened (TEC). Communities can be recognised as Threatened under Commonwealth (EPBC) and / or State (BC) Acts.

| Category | Description |
|---|---|
| Presumed totally destroyed (PU) | Adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. |
| Critically Endangered (CR) | Adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. |
| Endangered (EN) | Adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. |
| Vulnerable (VU) | Adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium (within approximately 50 years) to long-term future. |

Table A5. The categories for ecological communities listed as Priority (PEC) with the Department of Biodiversity, Conservation and Attractions.

| Category | Description |
|---|---|
| Priority One (P1) | Known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤ 100ha) and are currently under threat |
| Priority Two (P2) | Known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha). At least some occurrences are not believed to be under immediate threat (within approximately 10 years) |
| Priority Three (P3) | Known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:<br>(ii) known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat (within approximately 10 years), or;<br>(iii) made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, inappropriate fire regimes, clearing, hydrological change etc |
| Priority Four (P4) | Adequately known, rare but not threatened or meet criteria for Near Threatened or that have been recently removed from the threatened list. These communities require regular monitoring |
| Priority Five (P5) | Conservation dependant ecological communities. Not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years |

Table A6. Species that **are 'i**ntroduced' or 'weeds' can potentially be listed under the state Biosecurity Management Act (DPIRD 2019) or under the commonwealth Weeds of National Significance (WoNS) (DotEE 2019b).

| Category | Description |
|---|---|
| Declared Pest, Prohibited - s12 | Prohibited organism and may only be imported and kept subject to permits. Permit conditions applicable to some species may only be appropriate or available to research organisations or similarly secure institutions |
| Permitted - s11 | Permitted organisms must satisfy any applicable import requirements when imported. They may be subject to an import permit if they are potential carriers of high-risk organisms |
| Declared Pest - s22(2) | Declared pests must satisfy any applicable import requirements when imported, and may be subject to an import permit if they are potential carriers of high-risk organisms. They may also be subject to control and keeping requirements once within Western Australia |
| Permitted, Requires Permit - r73 | Regulation 73 permitted organisms may only be imported subject to an import permit. These organisms may be subject to restriction under legislation other than the Biosecurity and Agriculture Management Act 2007. Permit conditions applicable to some species may only be appropriate or available to research organisations or similarly secure institutions |
| WoNS | Weeds of National Significance – this is nationally recognised list of weeds agreed by Australian governments based on an assessment process that prioritised weeds based on their invasiveness, potential for spread and environmental, social and economic impacts. Consideration was also given to their ability to be successfully managed. |

# 9 APPENDIX B – Map Series 1-8 A-B (see attached)

**CONTENTS:**

565000 570000 575000 580000 585000

6140000 6135000 6130000 6125000 6120000 6115000 6110000

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1 2 3 4 5 6 7 8

0 0.5 1 2 3
Kilometers

# Overview Map and Desktop Biological Data within the Study Area, Albany Ring Road.

Map produced by Damien Rathbone on 20/01/2020.
Report Reference: Rathbone, DA & Gilfillan, S (2020). Biological Survey: Albany Ring Road.
Unpublished report by Southern Ecology for Main Roads Western Australia (SE1810).
Map Projection: Transverse Mercator Horizontal Datum GDA 1994
Grid: MGA Zone 50  Map Size: A3 Scale 1:100,000


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Map Series Index 1-8
Survey Area
Survey Area 10 km Buffer

Conservation Signficant Flora (DBCA)
X
T
1
2
3
4

Conservation Signficant Fauna (DBCA)
Threatened Fauna
Other Fauna (Priority, IA, CD)

Conservation Significant Vegetation (DBCA)
Threatened Ecological Community
Priority Ecological Community
Environmentally Sensitive Areas (ESA)

574800 575000 575200 575400 575600 575800 576000 576200

6131400 6131200 6131000 6130800 6130600 6130400 6130200 6130000 6129800

N

0 50 100 200
Metres

# Map 1A: Vegetation Type and Conservation Signficant Flora, Albany Ring Road.

Map produced by Damien Rathbone on 20/01/2020.
Report Reference: Rathbone, DA & Gilfillan, S (2020). Biological Survey: Albany Ring Road. Unpublished report by Southern Ecology for Main Roads Western Australia (SE1810).
Map Projection: Transverse Mercator Horizontal Datum GDA 1994
Grid: MGA Zone 50 Map Size: A3 Scale 1:6,000


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Vegetation Association

- *Hakea* spp Shrubland/Woodland Complex
- Jarrah/Marri/Sheoak Laterite Forest
- Jarrah/Sheoak/*E.staeri* Sandy Woodland
- *Homalospermum firmum/Callistemon glaucus* Peat Thicket
- Woody Weeds (Victorian Tea Tree, Taylorina, Sydney Wattle, Kangaroo Acacia or Bamboo with isolated native plants)
- Other Weeds (Watsonia, Bracken Fern or Blackberry with isolated native plants)
- Mature Planted Trees (Iron Barks, Blue Gum, Tuart, other Eucalypts and Peppermint generally > 10 years old)
- Revegetation (mixed shrubs and trees generally <10 years old)
- Isolated Plants (Pasture and herbaceous weeds with isolated native plants)
- Cleared

Conservation Significant Flora

- *Boronia crassipes* (P3)
- *Synaphea incurva* (P3)
- *Andersonia* sp. Jamesii (J. Liddelow 84) (P4)
- *Thysanotus isantherus* (P4)
- *Prasophyllum paulinae* (P1) Habitat
- Survey Area

573600 573800 574000 574200 574400 574600 574800 575000

6131000 6130800 6130600 6130400 6130200 6130000 6129800 6129600 6129400

N

0 50 100 200
Metres

# Map 2A: Vegetation Type and Conservation Signficant Flora, Albany Ring Road.

Map produced by Damien Rathbone on 20/01/2020.
Report Reference: Rathbone, DA & Gilfillan, S (2020). Biological Survey: Albany Ring Road. Unpublished report by Southern Ecology for Main Roads Western Australia (SE1810).
Map Projection: Transverse Mercator Horizontal Datum GDA 1994
Grid: MGA Zone 50 Map Size: A3 Scale 1:6,000


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Vegetation Association

- *Hakea* spp Shrubland/Woodland Complex
- Jarrah/Marri/Sheoak Laterite Forest
- Other Weeds (Watsonia, Bracken Fern or Blackberry with isolated native plants)
- Mature Planted Trees (Iron Barks, Blue Gum, Tuart, other Eucalypts and Peppermint generally > 10 years old)
- Revegetation (mixed shrubs and trees generally <10 years old)
- Isolated Plants (Pasture and herbaceous weeds with isolated native plants)
- Cleared

Conservation Significant Flora

- *Boronia crassipes* (P3)
- *Synaphea incurva* (P3)
- *Andersonia* sp. Jamesii (J. Liddelow 84) (P4)
- *Thysanotus isantherus* (P4)
- *Prasophyllum paulinae* (P1) Habitat
- Survey Area


# Map 3A: Vegetation Type and Conservation Signficant Flora, Albany Ring Road.

Map produced by Damien Rathbone on 20/01/2020.
Report Reference: Rathbone, DA & Gilfillan, S (2020). Biological Survey: Albany Ring Road. Unpublished report by Southern Ecology for Main Roads Western Australia (SE1810).
Map Projection: Transverse Mercator Horizontal Datum GDA 1994
Grid: MGA Zone 50 Map Size: A3 Scale 1:6,000


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Vegetation Association

- *Hakea* spp Shrubland/Woodland Complex
- Jarrah/Marri/Sheoak Laterite Forest
- Jarrah/Sheoak/*E.staeri* Sandy Woodland
- *Homalospermum firmum/Callistemon glaucus* Peat Thicket
- Other Weeds (Watsonia, Bracken Fern or Blackberry with isolated native plants)
- Mature Planted Trees (Iron Barks, Blue Gum, Tuart, other Eucalypts and Peppermint generally > 10 years old)
- Isolated Plants (Pasture and herbaceous weeds with isolated native plants)
- Cleared

Conservation Significant Flora

- *Boronia crassipes* (P3)
- *Synaphea incurva* (P3)
- *Andersonia* sp. Jamesii (J. Liddelow 84) (P4)
- *Thysanotus isantherus* (P4)
- *Prasophyllum paulinae* (P1) Habitat
- Survey Area

573600 573800 574000 574200 574400 574600 574800 575000

6127600 6127400 6127200 6127000 6126800 6126600 6126400 6126200 6126000 6125800

N

0 50 100 200
Metres

# Map 4A: Vegetation Type and Conservation Signficant Flora, Albany Ring Road.

Map produced by Damien Rathbone on 20/01/2020.
Report Reference: Rathbone, DA & Gilfillan, S (2020). Biological Survey: Albany Ring Road. Unpublished report by Southern Ecology for Main Roads Western Australia (SE1810).
Map Projection: Transverse Mercator Horizontal Datum GDA 1994
Grid: MGA Zone 50 Map Size: A3 Scale 1:6,000


