

**NATIVE VEGETATION CLEARING PERMIT  
APPLICATION**

**SUPPORTING DOCUMENT**

**CBH BALLIDU RAIL OUT-LOADING PROJECT  
CO-OPERATIVE BULK HANDLING LTD**

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Native Vegetation Clearing Permit Application Supporting Document  
CBH Ballidu Rail Out-loading Project

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## EXECUTIVE SUMMARY

Co-operative Bulk Handling Limited (CBH), an agricultural co-operative based in Western Australia (WA), is making changes to adapt to the ongoing growth of crops received in WA each year. With a projected average yearly intake of 22 million tonnes (Mt) by 2033, there is a need to construct additional grain storage capacity and efficient facilities to accommodate the expected intake. In anticipation of increased yields, CBH is currently evaluating its network; implementing safety and risk mitigation upgrades at various sites.

To achieve CBH's strategic objectives of exporting 70 % of a 22 Mt crop in the first half of the year and 3 Mt of peak export capacity by 2033 will require significant investment in out-loading infrastructure. CBH Ballidu is a key Network Site in the Kwinana North Zone that has been prioritised for rail out-loading investment through the Agricultural Supply Chain Initiative (ASCI), Network Plan and the 2026 financial year (FY) budget.

The Pre-Feasibility Study phase and Early Works Feasibility Study were completed and in April 2023, the preferred option for the Rail siding and out-loading facility was approved by key project stakeholders. The endorsed option includes two times approximately 1,750 Wheat Tonne Equivalent (WTE) over rail bins (ORBs) and an approximately 616 m siding, which will accommodate loading of a 52-wagon train in approximately four hours.

Key benefits of the project are:

- Supply chain benefits and grower value in line with our strategic objectives including:
  - Additional peak export capacity of approximately 20,000-25,000 tonnes (t) per month driven by a significant increase in rail out-loading capability at Ballidu which will facilitate loading/shunting of a 52-wagon train in approximately four hours representing an approximately seven-hour reduction in site dwell time from the current state.
  - Incremental export revenue associated with shifting approximately 4,500-5,000 t per month (approximately 27,000 t in one-hour).
- Operational efficiencies: will reduce site staffing and road resource requirements (currently compensating inefficient rail) and improve the sustainability of rail out-loading operations on site. This will reduce road transport, which is expected to be the largest operational financial benefit.
- Community/safety benefits: As a result of a reduction in road out-loading requirements, taking trucks off the road, improving safety and providing environmental benefits associated with less emission intensive rail movements.

To enable the project to proceed, CBH proposes to clear **2.20 hectares (ha)** of native vegetation at the CBH Ballidu facility within the Disturbance Footprint (DF) comprising **0.62 ha** Very Good, **1.55 ha** Good and **0.03 ha** Degraded condition native vegetation. The proposed Development Envelope (DE) includes both the DF and proposed Revegetation Area.

To assist in understanding the potential impact of the project upon the existing environment, CBH commissioned AECOM Australia Pty Ltd (AECOM) to undertake a Spring reconnaissance flora and vegetation assessment. The **174.34 ha** survey area included the proposed DE and comprised **136.53 ha** of cleared areas and **37.81 ha** of native vegetation restricted to road and rail reserves. The Spring flora and vegetation and targeted Threatened/Priority Ecological Community (TEC/PEC) survey was conducted in November 2022.

Key findings from within the flora and vegetation survey area included:

- The survey area does not intersect with any land managed by Department of Biodiversity, Conservation and Attractions (DBCA) pursuant to the *Conservation and Land Management Act 1984*<sup>1</sup> (CALM Act). The nearest reserve is 9 km from the survey area.
- Native vegetation represents pre-European Vegetation Association 1024 which has been extensively cleared, with only 13.25 % remaining in WA, and 5.91 ha remaining in the Shire of Wongan-Ballidu.
- No significant landforms were identified with the area comprising flat terrain with clay, clay loam, and sandy soils.
- The desktop assessment identified three Threatened Ecological Communities (TEC) were likely to occur. None of these intersect with the survey area or the proposed DE.
- Six native vegetation communities were mapped comprising three Shrublands, two Mallee Woodlands and one Heathland. *Allocasuarina campestris* shrubland McGdWa was the most dominant representing 21.26 ha (56 % of native vegetation). This vegetation is typical of pre-European Association 1024 and is the only vegetation community found within the proposed DF (2.20 ha).
- Native vegetation comprised 22 % of the total survey area extent. Of this, the majority was considered Very Good (13.38 ha, 35 %) and Good (11.74 ha, 31 %). Degradation was caused by historical earthworks, partial clearing, and edge effects.
- Six significant flora species were recorded within the survey area:
  - *Acacia lirellata* subsp. *compressa* (DBCA Priority 2) 10 individuals.
  - *Acacia scalena* (DBCA Priority 3) 36 individuals.
  - *Dampiera glaberrima* (DBCA Priority 1) 190 individuals.
  - *Grevillea dryandroides* subsp. *dryandroides* (EPBC Act Endangered, BC Act Critically Endangered) 1 individual.
  - *Grevillea rosieri* (DBCA Priority 2) no population information available. Represents significant range extension.
  - *Verticordia venusta* (DBCA Priority 3) two individuals. The survey was successful with no significant limitations identified that may influence the results of the surveyOf these species, three individuals of *Acacia lirellata* subsp. *compressa* (DBCA Priority 2) occur within the proposed DE, outside of the DF.

Bamford Consulting Ecologists (BCE) was commissioned by CBH to conduct a Basic (Environmental Protection Authority 2020<sup>2</sup>) fauna assessment (desktop review, fauna habitat identification and a 122 ha survey area site inspection), including targeted black-cockatoo and trapdoor spider assessments, of the survey area at Ballidu.

Key findings from within the fauna survey area included:

- Vegetation Substrate Associations (VSA): the majority of the survey area consists of paddocks (VSA 1; weedy grasses and oats, with a ground cover of shrubs and herbs over red loam). Approximately 6.99 ha of VSA 2 (Complex Shrubland) is found within the proposed DE and 1.78 ha within the proposed DF.
- Fauna assemblage: the assemblage of vertebrate fauna is typical of degraded and fragmented vegetation in the Wheatbelt region, characterised by species loss, a higher proportion of species

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<sup>1</sup> Government of Western Australia 2024 (current), *Conservation and Land Management Act 1984*. Online resource: [WALW - Conservation and Land Management Act 1984 - Home Page \(legislation.wa.gov.au\)](https://www.legislation.wa.gov.au/legislation/homePage.nsf/0/00000000-0000-0000-0000-000000000000?open)

<sup>2</sup> **Environmental Protection Authority 2020**, Terrestrial vertebrate fauna surveys for environmental impact assessment. Online resource: [2020.09.17 - EPA Technical Guidance - Vertebrate Fauna Surveys - Final.pdf](https://www.epa.wa.gov.au/publications/2020-09-17-EPA-Technical-Guidance-Vertebrate-Fauna-Surveys-Final.pdf)

expected only irregularly, and uncertainty as to the status of many species (likely to be irregular visitors or absent).

- Species of conservation significance: the majority of species that are still present are considered to be of local conservation significance (CS3) because of the extensive clearing and degraded nature of remnant vegetation.
- Trapdoor spider assessment: Two conservation significant trapdoor spiders were confirmed within the survey area: Shield-backed Trapdoor Spider (CS1) and Tree-stem Trapdoor Spider (CS2). Suitable habitat for trapdoor spiders was present within the survey area in the Complex Shrubland of VSA 2; two Shield-backed Trapdoor Spiders and one Tree-stem Trapdoor Spider burrow were found in this habitat during the first targeted survey in October 2023. Two Shield-backed Trapdoor Spider burrows were recorded within surrounding bushland in the February 2024 survey. There is one burrow within the proposed DE, outside of the DF.
- Black cockatoo assessment: Three confirmed breeding sites have been identified within 40 km of the survey area with the closest known record of breeding for Carnaby's Black-cockatoo being approximately 18 km to the south-west. Carnaby's Black-cockatoo was not recorded during the site inspection and there was no evidence of foraging by this species. The survey area is within the range of the species, and it is expected as a regular visitor to the survey area. Key findings of the black cockatoo assessment were:
  - Foraging value: Overall, the foraging value of the survey area is moderate to low. VSA 2 (Complex Shrubland), which is found within the proposed DE, provides the highest foraging value at 4/10.
  - Breeding value: 23 trees within the survey area were assessed as potential nest-trees for black-cockatoos; one was assigned a rank of 3 and one was assigned a rank of 4, with the remainder given a rank of 5. None of the potential nest-trees are located within the proposed DE.
  - Roosting value: There are no known roosting sites within 40 km of the Ballidu site, with the closest known roosting site approximately 74 km to the south-west.

The survey results outlined above, are presented in more detail in this supporting document. An assessment of the proposal to clear **2.20 ha** from within the **15.33 ha** proposed DE against the 10 Clearing Principles indicates that Principle **(b)** may be at variance and Principles **(a)** and **(e)** are at variance.

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## ACRONYMS AND ABBREVIATIONS

<b>BAM Act</b>	Western Australian <i>Biosecurity and Agriculture Management Act 2007</i>
<b>BC Act</b>	Western Australian <i>Biodiversity Conservation Act 2016</i>
<b>BoM</b>	Bureau of Meteorology
<b>C1, C2, C3</b>	Declared Pest categories under the BAM Act
<b>CS1, CS2, CS3</b>	Fauna species listed under State or Commonwealth Acts or species not listed under Acts or in publications but considered of at least local significance because of their pattern of distribution
<b>CALM Act</b>	Western Australian <i>Conservation and Land Management Act 1984</i>
<b>CAGR</b>	Compounding Average Growth Rate
<b>CD</b>	Conservation Dependent (fauna; specially protected species under the Western Australian BC Act)
<b>CR</b>	Critically Endangered (listed under the Commonwealth EPBC Act and/or Western Australian BC Act)
<b>DAFWA</b>	Department of Agriculture and Food, Western Australia (2006-2017, now DPIRD)
<b>DAWE</b>	Commonwealth Department of Agriculture, Water and Environment (2020-2022, now DCCEEW)
<b>DBCA</b>	Western Australian Department of Biodiversity, Conservation and Attractions
<b>DBH</b>	Diameter at Breast Height (1.3 m)
<b>DCCEEW</b>	Department of Climate Change, Energy, the Environment and Water
<b>DEWHA</b>	Commonwealth Department of the Environment, Water, Heritage, and the Arts (2007-2010, now DCCEEW)
<b>DPAW</b>	Western Australian Department of Parks and Wildlife (2013-2017, now DBCA)
<b>DoE</b>	Commonwealth Department of the Environment (2013-2016, now DCCEEW)
<b>DotEE</b>	Commonwealth Department of the Environment and Energy (2016-2020, now DCCEEW)
<b>DPIRD</b>	Western Australian Department of Primary Industries and Regional Development
<b>DSEWPaC</b>	Commonwealth Department of Sustainability, Environment, Water, Population and Communities (2010-2013, now DCCEEW)
<b>DWER</b>	Western Australian Department of Water and Environmental Regulation
<b>eFS</b>	Early Works Feasibility Study
<b>EN</b>	Endangered (listed under the Commonwealth EPBC Act and/or Western Australian BC Act)
<b>EP Act</b>	Western Australian <i>Environmental Protection Act 1986</i>
<b>EPA</b>	Western Australian Environmental Protection Authority
<b>EPBC Act</b>	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
<b>FS</b>	Feasibility Study
<b>GDA 94</b>	Geographic Datum of Australia 1994
<b>GIS</b>	Geographic Information System
<b>GPS</b>	Global Positioning System
<b>ha</b>	hectare(s)
<b>IBRA</b>	Interim Biogeographic Regionalisation for Australia
<b>IUCN</b>	International Union for Conservation of Nature
<b>km</b>	kilometre(s)



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<b>kt</b>	kilo tonne
<b>m</b>	metre(s)
<b>MT</b>	Million tonne
<b>mT</b>	Metric tonne
<b>MGA</b>	Map Grid of Australia
<b>MI</b>	Migratory species (fauna; specially protected species under the Western Australian BC Act)
<b>NVIS</b>	National Vegetation Inventory System
<b>MNES</b>	Matters of National Environmental Significance
<b>ORB</b>	Over Rail Bin
<b>P, P1, P2, P3, P4, P5</b>	Priority Flora and Fauna species rankings (P1-P4) or Priority Ecological Communities (P1-P5)
<b>PDG</b>	Project Delivery Group
<b>PEC</b>	Priority Ecological Community
<b>PFS</b>	Pre-Feasibility Study
<b>PMST</b>	Protected Matters Search Tool (Commonwealth hosted by DCCEEW)
<b>PID</b>	Project Initiation Document
<b>sp./spp.</b>	Specie(s)
<b>subsp.</b>	Subspecies (infrataxon)
<b>S1</b>	Schedule 1 Fauna species listed under the Western Australian BC Act
<b>t</b>	Tonne (s)
<b>TAL</b>	Tonne Axle Loading
<b>TEC</b>	Threatened Ecological Community
<b>TF</b>	Threatened Flora (formerly termed Declared Rare Flora, DRF, in Western Australia)
<b>tph</b>	tonnes per hour
<b>var.</b>	Variety (infrataxon)
<b>VSA</b>	Vegetation Substrate Associations
<b>VU</b>	Vulnerable (listed under Commonwealth EPBC Act and/or Western Australian BC Act)
<b>WAH</b>	Western Australian Herbarium
<b>WAM</b>	Western Australian Museum
<b>WAOL</b>	Western Australian Organism List
<b>WONS</b>	Weeds of National Significance
<b>WTE</b>	Wheat Tonne Equivalent

## 1. PROJECT OVERVIEW

Co-operative Bulk Handling Limited (CBH), an agricultural co-operative based in Western Australia (WA), is making changes to adapt to the ongoing growth of crops received in WA each year (**Figure 1**). With a projected average yearly intake of 22 Mt by 2033, there is a need to construct additional grain storage capacity and efficient facilities to accommodate the expected intake. In anticipation of increased yields, CBH is currently evaluating its network and implementing safety and risk mitigation upgrades at various sites.

Achieving the CBH 2033 strategic objectives of exporting 70 % of a 22 Mt crop in the first half of the year and 3 Mt of peak export capacity by 2033 will require significant investment in out-loading infrastructure. CBH's grain receival site at Ballidu is a key Network Site in the Kwinana North Zone that has been prioritised for rail out-loading investment through the Agricultural Supply Chain Initiative (ASCI), Network Plan and the 2026 financial year (FY) budget.

The Project Delivery Group (PDG) has completed the Pre-Feasibility Study (PFS) phase and Early Works Feasibility Study (eFS) and subsequently recommended that the CBH Ballidu Rail Out-loading Project be endorsed to proceed to complete the Feasibility Study (FS) phase.

In April 2023, the preferred option for the rail siding and out-loading facility was approved by key project stakeholders. The endorsed option includes two times approximately 1,750 WTE ORBs and an approximately 616 m siding, which will accommodate loading of a 52-wagon train in approximately four hours at CBH Ballidu.

Key benefits of the project are:

- Supply chain benefits and grower value in line with our strategic objectives including:
  - Additional peak export capacity of approximately 20,000-25,000 t per month driven by a significant increase in rail out-loading capability at Ballidu which will facilitate loading/shunting of a 52-wagon train in approximately four hours. This represents an approximate seven-hour reduction in site dwell time. Further benefits will also be realised through operation of additional trainsets in the Kwinana North Zone, following the procurement of additional Narrow Gauge rollingstock.
  - Incremental export revenue associated with shifting approximately 4,500-5,000 t per month (approximately 27,000 t in one-hour).
  - Further benefits will also be realised through operation of additional trainsets in the Kwinana North Zone, following the procurement of additional Narrow Gauge rollingstock.
- Operational efficiencies: Driven by an increase in the efficiency of train loading, will reduce site staffing and road resource requirements (currently compensating inefficient rail) and improve the sustainability of rail out-loading operations on-site. This will reduce road transport, which is expected to be the largest operational benefit.
- Community/safety benefits: As a result of a reduction in road out-loading requirements, taking trucks off the road, improving safety, reducing risk of fauna strikes by trucks, and providing environmental benefits associated with less emissions-intensive rail movements.

To enable the project to proceed, CBH proposes to clear **2.20 ha** of native vegetation in the DF within a 15.33 ha DE at the CBH Ballidu facility (Figure 2). This vegetation comprises **0.62 ha** Very Good, **1.55 ha** Good and **0.03 ha** Degraded condition native vegetation.

This document has been prepared to support the granting of a NVCP for the proposal under Part V Division 2 of the *Environmental Protection Act 1986*<sup>3</sup> (EP Act) and includes the following information:

- The justification for the proposal.
- An overview of the existing environmental conditions of the site.
- Proposed environmental mitigation and management actions.
- An evaluation of potential impacts of the proposed native vegetation clearing.
- An evaluation of compliance of the proposed impact against the ten clearing principles listed under Schedule 5 of the EP Act.

### 1.1 Project Location and Land Ownership

Located approximately 383 km north of Perth, the proposed DE is located within the Shire of Wongan-Ballidu and is situated approximately 1 km to the southeast of the Ballidu township (**Figure 1**).

The areas surrounding the CBH facility and Ballidu township are characterised as agricultural, predominantly producing cereal crops. There are some patches of native vegetation in the immediate areas surrounding the township of Ballidu and to the north and to the west. The immediate surroundings to the east of the survey area have been completely cleared of native vegetation.

The legal description for the landholding that comprises the **15.33 ha** proposed DE is shown in **Table 1**.

**TABLE 1: Legal description of the proposed development envelope**

Lot No.	Land ID	Volume/Folio	Registered proprietor
127, Deposited Plan 428813	30263700	CT4076/958	CBH Group
A Rail Way	3124108		Public Transport Authority
A Rail Way	3111247		Public Transport Authority

Source: CBH Group 2025

The existing rail corridor will be used for the location of the rail siding. The corridor is owned by Public Transport Authority and managed by Arc Infrastructure.

All titles within the DE are held by CBH or accessible through legal agreement (letters of authority) (Appendices 1 and 2).

CBH has now completed the acquisition and amalgamation of the closed portion of unmade road reserve land at Ballidu that sits between the rail reserve and CBH Ballidu lot. This is now part of Lot 27 on Plan 428813.

### 1.2 Project Justification

Since 2018, CBH has been working closely with the Western Australian (WA) Government on an agricultural supply chain freight strategy - the Revitalising Agricultural Region Freight (RARF) Strategy. The RARF identified several infrastructure projects to improve freight productivity, efficiency, and safety.

In early 2020, the WA Government commissioned an independent expert to undertake a study on estimating the costs to reinstate Tier 3 rail lines within WA. This report, published in September 2020,

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<sup>3</sup> Government of Western Australia 1986, *Environmental Protection Act 1986*. Current March 2024. Online resource: [WALW - Environmental Protection Act 1986 - Home Page \(legislation.wa.gov.au\)](https://legislation.wa.gov.au/legislation/homePage.nsf/0/EnvironmentalProtectionAct1986-HomePage)

was submitted by the WA Government to Infrastructure Australia (IA) for funding. Initially, three lines were funded (York to Quairading, Kulin to Narrogin and Kondinin to Merredin) but this was subsequently expanded to include sidings at Cranbrook, Broomehill, Brookton, and Moora, with the Government's funding initiative renamed the Agricultural Supply Chain Initiative (ASCI).

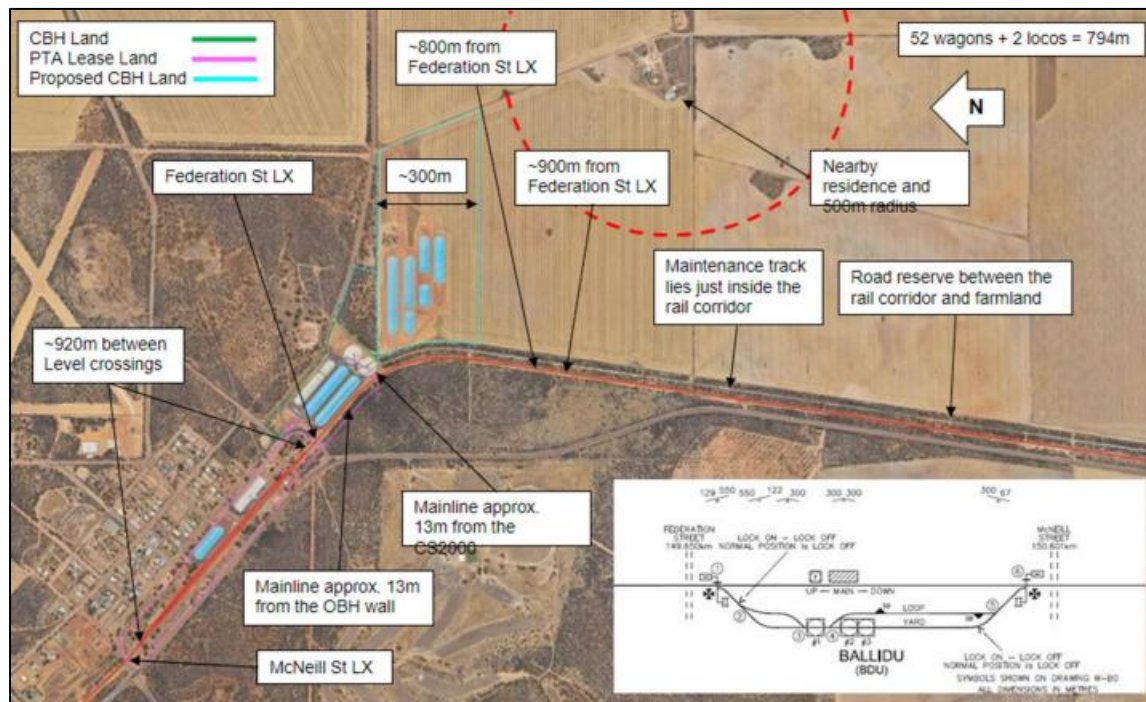
The ASCI was entered on the IA's infrastructure priority initiative list in February 2021 and formally announced in May of that year. The Commonwealth and WA Governments have jointly funded ASCI Package 1, with \$160 million and \$40 million of funding, respectively. The projects that have been funded were determined through consultation with the State and Federal Governments, CBH, rail network manager Arc Infrastructure (ARC), grower groups and local government authorities. The \$200 million package will go towards four priority project areas:

- Rail siding extensions at CBH rail out-loading sites at Moora, Brookton, Cranbrook, and Broomehill, which are to complement CBH's investment in the rail loading facilities.
- Seven additional grain rail siding upgrades planned for Meenaar, Kellerberrin, Dowerin, Konnongorring, **Ballidu**, Mingenew, and Perenjori North, which will enable CBH to load longer trains much more efficiently.
- Upgrading the Midland narrow gauge line from 16 Tonne Axle Loading (TAL) to 19 TAL between Carnamah and Mingenew, allowing heavier trains and a 20 % increase in train loads.
- Progressive recommissioning of the Narrogin-Kulin rail line and associated works to service grain and other potential customers in the Narrogin-Wickepin area via a Tier 3 line.

Due to the economic advantages associated with using rail, CBH is planning to expand its rail infrastructure at key receival sites such as Ballidu. The program specifically addresses issues with loading of trains including excessive splitting and shunting of trains, low or poor out-loading performance, limited ability to store a train load of product on demand and safety implications with trains blocking local roads and mainline tracks.

The site's 2019-2023 five-year average grower receivals of 184 kt WTE is expected to grow at a Compounding Average Growth Rate (CAGR) of 4.76 % p.a. to 232 kt WTE by 2028. By 2033 the site is expected to receive average grower receivals of 293 kt and have a storage capacity shortfall of approximately 220 kt (including carryover and loss of fixed storage).