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Vegetation Association

- *Hakea* spp Shrubland/Woodland Complex
- Jarrah/Marri/Sheoak Laterite Forest
- Jarrah/Sheoak/*E.staeri* Sandy Woodland
- Marri/Jarrah Forest/Peppermint Woodland
- *Homalospermum firmum/Callistemon glaucus* Peat Thicket
- Woody Weeds (Victorian Tea Tree, Taylorina, Sydney Wattle, Kangaroo Acacia or Bamboo with isolated native plants)
- Other Weeds (Watsonia, Bracken Fern or Blackberry with isolated native plants)
- Mature Planted Trees (Iron Barks, Blue Gum, Tuart, other Eucalypts and Peppermint generally > 10 years old)
- Isolated Plants (Pasture and herbaceous weeds with isolated native plants)
- Cleared

Conservation Significant Flora

- *Boronia crassipes* (P3)
- *Synaphea incurva* (P3)
- *Andersonia* sp. Jamesii (J. Liddelow 84) (P4)
- *Thysanotus isantherus* (P4)
- *Prasophyllum paulinae* (P1) Habitat
- Survey Area

573800 574000 574200 574400 574600 574800 575000 575200

6126200 6126000 6125800 6125600 6125400 6125200 6125000 6124800 6124600

N

0 50 100 200
Metres

# Map 5A: Vegetation Type and Conservation Signficant Flora, Albany Ring Road.

Map produced by Damien Rathbone on 20/01/2020.
Report Reference: Rathbone, DA & Gilfillan, S (2020). Biological Survey: Albany Ring Road. Unpublished report by Southern Ecology for Main Roads Western Australia (SE1810).
Map Projection: Transverse Mercator Horizontal Datum GDA 1994
Grid: MGA Zone 50 Map Size: A3 Scale 1:6,000


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Vegetation Association

- Jarrah/Marri/Sheoak Laterite Forest
- Jarrah/Sheoak/*E.staeri* Sandy Woodland
- Marri/Jarrah Forest/Peppermint Woodland
- *Homalospermum firmum/Callistemon glaucus* Peat Thicket
- *Evandra aristata* Sedgeland
- *Melaleuca preissiana* Low Woodland
- *Taxandria juniperina* Closed Forest
- Woody Weeds (Victorian Tea Tree, Taylorina, Sydney Wattle, Kangaroo Acacia or Bamboo with isolated native plants)
- Other Weeds (Watsonia, Bracken Fern or Blackberry with isolated native plants)
- Mature Planted Trees (Iron Barks, Blue Gum, Tuart, other Eucalypts and Peppermint generally > 10 years old)
- Cleared

Conservation Significant Flora

- *Boronia crassipes* (P3)
- *Synaphea incurva* (P3)
- *Andersonia* sp. Jamesii (J. Liddelow 84) (P4)
- *Thysanotus isantherus* (P4)
- *Prasophyllum paulinae* (P1) Habitat
- Survey Area

575200 575400 575600 575800 576000 576200 576400 576600

6125800 6125600 6125400 6125200 6125000 6124800 6124600 6124400 6124200

N

0 50 100 200
Metres

# Map 6A: Vegetation Type and Conservation Signficant Flora, Albany Ring Road.

Map produced by Damien Rathbone on 20/01/2020.
Report Reference: Rathbone, DA & Gilfillan, S (2020). Biological Survey: Albany Ring Road. Unpublished report by Southern Ecology for Main Roads Western Australia (SE1810).
Map Projection: Transverse Mercator Horizontal Datum GDA 1994
Grid: MGA Zone 50 Map Size: A3 Scale 1:6,000


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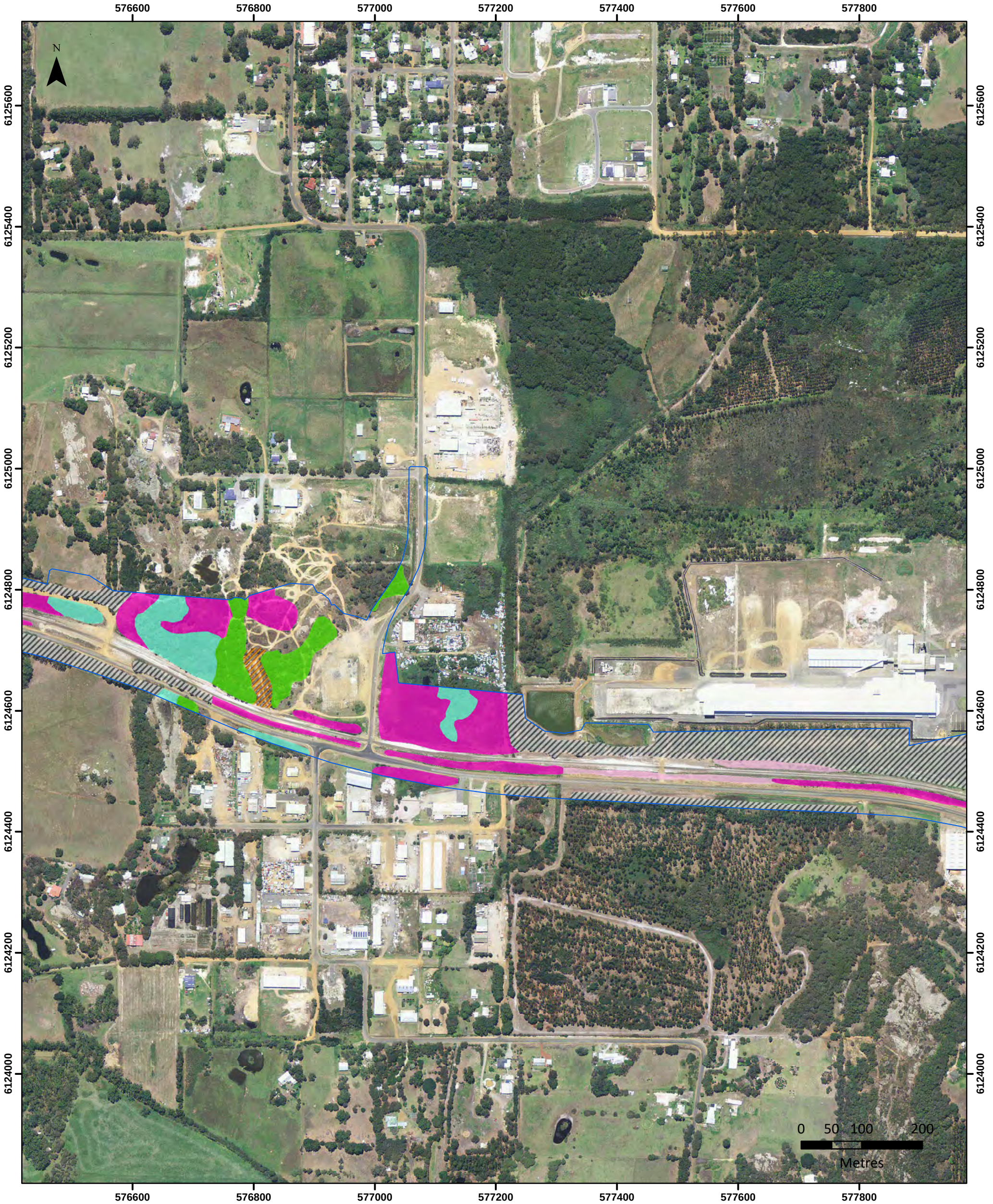
Vegetation Association

- *Homalospermum firmum/Callistemon glaucus* Peat Thicket
- *Taxandria juniperina* Closed Forest
- Woody Weeds (Victorian Tea Tree, Taylorina, Sydney Wattle, Kangaroo Acacia or Bamboo with isolated native plants)
- Mature Planted Trees (Iron Barks, Blue Gum, Tuart, other Eucalypts and Peppermint generally > 10 years old)
- Cleared

Conservation Significant Flora

- *Boronia crassipes* (P3)
- *Synaphea incurva* (P3)
- *Andersonia* sp. Jamesii (J. Liddelow 84) (P4)
- *Thysanotus isantherus* (P4)
- *Prasophyllum paulinae* (P1) Habitat
- Survey Area




# Map 7A: Vegetation Type and Conservation Signficant Flora, Albany Ring Road.

Map produced by Damien Rathbone on 20/01/2020.
Report Reference: Rathbone, DA & Gilfillan, S (2020). Biological Survey: Albany Ring Road. Unpublished report by Southern Ecology for Main Roads Western Australia (SE1810).
Map Projection: Transverse Mercator Horizontal Datum GDA 1994
Grid: MGA Zone 50 Map Size: A3 Scale 1:6,000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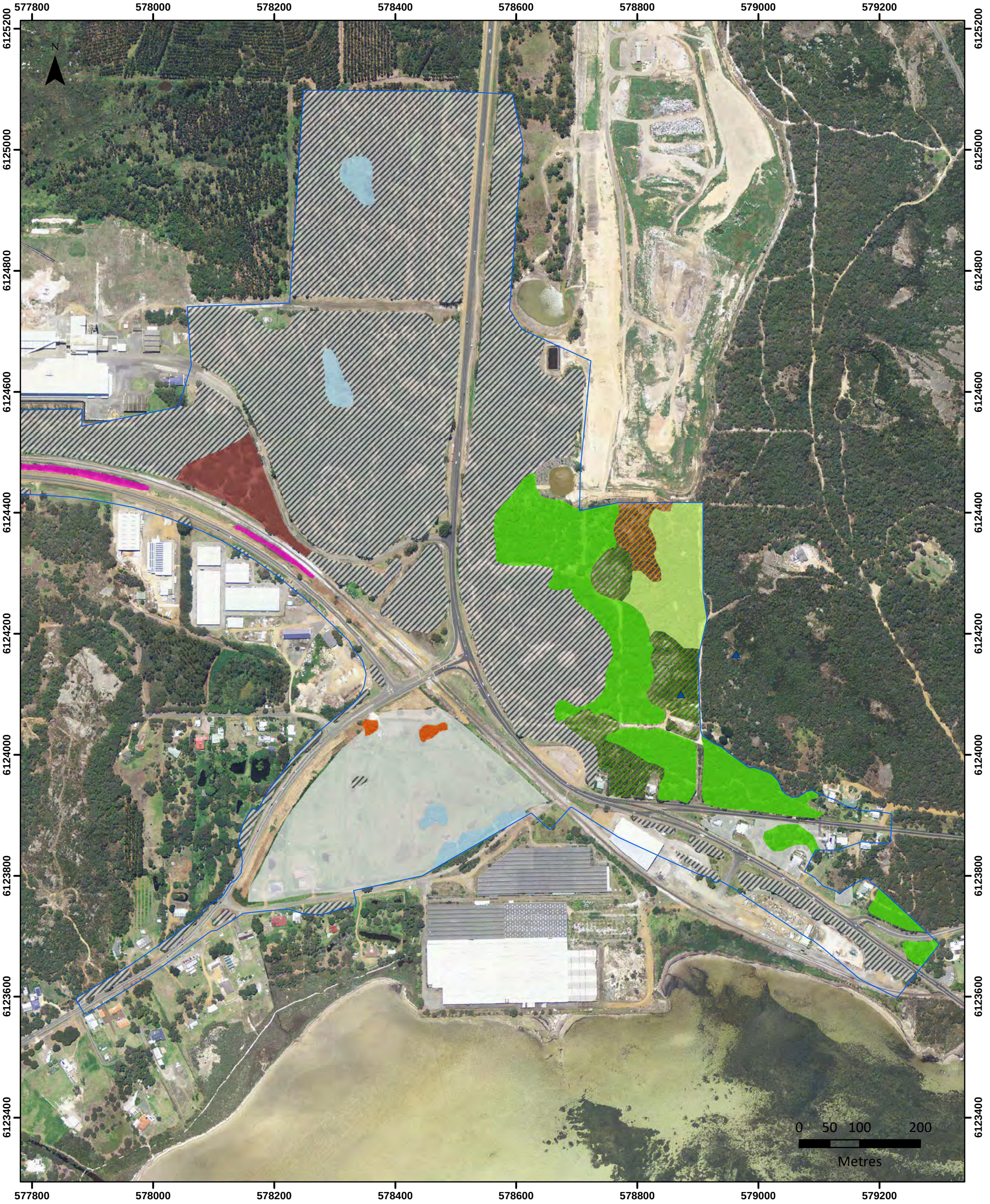
Vegetation Association

- Marri/Jarrah Forest/Peppermint Woodland
- *Taxandria juniperina* Closed Forest
- Mosaic *T. marginata/Leucopogon assimilis* Granite Shrubland; *Taxandria marginata* Granite Shrubland
- Woody Weeds (Victorian Tea Tree, Taylorina, Sydney Wattle, Kangaroo Acacia or Bamboo with isolated native plants)
- Other Weeds (Watsonia, Bracken Fern or Blackberry with isolated native plants)
- Mature Planted Trees (Iron Barks, Blue Gum, Tuart, other Eucalypts and Peppermint generally > 10 years old)
- Cleared

Conservation Significant Flora

- *Boronia crassipes* (P3)
- *Synaphea incurva* (P3)
- *Andersonia* sp. Jamesii (J. Liddelow 84) (P4)
- *Thysanotus isantherus* (P4)
- *Prasophyllum paulinae* (P1) Habitat
- Survey Area




# Map 8A: Vegetation Type and Conservation Signficant Flora, Albany Ring Road.

Map produced by Damien Rathbone on 20/01/2020.
Report Reference: Rathbone, DA & Gilfillan, S (2020). Biological Survey: Albany Ring Road. Unpublished report by Southern Ecology for Main Roads Western Australia (SE1810).
Map Projection: Transverse Mercator Horizontal Datum GDA 1994
Grid: MGA Zone 50 Map Size: A3 Scale 1:6,000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Vegetation Association

- Marri/Jarrah Forest/Peppermint Woodland
- Marri/Jarrah Coastal Hills Forest
- Yate Woodland
- Peppermint Low Forest
- *Melaleuca preissiana* Low Woodland
- Mosaic *T. marginata/Gastrolobium bilobum* Granite Shrubland/Yate Woodland
- Mosaic *T. marginata/Leucopogon assimilis* Granite Shrubland; *Taxandria marginata* Granite Shrubland
- Woody Weeds (Victorian Tea Tree, Taylorina, Sydney Wattle, Kangaroo Acacia or Bamboo with isolated native plants)
- Other Weeds (Watsonia, Bracken Fern or Blackberry with isolated native plants)
- Mature Planted Trees (Iron Barks, Blue Gum, Tuart, other Eucalypts and Peppermint generally > 10 years old)
- Isolated Plants (Pasture and herbaceous weeds with isolated native plants)
- Cleared

Conservation Significant Flora

- *Boronia crassipes* (P3)
- *Synaphea incurva* (P3)
- *Andersonia* sp. Jamesii (J. Liddelow 84) (P4)
- *Thysanotus isantherus* (P4)
- *Prasophyllum paulinae* (P1) Habitat
- Survey Area

574800 575000 575200 575400 575600 575800 576000 576200

6131400 6131200 6131000 6130800 6130600 6130400 6130200 6130000 6129800

N

0 50 100 200
Metres

## Map 1B: Vegetation Condition and Weeds, Albany Ring Road.

Map produced by Damien Rathbone on 20/01/2020.
Report Reference: Rathbone, DA & Gilfillan, S (2020). Biological Survey: Albany Ring Road. Unpublished report by Southern Ecology for Main Roads Western Australia (SE1810).
Map Projection: Transverse Mercator Horizontal Datum GDA 1994
Grid: MGA Zone 50  Map Size: A3 Scale 1:6,000


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Vegetation Condition
- Excellent
- Very Good
- Good
- Degraded
- Completely Degarded

Weeds
- *Asparagus asparagoides*
- *Lantana camara*
- *Rubus fruticosus aggregate*
- *Ulex europaeus*
- *Zantedeschia aethiopica*

Survey Area

573600 573800 574000 574200 574400 574600 574800 575000

6131000 6130800 6130600 6130400 6130200 6130000 6129800 6129600 6129400

N

0 50 100 200
Metres

## Map 2B: Vegetation Condition and Weeds, Albany Ring Road.

Map produced by Damien Rathbone on 20/01/2020.
Report Reference: Rathbone, DA & Gilfillan, S (2020). Biological Survey: Albany Ring Road. Unpublished report by Southern Ecology for Main Roads Western Australia (SE1810).
Map Projection: Transverse Mercator Horizontal Datum GDA 1994
Grid: MGA Zone 50  Map Size: A3 Scale 1:6,000


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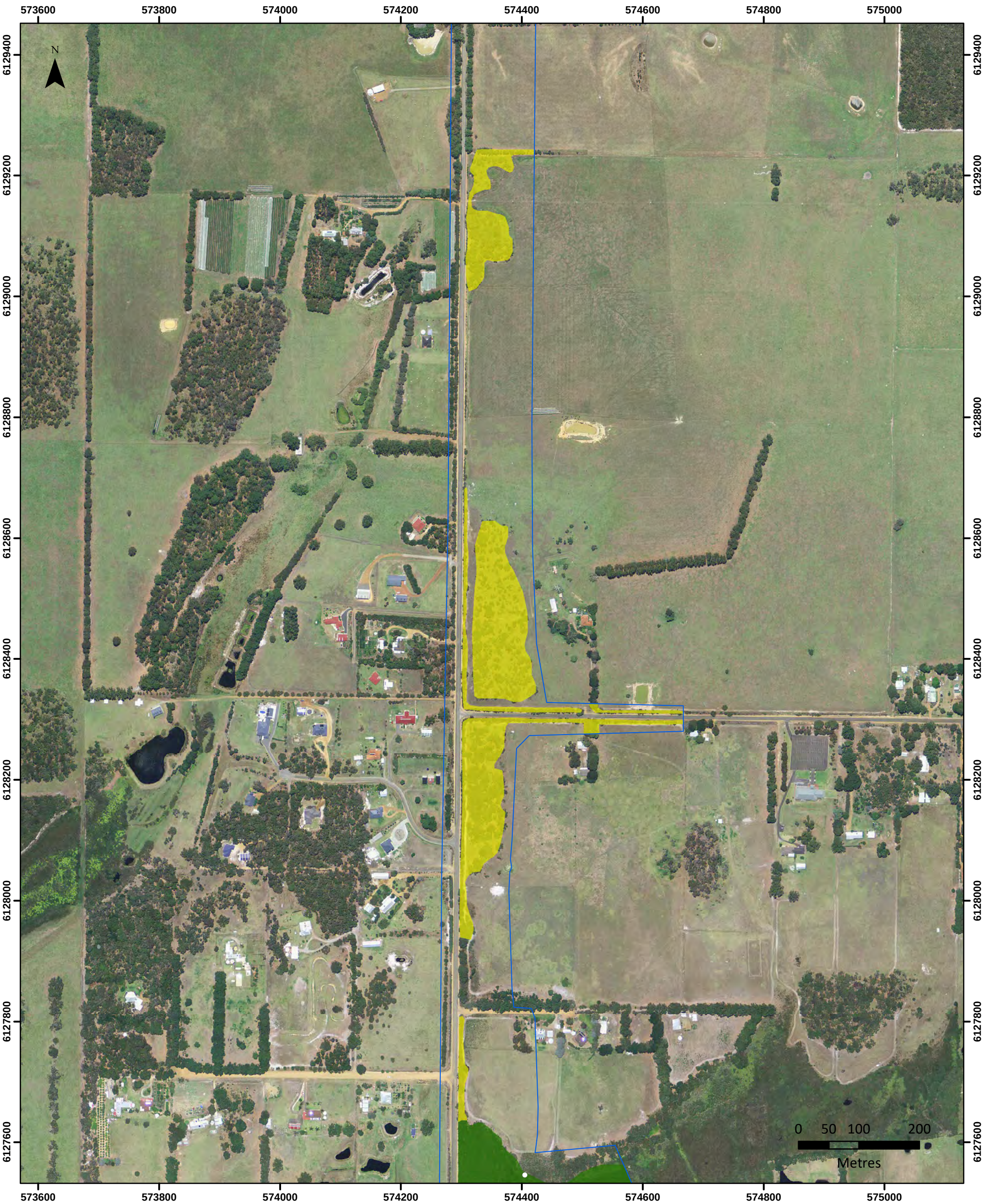
**M: 0408 802 404**