Currently, Ballidu is located on the 16 TAL narrow gauge McLevie rail line and is accessible via a rail siding. As shown in **Plate 1**, the existing siding is equivalent to 52 wagons in length and the current rail loading infrastructure comprises 75 t of above rail capacity, with a 300 t per hour (TPH) load rate. This takes 10 hours (including two hours of shunt) to load a 52-wagon train with two locomotives (current standard). Under current conditions, trains are loaded in 26 wagon parts, forcing splits and multiple shunts to load a train.



**Plate 1: Ballidu Existing Site Conditions and Constraints (Source: CBH Group 2023)**

Approximately 40 % of the site's out-loading task is moved via rail with the remaining 60 % moved via road to a combination of sites (Avon, McLevie, MGC) or directly to Kwinana Port (5-year average). In FY22 and FY23, all but 11,000 t of the Ballidu out-loading task was moved via road direct to Port or road to rail hub. Efficiency improvements are required to support the transportation of more tonnes on rail, which is the least cost pathway to port from this site and offers improved safety and environmental benefits.

In May 2022, a Project Initiation Document (PID) was approved by CBH to investigate enhancing rail out-loading capability at Ballidu. This included enabling the loading of an (maximum) 80-wagon train noting that 52-wagon trains would likely be the standard train length operated in the near-term. This Project will assist in achieving CBH's 2033 strategic objectives of exporting 70% of a 22 Mt crop in the first half of the year and 3 Mt of monthly peak export capacity by 2033.

The Project aims to deliver on the following key requirements:

- A new rail siding adjacent to the mainline to enable the efficient transportation of tonnes from Ballidu to Port via rail, catering for a maximum train length of 80-wagons and three locomotives (locos), noting that 52 wagons and two locos would be the standard train length operated in the near-term. A longer siding needs to be reviewed in conjunction with the site master plan. Trade-offs associated with costs /benefits and implications associate with the proposed DE also need to be considered.
- An alternative cost-effective rail loading solution which may include a simplified over rail loading solution, utilising redundant infrastructure from another site or a mobile rail loading solution.
- A standardised fixed rapid rail loading facility that may range in size from two to four v-bottom silos (2.2 kt to 4.4 kt capacity) or equivalent with a single in-loading grid, elevator and feed conveyors. The facility must be able to repeatedly and accurately weigh prior to or during loading to an accuracy of  $\pm 1\%$  at an instantaneous discharge rate of nominally 1,500 tph (nominally 1,130 tph on a continuous basis) by way of batch weigher or other proven method.

Considering this, the preferred option is described in two broad groups:

- i) Rail Infrastructure Concept 6B (52-wagon), 616 m siding off the mainline has been nominated as the preferred rail infrastructure. It is able to deliver the best safety outcomes for rail operation, provides best noise impacts and delivers optimum train scheduling options (**Plate 2**).
- ii) Two times approximately 1,750 WTE ORB facility has been selected as the preferred loadout and storage solution able to deliver rapid rail loading and the rail operations that Ballidu operations require (**Plate 3** over the page).

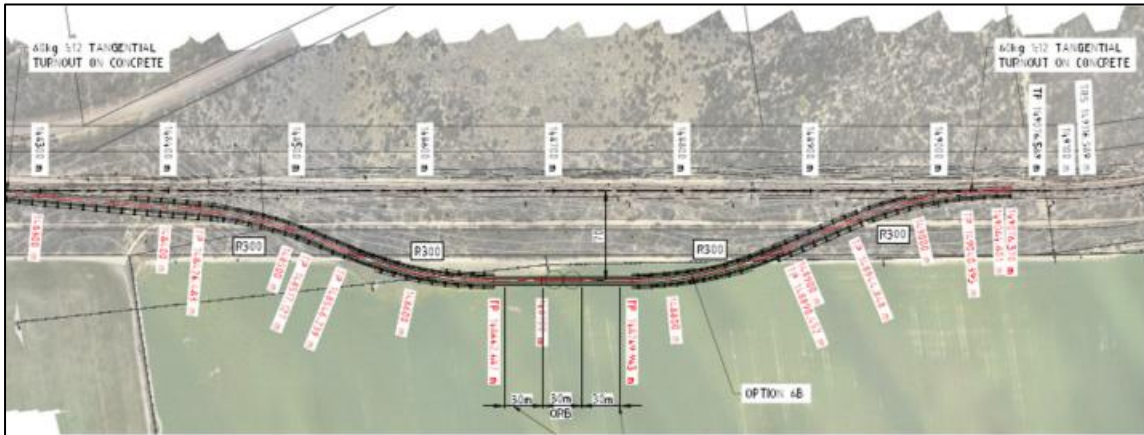


Plate 2: Option 6B – Preferred Rail Siding (Source: CBH Group 2023)



Plate 3: Preferred 60 % Design ORB Facility Diagram (Source: CBH Group 2023)



### 1.3 Alternative Project Options Considered

A range of rail sidings and facility placements were explored to meet the requirements of this project and the constraints of the site. Land ownership, land re-zoning, geography, environmental, heritage and future proofing were considered. Preference was given for rail sidings that minimised the extent of the proposed DE and consequent DF.

Initially 11 Concept Options were considered and through further studies and stakeholder workshops a siding (Option 9) was chosen. However, due to identified priority flora, a further Option 9A was investigated which avoided this flora. This option was presented to ARC but not accepted by ARC due to the introduction of Contraflexure turn-out. Due to the facility being close to the town of Ballidu, a Noise Report was commissioned for Option 9A. The report noted that the proposed option incorporates overhead rail bins located near the eastern end of the existing grain storage building at CBH Ballidu and was predicted to cause exceedances of night-time 'assigned levels' at an existing residence without significant noise mitigation. Thus, predicted noise emissions would not comply with the noise limit requirements of the Regulations<sup>4</sup>.

Further discussion with ARC led to option 6B being re-visited which was already excluded due to not allowing the consist to be stabled off the main line. Agreement that the consist would need to stable off the main line using the existing town siding when requested led to the option being accepted by ARC and recommended as the 'Go-Forward' PFS option.

As part of the study, a Spring flora and vegetation assessment<sup>5</sup>, Level 1 fauna and targeted black-cockatoo assessment and Shield-backed Trapdoor Spider<sup>6</sup> assessment were undertaken to enable feasibility phase detailed engineering to be focused on the single 'Go Forward' option.

The decision to progress Concept 6B was underpinned by:

- The intention to minimise the impact on sensitive environmental areas, which resulted in progressing a short siding in the chosen location.
- Providing community benefits:
  - This option will also mitigate potential noise and dust impacts on residents by moving rail operations further away from town.
  - Reducing the impact of train loading activities on level crossings in town, particularly Federation Street.
- Approval by ARC to foul the main line while loading due to CBH being the only user of the McLevie Line and the flattest gradients to tie the siding back into the main line.

The proposed general arrangement for Concept 6B is shown in **Plate 4**.

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<sup>4</sup> Government of Western Australia 2022, *Environmental Protection (Noise) Regulations 1997*. Online source: [WALW - Environmental Protection \(Noise\) Regulations 1997 - Home Page \(legislation.wa.gov.au\)](https://www.wa.gov.au/government/legislation/environmental-protection-noise-regulations-1997)

<sup>5</sup> AECOM Australia Pty Ltd 2023, *Ballidu – Flora and Vegetation Assessment*.

<sup>6</sup> Bamford Consulting Ecologists 2024, *CBH Ballidu Level 1 Fauna Assessment, Black-Cockatoo and Targeted Trapdoor Spider Assessment*.

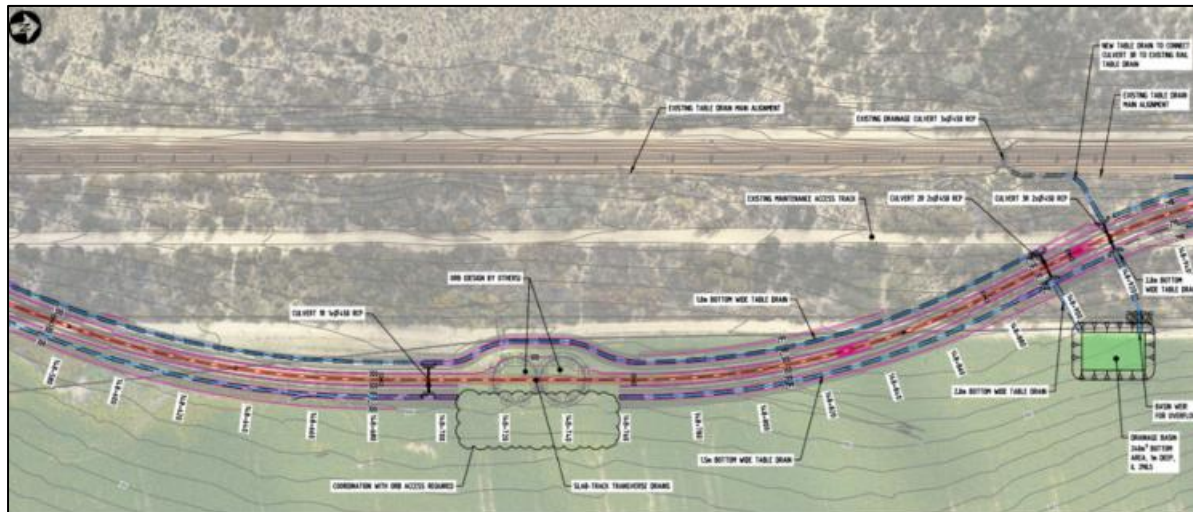


Plate 4: Proposed General Arrangement (Source: CBH Group 2023)



## 2. EXISTING ENVIRONMENT

### 2.1 Climate

The climate of Ballidu can be characterised by hot and dry summers, long and cold winters, and is typically windy and mostly clear year-round.

The Bureau of Meteorology's Wongan Hills weather station (station number 008137<sup>7</sup>) is the closest station providing long-term weather data (1966-2024) and is located approximately 35.7 km north from Ballidu. The Ballidu area receives, on average, an annual rainfall total of 386.5 mm with most rainfall occurring during the months of May-September. July experiences the highest long-term mean rainfall of 69.0 mm (Bureau of Meteorology 2024).

The average annual temperature for Wongan Hills ranges from 12.0 °C to 25.8 °C; the average summer temperature ranges between 18.4-34.7 °C, while average winter temperatures ranges between 6.6-17.1 °C (Bureau of Meteorology 2024).

### 2.2 Geology and Landforms

The survey area is located across two geological systems as mapped and described in the Department of Primary Industries and Regional Development [DPIRD] 2022 document *Soil Landscape Mapping*. Most of the survey area (>98 %) is situated on the Ballidu 3 Subsystem, which is characterised by undulating plain, crests and upper slopes from weathered granite. Soils are mainly loamy gravel, yellow deep sand, sandy and loamy earth, red shallow loamy duplex and minor sandy loamy duplex.

A small portion of the survey area (approximately 1 %) is situated on the Ballidu 4 Subsystem comprising gently undulating sandplain to gently undulating sandy rises with long gentle slopes from weathered granite. Yellow deep sands and earths, often acid, some gravels and sandy duplexes.

### 2.3 Hydrology

The proposed DE does not lie within any Public Drinking Water Source areas (Department of Water and Environmental Regulation [DWER] 2023<sup>8</sup>). There are no significant wetlands or waterways located within the proposed DE.

The proposed DE lies within the Northern Zone of Ancient Drainage hydrological zone (DPIRD 2024). Located within the North Mortlock Avon catchment, this catchment is one of the catchments responsible for feeding saline water into the Avon River. Having a large catchment, it drains the northern part of the Shire of Northam, most of the Shires of Goomalling and Wongan-Ballidu, the western portion of the Shires of Dowerin and Cunderdin and the eastern portions of the Shires of Toodyay and Victoria Plains (Water and Rivers Commission 2003<sup>9</sup>).

The Mortlock River System is seasonally active and flows intermittently after heavy rainfall events (winter, spring, and early summer). In many cases the channel is undefined consisting of a wide, shallow floodplain (Water and Rivers Commission 2023).

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<sup>7</sup> Bureau of Meteorology 2024, *Climate Statistics for Wongan Hills*. Available from: [Climate statistics for Australian locations \(bom.gov.au\)](https://www.bom.gov.au)

<sup>8</sup> Department of Water and Environmental Regulation 2023, *Gazetted public drinking water source areas* in Water quality protection note No. 75. Online resource: [WQPN 75 Gazetted public drinking water source areas \(www.wa.gov.au\)](https://www.wa.gov.au)

<sup>9</sup> Water and Rivers Commission 2003, *Foreshore and Channel Assessment of Mortlock River North*. Water and Rivers Commission, Water Resource Management Report WRM 39. Available at: [Foreshore and Channel Assessment of Mortlock River North - DocsLib](#)

## 2.4 Biogeographic Region

The proposed DE is located within the Avon Wheatbelt Interim Biogeographical Regionalisation for Australia (IBRA) Bioregion and the Merredin subregion (Department of Climate Change, Energy, the Environment and Water 2024a).

The Avon Wheatbelt IBRA region (AVW), is characterised by a gently undulating landscape with low relief. It lies on the Yilgarn Craton, an ancient block of crystalline rock, which was uplifted in the Tertiary and dissected by rivers. The Craton is overlain by laterite deposits, which in places have decomposed into yellow sandplains, particularly on low hills. Steep-sided erosional gullies, known as breakaways, are common.

In the Merredin IBRA subregion (AVW01), streams are mostly perennial, and feed rivers drain westwards to empty into the Indian Ocean.

## 2.5 Pre-European Vegetation

The pre-European vegetation type and extent mapping undertaken by J.S. Beard (1979) attempted to depict the native vegetation as it was presumed to be at the time of settlement. Digital mapping (Shepherd, Beeston, and Hopkins 2002)<sup>10</sup> was subsequently updated by the DPIRD in 2019 (DPIRD 2019).

A GIS search of J.S. Beard's (Beard *et al.* 2013) vegetation classification places the survey area within one Vegetation Association 1024 (DPIRD 2019). As shown in **Table 2**, Vegetation Association 1024 has been largely cleared within Western Australia, the Avon Wheatbelt, and the Shire of Wongan-Ballidu.

**TABLE 2: Vegetation Association and Percentage Remaining**

Vegetation Association	Description	Percentage Remaining		
		Western Australia	Avon Wheatbelt IBRA Region	Shire of Wongan-Ballidu
1024	Shrubland; mallee and casuarina thickets	13.25	11.45	5.91

Source: AECOM 2023 (Appendix 3)

## 2.6 Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are defined under s51B of the *Environmental Protection Act 1986* and are declared by the DWER to prevent the degradation of important environmental values such as Threatened flora, Threatened Ecological Communities (TECs) or significant wetlands.

As shown in **Table 3** (over the page), the nearest conservation reserves are located between 9 km and 12 km from the proposed DE.

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<sup>10</sup> Vegetation extents are updated every two years by the DBCA (Department of Primary Industries and Rural Development 2019)

**TABLE 3: Nature Reserves within the Vicinity of the Proposed Development Envelope**

Name			Type	Purpose	Area (ha)	Distance (km)
Damboring Siding Nature Reserve			Nature reserve	Conservation of flora and fauna	380	9
Un-named Nature Reserve			Nature reserve	Conservation of flora and fauna	16	12

Source: AECOM 2023 (Appendix 3)

The proposed DE does not intersect with any clearing regulation ESAs with the nearest ESA located approximately 9 km to the northwest (DWER 2021).

## 2.7 Heritage

An Aboriginal archaeological and ethnographic assessment of the site was conducted in November 2022<sup>11</sup>.

Yued Traditional Owners participated in all aspects of the archaeological survey and site recording. No Aboriginal heritage sites were found during the survey. The site has undergone various ground disturbance works in the preceding decades and consists of both remnant vegetation and built environment. The Yued representatives agreed that they been provided with sufficient information to make an informed decision about the proposed works. They understood that the increased rail capacity would result in fewer road trains and ultimately safer roads. The Yued representatives unanimously gave their support for the Rapid Rail Loading Facility and associated works (CBH Group 2023).

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<sup>11</sup> **Archae-aus (2022)** Report on an Archaeological and Ethnographic Heritage Assessment CBH's Proposed Rapid Rail Loading Facility at Ballidu, Western Australia; Prepared for CBH Group by Archae-aus Pty Ltd, North Fremantle, December 2022.

### 3. FLORA AND VEGETATION ASSESSMENT

Co-Operative Bulk Handling Limited commissioned AECOM Australia Pty Ltd (AECOM) to undertake a Spring reconnaissance flora and vegetation assessment, including a targeted Threatened/Priority Ecological Community (TEC/PEC) survey of the proposed CBH Ballidu site. The survey was undertaken on 19 and 20 November 2022 by two qualified botanists.

The **174.34 ha** survey area included the proposed DE (identified in **Figure 2**) and comprised **136.53 ha** of cleared areas and **37.81 ha** of native vegetation restricted to road and rail reserves. Data was collected from 10 quadrats and four unbounded relevés. Data collected included the presence of plant species, their cover abundance, structural composition of vegetation, physical environment, and presence/absence of disturbance.

The following information has been taken from the AECOM flora and vegetation assessment report (2023) which is included as **Appendix 3**.

#### 3.1 Methodology

Prior to conducting the field survey, a desktop assessment was conducted to identify the potential and possible occurrence of TECs, PECs and Threatened and Priority flora species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) (Australian Government 2024<sup>12</sup>) and the *Biodiversity Conservation Act 2016* (WA) (BC Act) (Western Australian Government Gazette 2023<sup>13</sup>) and by the DBCA within the survey area or the surrounding area (DBCA 2024a, 2024b).

Desktop database searches were requested from the following government databases (including a variable radius):

- DBCA Threatened Species and Communities database including Threatened and Priority flora (20 km buffer from survey area), and communities (20 km buffer from survey area).
- Western Australian Herbarium (WAH 1998) records.
- EPBC Act Protected Matters Search Tool (PMST). Significant flora species likelihood of occurrence was assessed systematically using a point-based system which considers proximity (Department of Climate Change, Energy, the Environment and Water 2024b).

A detailed flora and vegetation assessment was undertaken utilising methods outlined in the Flora Survey Technical Guide (EPA, 2016). The field surveys were undertaken by Floora De Wit (collection permit FB62000137) and Adam Fenton (FB62000488) on 19 November and 20 November 2022.

Refer to Section 4.2 of Appendix 3 for further detail on the methodology.

#### 3.3 Results

##### 3.3.1 Desktop Assessment

##### Threatened Flora:

Database searches identified that 92 significant flora species were as potentially occurring. Of these, 37 are listed under the EPBC Act, 36 are listed under the BC Act, and 56 are listed as Priority by DBCA.

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<sup>12</sup> Australian Government 2024, *Environment Protection and Biodiversity Conservation Act 1999*. Online resource: [Federal Register of Legislation - Environment Protection and Biodiversity Conservation Act 1999](#)

<sup>13</sup> Government of Western Australia 1986, *Environmental Protection Act 1986*. Current March 2024. Online resource: [WALW - Environmental Protection Act 1986 - Home Page \(legislation.wa.gov.au\)](#)

The DBCA and/or WA Herbarium records indicated that four significant flora species are known to occur within the survey area. This includes one threatened species, *Grevillea dryandroides* subsp. *dryandroides* (Endangered under the EPBC Act and Critically Endangered under the BC Act). Three Priority flora are known to occur, and nine other species were considered 'likely' to occur. Another 39 significant flora species were considered to 'possibly' occur, while the remaining 40 flora species were considered 'unlikely' or have a 'negligible' likelihood due to absence of suitable habitat, age of record, and lack of known records in the vicinity.

#### Threatened and Priority Ecological Communities:

The desktop assessment identified three ecological communities as potentially being present within 50 km of the survey area. This includes the *Eucalypt Woodlands of the Western Australian Wheatbelt* TEC/PEC (Wheatbelt Woodlands TEC) listed as Critically Endangered under the EPBC Act and Priority 3 PEC under the BC Act. The closest occurrence of this TEC/PEC to the proposed DE is 4.5 km.

The Wheatbelt Woodlands TEC represents two PECs listed by the DBCA, including the Wheatbelt Woodlands TEC, and York Gum Woodlands of the Wheatbelt. Another PEC, Gimlet Woodlands of the Wheatbelt is known to occur in the vicinity of the proposed DE.

The York Gum Woodlands of the Wheatbelt, part of the Wheatbelt Woodlands TEC, is listed as P3 under the BC Act. The closest occurrence of this TEC/PEC to the proposed DE is 50 km.

The Gimlet (*Eucalyptus salubris*) Wheatbelt Woodlands is listed as Priority 3 PEC under the BC Act. The closest occurrence of this PEC to the proposed DE is 23 km.

None of the TECs or PECs overlap with the survey area or the proposed DE.

#### 3.3.2 Field Survey

##### Floral Diversity:

A total of 120 flora species were recorded comprising 116 native and four weed species were recorded within the survey area. The most commonly occurring families were Myrtaceae (20 species), Proteaceae (15 species), Poaceae and Fabaceae (13 species each).

##### Conservation Significant Flora:

Six significant flora species were recorded within the survey area including one species, *Grevillea dryandroides* subsp. *dryandroides* listed as Endangered under the BC Act, and five flora species listed as Priority by the DBCA<sup>14</sup>.

##### ***Acacia lirellata* subsp. *compressa* (DBCA P2)**

Collected at one location, the species was in fruit at the time of the survey and easily distinguished by its unique leaf morphology. Ten individuals of the species were recorded, representing one population. This population is part of the Threatened and Priority Flora List (TPFL) verified DBCA population #1. The majority of the individuals are on yellow sandplains associated with **AcBs** (eight individuals) but also **McEm** (one individual) and **McGdWa** (one individual).

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<sup>14</sup> The locations of the species individuals are shown in **Figure 8** in **Appendix 3**. Collection and accession numbers are shown in **Section 7.3.1** in **Appendix 3**. Speciation confirmations were undertaken by Mike Hislop.

***Acacia scalena* (DBCA Priority 3)**

Thirty-six individuals were recorded sporadically throughout the survey area in remnant native vegetation and growing along the fence in cleared areas. This species was confidently identified in the field from morphological features. The species was predominantly associated with the tall *Allocasuarina campestris* shrubland **McGdWa** (28 individuals), and occasionally elsewhere in **McEm** and **EpActTp** (two individuals each) and in cleared areas (three individuals).

***Dampiera glabrescens* (DBCA Priority 1)**

This species was known to occur in the survey area from WA Herbarium records and TPFL verified population #1. Comprising 190 individuals recorded, 90 were found in cleared roadside, 99 were in the *Allocasuarina campestris* shrubland **McGdWa** and one was in the Mallee Woodland **EpActTp**. It was in flower at the time of the survey and confidently identified in the field.

***Grevillea dryandroides* subsp. *dryandroides* (EPBC Act Endangered, BC Act Critically Endangered)**

One individual was recorded in the survey area. The individual was in flower at the time of the survey which assisted in the detection of the species. It grows underneath other plants and can be very obscure. The individual was recorded in *Allocasuarina campestris* shrubland **McGdWa**.

***Grevillea rosieri* (P2)**

This species was recorded in quadrat 1 where it was collected. It was not recognised as a Priority flora species at the time therefore no population counts are available. The species was recorded as 120 cm tall with a '0' for foliage cover, indicating that it was locally rare. Quadrat 1 is in *Allocasuarina campestris* shrubland **McGdWa** situated on flat terrain with light brown clay loam soils

***Verticordia venusta* (P3)**

This species was recorded at one location representing two individuals. The species was in flower at the time of the survey and was identified through the morphology of flowers and leaves. The individuals were both recorded on yellow sandplain **AcBs**.