Vegetation Condition
- Excellent
- Very Good
- Good
- Degraded
- Completely Degarded

Weeds
- *Asparagus asparagoides*
- *Lantana camara*
- *Rubus fruticosus aggregate*
- *Ulex europaeus*
- *Zantedeschia aethiopica*

Survey Area

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- *Lantana camara*
- *Rubus fruticosus aggregate*
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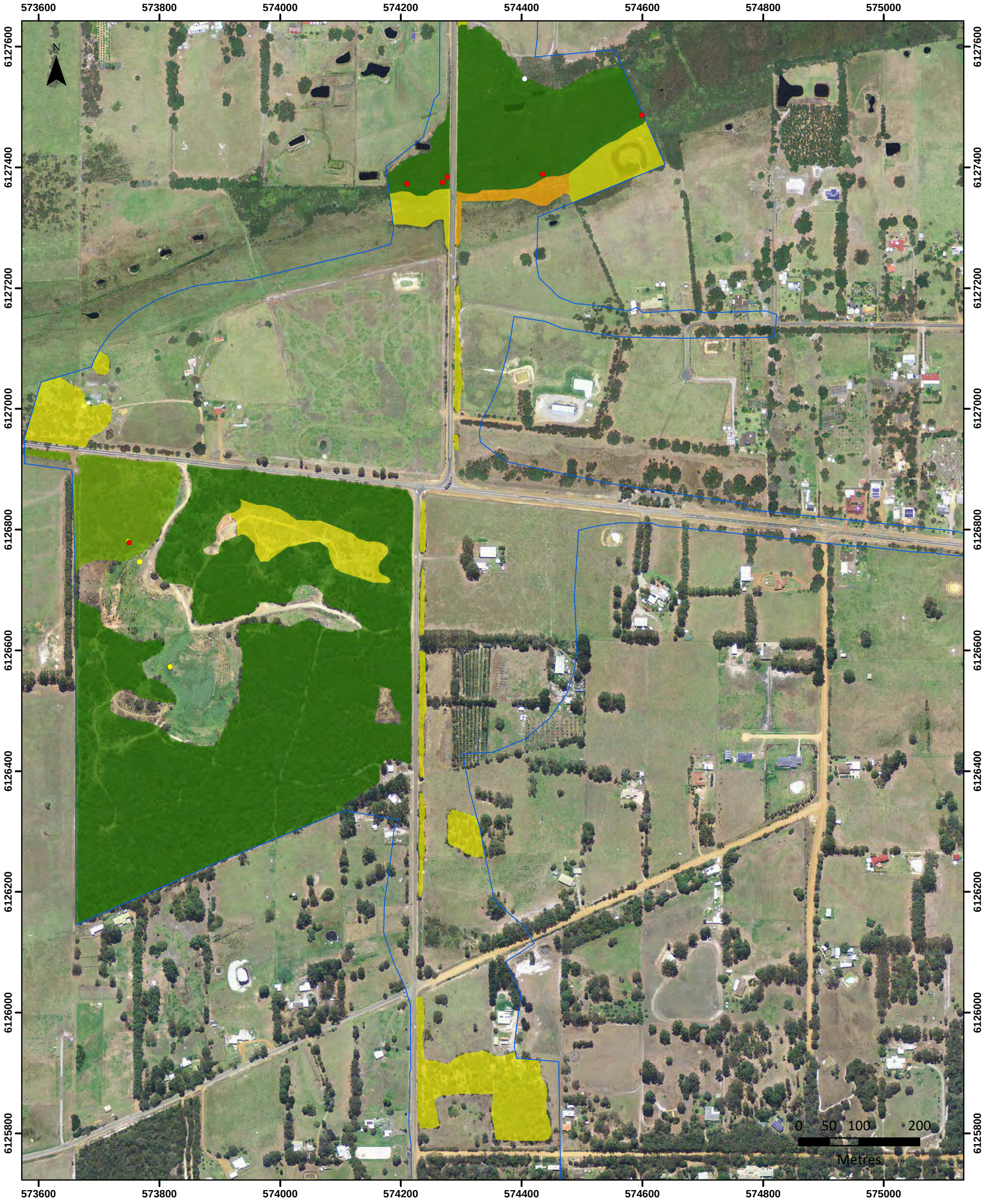
Survey Area




## Map 4B: Vegetation Condition and Weeds, Albany Ring Road.

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- *Lantana camara*
- *Rubus fruticosus aggregate*
- *Ulex europaeus*
- *Zantedeschia aethiopica*

Survey Area


## Map 5B: Vegetation Condition and Weeds, Albany Ring Road.

Vegetation Condition
- Excellent
- Very Good
- Good
- Degraded
- Completely Degarded

Weeds
- *Asparagus asparagoides*
- *Lantana camara*
- *Rubus fruticosus aggregate*
- *Ulex europaeus*
- *Zantedeschia aethiopica*
- Survey Area

Map produced by Damien Rathbone on 20/01/2020.
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575200 575400 575600 575800 576000 576200 576400 576600

6125800 6125600 6125400 6125200 6125000 6124800 6124600 6124400 6124200

N

0 50 100 200
Metres

## Map 6B: Vegetation Condition and Weeds, Albany Ring Road.

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Weeds
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- *Ulex europaeus*
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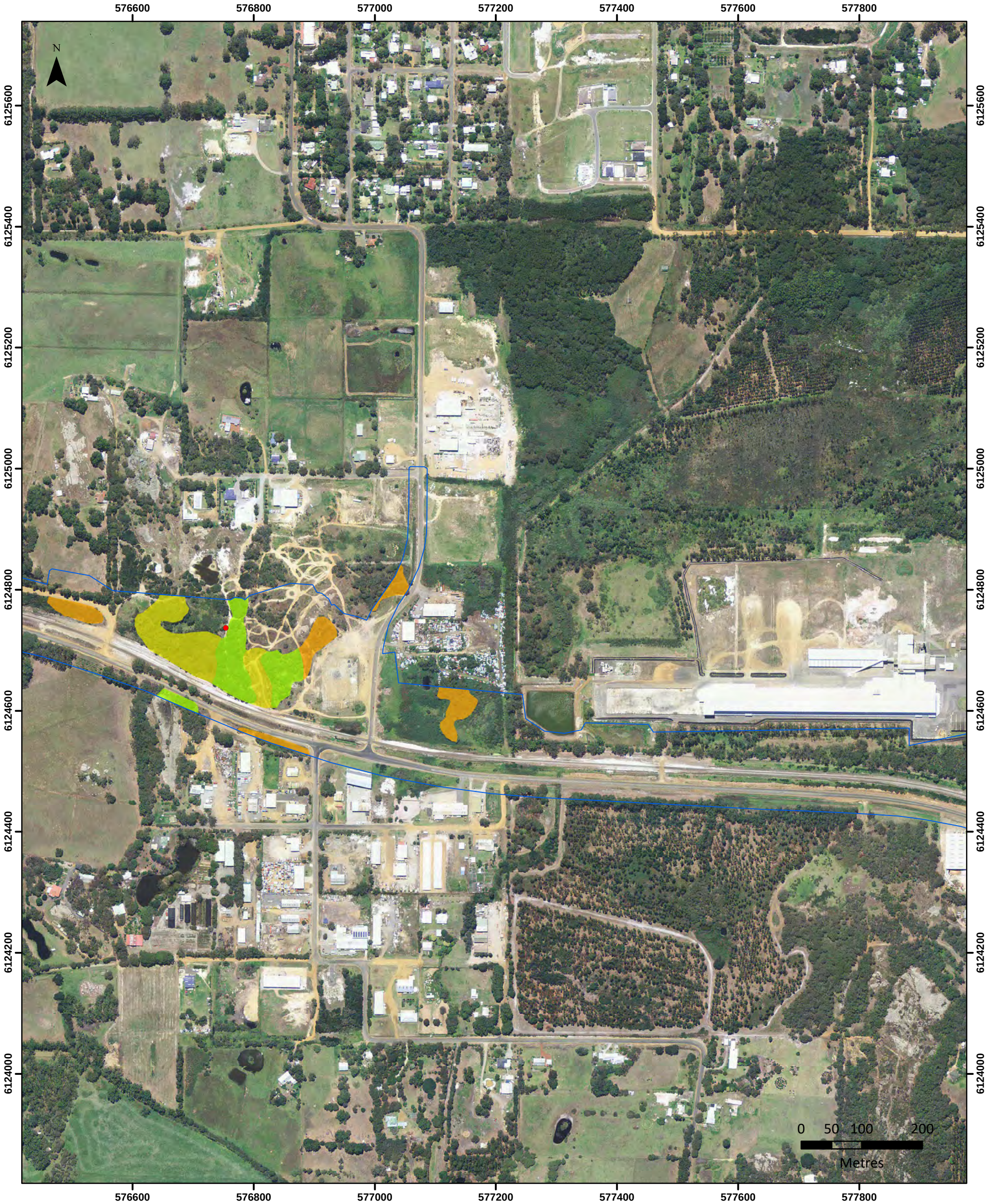
Survey Area