One individual of *Acacia lirellata* subsp. *compressa* plant and two individuals of *Acacia scalena* are located within the proposed DE, however, all are located within the proposed Revegetation Area, outside of the DF. The location of the plants are shown in **Figure 4**.

**Vegetation Units:**

Six vegetation communities were identified, described, and mapped across the **37.81 ha** of native vegetation, comprising:

- Three Shrublands:
  - **AcDr** - *Allocasuarina campestris*, *Hakea meisneriana* and *Melaleuca conothamnoides* tall shrubland over *Dianella revoluta*, *Pimelea imbricata* var. *piligera* and *Ricinocarpos undulatus* low sparse forbland representing dense overstorey over sparse understorey on flats with gravel brown soils.
  - **McEm** - *Melaleuca cordata*, *Allocasuarina campestris* and *Melaleuca conothamnoides* tall shrubland over *Ecdeiocolea monostachya*, *Platysace trachymenioides* and *Amphipogon amphipogonoides* mixed tall sedge, forb and low grassland recorded on yellow sandplain.
  - **McGdWa** - *Melaleuca conothamnoides*, *Allocasuarina campestris* and *Grevillea paradoxa* tall shrubland over *Gahnia drummondii* low to tall open sedgeland over *Waitzia acuminata* var. *acuminata*, *Trachymene pilosa* and *Platysace trachymenioides* low sparse forbland recorded on hard yellow orange clay loam soils.

- Two Mallee Woodlands:
  - **EpAcTp** - *Eucalyptus phenax* subsp. *phenax* mallee woodland over *Allocasuarina campestris*, *Hibbertia exasperata* and *Chamelaucium brevifolia* tall to low open shrubland over *Trachymene pilosa*, *Dianella revoluta* and *Amphipogon caricinus* var. *caricinus* low mixed grass and forbland recorded on flats with yellow brown clay soils.
  - **EwMhAs** – recorded on flats with sandy clay soils.
- Heathland:
  - **AcBs** - *Allocasuarina campestris*, *Melaleuca orbicularis* and *Styphelia crassiflora* tall open heathland over *Borya sphaerocephala*, *Ecdeiocolea monostachya* and *Mesomelaena preissii* tall sedgeland recorded on yellow sandplain.

The most dominant community was **McGdWa** representing *Allocasuarina campestris* tall shrubland recorded within the rail and road reserve comprising 21.26 ha (56 %) of the native vegetation within the survey area<sup>15</sup>. This vegetation unit is the only one that occurs across the proposed DF and its distribution within the proposed DF is shown in **Figure 4**.

### Vegetation Condition:

The vegetation condition for the survey area has been mapped using the condition rating scale (adapted from Keighery 1994) outlined in the EPA document *Flora and Vegetation Survey Technical Guidance* (2016).

As previously stated, the survey area comprised 174.34 ha of which 136.53 ha (78 %) has been cleared for transport and grain storage infrastructure and agriculture. The remaining 37.81 ha of native vegetation varied between Excellent and Completely Degraded, with majority of native vegetation mapped as Very Good (13.38 ha, 35 % of native vegetation extent).

Factors that contributed to vegetation condition decline included partial clearing, weed invasion, and edge effects from roads, tracks, and rail. Some rubbish and mounds of dirt from earth works were observed.

The condition rating and areal extent of the **McGdWA** vegetation unit occurring within the proposed DE is identified in **Table 4**.

**TABLE 4: Vegetation Condition Rating of McGdWa within the Proposed DF**

Condition rating	Area (ha)	Native vegetation %
Very Good	0.62	28.18
Good	1.55	70.45
Degraded	0.03	1.37
<b>TOTAL</b>	<b>2.20</b>	<b>100</b>

Source: CBH 2024

Vegetation condition mapping is shown in **Figure 5**.

<sup>15</sup> Descriptions of the vegetation communities recorded within the survey area are presented in Table 13 and mapped in Figure 8 of **Appendix 3**.

#### 4. TERRESTRIAL FAUNA ASSESSMENT

Co-Operative Bulk Handling Limited commissioned Bamford Consulting Ecologists (BCE) to undertake a Basic (EPA 2020<sup>16</sup>) fauna assessment (desktop review, fauna habitat identification and a site inspection), including targeted black-cockatoo and trapdoor spider assessments, of the site at Ballidu.

The survey area comprised approximately 122 ha and consisted of remnant native vegetation, planted native trees, roads, paddocks and CBH infrastructure. The surrounding landscape is predominantly paddocks, with some areas of vegetation which are isolated and heavily fragmented because of agricultural practices. These patches of vegetation include remnant native vegetation and plantations/areas of rehabilitation.

Fieldwork within the survey area was conducted on the 9 November 2022 for the site inspection and black-cockatoo assessment, and 7 October 2023 and 22 and 23 February 2024 for the targeted trapdoor spider assessment.

The following information has been taken from the BCE assessment report (2024) which is included as **Appendix 4**.

##### 4.1 Methodology

###### 4.1.1 Desktop Assessment

Prior to conducting the field survey, desktop searches of Threatened and Priority fauna databases were undertaken using the Australian Government EPBC Act Protected Matters Search Tool (PMST), *NatureMap*, Department of Climate Change, Energy, the Environment and Water (DCCEEW) and DBCA databases and available published literature.

A summary of the database searches is presented in **Table 5**.

**TABLE 5: Fauna Database Searches Undertaken for the Survey Area**

Database	Reference	Buffer (km) <sup>17</sup>
EPBC Act <i>Protected Matters Search Tool</i> (PMST) for Threatened species and communities listed under the EPBC Act	DCCEEW, 2023f	40
DBCA and Western Australian Museum (WAM) <i>NatureMap</i> online database for Threatened and Priority fauna	DBCA 2023c,e	40
Index of Biodiversity Surveys for Assessment (IBSA)	DWER 2023c	40
BirdLife Australia databases	BirdLife Australia, 2023a-c,	40
Atlas of Living Australia (ALA, 2023)	ALA 2023	40

Source: Bamford Consulting Ecologists 2024 (Appendix 4)

##### Expected Occurrence:

Species lists generated from the review of sources of information include records drawn from a large region and possibly from environments not represented in the survey area. Therefore, some species

<sup>16</sup> Environmental Protection Authority 2020, *Technical Guidance – Terrestrial vertebrate fauna surveys for environmental impact assessment*, EPA, Western Australia. Online resource: [2020.09.17 - EPA Technical Guidance - Vertebrate Fauna Surveys - Final.pdf](#)

<sup>17</sup> The buffer refers to distance in km around the survey area.



that were returned by one or more of the database and literature searches have been excluded because their ecology, or the environment within the survey area, determined that it is highly unlikely that these species will be present (**Appendix 4**).

The desktop assessment identified 212 vertebrate fauna species as potentially occurring in the survey area: eight frogs, 44 reptiles, 142 birds (including six introduced), 12 native mammals and six introduced mammals.

#### **Conservation Significance:**

All expected species were assessed for their conservation significance<sup>18</sup>. Three broad levels of conservation significance are used:

- Conservation Significance 1 (CS1) – species listed under the BC Act.
- Conservation Significance 2 (CS2) – species listed as Priority by DBCA but not listed under State or Commonwealth Acts.
- Conservation Significance 3 (CS3) – species not listed under Acts or in publications but considered of at least local significance because of their pattern of distribution as they are reliant on the very small areas of remnant native vegetation.

Of the 198 species of vertebrate fauna expected to occur in the survey area, 106 are considered to be of conservation significance: four CS1, two CS2 and 100 CS3. One hundred species that are expected to occur are considered to be of local significance (CS3), consisting of one frog, 26 reptile, 67 bird and six mammal species. The high number of CS3 (locally significant) species reflects the historical clearing and disturbance in the Wheatbelt; the result of which is that even tiny remnants of vegetation and any fauna they support are of local significance.

#### **4.1.2 Fauna Survey**

The first site inspection on 9 November 2022 involved the following investigations:

- Identification of Vegetation Substrate Associations (VSAs<sup>19</sup>) that provide fauna habitats.
- Targeted black-cockatoo assessment.
- Opportunistic fauna observations (birds and other fauna, including signs such as diggings, scats and tracks).

The first part of a targeted assessment for trapdoor spiders was conducted on 7 October 2023, when two personnel examined suitable habitat within the survey area for trapdoor spider burrows.

On 22 and 23 February 2024, two personnel returned to examine bushland surrounding the survey area (including Crown Land and land managed by the Shire of Wongan-Ballidu) for trapdoor spider burrows, in order to better understand the significance of burrows recorded in the survey area during the October 2023 survey.

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<sup>18</sup> Conservation significance is detailed in Appendix 1 of **Appendix 4** (attached).

<sup>19</sup> Vegetation and substrate associations (VSAs) combine vegetation types, the soils or other substrate with which they are associated, and the landform. In the context of fauna assessment, VSAs are the environments that provide habitats for fauna (BCE 2024).

#### 4.1.3 Black-cockatoo Assessment

##### Habitat Assessment:

The black-cockatoo habitat assessment was undertaken in accordance with the guidelines for the referral of actions that may result in impacts to black-cockatoos (for assessment under the EPBC Act) (DAWE, 2022). The survey and analysis reported here have been conducted with reference to both the referral guidelines provided by DSEWPac (2012) and DAWE (2022) and recommendations listed on the DAWE's Species Profile and Threats Database (DCCEEW, 2023c, 2023e, 2023d). Ecological values for black-cockatoos within the site were based on the definitions of breeding, foraging and roosting habitat as per the EPBC Act referral guidelines for black-cockatoos (DSEWPac, 2012). Actual scoring of foraging value and assessment of potential breeding habitat was based on systems developed by BCE that are outlined below. The DBCA has indicated that the methods developed and applied previously by BCE are an acceptable approach<sup>20</sup>.

As the survey area falls outside of the current distribution for the Baudin's Black Cockatoo and Forest Red Tailed Black Cockatoo (Department of Water and the Environment 2022), habitat assessments are applicable only to Carnaby's Black-cockatoo.

##### Foraging Habitat:

Foraging habitat was assessed based on the presence of tree and shrub species known to provide suitable dietary items for Carnaby's Black-cockatoo as outlined within the referral guidelines.

The foraging value of the vegetation depends upon the type, density and condition of trees and shrubs in an area and can be influenced by the context such as the availability of foraging habitat nearby. The BCE scoring system for value of foraging habitat has three components drawn from the DCCEEW offset calculator (DCCEEW, undated) but with the scoring approach developed by BCE:

- A score out of six for the vegetation composition, condition and structure
- A score out of three for the context of the site.
- A score out of one for species density.

Foraging value can thus be assigned a score out of six, based upon site vegetation characteristics, or a score out of 10 (the Habitat Quality Score; HQS) if context and species density are also considered. A higher score represents better foraging value.

Direct observations of birds or indirect evidence of black-cockatoo foraging (i.e., branch clippings and/or chewed *Eucalyptus* fruit and/or chewed *Banksia* cones) were also searched for to identify if the vegetation within the survey area has previously been or is currently being used by Carnaby's Black-cockatoo for feeding. Any habitat for Carnaby's Black-cockatoo that occurred within the survey area and contained suitable foraging plant species was recorded as foraging habitat, regardless of whether evidence of foraging was identified.

As the survey area is within the Merredin subregion of the Avon Wheatbelt, the assessment was applicable only to Wheatbelt vegetation (i.e., coastal/Swan Coastal Plain species such as Marri were not relevant).

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<sup>20</sup>Refer to Appendix 3 in **Appendix 4** (attached). Scoring system for the assessment of foraging value of vegetation for black-cockatoos.

<sup>21</sup> DBH is measured approximately 1.3 metres from the ground) (Department of the Environment and Energy, 2017)

#### **Potential Breeding Habitat:**

Potential breeding habitat is defined as trees of suitable species with a diameter at breast height (DBH), equal to or greater than 500 mm for most tree species or >300 mm DBH for Salmon Gum and Wandoo) and/or the presence of suitable nest hollows (i.e., hollow at least 3 m from the ground with an entrance diameter greater than 10 cm (SEWPaC 2012). Black-cockatoos favour vertical hollows for the nest chamber, but the hollow entrance may be vertical (a chimney hollow), have a side entrance or have a horizontal spout entrance.

#### **Potential Roosting Habitat:**

Potential roosting habitat is defined as 'tall trees or group of tall trees' of a suitable tree species, often within or near to riparian environments or other natural or artificial water sources and usually within 6 km of foraging habitat' (SEWPaC 2012; DotEE 2017b). As the breeding and foraging surveys were conducted, areas likely to be used as roosting sites (e.g. sites adjacent to watercourses with large trees) or areas that had black-cockatoo activity in the late-afternoon were noted. The DBCA threatened species database (DBCA, 2023e) and BirdLife Australia's black-cockatoo roosting dataset (BirdLife Australia, 2023c) were queried for black-cockatoo roosting sites.

#### **4.1.4 Targeted Trapdoor Spider Assessment**

##### **Desktop assessment:**

Records were compiled from the *NatureMap* database to provide details of trapdoor spider records in the immediate area. Four conservation significant trapdoor spiders were recorded within approximately 20-60 km of Ballidu from the DBCA threatened species database (DBCA, 2023e):

- *Idiosoma nigrum*, Shield-backed Trapdoor Spider (listed as Endangered under Schedule 2 Division 2 of the BC Act, records approximately 25 km away.
- *Idiosoma castellum*, Tree-stem Trapdoor Spider (Priority 4, DBCA), records approximately 24 km away.
- *Idiosoma kopejtkaorum*, Lake Goorly Shield-backed Trapdoor Spider (listed as Endangered (Schedule 2 Division 2) of the BC Act), records approximately 45 km away.
- *Idiosoma dandaragan*, Dandaragan Plateau Shield-backed Trapdoor Spider (Priority 2, DBCA), records approximately 55 km away.

##### **Survey 1 – October 2023:**

In October 2023, two areas of suitable habitat within VSA 2 (Complex shrubland) were examined for any signs of trapdoor spiders. Any burrows that were found were inspected with a milliscope to determine whether the burrow was occupied.

##### **Survey 2 – February 2024:**

To better understand the significance of the spiders found within the survey area in October 2023, a second survey was conducted on 22 and 23 February 2024 to examine the bushland surrounding the survey area for evidence of trapdoor spiders. Within 12 parcels of Crown or Shire-owned land, areas of suitable habitat were searched. Any burrows that were found were inspected with a milliscope to determine whether the burrow was occupied.

#### **4.3 Field Survey Results**

##### **4.3.1 Vegetation Substrate Associations (VSA) 'Habitat Assessment'**

Four major vegetation and substrate associations (VSAs) were identified in relation to fauna in the survey area. The VSAs identified are as follows:

**VSA 1 Cleared paddocks:** Weedy grasses and oats, with a ground cover of shrubs and herbs over red loam. This VSA covers approximately 55 % of the survey area.

**VSA 2 Complex shrubland:** Low vegetation of sedges, small shrubs of *Hakea*, *Melaleuca*, *Conospermum* (smoke bush), *Calothamnus* sp. with emergent Sheoak and *Grevillea* sp. on shallow sandy clay soils. This VSA covers approximately 16 % of the survey area.

**VSA 3 Eucalypt open woodland:** *Eucalyptus salmonophloia* (Salmon gum) and *Eucalyptus salubris* (Gimlet) over salt bush, occasional *Acacia* sp/ and weedy grasses on red loam. This VSA covers approximately 1 % of the survey area.

**VSA 4 Planted trees:** Planted species in open areas of township, *Eucalyptus camaldulensis* and *Eucalyptus* sp. (unidentified) over grassy weeds and red loam sand. This VSA covers approximately 5 % of the survey area.

The remainder of the survey area (approximately 23 %) is made up of built environments such as roads and buildings.

As shown in **Figure 6**, within the proposed DE: VSA 1 Cleared Paddocks (**9 ha**) and VSA 2 Complex Shrubland (**2.8 ha**) were recorded.

#### **4.3.2 Fauna Assemblage**

The desktop assessment identified 212 vertebrate fauna species as potentially occurring in the **122 ha** survey area: eight frogs, 44 reptiles, 142 birds, 12 native mammals and six introduced mammals.

Several domesticated animals, particularly sheep and goats, may be present in the survey area but are not included in the expected species counts. The presence of 18 species of birds was confirmed during the November 2022 site inspection.

Sixty species have been omitted from the expected species list because they are extinct (11 mammal species), or considered locally extinct (four reptiles, 16 birds and 29 mammals)<sup>21</sup>. An additional 280 species were omitted due to habitat or range limitations, or because they are domesticated species.

The expected fauna assemblage presented in **Table 6** (over the page) is a conservative estimate of the fauna that may use the survey area, taking a very precautionary approach. Given the scarcity of vegetation within the 122 ha survey area and surrounding landscape, several species that would have been designated as 'residents' (as they are typically residents in other wheatbelt locations), have been classified as 'probably absent', reflecting that in reality populations of these species may no longer be present the survey area. Extinct or locally extinct species are not included in the number of expected vertebrate fauna species.

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<sup>21</sup> These species are listed in Appendices 6 and 7 of **Appendix 4** (attached).

**TABLE 6 Composition of Expected Vertebrate Fauna Assemblage of the Survey Area**

Taxon	Total	Resident	Number of species in each status category				<i>Extinct or locally extinct</i>
			Probably absent	Regular visitor	Irregular visitor	Vagrant	
Frogs	8	0	1	4	3	0	0
Reptiles	44	31	12	0	1	0	4
Birds – Native	136	21	0	51	54	10	16
Birds – Introduced	6	0	0	1	5	0	0
Mammals – native	12	1	1	5	5	0	40
Mammals – introduced	6	4	0	1	0	1	0
Total	212	57	14	62	68	11	60

Source: Bamford Consulting Ecologists 2024 (Appendix 4)

Overall, the assemblage of vertebrate fauna expected in the survey area is typical of fragmented and degraded vegetation in the Wheatbelt region, with a high level of species decline and loss. The list of species expected to be present is considered to be generous.

#### 4.3.3 Conservation Significant Fauna

Pre-survey database searches identified 106 conservation significant terrestrial vertebrate fauna species as potentially occurring within the 122 ha survey area, comprising four CS1, two CS2 and 100 CS3<sup>22</sup>.

The small number of expected species listed under state or federal legislation or publications (CS1 and CS2 categories) likely reflect the high level of local extinction in the region. For example, no CS1 or CS2 mammals are expected to occur in the survey area, due to the large number of mammals that are extinct or considered locally extinct.

The high number of CS3 (locally significant) species reflects the historical clearing and disturbance in the Wheatbelt; the result of which is that even tiny remnants of vegetation and any fauna they support are of local significance.

The number of Conservation significant species in each vertebrate class expected to occur within the **122 ha** survey area are shown in **Table 7** (over the page). Extinct or locally extinct species are not included in the number of expected vertebrate fauna species.

<sup>22</sup> See Appendix 1 in **Appendix 4 (attached)** for full explanation of Conservation Significance (CS) levels: CS1 = listed under WA State and/or Commonwealth legislation; CS2 = listed as Priority by DBCA; CS3 = considered locally significant. LE = locally extinct

**TABLE 7: Number of Conservation Significant Vertebrate Species Expected to Occur within the Survey Area**

CLASS	Total	CONSERVATION SIGNIFICANCE			
		CS1	CS2	CS3	<i>Extinct or LE</i>
Frogs	1	0	0	1	0
Reptiles	26	0	0	26	4
Birds	73	4	2	67	16
Mammals	6	0	0	6	40
<b>Total</b>	<b>106</b>	<b>4</b>	<b>2</b>	<b>100</b>	<b>60</b>

Source: Bamford Ecological Consultants 2024 (Appendix 4)

The likelihood of occurrence assessment within the survey area for conservation significant fauna species identified the following CS1 and CS2 species (six bird species). Information relating to their status and likelihood of occurrence is shown below.

**Fork-tailed Swift (*Apus pacificus*):**

Conservation status – Migratory under Schedule 6 of the BC Act.

Expected occurrence – Regular visitor. There are no records within 40 km of the survey area. Individuals may flyover the survey area but are unlikely to utilise it.

**Peregrine Falcon (*Falco peregrinus*):**

Conservation status – Schedule 7 under the BC Act.

Expected occurrence – Regular visitor. The Peregrine Falcon is known from the general region and the survey area is likely to be within the home range of a pair. The survey area has some tall trees that may be suitable for nesting.

**Carnaby's Black-cockatoo (*Zanda latirostris*):**

Conservation status – Endangered under Schedule 2 of the BC Act.

Expected occurrence – Regular visitor. There is a cluster of records south of Ballidu and scattered records to the west and northwest in the DBCA threatened fauna database. There is limited foraging habitat and no nesting habitat in the survey area.

**Grey Wagtail (*Motacilla cinerea*):**

Conservation status – Migratory under Schedule 5 of the BC Act.

Expected occurrence – Vagrant. The Grey Wagtail is a vagrant to the south-west region, and when reported tends to be close to the fringe of shallow wetlands or irrigated grasslands. The survey area thus lacks habitat for a species that is not expected to occur regularly within the greater region.

**Letter-winged Kite (*Elanus scriptus*):**

Conservation status – Listed as Priority 4 by the DBCA.

Expected occurrence – Vagrant. Does not normally occur in the broader region of the South-West, but the species can irrupt almost anywhere in Australia.

**Western Rosella (inland) (*Platycercus icterotis xanthogenys*):**

Conservation status – Listed as Priority 4 by the DBCA.

Expected occurrence – Probably absent. The survey area is within the range for the species, and it would be expected as a resident in this region if sufficient habitat was available. While this species may persist in remnant vegetation in the survey area, it is considered unlikely to be present due to the highly fragmented and disturbed nature of the remnant native vegetation in and around the survey area. In support of this conclusion, there are no records of this species within 40 km of the survey area.

#### 4.3.4 Black Cockatoo Assessment

The expected occurrence of Carnaby's black-cockatoo in the Ballidu survey area is 'regular visitor', and the survey area is out of range for the Forest Red-tailed Black-Cockatoo and Baudin's Black-Cockatoo. Therefore, the following sections relate only to **Carnaby's Black-cockatoo**.

##### **Black-cockatoo Presence:**

Carnaby's Black-cockatoo was not observed during field investigations. No evidence of foraging by Carnaby's Black-cockatoos was observed during the field investigations. The survey area is on the margin of the species' range. Within the DBCA database there are 30 records within 15-40 km of the survey area, the most recent being from 2013.

##### **Black-Cockatoo Foraging Habitat Assessment:**

The survey area is generally of low to moderate foraging value for Carnaby's Black-Cockatoo. The foraging value for each VSA located within the proposed DE and related location identified within the proposed DE are identified in **Figure 7**.

The highest foraging score was 4 out of 10; this was for the area of VSA 2 (Complex shrubland) which occurs within the proposed DE (**6.99 ha**). This VSA contains some proteaceous shrubs that are likely to be suitable for foraging by the species, so was given a 3 out of 6 for vegetation characteristics and a 1 out of 3 for context. This context score reflects the extent of regional clearing as even small areas of moderate foraging value vegetation can be important in such a landscape.

VSA 4 (Planted trees), which also occurs within the proposed DE (**3.20 ha**), received a 2 out of 6 for vegetation characteristics and also a 1 out of 3 for context due to the scarcity of foraging habitat in the region resulting in a total habitat quality score of 3 out of 10.

Cleared paddocks were given a total score of 1 out of 10 as it is of low value based on vegetation characteristics and is very extensive throughout the region. A stocking rate (presence) score of zero was given as the species is only expected as a regular visitor in the survey area and was not recorded, nor was there any evidence of recent foraging.