## Map 7B: Vegetation Condition and Weeds, Albany Ring Road.

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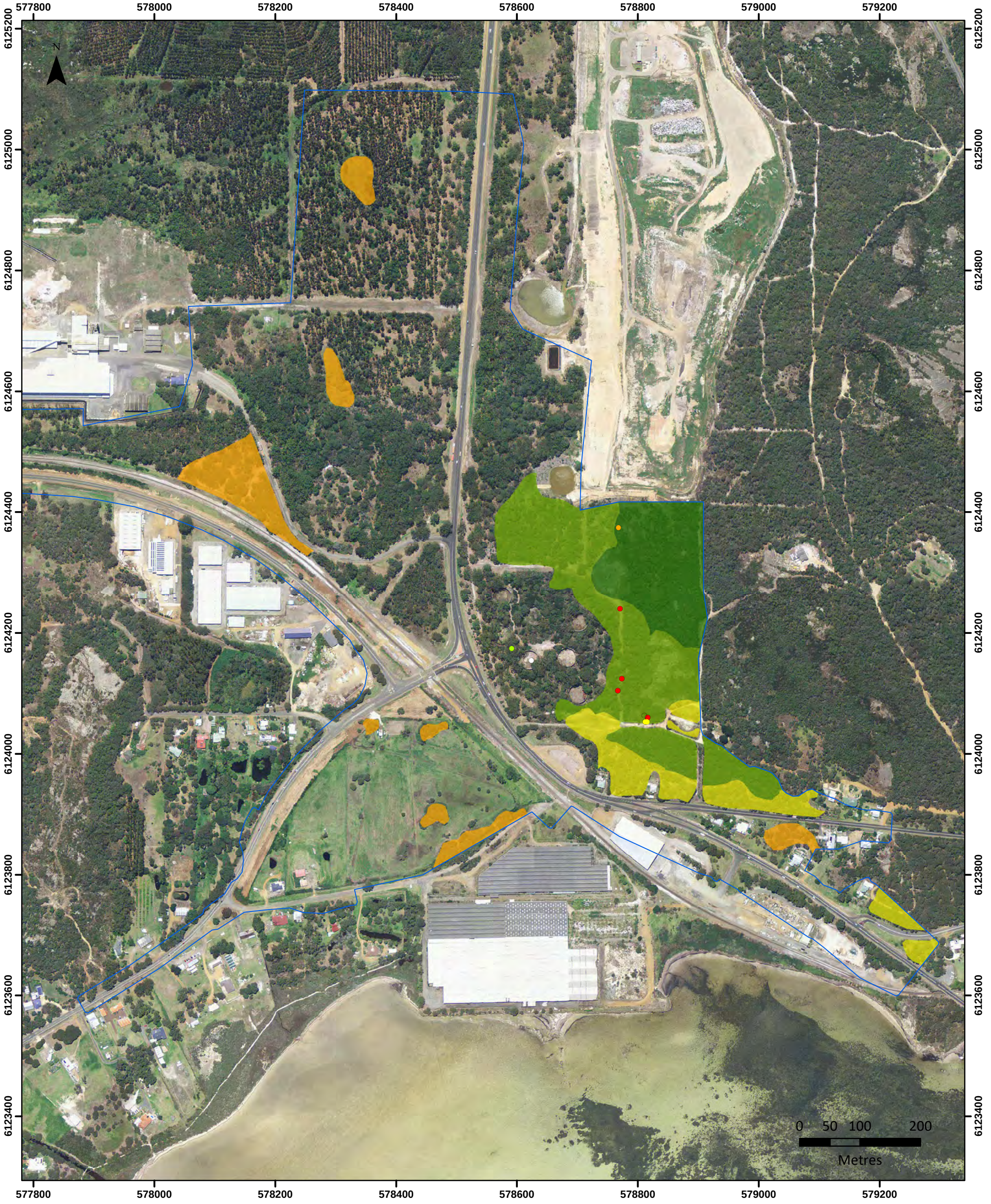
- *Ulex europaeus*
- *Zantedeschia aethiopica*

Survey Area




# Map 8B: Vegetation Condition and Weeds, Albany Ring Road.

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- *Zantedeschia aethiopica*

Survey Area


# Map 1C: Cockatoo Habitat and Potential Breeding Trees, Albany Ring Road.

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Map Projection: Transverse Mercator Horizontal Datum GDA 1994
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**Black Cockatoo Species Habitat**

- High quality breeding, roosting and feeding habitat
- Low quality breeding, roosting and feeding habitat
- High quality roosting habitat
- Low quality roosting habitat
- Low quality breeding habitat
- Low quality feeding habitat

**Significant Fauna Habitat Trees**

- *Eucalyptus marginata*
- *Eucalyptus staeri*
- *Eucalyptus gomphocephala*
- *Corymbia calophylla*
- Dead Eucalyptus/Corymbia sp.
- *Pinus radiata*

**Cockatoo Observations**

- Baudin's Cockatoo (T) feeding evidence
- Carnaby's Cockatoo (T) feeding evidence
- Red-tailed Black Cockatoo (T) feeding evidence
- Survey Area


# Map 2C: Cockatoo Habitat and Potential Breeding Trees, Albany Ring Road.

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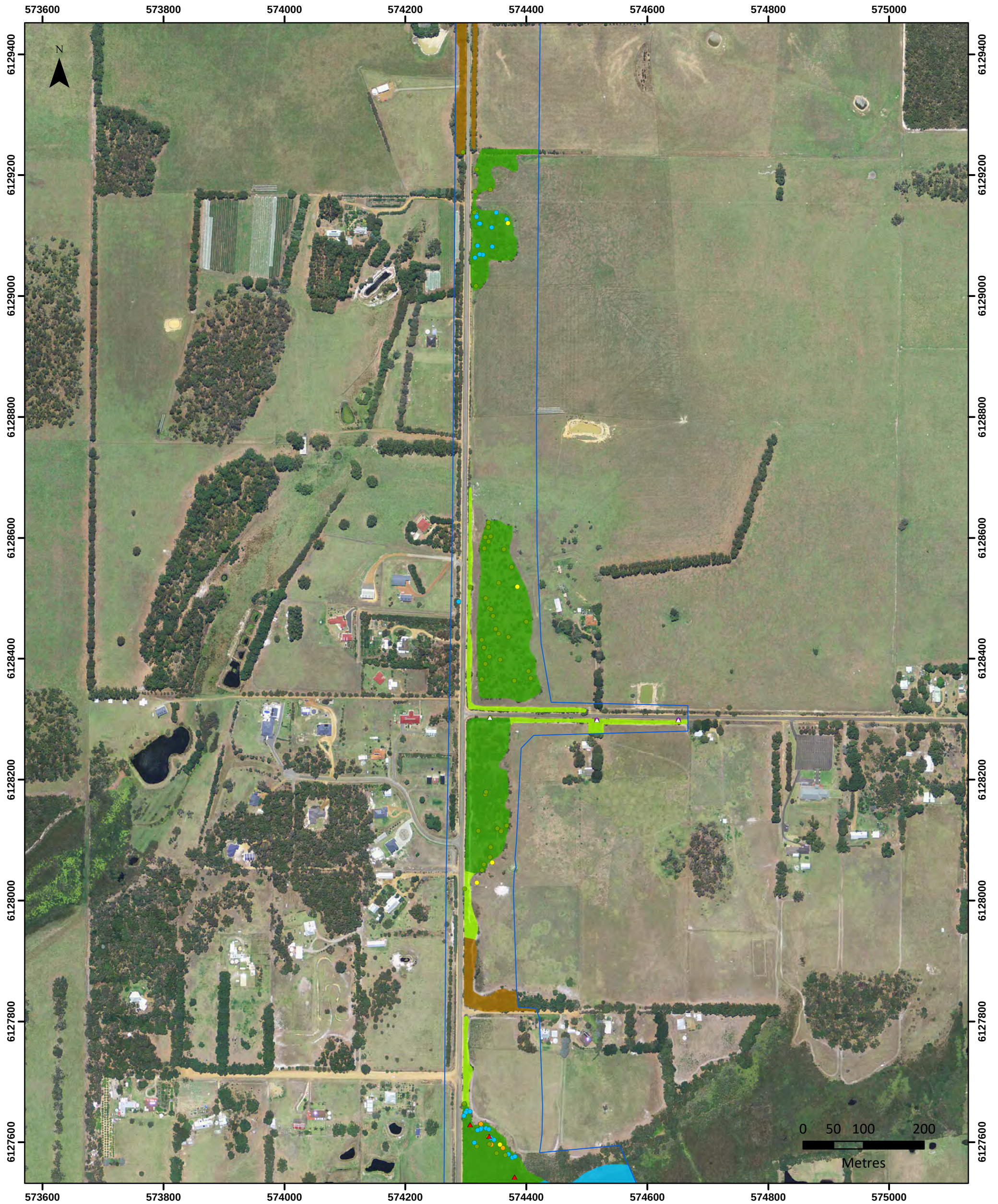
- *Corymbia calophylla*
- Dead Eucalyptus/Corymbia sp.
- *Pinus radiata*