There is a total of 1.78 ha of potential Carnaby's black-cockatoo foraging habitat with a foraging score of 4 (out of 10) within the proposed DF (**Figure 7**).

There is a total of 5.04 ha of potential Carnaby's black-cockatoo foraging habitat within the proposed Revegetation Area located within the DE, with the following foraging scores (**Figure 14**):

- 0.01 ha with a foraging score of 1
- 0.81 ha with a foraging score of 3
- 4.22 ha with a foraging score of 4.

##### **Breeding Habitat:**

Within the survey area, 23 trees were identified that met the potential nest-tree criteria of DAWE and DotEE (2017). These were all located in either VSA 3 or VSA 4 and are summarised in **Table 8** (over the page).

The majority of the potential nest trees were assigned a rank of 5; they were of sufficient size to be assessed but lacked large hollows. One tree was assigned a rank of 4 (trees with large hollows, but they are not the size or shape preferred by black-cockatoos) and one was assigned a rank of 3 (trees with hollows suitable for use by black-cockatoos, but no sign of use by black-cockatoos).

The rank 3 and rank 4 trees were both *Eucalyptus salmonophloia* and were in VSA 3, close to existing CBH infrastructure.

**TABLE 8: Potential Nest Trees Identified within the Survey Area**

Tree species	Rank				
	1	2	3	4	5
<i>Eucalyptus camaldulensis</i>	0	0	0	0	12
<i>Eucalyptus salmonophloia</i>	0	0	1	1	5
Unknown <i>Eucalyptus</i>	0	0	0	0	4
<b>TOTAL</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>21</b>

Source: Bamford Consulting Ecologists 2024 (Appendix 4)

There are no known breeding sites within 15 km of the survey area (BirdLife Australia 2023b; DBCA 2023e) and three known breeding sites within 40 km of the survey area. These are located approximately 18 km and 39 km south-west, and 36 km north-west of the survey area (DBCA 2023e<sup>23</sup>). Approximately 39 km south-west of the survey area there is a cluster of potential breeding sites, all of which are described as natural hollows. Additional potential nest trees may exist in surrounding areas, as there are scattered examples of eucalypt woodland within 15 km and these may contain some large trees.

There are six potential nest trees located within the proposed Revegetation Area within the DE, which will not be disturbed. Of these, four of the trees are rank 5, one tree is rank 4 and one tree is rank 3.

The location of potential Black-cockatoo breeding trees within the proposed DE are shown in **Figure 8**.

#### Roosting Habitat:

There are no known roosting sites within 40 km of the survey area (BirdLife Australia, 2023c; DBCA, 2023e). Tall trees in the north of the survey area (in VSA 4) were identified as suitable roosting trees.

#### 4.3.5 Targeted Trapdoor Spider Assessment

In total, five Trapdoor Spider burrows were found, with the Shield-backed Trapdoor Spider (*Idiosoma nigrum*) confirmed in two burrows, and one burrow found that was consistent in structure with a burrow of the Tree-stem Trapdoor Spider (*Idiosoma castellum*).

#### Survey 1 – October 2023:

Three Trapdoor Spider burrows were recorded within VSA 2 (Complex shrubland). Two of these burrows contained spiders which were identified as the Shield-backed Trapdoor Spider based on the ridged abdomens seen with a milliscope. The third burrow contained a bend, and it was not possible to see the occupant, however the burrow structure is consistent with that of a Tree-stem Trapdoor Spider.

<sup>23</sup> The locations of known Carnaby's Black-Cockatoo breeding sites within 15 km and 40 km of the survey area (DBCA, 2023e) are identified in Figure 3-7 in **Appendix 4**.



### **Survey 2 – February 2024:**

Despite extensive searching, only two Trapdoor Spider burrows were found in bushland surrounding the survey area. Neither contained a spider: one was old and deteriorated (lid broken off but fan intact) and had been taken over by two arthropods, while the other was in good condition with lid and fan intact, but was occupied by a gecko. The structure of both burrows was consistent with the Shield-backed Trapdoor Spider.

### **Significance of Recorded Burrows:**

The spider surveys confirmed the presence of the Shield-backed Trapdoor Spider and the Tree-stem Trapdoor Spider. Despite extensive survey effort in the survey area and in the surrounding bushland, spider burrows were only recorded in two areas within and adjacent to the survey area, with these areas being 1 km apart. It is likely that additional Trapdoor Spider burrows exist in the general area given the camouflaged nature of the lids which make them hard to detect. However, the results suggest that the spiders are not in high abundance and therefore any locations where they occur are likely to be important for the local populations.

The locations of Trapdoor Spider burrows found within the survey area during October 2023 and February 2024 field investigations are shown in **Figure 9**. One of the Trapdoor Spider burrows occurs within the DE, in the Revegetation Area, which is outside the proposed DF.

## 5 CLEARING OF NATIVE VEGETATION

Excluding activities that are exempt under the Clearing Regulations (Section 5 – Prescribed Clearing), all native vegetation clearing conducted by CBH (or its contractors) will be undertaken in accordance with conditions attached to a Native Vegetation Clearing Permit (NVCP).

### 5.1 Environmental Values in the Development Envelope

As a result of the flora, vegetation and fauna surveys that were undertaken, the following environmental values occur within the total DE:

- 6.52 ha of native vegetation representative of the Vegetation Association 1024, in the following condition:
  - 0.62 ha in Very Good condition
  - 5.17 ha in Good condition
  - 0.61 ha in Degraded condition
  - 0.12 in Completely Degraded condition
- 12.39 ha of potential Carnaby's Black-cockatoo foraging habitat, with the following foraging scores:
  - 4.59 ha with a foraging score of 1
  - 0.81 ha with a foraging score of 3
  - 6.99 ha with a foraging score of 4
- Six potential black-cockatoo breeding trees with the following rank:
  - Four trees with a rank of 5
  - One tree with a rank of 4
  - One tree with a rank of 3
- Two Priority flora species:
  - Two individuals of *Acacia scalena*
  - One individual of *Acacia lirellata* subsp. *compressa*.
- One Shield-backed Trapdoor Spider (*Idiosoma nigrum*) burrow.

### 5.2 Measures to Avoid and Minimise Clearing

The following sections outline the activities conducted by CBH to reduce disturbance to the smallest extent possible and to avoid critical value habitats and features.

#### 5.2.1 Impact Avoidance through Alternative Project Options

CBH has taken into consideration the results of the Spring flora and vegetation assessment and basic fauna and targeted black-cockatoo and trapdoor spider assessments and the mitigation hierarchy in order to reduce the project's potential impacts on the environment.

Through the process of reviewing alternative designs, the two project options discussed in **Section 1.3** were assessed. Initially siding Option 9 was chosen, however due to the presence of conservation significant flora, Option 9A was investigated which avoided this flora. This option was presented to ARC but not accepted by ARC due to the introduction of Contraflexure turn out.

Further discussion with ARC led to option 6B being chosen as the consist would stable off the main line using the existing town siding reducing the proposed DF from 4.98 ha (2022) to 2.80 ha in 2023 to 2.20 ha in 2025.

The location of the proposed 2.20 ha DF was chosen as it avoids all potential black cockatoo breeding trees and all conservation significant flora species. The DF has been re-designed many times to reduce the area from 4.98 ha to 2.20 ha and therefore avoiding an additional 2.78 ha of vegetation.

In terms of minimising environmental impacts, the choice of location of the proposed DF has avoided any vegetation that could contain Conservation Significant flora.

### 5.2.2 Impact Avoidance Through Environmental Management

Prior to the commencement of vegetation clearing/construction, CBH will prepare a Construction Environmental Management Plan (CEMP) to describe how the impacts of activities related to the potential disturbance to remnant vegetation during the construction phase of the Project will be managed to reduce potential direct and indirect impacts on the environment.

The CEMP will include, but not be restricted to, the following:

- Vegetation protection: Prior to clearing commencing, the areas of vegetation to be retained will be clearly demarcated with star pickets, coloured tape or bunting, or temporary fencing to protect native vegetation in these areas.
- Environmental induction: All personnel engaged in vegetation clearing and project construction will be required to participate in an environmental induction toolbox session to ensure they are made aware that native fauna/flora are protected under the *Biodiversity Conservation Act 2016* and of the measures to be implemented to prevent undue environmental harm.
- Dieback (*Phytophthora cinnamomi*): The movement of soils and plant material will be strictly managed within the proposed DE to ensure Dieback is not introduced into the surrounding vegetated areas. All clearing machinery will be washed down prior to entering and leaving the site. No Dieback soil or 'fill' will be brought into the proposed DE following clearing.
- Native fauna protection: Any fauna injured during construction will be taken to a designated veterinary clinic or a DBCA nominated wildlife carer.
- Hydrocarbon storage: If hydrocarbons are to be temporarily stored within the proposed DE, they will be contained within portable bunds. Precautions will be required to be taken when refuelling and a spill-response kit will be located in close proximity to any refuelling locations.

### 5.3 Direct impacts in Disturbance Footprint

Within the proposed DF, the following environmental values will be directly impacted due to clearing:

- 2.20 ha of native vegetation representative of the Vegetation Association 1024, in the following condition:
  - 0.62 ha in Very Good condition
  - 1.55 ha in Good condition
  - 0.03 ha in Degraded condition
- 1.78 ha of potential Carnaby's Black-cockatoo foraging habitat with a foraging score of 4.

### 5.4 Impact Mitigation through Rehabilitation

To mitigate the clearing of 2.20 ha of native vegetation that may be considered significant as a remnant of native vegetation in a landscape that has been extensively cleared, CBH proposes to implement onsite revegetation within the proposed DE and implement a Revegetation Management Plan (RMP) (Figure 10).

CBH is proposing to improve the condition of a 5.21 ha revegetation area within the proposed DE (**Figure 12**). To support this proposal, a draft RMP has been prepared in accordance with DWER guidelines and is provided within Appendix 5.

The principal objectives of the RMP are to:

- reestablish native vegetation on 1.46 ha cleared and completely degraded land with a focus on improving the availability of BCE foraging habitat within the area
- Improve native vegetation condition on 0.57 ha of degraded condition and 3.18 ha of good condition vegetation with a focus on improving the availability of BCE habitat including structural/ potential nesting.

The vegetation within the proposed Revegetation Area is predominantly made up of vegetation type McGdWa (2.77 ha); other vegetation communities within the proposed Revegetation Area include EwMhAs (0.93 ha), AcDr (0.10 ha), and Trees (0.07 ha) the remainder is cleared (1.34 ha) (**Figure 11**).

The proposed Revegetation Area contains three of the four VSAs recorded in the survey area, including 4.21 ha VSA 2, 0.81 ha of VSA 3, and 0.01 ha of VSA 1 The remainder is mapped as Built Environment (0.18 ha) (**Figure 13**).

Based on a previous methodology for assigning habitat scores (CPS 10003-1 Cranbrook 2022), it is anticipated that as a result of the project, the re-vegetation area will need to cover a quantum of impact of 1.23 ha of remnant vegetation.

The 1.23 ha quantum of impact has been based on the proposed clearing of 0.03 ha of Degraded native vegetation having a quality (scale) score of 2, 1.55 ha of Good native vegetation having a quality (scale) score of 5, and 0.62 ha of Very Good condition having a quality (scale) score of 7 due to a 0.1 % conservation significance score for terrestrial native vegetation complex - <30 % extent remaining in the bioregion.

**Table 9** represents the three calculations completed through the DWER offset calculator to obtain the significant residual impact and the rehabilitation credits associated.

**TABLE 9: Significant Residual Impacts**

<b>Vegetation Condition</b>	<b>Area (ha)</b>	<b>Significant Residual Impact</b>	<b>Rehabilitation Credit</b>
Cleared/ Completely Degraded	1.46	0.71	0.52
Degraded	0.57	1.02	0.20
Good	3.18	1.89	0.57
		<b>3.62</b>	<b>1.29</b>

## 6. APPLICATION OF THE TEN CLEARING PRINCIPLES

On the basis of the information provided in the AECOM and BCE environmental assessment reports (**Appendices 2 and 3**), an assessment of the proposal to clear **2.20 ha** of native vegetation from within the proposed **15.33 ha** DE against each of the Ten Clearing Principles outlined in Schedule 5 of the EP Act is provided in **Sections 6.1 – 6.10**. A summary of the assessment is shown in **Table 10**.

**TABLE 10: Summary of Assessment Against the Ten Clearing Principles**

Clearing principle	Not at variance	Unlikely to be at variance	May be at variance	Is at variance
<b>Principle (a)</b> Native vegetation should not be cleared if it comprises a high level of biological diversity (refer to <b>Section 6.1</b> ).				<b>X</b>
<b>Principle (b)</b> Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia (refer to <b>Section 6.2</b> ).			<b>X</b>	
<b>Principle (c)</b> Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora (refer to <b>Section 6.3</b> ).	<b>X</b>			
<b>Principle (d)</b> Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community (refer to <b>Section 6.4</b> ).	<b>X</b>			
<b>Principle (e)</b> Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared (refer to <b>Section 6.5</b> ).				<b>X</b>
<b>Principle (f)</b> Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland (refer to <b>Section 6.6</b> ).	<b>X</b>			
<b>Principle (g)</b> Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation (refer to <b>Section 6.7</b> ).	<b>X</b>			
<b>Principle (h)</b> Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area (refer to <b>Section 6.8</b> ).	<b>X</b>			
<b>Principle (i)</b> Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water (refer to <b>Section 6.9</b> ).	<b>X</b>			
<b>Principle (j)</b> Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding (refer to <b>Section 6.10</b> ).	<b>X</b>			

### 6.1 Principle (a)

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

#### 6.1.1 Assessment

Native vegetation comprises **37.81 ha** within the **174.34 ha** survey area. In total, 78 % of the survey area's vegetation is cleared. The remaining 22 % was native vegetation and condition varied between Excellent and Completely Degraded. Degradation was caused by earthworks, partial clearing, and edge effects.

The site occurs within the Central and Eastern Avon Wheatbelt biodiversity hotspot identified by the Threatened Species Scientific Committee (TSSC) and is situated in the Avon Wheatbelt IBRA region. The vegetation in surrounding areas is considered a part of multiple crown reserves, containing multiple ESAs. The closest ESA to the proposed DE is located 9 km to the northwest.

No TECs or PECs were recorded within the survey area or the proposed DE.

Six native vegetation communities were mapped across the survey area comprising three Shrublands, two Mallee Woodlands and one Heathland. One vegetation community **McGdWa** *Melaleuca conothamnoides*, *Allocasuarina campestris* and *Grevillea paradoxa* tall shrubland over *Gahnia drummondii* low to tall open sedgeland over *Waitzia acuminata* var. *acuminata*, *Trachymene pilosa* and *Platysace trachymenioides* low sparse forbland recorded on hard yellow orange clay loam soils occurs within the proposed DF.

A total of 120 flora species comprising 116 native and four weed species were recorded within the survey area. The most commonly occurring families were Myrtaceae (20 species), Proteaceae (15 species), Poaceae and Fabaceae (13 species each).

Conservation Significant species recorded included one species listed as Threatened under the EPBC Act and BC Act, and five conservation significant flora species. One individual of *Acacia lirellata* subsp. *compressa* (DBCA Priority 2) and two individuals of *Acacia scalena* (DBCA Priority 3) are found within the proposed DE, however, these are all within the proposed Revegetation Area and will not be disturbed.

### 6.1.2 Conclusion

The presence of good quality, intact native vegetation in the Wheatbelt region is rare, and must be considered. Based on this assessment, it is considered that the vegetation within the proposed DE may represent a high level of biological biodiversity.

**The proposed clearing of 2.20 ha of native vegetation from within the proposed DF is at variance with this Principle.**

## 6.2 Principle (b)

*Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.*

### 6.2.1 Assessment

Four fauna habitats were identified within the survey area and two within the proposed DF. Approximately 1.78 ha of VSA2 (Complex Shrubland) is found within the proposed DF.

The fauna assemblage is typical of degraded and fragmented vegetation in the Wheatbelt region, characterised by species loss, a higher proportion of species expected only irregularly, and uncertainty as to the status of many species (likely to be irregular visitors or absent). The majority of species that are still present are considered to be of local conservation significance (CS3) because of the extensive clearing and degraded nature of remnant vegetation.

Two conservation significant trapdoor spiders were confirmed within the survey area: Shield-backed Trapdoor Spider (CS1) and Tree-stem Trapdoor Spider (CS2). Suitable habitat for trapdoor spiders was

present within the survey area in the Complex Shrubland of VSA 2; two Shield-backed Trapdoor Spiders and one Tree-stem Trapdoor Spider burrow were found in this habitat during the first targeted survey in October 2023. Two Shield-backed Trapdoor Spider burrows were recorded within surrounding bushland in the February 2024 survey. There is one burrow within the proposed DE, however, it is located within the proposed Revegetation Area and will not be disturbed.

Three confirmed Carnaby's Black-cockatoo breeding sites have been identified within 40 km of the survey area with the closest known record of breeding being approximately 18 km to the south-west. Carnaby's Black-Cockatoo was not recorded during the site inspection and there was no evidence of foraging by this species. The survey area is within the range of the species, and it is expected as a regular visitor to the survey area.

Key findings of the Black cockatoo assessment were:

- Carnaby's Black-Cockatoo was not observed during field investigations and no evidence of foraging by Carnaby's Black-Cockatoos was observed.
- Foraging value: Overall, the foraging value of the survey area is moderate to low. VSA 2 (complex shrubland), which is found within the proposed DF, provides the highest foraging value at 4/10.
- Breeding value: 23 trees within the survey area were assessed as potential nest-trees all located in either VSA 3 or VSA 4. The majority of the potential nest trees were assigned a rank of 5; they were of sufficient size to be assessed but lacked large hollows. One tree was assigned a rank of 4 (trees with large hollows, but they are not the size or shape preferred by black-cockatoos) and one was assigned a rank of 3 (trees with hollows suitable for use by black-cockatoos, but no sign of use by black-cockatoos). The rank 3 and rank 4 trees were both *Eucalyptus salmonophloia* and were located in VSA 3, very close to existing CBH infrastructure. None of the potential nesting trees are located within the proposed DF with the closest being approximately 390 m to the northeast.
- Roosting value: There are no known roosting sites within 40 km of the Ballidu site, with the closest known roosting site approximately 74 km to the south-west.

### 6.2.2 Conclusion

The presence of 1.78 ha of VSA2 with a foraging value of 4 out of 10 within the proposed DF is relevant. This VSA contains some proteaceous plants that are likely to be suitable for foraging by Carnaby's Black-Cockatoo and was given a 3 out of 6 for vegetation characteristics and a 1 out of 3 for site context. The presence of a group of 10 potential nest-trees approximately 390 m to the northeast of the proposed DE is also relevant. While the survey area is on the margin of the species' range, there are 30 records within 15-40 km of the survey area, the most recent being from 2013.

**The proposed clearing of 2.20 ha of native vegetation from within the proposed DF may be at variance with this Principle.**

### 6.3 Principle (c)

*Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.*

#### 6.3.1 Assessment

A desktop assessment using the DBCA flora database identified 95 significant flora species as potentially occurring within 20 km of the 122 ha survey area. Of these, 36 are listed under the BC Act.

Four significant flora species are considered “known” to occur within the area, including one considered Critically Endangered under the BC Act.

A total of 116 native flora species were recorded during the field survey, including six conservation significant species. One individual of the species *Grevillea dryandroides* subsp. *dryandroides*, listed as Critically Endangered BC Act/ DBCA), was recorded. One species, *Grevillea rosieri* (DBCA Priority 2), represented a significant range extension was also recorded

Ten individuals of the species *Acacia lirellata* subsp. *compressa* (DBCA Priority 2) were recorded, representing one population. The majority of the individuals were on yellow sandplains associated with vegetation unit **AcBs** (eight individuals), **McEm** (one individual) and **McGdWa** (one individual). The latter record is located within the proposed DE.

Priority 2 species are poorly-known species, known from few locations, generally five or less, some of which are on lands managed primarily for nature conservation, for example, national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation.

One individual of *Acacia lirellata* subsp. *compressa* (DBCA Priority 2) and two individuals of *Acacia scalena* (DBCA Priority 3) were found within the proposed DE but outside of the proposed DF. however, all of these Priority flora will be protected within the proposed Revegetation Area.

#### 6.3.2 Conclusion

Since the flora assessment was conducted, the alignment of the railway corridor has been revised to ensure that all Conservation Significant flora species were avoided. All Priority flora within the DE will be protected within the proposed Revegetation Area.

**The proposed clearing of 2.20 ha of native vegetation from within the proposed DF is not at variance with this Principle.**

#### 6.4 Principle (d)

*Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.*

##### 6.4.1 Assessment

A desktop examination of the DBCA TEC spatial database indicates that the *Eucalypt Woodlands of the Western Australian Wheatbelt* TEC, listed as Critically Endangered under the EPBC Act, may occur within the vicinity of the survey. No TECs intersect the survey area.

The field survey confirmed the absence of TEC or PEC occurrence within the survey area. The closest mapped TEC was 4.5 km from the survey area.

##### 6.4.2 Conclusion

The native vegetation present within the proposed DE does not comprise whole or part of, nor is it considered necessary for the maintenance of an identified TEC.

**The proposed clearing of 2.20 ha of native vegetation from within the proposed DF is not at variance with this Principle.**



## 6.5 Principle (e)

*Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.*

### 6.5.1 Assessment

The survey area has been mapped by Beard as Vegetation Association 1024, characterised by Shrublands; mallee and Casuarina thicket.

Vegetation Association 1024 has been largely cleared within the Wheatbelt. Approximately 5.91 % is currently mapped as remaining within the Shire of Wongan-Ballidu, 11.45 % remaining in the Avon Wheatbelt IBRA Region and 13.25 % within Western Australia (GoWA 2019). The National Objectives and Targets for Biodiversity Conservation 2001-2005 (Commonwealth of Australia, 2001) recognised the retention of 30 % or more of the pre-clearing extent of each ecological community is necessary at a state level to protect Australia's biodiversity. This level of clearing is below 30 %, considered to be the threshold as extensively cleared.

### 6.5.2 Conclusion

Clearing of vegetation will result in further fragmentation of vegetation in an already highly fragmented landscape. The scarcity of remnant vegetation in the region renders any remaining remnant vegetation ecologically important.

**The proposed clearing of 2.20 ha of native vegetation from within the proposed DF is at variance with this Principle.**

## 6.6 Principle (f)

*Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.*

### 6.6.1 Assessment

The field survey identified no vegetation growing in, or in association with, a watercourse. There was no evidence observed during the field survey of any watercourse. There are no wetlands within a 50 km radius of the site.

### 6.6.2 Conclusion

There are no significant watercourses or wetlands within or in close proximity to the proposed DE that would be impacted by the proposed clearing.

**The proposed clearing of 2.20 ha of native vegetation from within the proposed DF is not at variance with this Principle.**

## 6.7 Principle (g)

*Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.*

### 6.7.1 Assessment

Most of the survey area is situated on the Ballidu 3 Sub-system, which is characterised by undulating plains, crests, and upper slopes from weathered granite. Mainly loamy gravel, yellow deep sand,

sandy and loamy earth, red shallow loamy duplex and minor sandy loamy duplex. A small portion of the survey area (approximately 1 %) is situated on the Ballidu 4 Subsystem comprising gently undulating sandplain to gently undulating sandy rises with long gentle slopes from weathered granite. Yellow deep sands and earths often acidic, some gravels and sandy duplexes.

Soils of this nature generally have a high permeability and are therefore unlikely to contribute to on-site/off-site run-off. As the soil type is predominantly sand, it is less likely to be prone to water and/or wind erosion due to the particle size. Additionally, waterlogging is unlikely due to the nature of these soils.