**Cockatoo Observations**

- Baudin's Cockatoo (T) feeding evidence
- Carnaby's Cockatoo (T) feeding evidence
- Red-tailed Black Cockatoo (T) feeding evidence
- Survey Area




## Map 3C: Cockatoo Habitat and Potential Breeding Trees, Albany Ring Road.

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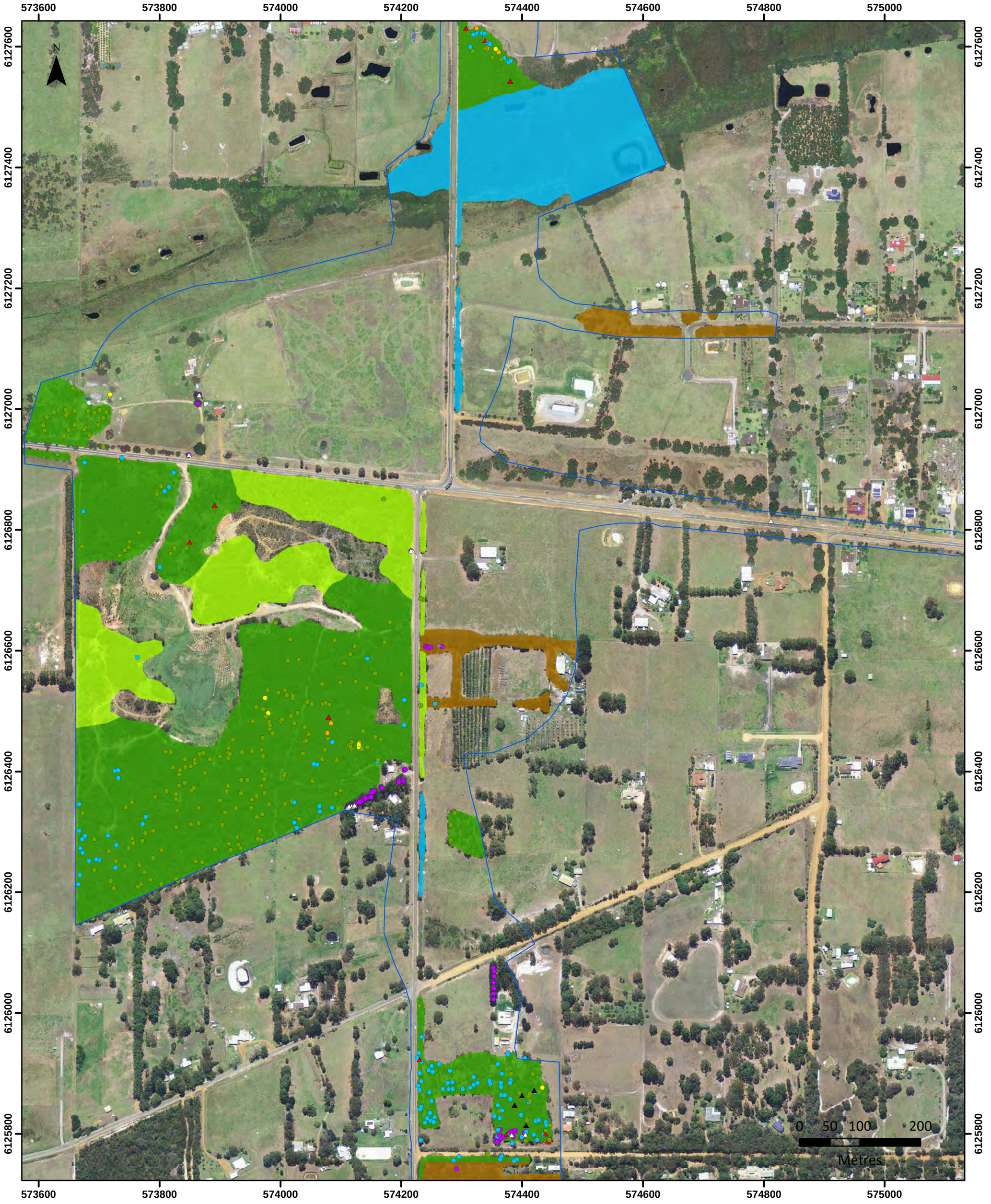
- Survey Area




## Map 4C: Cockatoo Habitat and Potential Breeding Trees, Albany Ring Road.

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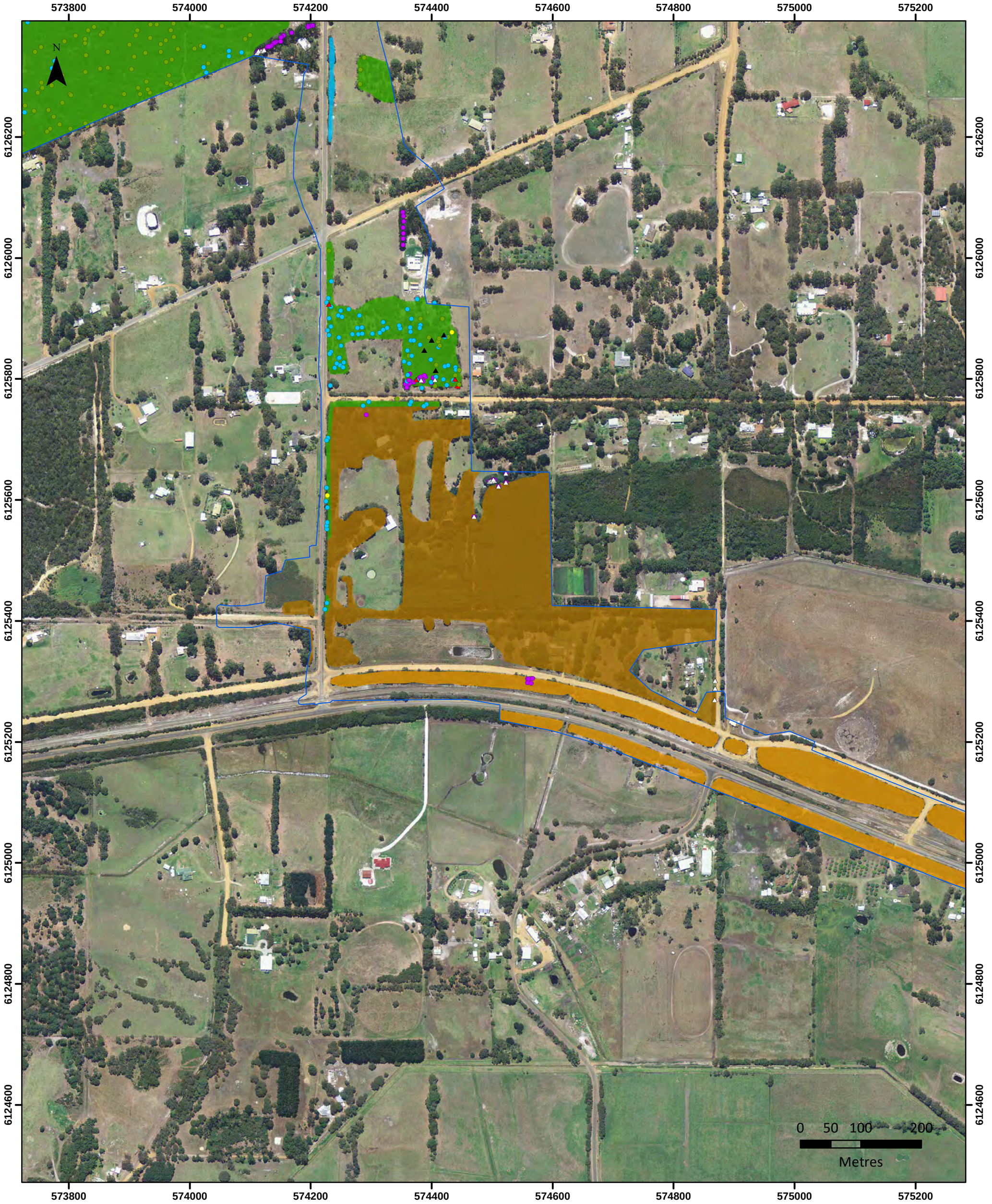