The mapped average annual rainfall in the Wongan-Ballidu area, according to the BoM, is 386.5 mm. The site is approximately 304.8 mAHD, with a generally gentle slope. As the area has relatively low rainfall and a small slope, it is unlikely to heavily contribute to a potential for wind/water erosion and on-site/off-site runoff.

#### **6.7.2 Conclusion**

The proposed potential disturbance to native vegetation within the proposed DF is unlikely to impact the underlying soils. The CEMP that is proposed includes implementing best practice management during clearing and construction which will reduce the potential for erosion and waterlogging to occur.

**The proposed clearing of 2.20 ha of native vegetation from within the proposed DF is not at variance with this Principle.**

#### **6.8 Principle (h)**

*Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.*

##### **6.8.1 Assessment**

The survey area is not located on a Conservation Reserve or Environmental Sensitive Area. The vegetation proposed to be cleared, is not considered representative of a federally protected TEC. The nearest conservation area to the proposed clearing is Damboring Siding Nature Reserve, 9 km to the northeast of site, and is not ecologically linked to site.

The survey area does provide some benefits as a buffer from Northam-Pithara Road, protecting vegetation to the west from weeds, vehicle emissions, dust, and edge effects, and from agricultural inputs.

##### **6.8.2 Conclusion**

The proposed DE is not located on or near any lands vested for conservation that would be affected by any works conducted within it. The absence of an ecological linkage and the distance to the closest conservation area proposal is unlikely to be at variance to this principle.

**The proposed clearing of 2.20 ha of native vegetation from within the proposed DF is not at variance with this Principle.**

## 6.9 Principle (i)

*Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.*

### 6.9.1 Assessment

The desktop assessment indicated that there are no wetlands within a 50 km radius of the site. There were no surface water features or vegetation associated with watercourses noted on or in the vicinity of survey area during the field survey.

The proposed DE lies within the Northern Zone of Ancient Drainage hydrological zone and does not overlap with any Public Drinking Water Source Areas.

The proposed clearing will not interfere with any surface or groundwater features.

### 6.9.2 Conclusion

Given the extensive clearing for agricultural use that already surrounds the survey area, the proposed clearing is unlikely to result in significant changes to the water table.

**The proposed clearing of 2.20 ha of native vegetation from within the proposed DF is not at variance with this Principle.**

## 6.10 Principle (j)

*Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.*

### 6.10.1 Assessment

There are no wetlands within a 50 km radius of the survey area neither is there evidence of watercourses or waterbodies in the vicinity of the survey area. The soil and conditions within the survey area are not prone to waterlogging or generating surface water run-off.

The DWER document “a guide to the assessment of applications to clear native vegetation” states the following for Principle (j): “Consideration of this principle may require extensive modelling of the whole catchment and should only be considered for large clearing projects. For smaller applications, clearing should not cause waterlogging (localised flooding).”

### 6.10.2 Conclusion

The cleared nature and agricultural use of the surrounding land and site conditions renders the clearing of 2.20 ha of native vegetation unlikely to increase or exacerbate the incidence of flooding.

**The proposed clearing of 2.20 ha of native vegetation from within the proposed DF is not at variance with this Principle.**

## 7. SUMMARY AND CONCLUSION

### 7.1 Summary

Within the proposed DF, approximately **2.20 ha** of native vegetation is proposed to be cleared, including:

- 2.20 ha of native vegetation representative of the Vegetation Association 1024, in the following condition:
  - 0.62 ha in Very Good condition
  - 1.55 ha in Good condition
  - 0.03 ha in Degraded condition
- 1.78 ha of potential Carnaby's Black-cockatoo foraging habitat with a foraging score of 4.

CBH is proposing to improve the condition of a 5.21 ha revegetation area within the proposed DE (**Figure 10**). The objective of the revegetation plan will be to:

- Reestablish native vegetation on 1.46 ha cleared and completely degraded land with a focus on improving the availability of BCE foraging habitat within the area.
- Improve native vegetation condition on 0.57 ha of degraded condition and 3.18 ha of good condition vegetation with a focus on improving the availability of BCE habitat including structural/ potential nesting. The revegetation area will be fenced and placed under a conservation covenant and maintained throughout duration of the permit.

### 7.2 Conclusion

Potential impacts associated with the proposed vegetation clearing to allow for the proposed upgrade of railway and grain storage infrastructure of the CBH Ballidu facility have been considered with respect to the 10 Clearing Principles outlined in Schedule 5 of the EP Act.

As discussed in **Section 6**, it is concluded that the proposed clearing of **2.20 ha** native vegetation from within the **15.33 ha** proposed DE indicates that Clearing Principles **(a)** and **(e)** are at variance and Principle **(b)** may be at variance.

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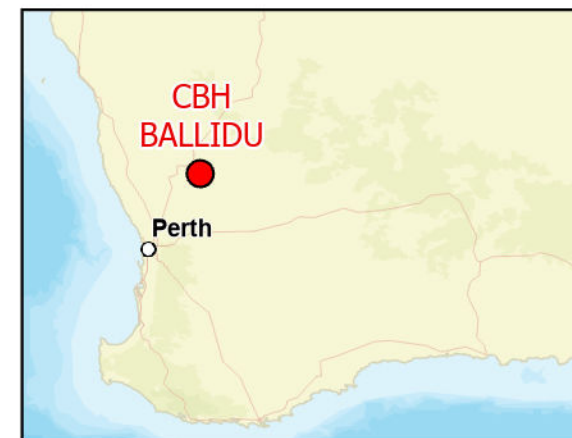
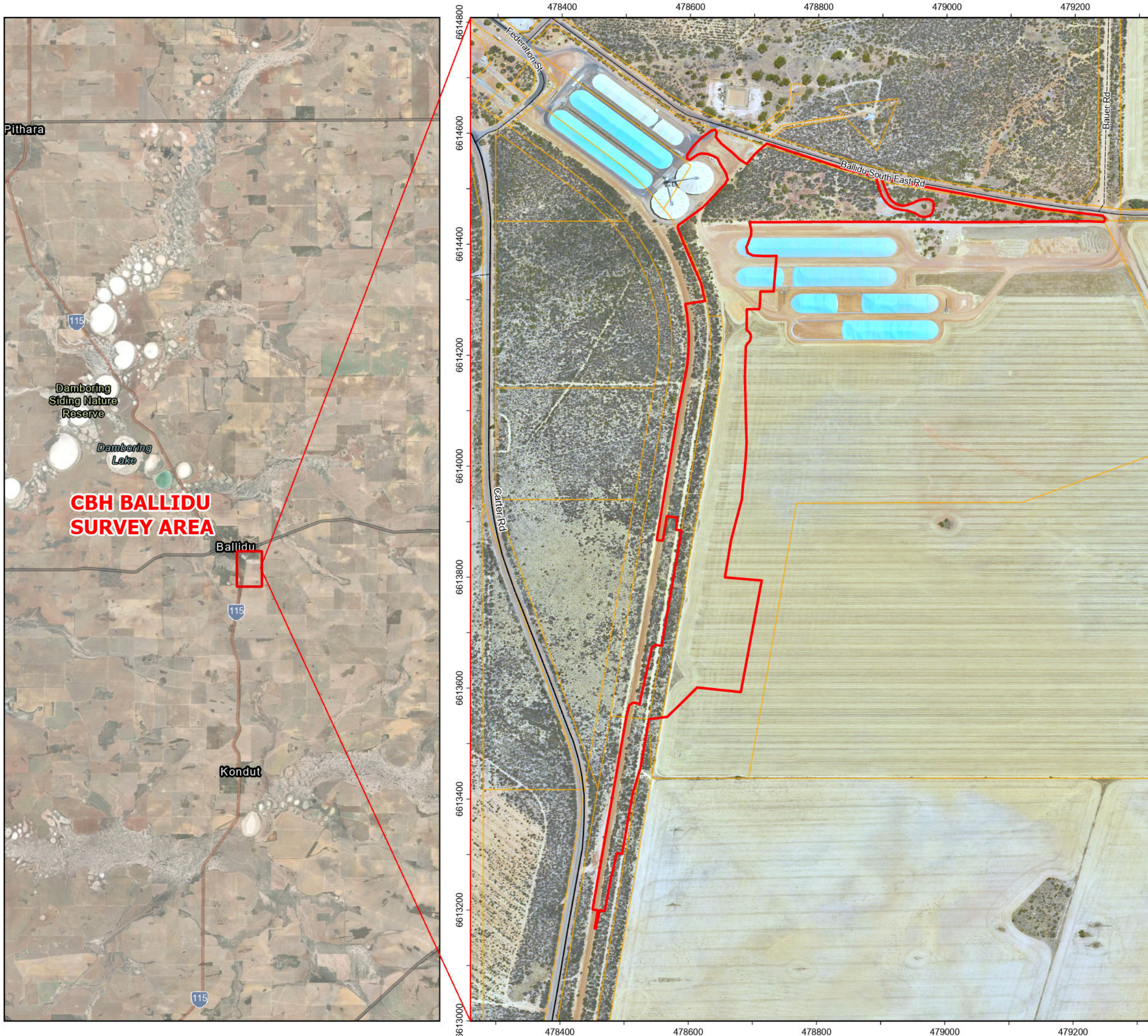
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## **FIGURES**

**NATIVE VEGETATION CLEARING PERMIT APPLICATION  
SUPPORTING DOCUMENT**

**CBH BALLIDU RAIL OUT-LOADING PROJECT  
CO-OPERATIVE BULK HANDLING LTD**





**FIGURE 1**  
**NVCP APPLICATION**  
**CBH BALLIDU**  
**REGIONAL LOCATION**

**LEGEND**

**Road Network (LGATE-195)**

- Main Road (Sealed)
- Minor Road (Sealed)
- - - Minor (Unsealed)
- Development Envelope (15.33 ha)
- Cadastre (LGATE-002)

Publication Date: 28/05/2025 11:30 AM  
Map Scale: 1:6,500 (when printed at A3)  
Spatial Reference System: GDA2020  
Datum: GDA2020  
Map Units: Metre



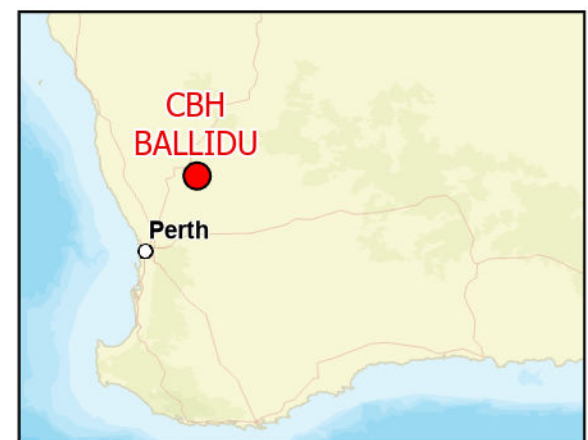
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Ballidu v2.aprx  
Layout Name: BLD20250522\_Fig001\_RegionalLocation\_v3





**FIGURE 2**  
**NVCP APPLICATION**  
**CBH BALLIDU**  
**DEVELOPMENT**  
**ENVELOPE OVERVIEW**

- LEGEND**
- Road Network (LGATE-195)**
- Main Road (Sealed)
  - Minor Road (Sealed)
  - - - Minor (Unsealed)
- Disturbance Footprint (2.20 ha)
- Development Envelope (15.33 ha)
- Ballidu Survey Extent
- Cadastre (LGATE-002)

Publication Date: 28/05/2025 11:37 AM  
Map Scale: 1:14,500 (when printed at A3)  
Spatial Reference System: GDA2020 MGA Zone 50  
Datum: GDA2020  
Projection: Transverse Mercator  
Map Units: Metre

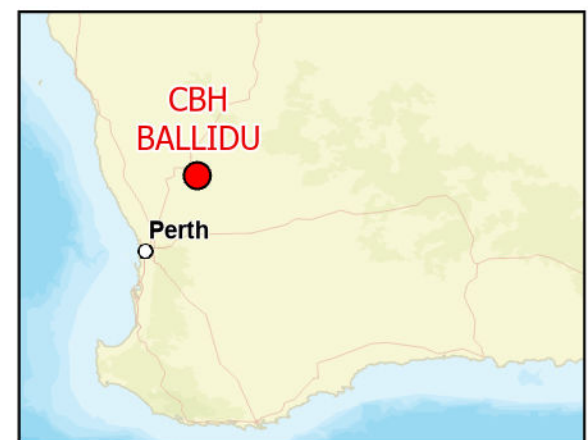
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Layout Name: BLD20250522\_Fig002\_DevEnvelope\_v3





**FIGURE 3**  
**NVCP APPLICATION**  
**CBH BALLIDU**  
**DISTURBANCE**  
**FOOTPRINT**

- LEGEND**
- Road Network (LGATE-195)**
- Main Road (Sealed)
  - Minor Road (Sealed)
  - - - Minor (Unsealed)
- Disturbance Footprint (2.20 ha)
- Development Envelope (15.33 ha)
- Cadastre (LGATE-002)

Publication Date: 28/05/2025 11:44 AM  
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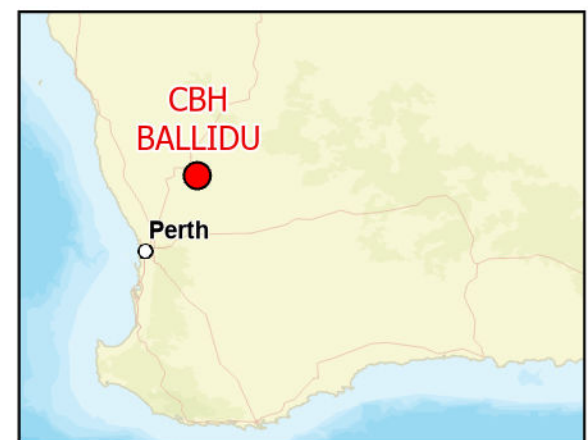
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Layout Name: BLD20250522\_Fig003\_DisturbanceFootprint





**FIGURE 4**  
**CBH BALLIDU**  
**NVCP APPLICATION**  
**VEGETATION COMMUNITIES**  
**AND SIGNIFICANT FLORA**

**LEGEND**

- Priority Flora**
- *Acacia lirellata* subsp. *compressa*, P2
  - Releve
- Road Network (LGATE-195)**
- Main Road (Sealed)
  - Minor Road (Sealed)
  - - - Minor (Unsealed)
  - Disturbance Footprint (2.20 ha)
  - Development Envelope (15.33 ha)
- Vegetation Communities**
- McGdWa (2.20 ha)
  - Cadastre (LGATE-002)

Publication Date: 5/06/2025 5:00 PM  
Map Scale: 1:5,500 (when printed at A3)  
Spatial Reference System: GDA2020  
Datum: GDA2020  
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0 50 100 150 200 250 Metres

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Layout Name: BLD20250522\_Fig004\_VegCommAndFlora\_v3






**FIGURE 5**  
**NVCP APPLICATION**  
**CBH BALLIDU**  
**VEGETATION CONDITION**  
**AND PRIORITY FLORA**

- LEGEND**
- Priority Flora**
- *Acacia lirellata* subsp. *compressa*, P2
- Road Network (LGATE-195)**
- Main Road (Sealed)
  - Minor Road (Sealed)
  - - - Minor (Unsealed)
- Disturbance Footprint (2.20 ha)**
- 
- Development Envelope (15.33 ha)**
- 
- Vegetation Condition**
- Degraded (0.03 ha)
  - Good (1.55 ha)
  - Very Good (0.62 ha)
  - Cadastre (LGATE-002)

Publication Date: 28 May 2025 11:53  
Map Scale: 1:5,500 (@A3)  
Spatial Reference: GDA2020 MGA Zone 50  
Datum: GDA2020  
Map Units: Meter

0 50 100 150 200 250  
Metres

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**FIGURE 6**  
**NVCP APPLICATION**  
**CBH BALLIDU**  
**VEGETATION SUBSTRATE**  
**ASSOCIATIONS (VSA)**


- LEGEND**
- Road Network (LGATE-195)**
- Main Road (Sealed)
  - Minor Road (Sealed)
  - - - Minor (Unsealed)
- Disturbance Footprint (2.20 ha)**
- Development Envelope (15.33 ha)**
- Vegetation Substrate Associations (VSA)**
- VSA 2 Complex Shrubland (1.78 ha)
  - Built environment (0.42 ha)
  - Cadastre (LGATE-002)

Publication Date: 28 May 2025 11:57  
Map Scale: 1:5,500 (@A3)  
Spatial Reference: GDA2020 MGA Zone 50  
Datum: GDA2020  
Map Units: Meter

0 50 100 150 200 250  
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**FIGURE 7**  
**NVCP APPLICATION**  
**CBH BALLIDU**  
**DISTRIBUTION OF**  
**CARNABY'S COCKATOO**  
**FORAGING SCORES**

**LEGEND**

**Road Network (LGATE-195)**

- Main Road (Sealed)
- Minor Road (Sealed)
- - - Minor (Unsealed)

**Disturbance Footprint (2.20 ha)**

**Development Envelope (15.33 ha)**

**BCE Foraging Score**


- 0 (0.42 ha)
- 4 (1.78 ha)

**Cadastre (LGATE-002)**

Publication Date: 28 May 2025 12:21  
Map Scale: 1:5,500 (@A3)  
Spatial Reference: GDA2020 MGA Zone 50  
Datum: GDA2020  
Map Units: Meter

0 50 100 150 200 250  
Metres

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**FIGURE 8**  
**NVCP APPLICATION**  
**CBH BALLIDU**  
**LOCATION OF POTENTIAL**  
**NEST TREES**

**LEGEND**

**Road Network (LGATE-195)**

- Main Road (Sealed)
- Minor Road (Sealed)
- - - Minor (Unsealed)

**Nest Tree Rank**

- ▲ 3
- ▲ 4
- △ 5

▨ Disturbance Footprint (2.20 ha)


▭ Development Envelope (15.33 ha)

▭ Cadastre (LGATE-002)

Publication Date: 28 May 2025 12:23  
Map Scale: 1:5,500 (@A3)  
Spatial Reference: GDA2020 MGA Zone 50  
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0 50 100 150 200 250  
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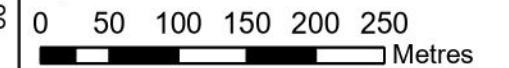


**FIGURE 9**  
**NVCP APPLICATION**  
**CBH BALLIDU**  
**LOCATION OF TRAPDOOR**  
**SPIDER BURROWS**

**LEGEND**

- Survey**
- Nov-23
- Road Network (LGATE-195)**
- Main Road (Sealed)
  - Minor Road (Sealed)
  - Minor (Unsealed)
- Disturbance Footprint (2.20 ha)**
- Development Envelope (15.33 ha)**
- Cadastre (LGATE-002)**

Publication Date: 28 May 2025 12:40  
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**FIGURE 10**  
**NVCP APPLICATION**  
**CBH BALLIDU**  
**REVEGETATION AREA**

- LEGEND**
- Road Network (LGATE-195)**
- Main Road (Sealed)
  - Minor Road (Sealed)
  - - - Minor (Unsealed)
  - Revegetation Area (5.21 ha)
  - Development Envelope (15.33 ha)
  - Cadastre (LGATE-002)

Publication Date: 28 May 2025 12:47  
Map Scale: 1:5,500 (@A3)  
Spatial Reference: GDA2020 MGA Zone 50  
Datum: GDA2020  
Map Units: Meter

0 50 100 150 200 250  
Metres

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**FIGURE 11**  
**NVCP APPLICATION**  
**CBH BALLIDU**  
**REVEGETATION AREA**  
**VEGETATION COMMUNITIES**

**LEGEND**

**Road Network (LGATE-195)**

- Main Road (Sealed)
- Minor Road (Sealed)
- - - Minor (Unsealed)

**Revegetation Area (5.21 ha)**

**Development Envelope (15.33 ha)**

**Vegetation Communities**

- AcDr (0.1 ha)
- Cleared (1.34 ha)
- EwMhAs (0.93 ha)
- McGdWa (2.77 ha)
- Trees (0.07 ha)
- Cadastre (LGATE-002)

Publication Date: 28 May 2025 13:58  
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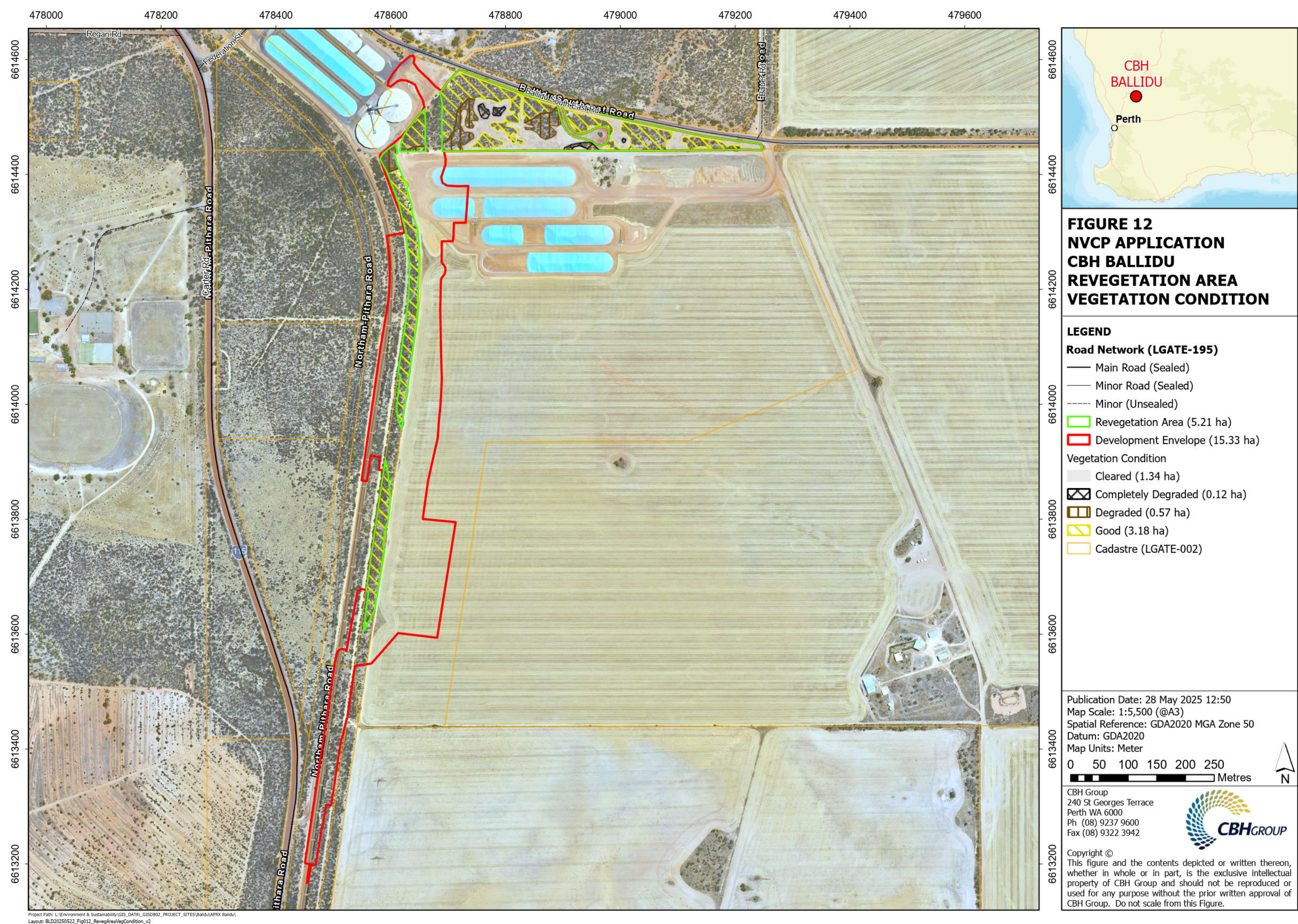
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**FIGURE 13**  
**NVCP APPLICATION**  
**CBH BALLIDU**  
**REVEGETATION AREA**  
**VEGETATION SUBSTRATE**  
**ASSOCIATION**

- LEGEND**
- Road Network (LGATE-195)**
- Main Road (Sealed)
  - Minor Road (Sealed)
  - - - Minor (Unsealed)
- Revegetation Area (5.21 ha)**
- Development Envelope (15.33 ha)**
- Vegetation Substrate Association (VSA)**
- Built environment (0.18 ha)
  - VSA 1 Cleared Paddocks (0.01 ha)
  - VSA 2 Complex Shrubland (4.21 ha)
  - VSA 3 Eucalypt Open Woodland (0.81 ha)
  - Cadastre (LGATE-002)

Publication Date: 28 May 2025 13:05  
Map Scale: 1:5,500 (@A3)  
Spatial Reference: GDA2020 MGA Zone 50  
Datum: GDA2020  
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0 50 100 150 200 250  
Metres

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# **APPENDICES**

**NATIVE VEGETATION CLEARING PERMIT APPLICATION  
SUPPORTING DOCUMENT**

**CBH BALLIDU RAIL OUT-LOADING PROJECT  
CO-OPERATIVE BULK HANDLING LTD**

## **APPENDIX 1**

**CERTIFICATE OF TITLE**  
**(Source: Landgate 2024)**

WESTERN



AUSTRALIA

TITLE NUMBER

Volume

Folio

4076

958

## RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

*BGRoberts*  
REGISTRAR OF TITLES



### LAND DESCRIPTION:

LOT 127 ON DEPOSITED PLAN 428813

### REGISTERED PROPRIETOR: (FIRST SCHEDULE)

CO-OPERATIVE BULK HANDLING LTD OF LEVEL 6 240 ST GEORGES TERRACE PERTH WA 6000  
(AF Q509489 ) REGISTERED 16/7/2025

### LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS: (SECOND SCHEDULE)

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.  
Lot as described in the land description may be a lot or location.