# Map 5C: Cockatoo Habitat and Potential Breeding Trees, Albany Ring Road.

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Cockatoo Observations

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- Survey Area

575200 575400 575600 575800 576000 576200 576400 576600

6125800 6125600 6125400 6125200 6125000 6124800 6124600 6124400 6124200

N

0 50 100 200
Metres

# Map 6C: Cockatoo Habitat and Potential Breeding Trees, Albany Ring Road.

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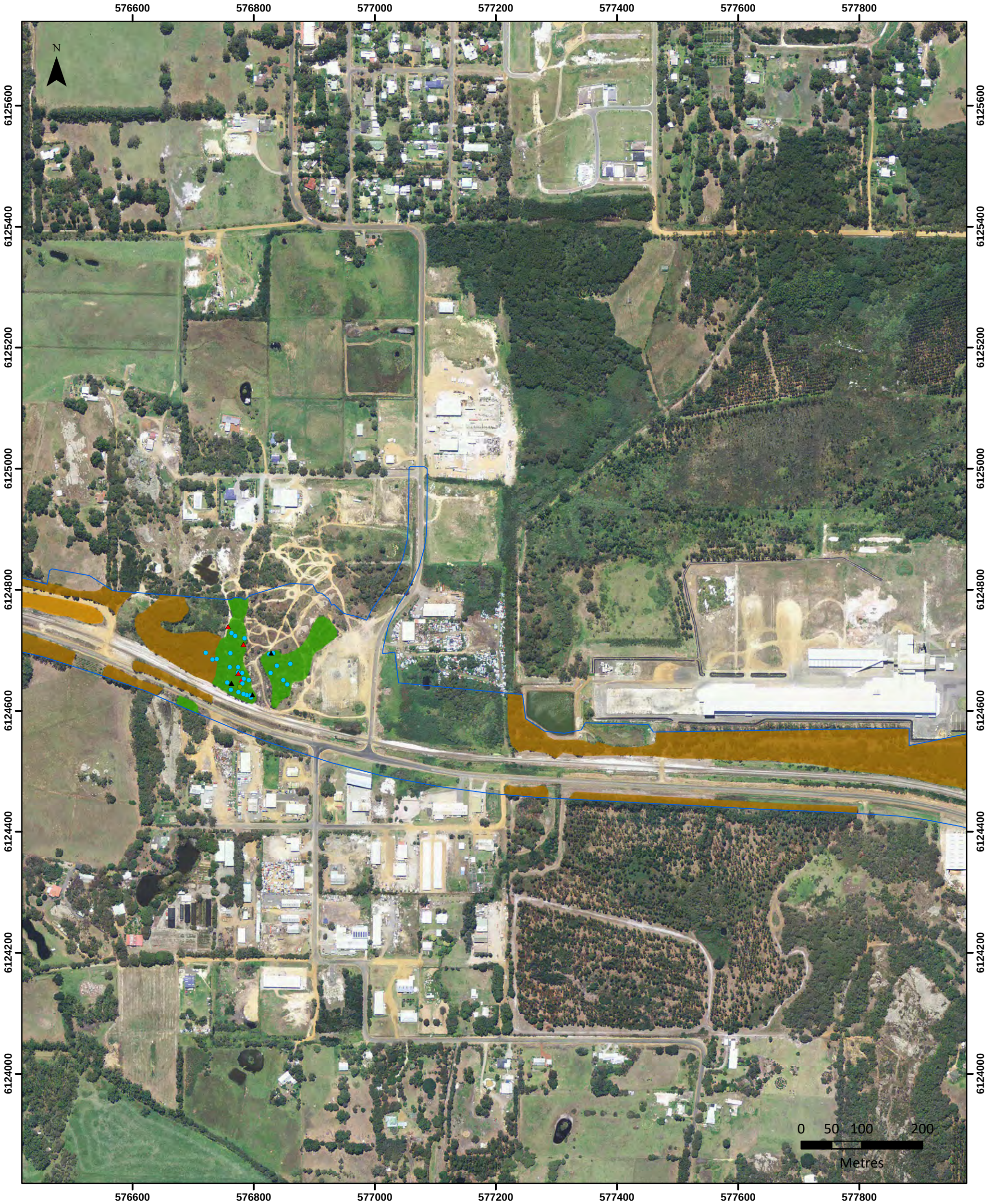


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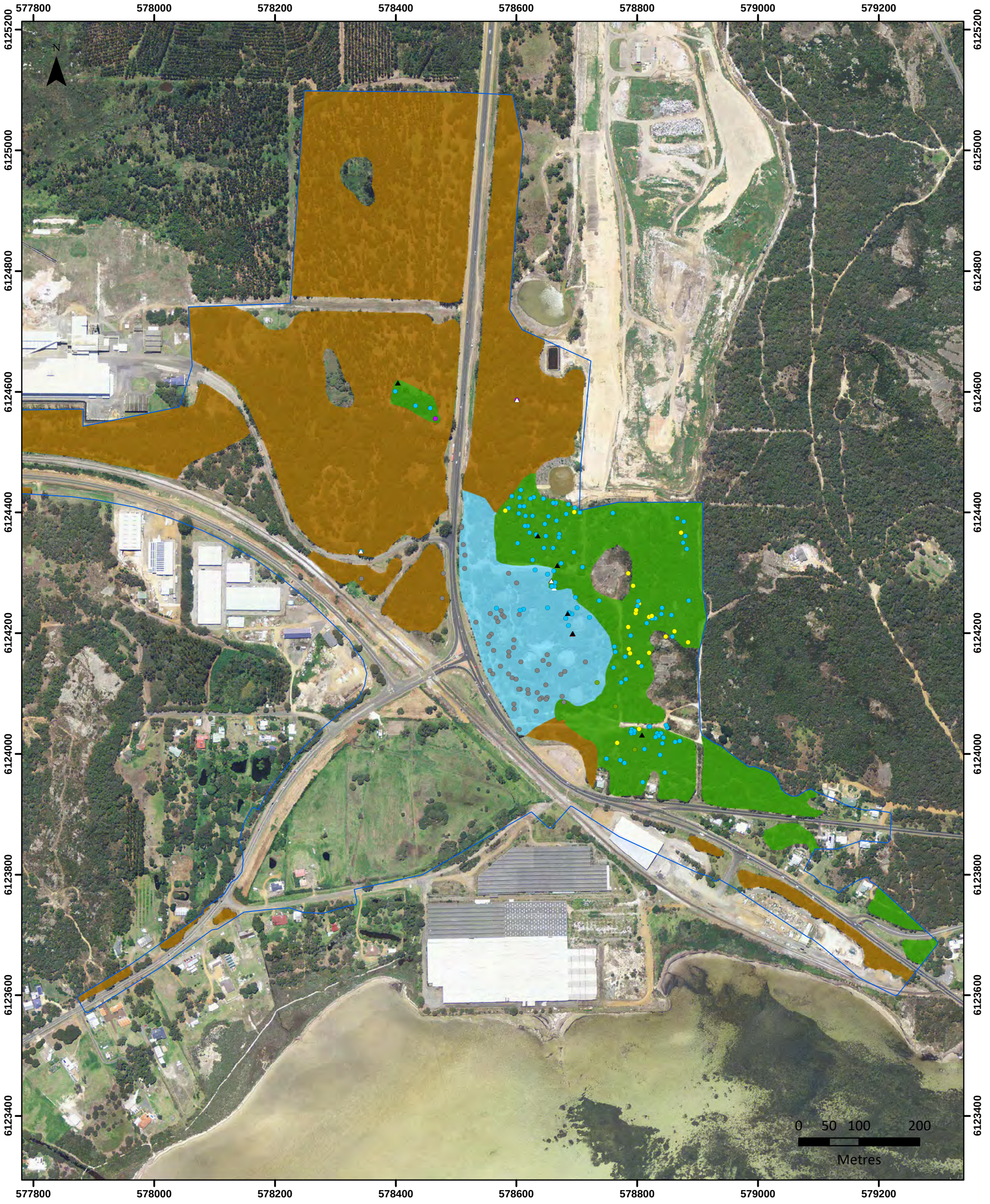


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- Survey Area

574800 575000 575200 575400 575600 575800 576000 576200

6131400 6131200 6131000 6130800 6130600 6130400 6130200 6130000 6129800

N

0 50 100 200

Metres

## Map 1D: Western Ringtail Possum Habitat and Fauna Observations, Albany Ring Road.

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Western Ringtail Possum Habitat
- Core
- Core (Urban)
- Supporting

Western Ringtail Possum Habitat Linkages
- Linkage
- Linkage likely
- Linkage possible

Fauna Observations
- Western Ringtail Possum Scats
- Western Ringtail Possum Drey
- Quenda Evidence
- Potential Brush-tail Phascogale Occupied Hollow
- Survey Area

573600 573800 574000 574200 574400 574600 574800 575000

6131000 6130800 6130600 6130400 6130200 6130000 6129800 6129600 6129400

N

0 50 100 200
Metres

## Map 2D: Western Ringtail Possum Habitat and Fauna Observations, Albany Ring Road.

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- Supporting

Western Ringtail Possum Habitat Linkages
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Fauna Observations
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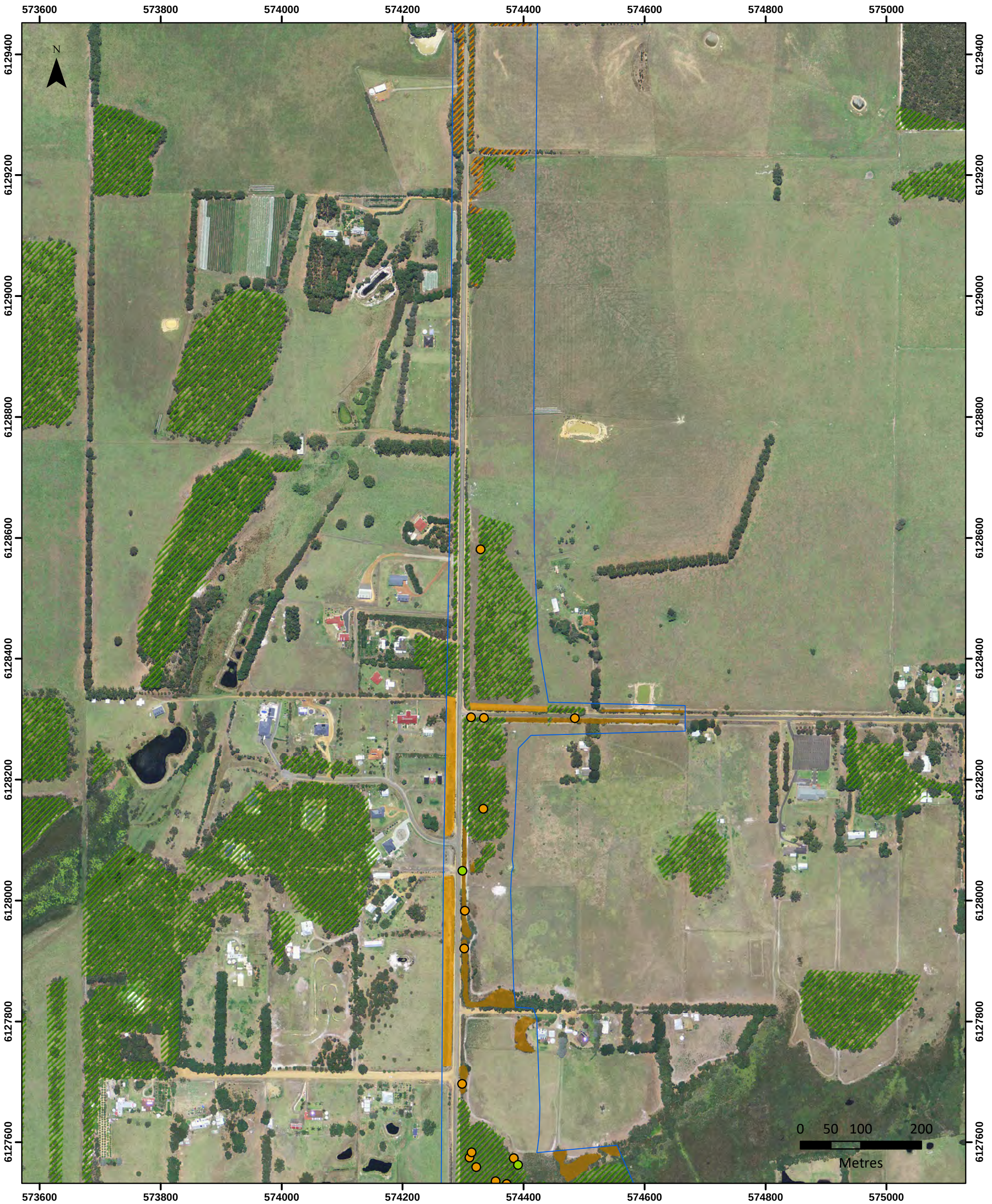
- Survey Area




## Map 3D: Western Ringtail Possum Habitat and Fauna Observations, Albany Ring Road.

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Western Ringtail Possum Habitat
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- Supporting

Western Ringtail Possum Habitat Linkages
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Fauna Observations
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- Quenda Evidence
- Potential Brush-tail Phascogale Occupied Hollow
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## Map 4D: Western Ringtail Possum Habitat and Fauna Observations, Albany Ring Road.

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## Map 5D: Western Ringtail Possum Habitat and Fauna Observations, Albany Ring Road.

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Western Ringtail Possum Habitat
- Core
- Core (Urban)
- Supporting

Western Ringtail Possum Habitat Linkages
- Linkage
- Linkage likely
- Linkage possible

Fauna Observations
- Western Ringtail Possum Scats
- Western Ringtail Possum Drey
- Quenda Evidence
- Potential Brush-tail Phascogale Occupied Hollow
- Survey Area

575200 575400 575600 575800 576000 576200 576400 576600

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0 50 100 200
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# Map 6D: Western Ringtail Possum Habitat and Fauna Observations, Albany Ring Road.

Map produced by Damien Rathbone on 20/01/2020.
Report Reference: Rathbone, DA & Gilfillan, S (2020). Biological Survey: Albany Ring Road. Unpublished report by Southern Ecology for Main Roads Western Australia (SE1810).
Map Projection: Transverse Mercator Horizontal Datum GDA 1994
Grid: MGA Zone 50 Map Size: A3 Scale 1:6,000


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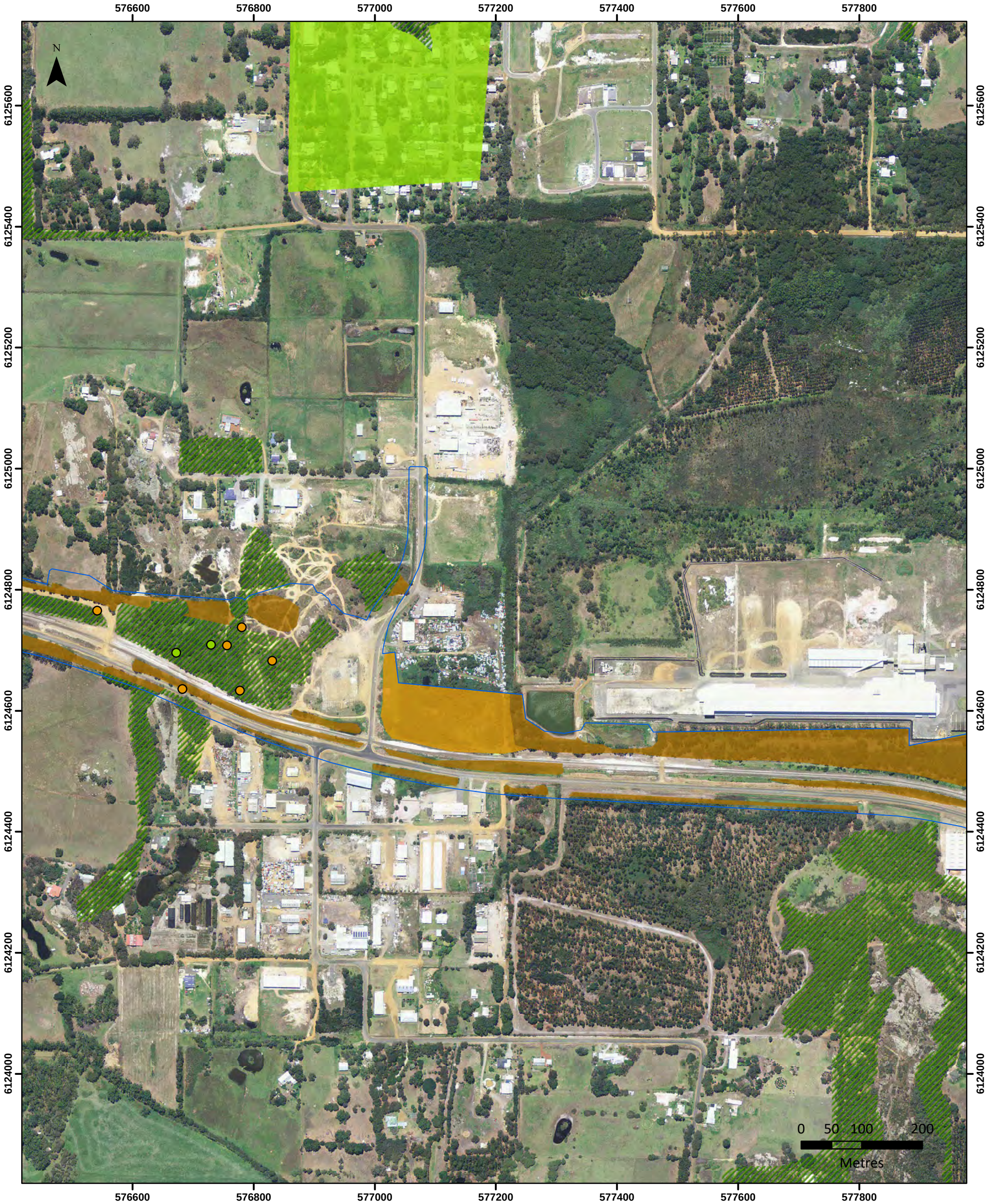


## Map 7D: Western Ringtail Possum Habitat and Fauna Observations, Albany Ring Road.

Map produced by Damien Rathbone on 20/01/2020.
Report Reference: Rathbone, DA & Gilfillan, S (2020). Biological Survey: Albany Ring Road. Unpublished report by Southern Ecology for Main Roads Western Australia (SE1810).
Map Projection: Transverse Mercator Horizontal Datum GDA 1994
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