-----END OF CERTIFICATE OF TITLE-----

### STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: DP428813  
PREVIOUS TITLE: 4057-470  
PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.  
LOCAL GOVERNMENT AUTHORITY: SHIRE OF WONGAN-BALLIDU

## **APPENDIX 2**

### **LETTER OF AUTHORITY**



5 December 2024

Mr Aaron Lohman  
Principal – Planning and Approvals  
CBH Group  
Level 6, 240 St Georges Tce  
PERTH WA 6000

Dear Mr Lohman,

**RE: Letter of Authority to Submit Clearing Permit to Department of Water and Environmental Regulation.**

The Public Transport Authority (PTA) is the agency responsible for the land parcel known as 'A Rail Way', Land ID 3124108 and 3111247, East Ballidu, in the Shire of Wongan – Ballidu.

CBH Group have requested authorisation from the PTA to access and clear native vegetation on 'A Rail Way', approximately 1 km south east from the Ballidu townsite, for the purposes of constructing the Ballidu Rail Loading Facility.

The PTA authorises the CBH Group to access and clear native vegetation on 'A Rail Way' land parcel, subject to PTA receiving confirmation of either a referral decision that no clearing permit is required or the granting of a clearing permit from the Department of Water and Environmental Regulation.

Yours sincerely,

**Michael Parker**  
**EXECUTIVE DIRECTOR**  
**INFRASTRUCTURE PLANNING & LAND SERVICES**  
Public Transport Authority of Western Australia

## **APPENDIX 3**

**BALLIDU - FLORA AND VEGETATION SURVEY**  
**(Source: AECOM Australia Pty Ltd 2023)**



# Ballidu - Flora and Vegetation Assessment

01-Sep-2023  
Doc No. 60697745\_0



# Ballidu - Flora and Vegetation Assessment

Client: CBH Group Pty Ltd

ABN: 29 256 604 947

Prepared by

**AECOM Australia Pty Ltd**

Whadjuk Nyoongar Country, Level 15, Alluvion Building, 58 Mounts Bay Road, Perth WA 6000, GPO Box B59, Perth WA 6849, Australia

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ABN 20 093 846 925

01-Sep-2023

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## Quality Information

Document Ballidu - Flora and Vegetation Assessment  
Ref 60697745  
Date 01-Sep-2023  
Originator F de Wit  
Checker/s M Clunies-Ross  
Verifier/s K Thomson

## Revision History

Rev	Revision Date	Details	Approved	
			Name/Position	Signature
A	18-May-2023	Draft Report	F de Wit Team Leader - Natural Resources	
0	01-Sep-2023	Final Submission	F de Wit Team Leader - Natural Resources	

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## Executive Summary

The CBH Group Ltd (CBH) engaged AECOM Australia Pty Ltd (AECOM) to undertake a flora and vegetation assessment for a defined survey area in Ballidu. The survey area was 174.34 ha and comprises largely of cleared areas (136.53 ha) and some native vegetation restricted to road and rail reserves (37.81 ha).

A detailed flora and vegetation assessment was undertaken. This included a detailed desktop assessment, field survey including systematic targeted searches and quadrat and relevés, and a reporting component.

A summary of results is presented below:

- The survey area does not intersect with any land managed by Department of Biodiversity, Conservation and Attractions (DBCA) pursuant to the *Conservation and Land Management Act 1984* (CALM Act). The nearest reserve is 9 km from the survey area.
- Native vegetation in the survey area represents pre-European Vegetation Association 1024 which has been extensively cleared, with only 13.25% remaining in WA, and 5.91 ha remaining in the Shire of Wongan-Ballidu.
- No significant landforms were identified. The survey area comprises flat terrain with clay, clay loam, and sandy soils.
- The desktop assessment identified:
  - three Threatened Ecological Communities, none of which intersect with the survey area and none were expected to occur
  - 95 significant flora species occur in the vicinity, of which four were known to occur, and nine were considered 'Likely' to occur based on habitat presence.
- Six native vegetation communities were mapped comprising three Shrublands, two Mallee Woodlands and one Heathland. The most dominant of these was an *Allocasuarina campestris* shrubland McGdWa representing 21.26 ha (56% of native vegetation). This vegetation is typical of pre-European Association 1024.
- Native vegetation comprises 22% of the total survey area extent. Of this, the majority was considered Very Good (13.38 ha, 35%) and Good (11.74 ha, 31%). Degradation was caused by earthworks, partial clearing, and edge effects
- Six significant flora species were recorded:
  - *Acacia lirellata* subsp. *compressa* (DBCA Priority 2) 10 individuals.
  - *Acacia scalena* (DBCA Priority 3) 36 individuals.
  - *Dampiera glaberrima* (DBCA Priority 1) 190 individuals.
  - *Grevillea dryandroides* subsp. *dryandroides* (EPBC Act Endangered, BC Act Critically Endangered) 1 individual.
  - *Grevillea rosieri* (DBCA Priority 2) no population information available. Represents significant range extension.
  - *Verticordia venusta* (DBCA Priority 3) two individuals.

The survey was successful with no significant limitations identified that may influence the results of the survey.

## 1.0 Introduction

### 1.1 Background

CBH Group (CBH) is planning to expand its operations over the next 10 years, with planned infrastructure upgrades and the development of new sites within the distribution network. As part of this expansion, CBH is required to undertake a suite of ecological surveys to ensure the works are undertaken in accordance with business values and Regulatory and Legal requirements.

AECOM has been engaged to undertake an assessment of flora and vegetation within the Perenjori survey area to support the environmental assessment and approval process.

### 1.2 Location

The survey area is located approximately 1 km northwest from the township of Ballidu – a small agricultural town in the Wheatbelt region of Western Australia, approximately 348 km north of Perth (Figure 1). The township of Ballidu is located within the Shire of Wongan-Ballidu and is a receival site for a Cooperative Bulk Handling (CBH) facility which serves as a logistical hub for grain receival and distribution within the region.

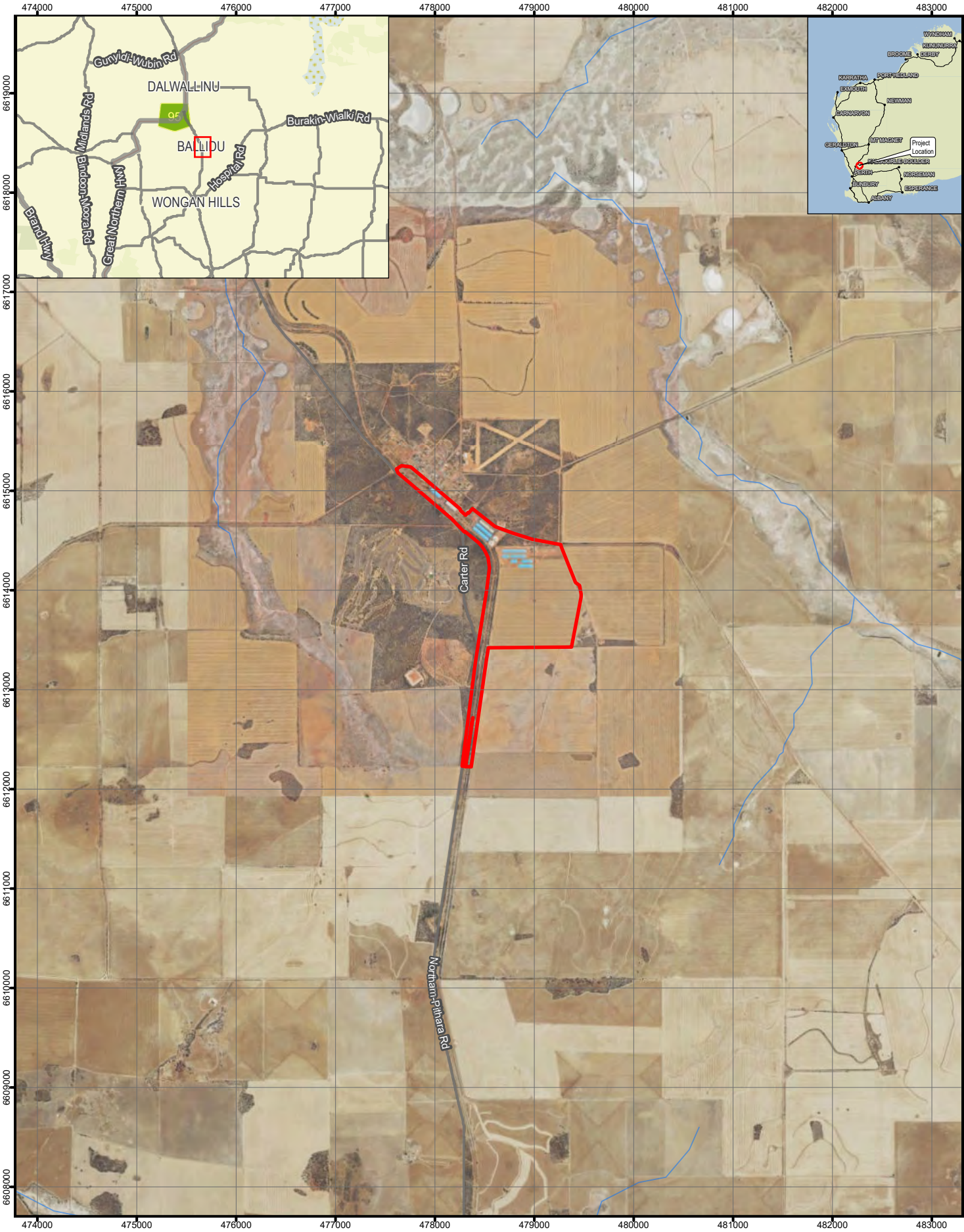
The areas surrounding the survey area and Ballidu can be characterised as agricultural, predominantly producing wheat and other cereal crops. There are some patches of native vegetation in the immediate areas surrounding the township of Ballidu and to the North and to the West of the Survey area. The immediate surroundings to the east of the survey area have been completely cleared of native vegetation (Figure 1).

### 1.3 Objectives


The objective of this scope of works was to undertake a flora and vegetation survey of the Ballidu survey area. The purpose of the field survey was to characterise the florist diversity, identify and map occurrences of conservation significant flora, identify, map and discuss the significance of any TECs and PECs, and classify and assess the condition of native vegetation.


This report describes results of the flora and vegetation desktop assessment and field survey undertaken at the Ballidu site on 19 and 20 November 2022.

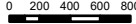





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LEGEND		
	Survey Area	

Survey Area	
CBH	
BALLIDU DETAILED FLORA AND VEGETATION ASSESSMENT	
BALLIDU	

Figure
1

## 2.0 Conservation Codes

### 2.1 Flora and Fauna

Species at risk of extinction are recognised at a Commonwealth level under the *Environment Protection, Biodiversity and Conservation Act 1999* (EPBC Act) and are categorised as outlined in Table 1.

**Table 1 Categories of species listed under Schedule 179 of the EPBC Act**

Code	Category
<b>Ex</b>	<b>Extinct Taxa</b> which at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
<b>ExW</b>	<b>Extinct in the Wild Taxa</b> which is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
<b>CE</b>	<b>Critically Endangered Taxa</b> which at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
<b>E</b>	<b>Endangered Taxa</b> which is not critically endangered and it is facing a very high risk of extinction in the wild in the immediate or near future, as determined in accordance with the prescribed criteria.
<b>V</b>	<b>Vulnerable Taxa</b> which is not critically endangered or endangered and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
<b>CD</b>	<p><b>Conservation Dependent Taxa</b> which at a particular time if, at that time:</p> <p>the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered the following subparagraphs are satisfied:</p> <p>the species is a species of fish</p> <p>the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised the plan of management is in force under a law of the Commonwealth or of a State or Territory cessation of the plan of management would adversely affect the conservation status of the species.</p>
<b>Mi</b>	<p>The EPBC Act also requires the compilation of a list of <b>migratory species</b> that are recognised under international treaties including the:</p> <ul style="list-style-type: none"> <li>• Japan Australia Migratory Bird Agreement 1981 (JAMBA)</li> <li>• China Australia Migratory Bird Agreement 1998 (CAMBA)</li> <li>• Republic of Korea-Australia Migratory Bird Agreement 2007 (ROKAMBA)</li> <li>• Bonn Convention 1979 (The Convention on the Conservation of Migratory Species of Wild Animals).</li> <li>• All migratory bird species listed in the annexes to these bilateral agreements are protected in Australia as a MNES under the EPBC Act.</li> </ul>
<b>Ma</b>	Species established under s248 of the EPBC Act.

Flora and fauna species that are considered Threatened and need to be specially protected because they are under identifiable threat of extinction are listed under the *Biodiversity Conservation Act 2016* (BC Act). These categories are defined in Table 2.

**Table 2 Conservation codes for WA flora and fauna listed under the BC Act (DBCA, 2019)**

Code	Category
<b>CR</b>	<b>Critically Endangered Species</b> Threatened species considered to be facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines. Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines.
<b>EN</b>	<b>Endangered Species</b> Threatened species considered to be facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines. Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines.
<b>VU</b>	<b>Vulnerable Species</b> Threatened species considered to be facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines. Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines.
<b>EX</b>	<b>Extinct Species</b> Species which have been adequately searched for and there is no reasonable doubt that the last individual has died, and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).
<b>MI</b>	<b>Migratory species</b> Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act). Includes 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 fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.
<b>CD</b>	<b>Species of special conservation interest (conservation dependent fauna)</b> Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act).
<b>OS</b>	<b>Other specially protected species</b> Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).

Species that have not yet been adequately surveyed to warrant being listed under the BC Act, or are otherwise data deficient, are added to a Priority List as Priority 1, 2 or 3 by the State Minister for Environment. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are listed as Priority 4. Categories and definitions of Priority Flora and Fauna species are provided in Table 3.



**Table 3 Conservation codes for WA flora and fauna as listed By DBCA and endorsed by the Minister for Environment**

Code	Category
<b>P1</b>	<b>Priority One – Poorly Known Species</b> Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
<b>P2</b>	<b>Priority Two – Poorly Known Species</b> Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
<b>P3</b>	<b>Priority Three – Poorly Known Species</b> Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
<b>P4</b>	<b>Priority Four – Rare, Near Threatened and other species in need of monitoring</b> 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. 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. Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

## 2.2 Vegetation Communities

Threatened Ecological Communities (TECs) are naturally occurring biological assemblages that occur in a particular type of habitat and that may be subject to processes that threaten to destroy or significantly modify the assemblage across its range. TECs are listed by both State and Commonwealth legislation.

Communities can be classified as Threatened Ecological Communities (TECs) under the EPBC Act. Categories of EPBC Act listed TECs are described in Table 4.

**Table 4 Categories of TECs that are listed under the EPBC Act**

Code	Category
<b>CE</b>	<b>Critically Endangered</b> If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.
<b>E</b>	<b>Endangered</b> If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
<b>V</b>	<b>Vulnerable</b> If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

Vegetation communities in Western Australia are described as TECs if they have been endorsed by the Western Australian Minister for Environment following recommendations made by the Threatened Species Scientific Committee. TECs are listed under the BC Act in one of four categories defined in Table 5.

The Department of Biodiversity, Conservation and Attractions (DBCA) maintains a database of state listed TECs which is available for online searches via their website. Possible TECs that do not meet survey criteria or are not adequately defined are listed as Priority Ecological Communities (PECs) under Priorities 1, 2 and 3. Ecological communities that are adequately known and are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. Conservation dependent communities are classified as Priority 5. PECs are endorsed by the Minister for Environment and are described in Table 6.

DBCA requires that all Priority and Threatened ecological communities are considered during environmental impact assessments and clearing permit applications.

**Table 5 Conservation codes for State listed Ecological Communities**

Code	Category
<b>PD</b>	<i>Presumed Totally Destroyed</i>
<b>CR</b>	<i>Critically Endangered</i>
<b>EN</b>	<i>Endangered</i>
<b>VU</b>	<i>Vulnerable</i>

**Table 6 Categories for Priority Ecological Communities**

Code	Category
<b>P1</b>	<b>Priority One:</b> poorly-known ecological communities
<b>P2</b>	<b>Priority Two:</b> poorly-known ecological communities
<b>P3</b>	<b>Priority Three:</b> poorly known ecological communities
<b>P4</b>	<b>Priority Four:</b> ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list.

## 3.0 Existing Environment

### 3.1 Climate

The climate of Ballidu can be characterised by hot and dry summers, long and cold winters, and is typically windy and mostly clear year-round. Over the course of the year, the temperature typically varies from 7°C to 37°.

The closest weather station with recent rainfall observations is the Ballidu Station (ID 008002) located approximately 0.4km from the township of Ballidu and the survey area. Rainfall was significantly higher than the long-term average in February and August of 2022. There was almost no rainfall experience in December 2021 and or Jan 2021, compared to the long-term average. The total rainfall in the 12 months preceding the survey was 73.7mm higher than the long-term average (Figure 2).

The closest weather stations with recent temperature observations is the Wongan Hills (ID 008137) located approximately 33km from the township of Ballidu. The mean maximum temperature was notably higher than the long-term average through December 2021 to February 202; returning to resume the long-term average for the remainder of 2022.

The mean minimum monthly temperature in the 12 months preceding the survey closely resembled the long-term average (1966 – 2023).

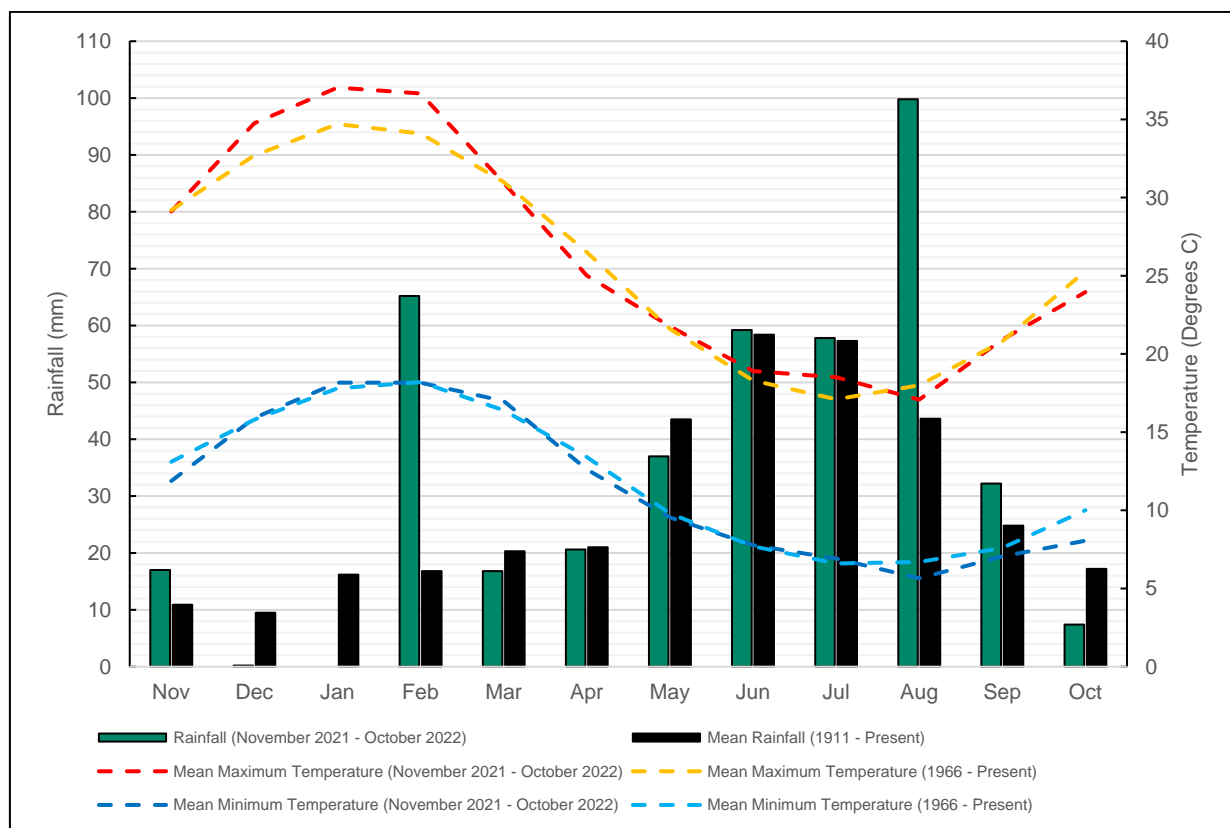


Figure 2 Ballidu climate statistics (BOM, 2023)

### 3.2 Interim Biogeographical Region of Australia Regions

The largest regional vegetation classification scheme recognised by Environmental Protection Authority (EPA) is the Interim Biogeographical Region of Australia (IBRA). The IBRA regions provide the planning framework for the systematic development of a comprehensive, adequate and representative (CAR) national reserve system. There are 89 recognised IBRA regions across Australia that have been defined based on climate, geology, landforms and characteristic vegetation and fauna (IBRA7, 2012).

Ballidu is situated in the Avon Wheatbelt IBRA region, which is characterised by gently undulating landscape with low relief. It lies on the Yilgarn Craton, an ancient block of crystalline rock, which was uplifted in the Tertiary and dissected by rivers. The craton is overlain by laterite deposits, which in places have decomposed into yellow sandplains, particularly on low hills. Steep-sided erosional gullies, known as breakaways, are common. The bioregion has a semi-arid Mediterranean climate, with hot, dry summers and mild winters, with most rainfall occurring in the winter months.

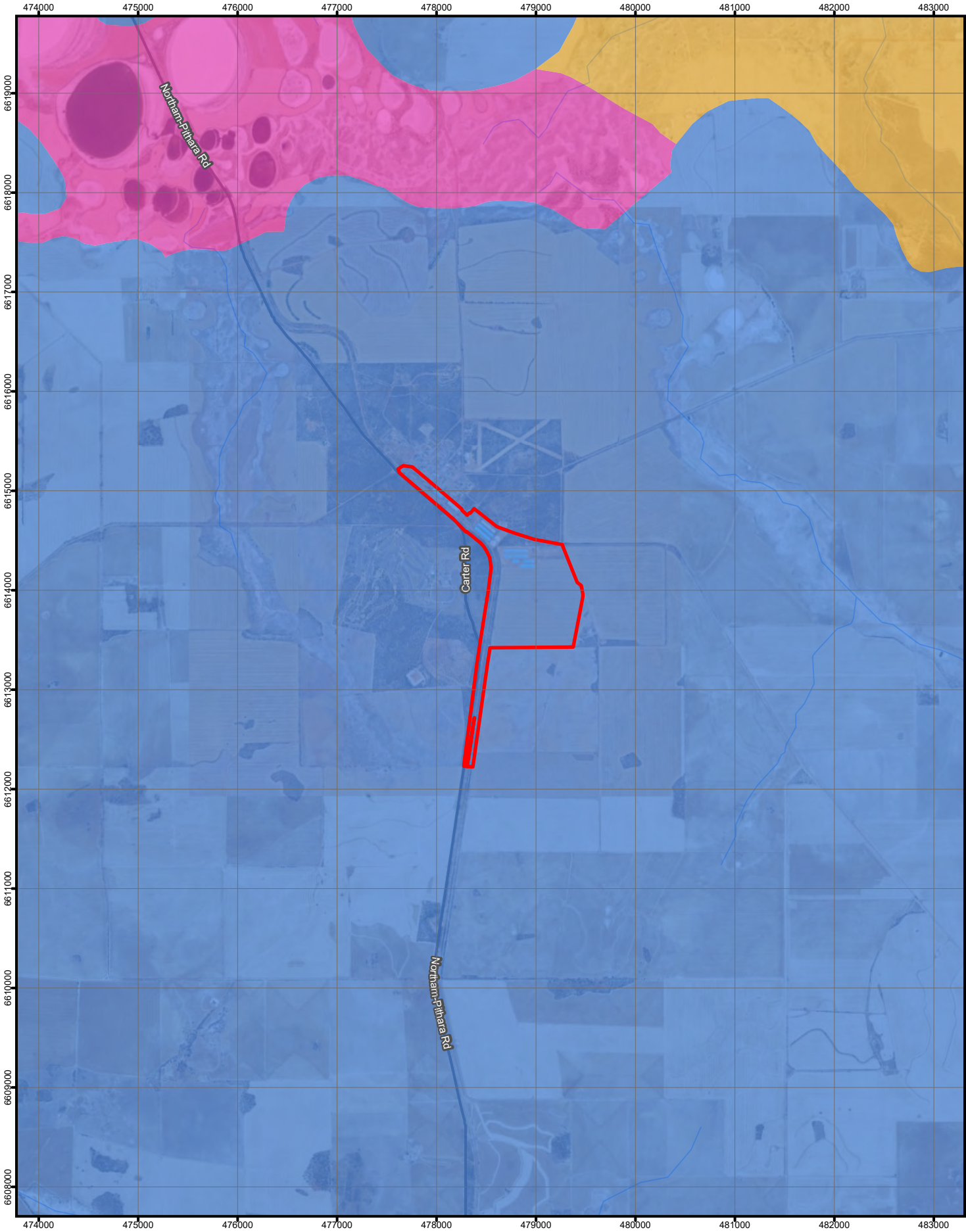
The project site is located in the Katanning IBRA subregion, where streams are mostly perennial, and feed rivers which drain westwards to empty into the Indian Ocean.

### **3.3 Geology and Landforms**

The survey area is situated across two geological systems as mapped and described in (DPIRD 2022).

Most of the survey area (>98%) is situated on the Ballidu 3 Subsystem, which characterised by undulating plain, crests and upper slopes from weathered granite. Mainly loamy gravel, yellow deep sand, sandy and loamy earth, Red shallow loamy duplex, minor of sandy loamy duplex (Figure 3).

A small portion of the survey area (~1%) is situated on the Ballidu 4 Subsystem comprising gently undulating sandplain to gently undulating sandy rises with long gentle slopes from weathered granite. Yellow deep sands and earths, often acid, some gravels and sandy duplexes




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LEGEND

 Survey Area

Land System

 Ballidu System

 Kellerberrin System

 Wallambin System

Land Systems

CBH

*BALLIDU DETAILED FLORA AND  
VEGETATION ASSESSMENT*

BALLIDU

Figure

3

### 3.4 Vegetation

Beard et al. (2013) mapping is used to determine the current extent of remnant vegetation remaining when compared to pre-European vegetation extent (Figure 4). The Beard (2013) vegetation association at the project site is Vegetation Association 1024, characterised by Shrublands; mallee & casuarina thicket. Vegetation association 1024 has been largely cleared within Western Australia, the Avon Wheatbelt, and the Shire of Wongan-Ballidu. (Table 7).

**Table 7 Beard et al. (2013) Vegetation Associations and Percent Remaining (Govt. of WA, 2019)**

Vegetation Association	Description	Percentage Remaining (%)		
		Western Australia	Avon Wheatbelt IBRA Region	Shire of Wongan-Ballidu
1024	Shrublands; mallee & casuarina thicket	13.25	11.45	5.91

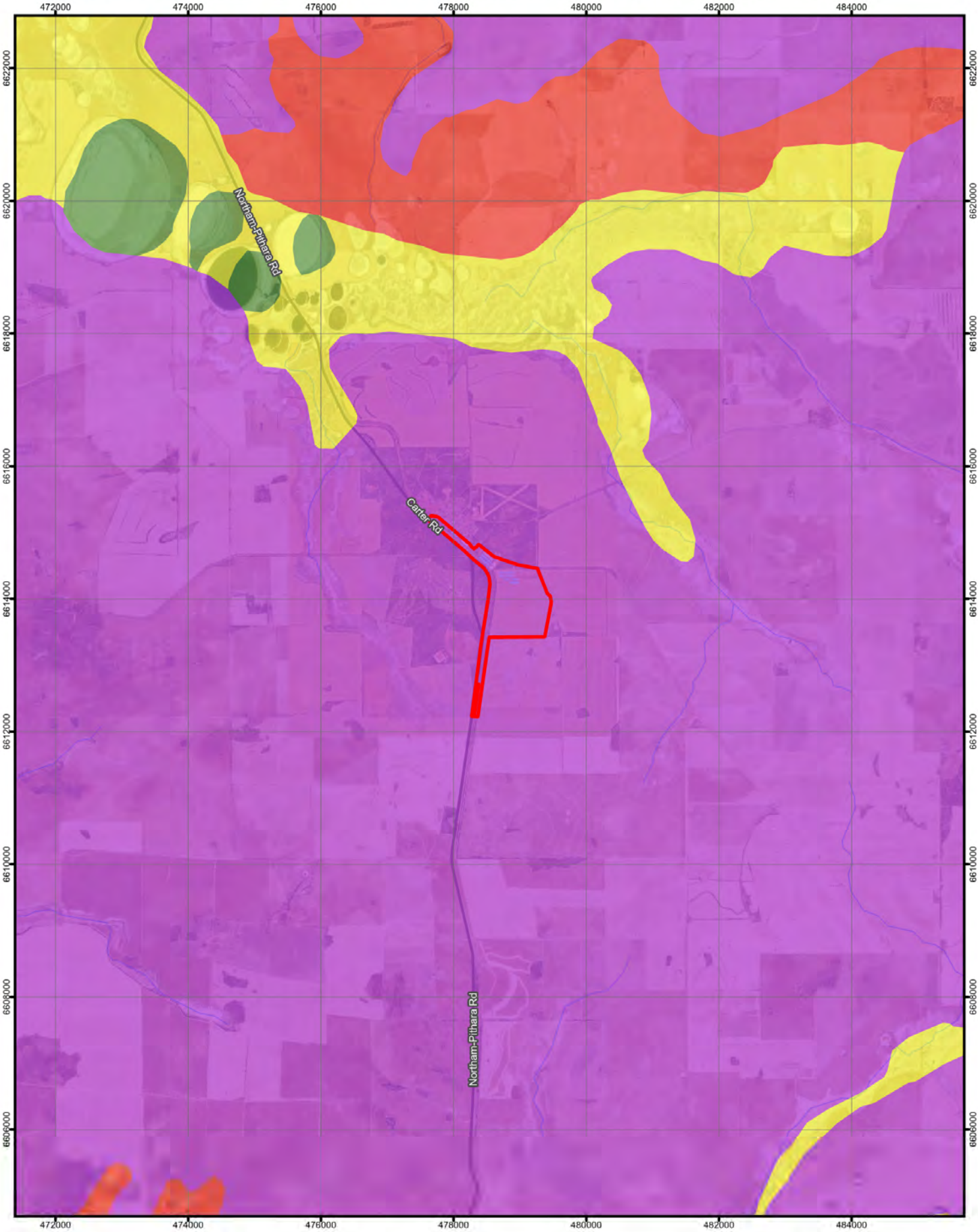
### 3.5 Conservation Reserves and Environmentally Sensitive Areas

The survey area is not located on a conservation reserve or Environmental Sensitive area. The nearest conservation reserve is 9 km northeast (Damboring Nature Reserve). DBCA legislated land within the vicinity of the project site are described in Table 8 and mapped in Figure 5.

**Table 8 Nature reserves within the vicinity of the survey area.**

Name	Type	Purpose	Area (ha)	Distance (km)
Damboring Nature Reserve	Nature Reserve	Conservation Of Flora and Fauna	380	9 km
Un-named Nature Reserve	Nature Reserve	Conservation Of Flora and Fauna	16	12 km





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LEGEND

Survey Area

125 - Bare areas; salt lakes

142 - Wheatbelt; York gum, salmon gum etc. *Eucalyptus loxophleba*, *E. salmonophloia*. Goldfields; gimlet, redwood etc. *E. salubris*, *E. oleosa*. Riverine; rivergum *E. camaldulensis*. Tropical; messmate, woollyb

988 - *Tecticornia* spp. with *Melaleuca* spp., *Acacia* spp

1024 - Shrublands; mallee & casuarina thicket

Pre-European Vegetation

CBH

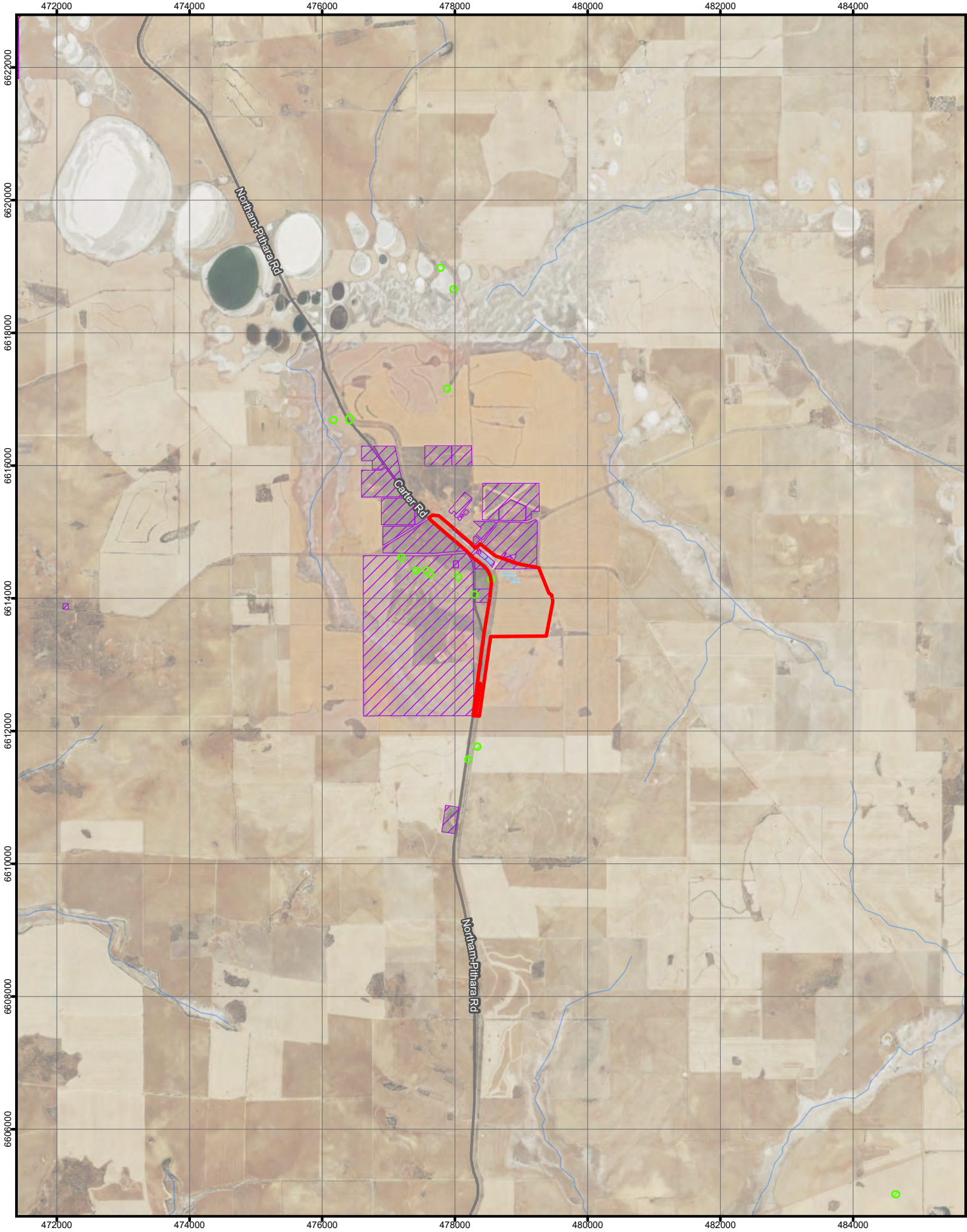
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Figure

4





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WMS:

**LEGEND**  
 Survey Area  
 Reserves (LGATE-227)  
 Clearing Regulations - Environmentally Sensitive Areas (DWER-046)

**DBCAs - Legislated Lands and Waters (DBCAs-011)**  
 Nature Reserve

**Reserves and Environmentally Sensitive Areas**

**CBH**  
  
BALLIDU DETAILED FLORA AND VEGETATION ASSESSMENT  
  
BALLIDU

**Figure 5**



## 4.0 Methodology

### 4.1 Desktop Study

A comprehensive desktop assessment was undertaken prior to the field survey to identify significant environmental values likely to be present in the survey area including flora, and vegetation communities. Desktop database searches were requested from the following government databases (including a variable radius):

- DBCA Threatened Species and Communities database including Threatened and Priority flora (20 km buffer from survey area), and communities (20 km buffer from survey area).
- Western Australian Herbarium (WAH, 1998) records.
- EPBC Act Protected Matters Search Tool (PMST).

Significant flora species likelihood of occurrence was assessed systematically using a point-based system which takes into account proximity (<5km) and date (<20 years) of known records, presence within the Local Government Area (LGA) and habitat suitability (Table 9).

The likelihood of significant ecological communities occurring depends on the presence of suitable landforms, land systems, known occurrences and distance of known occurrences.

**Table 9 Categories of likelihood of occurrence for flora species**

Likelihood of Occurrence	Score	Definition
Known	6	Species is known to occur in the survey area.
High (Likely)	5	Not known to occur in the survey area however there are records nearby and suitable habitat for the species is known or likely to be present within the survey area.
Moderate (Possible)	4 (if suitable habitat may be present within the survey area) 3 (if suitable habitat is known to be, or likely to be present)	Species is not known to occur within the survey area however there are nearby records AND/OR recent records OR records within the LGA AND suitable habitat for the species is known or likely to be present within the survey area. OR Not known to occur within the survey area but there are records nearby AND recent records AND records within the LGA, and suitable habitat for the species may be present (marginal habitat).
Low (Unlikely)	2,3	Species is not known to occur within the survey area but there are records nearby OR recent records OR within the LGA AND suitable habitat for the species may be present (marginal habitat).
Negligible (Suitable Habitat not Present)	1,2,3	Despite records nearby OR being present within the LGA OR recent records, no suitable habitat is present within the survey area and therefore the likelihood of the species occurring is negligible.

## 4.2 Flora and Vegetation Assessment

A detailed flora and vegetation assessment was undertaken utilising methods outlined in the *Flora Survey Technical Guide* (EPA, 2016). The field surveys were undertaken by Floora De Wit (collection permit FB62000137) and Adam Fenton (FB62000488). Floora has 14 years' experience undertaking flora and vegetation assessments. Floora completed a Bachelor of Science in Environmental Biology (Environmental Restoration) and completed a Postgraduate Diploma in Environmental Management and Impact Assessment. Adam has five years' experience in environmental and ecological assessment. Adam completed a Bachelor of Biological Science and Master of Environmental Science.

The survey was undertaken on 19 November and 20 November 2022. Data was collected from four unbounded relevés and observation points. Data collected included the presence of plant species, their cover abundance, structural composition of vegetation, physical environment, and presence/absence of disturbance.

Each site was given a unique site number, and the following parameters recorded:

- date
- location using hand-held GPS (accuracy of 5 m)
- sample site type and size
- photograph (north-west corner)
- soil details (type, colour, moisture)
- landform
- vegetation condition
- fire history
- species list including:
  - estimated height
  - estimated percentage cover (for trees both percentage within relevé and within community was recorded to enable better description of vegetation community).

Any species unable to be identified in the field were collected for identification in AECOM's in-house herbarium and the specimens and taxonomic references and keys at the Western Australian Herbarium (WAH). Naming of species followed the convention of the WAH (1998).

### 4.2.1 Vegetation Mapping

Vegetation communities were described and mapped based on changes in dominant species composition and landform. Vegetation community descriptions were based on the Association Level V in accordance with the National Vegetation Information System (NVIS) Framework (DotEE, 2017a). Delineation of vegetation communities was supported by analysing floristic data collected within quadrats.

Vegetation community mapping was supported by assessing floristic similarity of quadrat and relevé data. The program Primer-e was used to conduct bray-curtis similarity analysis and produce dendrograms that illustrate this similarity. Data was incorporated using presence absence and scaled foliage (compositional) data. Scaling the foliage data overcomes the degree of error that is common in recording foliage and removes problems of subjectivity (Kent, 2012).

Vegetation condition was determined using the Keighery (1994) vegetation condition scale as recommended in the *Flora Survey Technical Guide* (EPA, 2016).

No Eucalypt trees defined in Table 2 of the Eucalypt Woodlands of the WA Wheatbelt Conservation Advice (DotE, 2015) were identified therefore no patch assessments were undertaken.

#### 4.2.2 Targeted Flora Searches

Targeted searches were undertaken for conservation significant flora species that were known or likely to occur. A detailed field guide was produced which included photographs and describing morphological features that would assist in identifying the species in the survey area.

Where a potential Priority species was encountered, the following was recorded:

- location (using a hand-held GPS accuracy 5m)
- the number of individuals in the immediate population, or an estimate of the size (number) of the population with an estimated radius of its spatial extent plant height
- vegetation condition
- associated dominant species
- soil type and colour
- topography
- additional information relevant to the area including key characteristics and landforms.

## 5.0 Survey Limitations

No significant limitations were identified that may impact on the ability to use the data to inform the environmental impact assessment. Limitations of the biological surveys are discussed in Table 10.

**Table 10** Limitations of the Ballidu flora and vegetation survey

Limitation	Flora and Vegetation Survey
Availability of contextual information on the region	<b>Nil</b> Contextual information was available using the DBCA database results and publicly available information.
Competency/experience of consultant conducting survey	<b>Nil</b> The survey was led by Floora de Wit who has more than 15 years' experience undertaking flora and vegetation assessments.
Proportion of flora / fauna identified, recorded and/or collected (based on sampling, timing and intensity)	<b>Nil</b> The survey was undertaken in Spring following several months of average or above-average rainfall which maximises detection of flora species in the area. Floristic data was collected at 10 quadrats and 3 relevés from 37.92 ha of native vegetation. All areas of native vegetation were traversed on foot to undertake targeted searches.
Completion (is further work needed)	<b>Nil</b> The objectives of the flora and vegetation assessment were met to delineate key flora and vegetation values including targeting significant flora and communities. All Priority flora were confidently identified in the field and counted during the field survey. Not all vegetation communities were represented by three or more quadrats as outlined in the EPA Technical Guidance. This was particularly relevant for communities less than 1 ha or degraded communities.
Remoteness and/or access problems	<b>Nil</b> The entire survey area was traversed on foot.
Timing, weather, season, cycle	<b>Nil</b> The survey was undertaken during the ideal survey season of Spring as defined in the Technical Guide (EPA, 2016). Rainfall was near average in the months leading up to the survey and not expected to have influenced the outcome of the survey.
Disturbances (e.g. fire flood, accidental human intervention) which affected results of the survey	<b>Nil.</b> No disturbances were noted that may influence the outcome of the survey.

## 6.0 Desktop Assessment

### 6.1 Threatened and Priority Ecological Communities

Three significant ecological communities occur within 50 km of the survey area. This includes one TEC listed as Critically Endangered under the EPBC Act, the Eucalypt Woodlands of the Western Australian Wheatbelt (Eucalypt Woodland TEC). This TEC represents two PECs listed by DBCA, including the Eucalypt Woodlands, and York Gum Woodlands of the Wheatbelt. Another PEC, Gimlet Woodlands of the Wheatbelt is known to occur in the vicinity.

None of the TECs or PECs overlap with the survey area (Figure 6). The three communities are described in Table 11.

**Table 11 Significant Ecological Communities known to occur in the vicinity of the survey area**

Community Name and Description (DBCA, 2021)	Cons. Status <sup>1</sup>	Distance from survey area
<b>Eucalypt Woodlands of the Western Australian Wheatbelt</b> The structure of the ecological community is a woodland in which the minimum crown cover of the tree canopy in a mature woodland is 10%. The key dominant or co-dominant species of the tree canopy are species of Eucalyptus trees that typically have a single trunk. Native understorey is present but is of variable composition, being a combination of grasses, other herbs and shrubs (DotE, 2015).	EPBC Act: CE DBCA: P3	4.5 km
<b>York Gum Woodlands of the wheatbelt</b> Part of the Eucalypt Woodlands of the WA Wheatbelt. No further information available.	EPBC Act: CE DBCA: P3	50 km
<b>Gimlet Woodlands of the wheatbelt</b> The structure of the ecological community is a woodland in which the floristic diversity and density has a 'U'-shaped trend, likely due to dominant tree and shrub species achieving maximum cover over an intermediate period, which competitively excludes other plant species.	DBCA: P3	23 km

1. EPBC Act CE Critically Endangered, DBCA P=Priority

### 6.2 Significant Flora

A total of 92 significant flora species were identified in the desktop study as potentially occurring. Of these, 37 are listed under the EPBC Act, 36 are listed under the BC Act, and 56 are listed as Priority by DBCA.

Four significant flora species are known to occur in the area, that is there are known DBCA or WA Herbarium records within the survey area. This includes one threatened species *Grevillea dryandroides* subsp. *dryandroides* (Endangered under EPBC Act and Critically Endangered under BC Act). Three Priority flora are known to occur, and nine other species were considered 'likely' to occur. These 13 significant flora species are described in Table 12.

Another 39 significant flora species were considered to 'possibly' occur, while the remaining 40 flora species were considered 'unlikely' or have a 'negligible' likelihood due to absence of suitable habitat, age of record, and lack of known records in the vicinity.

The comprehensive desktop study is presented in Appendix C and records are mapped in Figure 6.

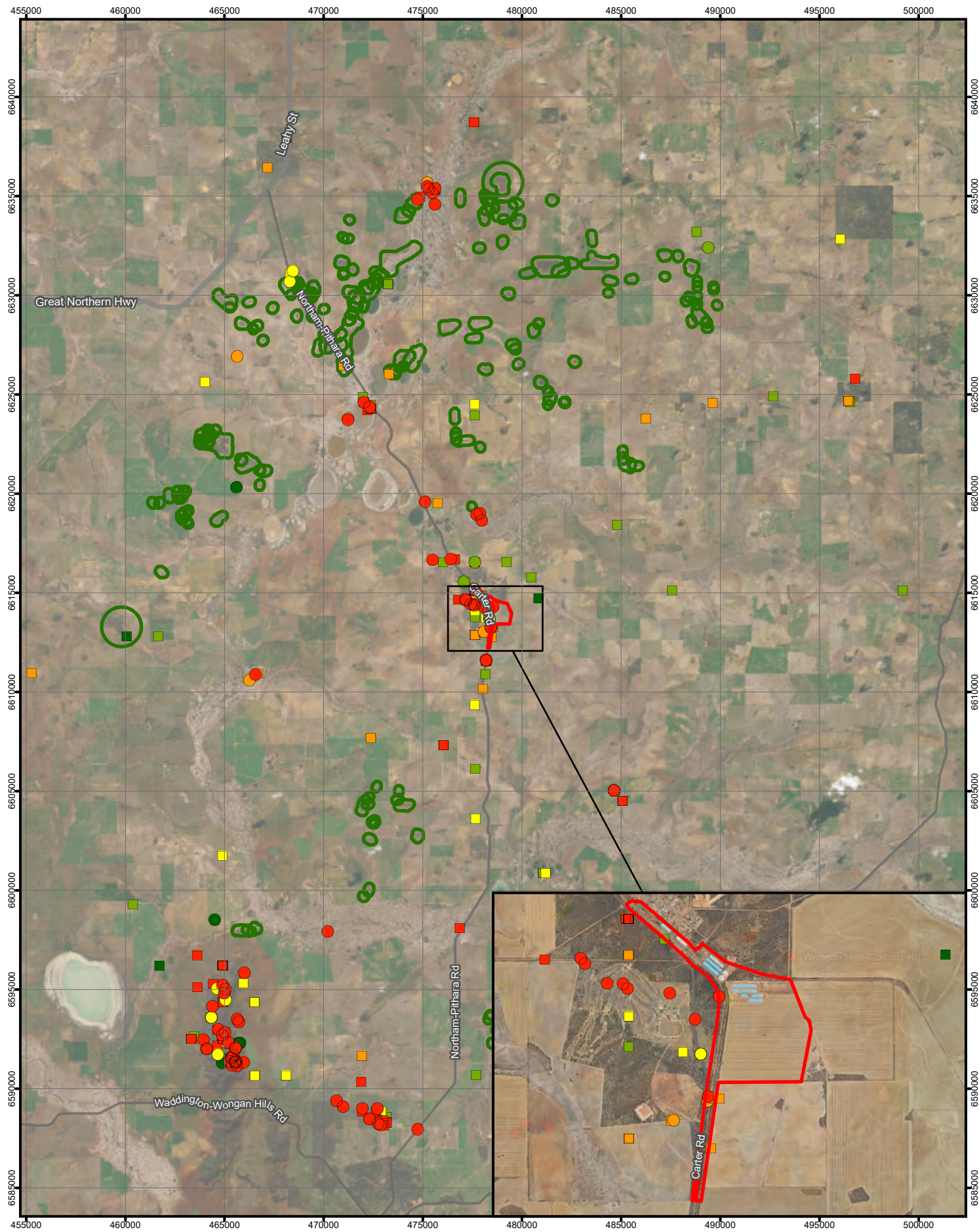
Table 12 Conservation significant flora species that are known and/or likely to occur

Species	Cons. Code <sup>1</sup>		Habitat <sup>2</sup>
	EPBC Act	BC Act / DBCA	
Known			
<i>Acacia lirellata</i> subsp. <i>Compressa</i>	-	P2	Bushy procumbent, spreading shrub, ca 0.5 m high, to 1.2 m wide. Fl. yellow. Yellow sand, clayey loam. Sandplains.
<i>Acacia scalena</i>	-	P3	Intricately branched, rigid, often straggly, prickly shrub, 0.5-1.5 m high. Fl. yellow, Jun to Sep. Yellow or yellow gravelly sand, loam.
<i>Dampiera glabrescens</i>	-	P1	Erect perennial, herb, 0.2-0.5(-0.9) m high. Fl. purple-blue, Sep. White or grey/yellow sand. Gravel pits, roadsides.
<i>Eremophila viscida</i>	Endangered	Endangered	Shrub, 1.2-4 m high. Fl. green-white-yellow, Sep to Nov. Granitic soils, sandy loam. Stony gullies, sandplains.
Likely			
<i>Gompholobium wonganense</i>	-	P3	Erect, spreading shrub, to 1.2 m high. Fl. yellow, Sep to Nov. Sand, laterite. Among hills.
<i>Grevillea dryandroides</i> subsp. <i>dryandroides</i>	Endangered	Critically Endangered	Lightly suckering shrub, 0.1-0.5 m high. Fl. red/pink-red, Sep to Oct or Feb. Yellow sand & gravel, clay.
<i>Grevillea kenneallyi</i>	-	P2	Spreading, dense shrub, 1.2-3 m high. Fl. white, Jul to Sep. Gravelly loam, laterite.
<i>Lepidobolus densus</i>	-	P4	Rhizomatous, caespitose perennial, herb (sedge-like), to 0.4 m high. Yellow lateritic sand, lateritic gravel. Dry kwongan.
<i>Rhodanthe chlorocephala</i> subsp. <i>chlorocephala</i>	-	P1	Erect annual, herb, 0.07-0.15 m high. Fl. yellow, Jul. Sandy soils. Near salt lake.
<i>Synaphea constricta</i>	-	P3	Compact, tufted shrub, 0.2-0.5 m high. Fl. yellow, Jun to Sep. Sand or sandy clay-loam over laterite.
<i>Urodon capitatus</i>	-	P3	Low spreading or upright shrub, (0.12-)0.3-1.2 m high, to 1 m wide. Fl. yellow-orange-red, Sep to Oct. Sandy gravelly soils. Plains.
<i>Verticordia venusta</i>	-	P3	Erect, spreading shrub, 0.2-2 m high. Fl. pink-purple/red-brown, Sep to Dec or Jan. Yellow sand, sandy gravel. Sandplains.

1. Conservation codes EN Endangered, VU Vulnerable, CR Critically Endangered, P Priority

1. Habitat derived from WAH (1998) Florabase





PROJECT ID 60697745  
CREATED BY MCDONNELLG  
APPROVED BY F. DE WIT  
LAST MODIFIED 15 MAY 2023

**AECOM**  
www.aecom.com

Datum: GDA 1994 MGA Zone 50  
1:250,000  
0 1 2 3 4  
km

Data sources:  
Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010).  
Service Layer Credits: World Imagery: Earthstar Geographics  
World Imagery: Maxar  
MMS:

**LEGEND**  
Survey Area

WA Herbarium database (WAHERB)  
Threatened  
P1  
P2  
P3  
P4

Threatened and Priority Flora database (TPFL)  
Threatened  
P1  
P2  
P3  
P4

TEC/PEC  
Priority 3

**Desktop Significant Flora and Communities**

**CBH**

**BALLIDU DETAILED FLORA AND VEGETATION ASSESSMENT**

**BALLIDU**

**Figure 6**

## 7.0 Field Survey Results

### 7.1 Vegetation



Cleared areas represented 136.53 ha of the 174.34 ha survey area. Six vegetation communities were described and mapped across 37.81 ha of native vegetation, comprising:



- three Shrublands
  - AcDr representing dense overstorey over sparse understorey on flats with gravel brown soils
  - McEm recorded on yellow sandplain
  - McGdWa recorded on hard yellow orange clay loam soils.
- two Mallee Woodlands
  - EpAcTp on flats with yellow brown clay soils
  - EwMhAs on flats with sandy clay soils
- one Heathland, AcBs recorded on yellow sandplain

The most dominant community was McGdWa representing *Allocasuarina campestris* tall shrubland recorded within the rail and road reserve. Descriptions of the vegetation communities recorded within the survey area are presented in Table 13 and mapped in Figure 8. The similarity of sample sites is presented in Figure 7 and demonstrates the relationship of the vegetation communities.





Table 13 Vegetation community descriptions and photographs

Description	Additional Detail	Photograph
<p>AcBs Open Heathland</p> <p><i>Allocasuarina campestris</i>, <i>Melaleuca orbicularis</i> and <i>Styphelia crassiflora</i> tall open heathland over <i>Borya sphaerocephala</i>, <i>Ecdeiocola monostachya</i> and <i>Mesomelaena preissii</i> tall sedgeland.</p> <p>Supports Priority species <i>Acacia lirellata</i> subsp. <i>compressa</i> (P2) and <i>Verticordia venusta</i> (P3). Community occurs on yellow sandplain.</p>	<p><b>Survey effort:</b> Quadrats 5, 6 and 7</p> <p><b>Area:</b> 2.54 ha</p> <p><b>Veg Condition:</b> Very Good</p> <p><b>Species Richness:</b> 48 native and 1 weed species</p>	
<p>AcDr Shrubland</p> <p><i>Allocasuarina campestris</i>, <i>Hakea meisneriana</i> and <i>Melaleuca conothamnoides</i> tall shrubland over <i>Dianella revoluta</i>, <i>Pimelea imbricata</i> var. <i>piligera</i> and <i>Ricinocarpos undulatus</i> low sparse forbland.</p> <p>Very dense overstorey over sparse understorey. Recorded on flats with gravelly brown soils.</p>	<p><b>Survey effort:</b> Quadrat 12</p> <p><b>Area:</b> 0.98 ha</p> <p><b>Veg Condition:</b> Good</p> <p><b>Species Richness:</b> 28 native and 1 weed species</p>	

Description	Additional Detail	Photograph
<p>EpAcTp Mid Mallee Woodland</p> <p><i>Eucalyptus phenax</i> subsp. <i>phenax</i> mallee woodland over <i>Allocasuarina campestris</i>, <i>Hibbertia exasperata</i> and <i>Chamelaucium brevifolia</i> tall to low open shrubland over <i>Trachymene pilosa</i>, <i>Dianella revoluta</i> and <i>Amphipogon caricinus</i> var <i>caricinus</i> low mixed grass and forbland.</p> <p>One occurrence recorded on flats with yellow brown clay.</p>	<p><b>Survey effort:</b> Quadrat 2</p> <p><b>Area:</b> 0.72 ha</p> <p><b>Veg Condition:</b> Very Good</p> <p><b>Species Richness:</b> 24 native and 2 weed species</p>	
<p>EwMhAs Open Mallee Woodland</p> <p><i>Eucalyptus wubinensis</i>, <i>Eucalyptus moderata</i> and <i>Acacia yorkrakinensis</i> subsp. <i>acrita</i> mid open woodland over <i>Melaleuca hamata</i>, <i>Acacia mackeyana</i> and <i>Acacia acuaria</i> tall to low open shrubland over <i>Austrostipa scabra</i>, <i>*Pentameris airoides</i> and <i>Waitzia acuminata</i> var. <i>acuminata</i> tall to low mixed sparse grass and forbland.</p> <p>Recorded on flats with sandy clay soils. Only recorded around carpark/partially cleared area north of CBH infrastructure.</p>	<p><b>Survey effort:</b> Relevé 11</p> <p><b>Area:</b> 1.27 ha</p> <p><b>Veg Condition:</b> Good</p> <p><b>Species Richness:</b> 20 native and 1 weed species</p>	



Description	Additional Detail	Photograph
<p>McEm Tall Shrubland</p> <p><i>Melaleuca cordata</i>, <i>Allocasuarina campestris</i> and <i>Melaleuca conothamnoides</i> tall shrubland over <i>Ecdeiocolea monostachya</i>, <i>Platysace trachymenioides</i> and <i>Amphipogon amphipogonoides</i> mixed tall sedge, forb and low grassland.</p> <p>Includes isolated occurrences of <i>Santalum acuminatum</i> and <i>Eucalyptus rigidula</i>. Recorded on flats with yellow sand.</p>	<p><b>Survey effort:</b> Quadrats 8 and 9</p> <p><b>Area:</b> 3.33 ha</p> <p><b>Veg Condition:</b> Very Good to Excellent</p> <p><b>Species Richness:</b> 21 native species</p>	
<p>McGdWa Tall Shrubland</p> <p><i>Melaleuca conothamnoides</i>, <i>Allocasuarina campestris</i> and <i>Grevillea paradoxa</i> tall shrubland over <i>Gahnia drummondii</i> low to tall open sedgeland over <i>Waitzia acuminata</i> var <i>acuminata</i>, <i>Trachymene pilosa</i> and <i>Platysace trachymenioides</i> low sparse forbland.</p> <p>Recorded on flat terrain with hard yellow orange clay loam soils. Includes isolated occurrences of <i>Eucalyptus wubinensis</i>.</p>	<p><b>Survey effort:</b> Quadrats 1, 3, 4, 10 and relevé 13</p> <p><b>Area:</b> 21.26 ha</p> <p><b>Veg Condition:</b> Good to Very Good</p> <p><b>Species Richness:</b> 48 native species</p>	

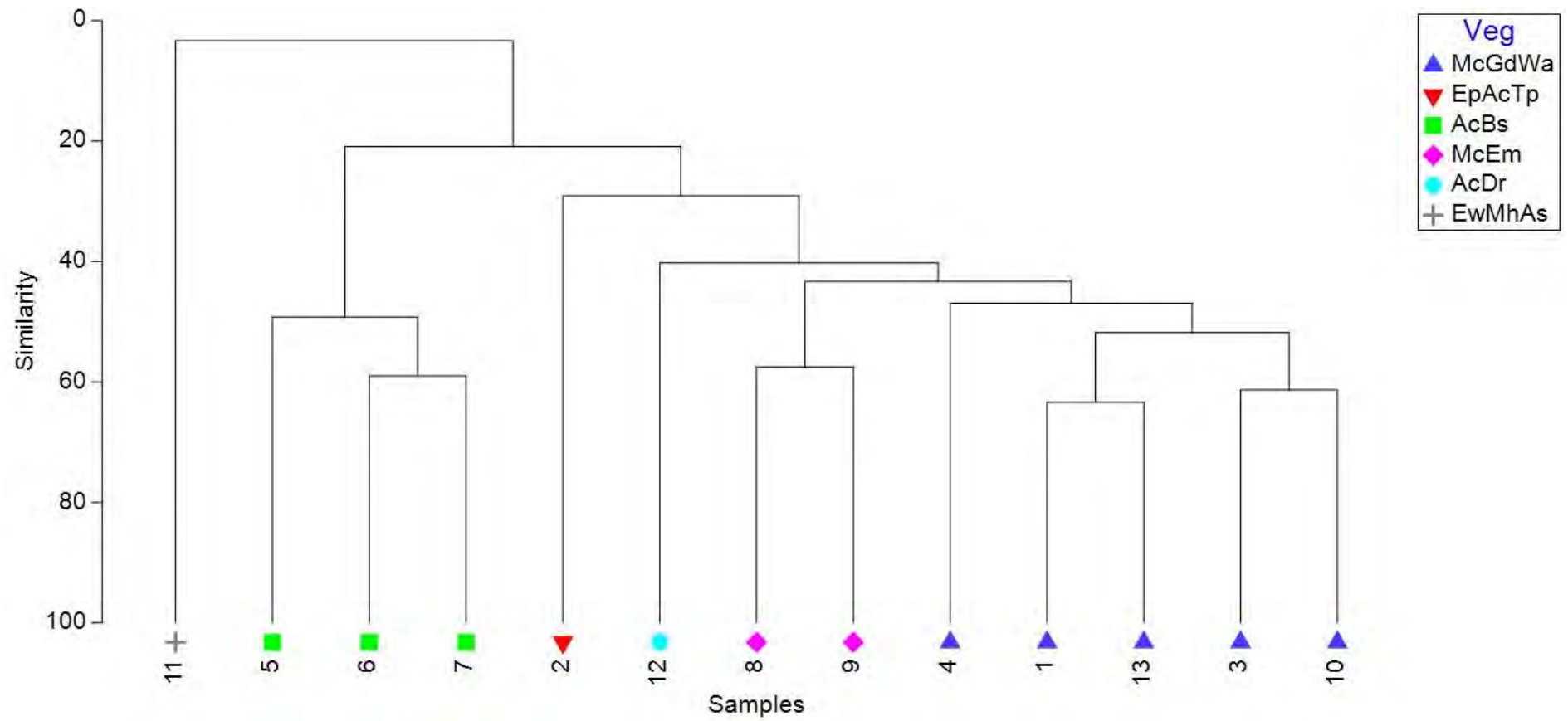


Figure 7 Similarity of floristic data from sample sites and symbolised by vegetation community

## 7.2 Vegetation Condition

The survey area comprises 174.34 ha of which 136.53 ha (78%) has been cleared for infrastructure and agriculture. The remaining 37.81 ha of native vegetation varied between Excellent and Completely Degraded, with majority of native vegetation mapped as Very Good (13.38 ha, 35% of native vegetation extent).

Extent of native vegetation condition and percent of native vegetation is presented in Table 14. Cleared area and total extent is also presented. Condition is mapped in Figure 9.

Factors that contributed to vegetation condition decline included partial clearing, weed invasion, and edge effects from roads, tracks and rail. Some rubbish and mounds of dirt from earth works were observed.

**Table 14 Vegetation condition extent**

Condition	Extent (ha)	Percent of Native Vegetation
Excellent	1.32	3
Very Good	13.38	35
Good	11.74	31
Degraded	3.59	9
Completely Degraded	7.78	21
<b>Total Native Vegetation</b>	<b>37.81</b>	<b>100</b>
Cleared	136.53	
<b>TOTAL</b>	<b>174.34</b>	<b>NA</b>

## 7.3 Flora

A total of 120 flora species were recorded comprising 116 native and four weed species. The most prolific families were Myrtaceae (20 species), Proteaceae (15 species), Poaceae and Fabaceae (13 species each).

### 7.3.1 Significant Flora

Six significant flora species were recorded including one species, *Grevillea dryandroides* subsp. *dryandroides* listed as Endangered under the EPBC Act and BC Act, and five flora species listed as Priority by DBCA. The details of all six species are presented in the sub-sections below.

#### 7.3.1.1 *Acacia lirellata* subsp. *compressa* (DBCA P2)

*Acacia lirellata* subsp. *compressa* was collected at one location (FdW221118-164) and confirmed by Mike Hislop (accession 9925). The species was in fruit at the time of the survey, and easily distinguished by its unique leaf morphology (Plate 1).

Ten individuals of *Acacia lirellata* subsp. *compressa* were recorded, representing one population. This population is part of the Threatened and Priority Flora List (TPFL) verified DBCA population #1. The majority of the individuals are on yellow sandplains associated with AcBs (8 individuals) but also McEm (one individual) and McGdWa (one individual).





**Plate 1** *Acacia lirellata* subsp. *compressa* (P2) leaf morphology (above), habit and habitat (below)

#### **7.3.1.2 *Acacia scalena* (DBCA Priority 3)**

Thirty-six individuals of *Acacia scalena* were recorded sporadically throughout the survey area in remnant native vegetation and growing along the fence in cleared areas (Plate 2; Figure 8). This species was confidently identified in the field from morphological features. It was collected at one location (FdW221118-161) and identified by Mike Hislop (accession 9925).

The species was predominantly associated with the tall *Allocasuarina campestris* shrubland McGdWa (28 individuals), and occasionally elsewhere in McEm and EpActTp (two individuals each) and in cleared areas (three individuals).





**Plate 2** *Acacia scalena* leaf morphology (top left), habit on fence (top right) and in fruit (bottom)

### 7.3.1.3 *Dampiera glabrescens* (DBCA Priority 1)

*Dampiera glabrescens* was known to occur in the survey area from WA Herbarium records and TPFL verified population #1. There were 190 individuals recorded of which 90 were found in cleared roadside, 99 were in the *Allocasuarina campestris* shrubland McGdWa and one was in the Mallee Woodland EpAcTp (Plate 3; Figure 8).

One collection was made (FdW221118-160) and identified by Mike Hislop (accession 9925). It was in flower at the time of the survey and confidently identified in the field.





Plate 3 *Dampiera glaberrima* in flower (above) and roadside habitat with flowering individual in centre of photo at base of shrub (below)

#### 7.3.1.4 *Grevillea dryandroides* subsp. *dryandroides* (EPBC Act Endangered, BC Act Critically Endangered)

One individual of *Grevillea dryandroides* subsp. *dryandroides* was recorded in the survey area. The individual was in flower at the time of the survey which assisted in the detection of the species. It grows underneath other plants and can be very obscure. The individual was recorded in *Allocasuarina campestris* shrubland McGdWa (Figure 8).

No collections were made as this species was readily identified in the field from morphological features (Plate 4).





**Plate 4** *Grevillea dryandroides* subsp. *dryandroides* in flower in survey area (left) and the image available on Florabase (WAH, 1998) (right)

#### 7.3.1.5 *Grevillea rosieri* (P2)

*Grevillea rosieri* was recorded in quadrat 1 where it was collected (FdW221119-170). It was not recognised as a Priority flora species at the time therefore no population counts are available. The species was recorded as 120 cm tall with a '0' for foliage cover, indicating that it was locally rare.

Quadrat 1 is in *Allocasuarina campestris* shrubland McGdWa situated on flat terrain with light brown clay loam soils. Its location is mapped in Figure 8.

#### 7.3.1.6 *Verticordia venusta* (P3)

*Verticordia venusta* was recorded at one location representing two individuals. The species was in flower at the time of the survey and was identified through the morphology of flowers and leaves (Plate 5). One collection was made (FdW221120-204) and confirmed by Mike Hislop (accession 9925).

The individuals were both recorded on yellow sandplain AcBs (Figure 8).



Plate 5 *Verticordia venusta* in flower (above) and habit (below)



## 8.0 Discussion

### 8.1 Vegetation

The survey area was 174.34 ha of which 37.81 ha represented native vegetation. The vegetation was dominated by *Allocasuarina campestris* shrubland over open understorey. This community, represented by McGdWa, was mapped for 21.26 ha (56% of native vegetation). The other five native vegetation communities were isolated occurrences, each representing less than 9% of total native vegetation extent.

Vegetation communities encountered were considered typical of the pre-European vegetation association which describes it as “shrublands; mallee and Casuarina thicket”. This aligns with the Shrublands, Mallee Woodlands and Heath encountered. The native vegetation represents a vegetation association that has been extensively cleared, with only 13.25% remaining in WA, and 5.91 ha remaining in the Shire of Wongan-Ballidu.

### 8.2 Flora

Flora diversity was relatively high (116 native flora recorded) given the extent of native vegetation (37.81 ha). One range extension was identified, the Priority 2 species *Grevillea rosieri* is not known from within 50 km of the survey area.

*Grevillea dryandroides* subsp. *dryandroides* is listed as Endangered under the EPBC Act and Critically Endangered under the BC Act. This species was originally known from Ballidu, Pithara and Wubin (TSSC, 2016b). Since 1999 the population has reduced to five populations known only from Ballidu within the Main Roads road reserve, Westrail reserve and the Shire reserve. In 1999 the five populations included 115 individuals (TSSC, 2016b).

One individual was recorded in the survey area. The individual is on the east side of the railway within a narrow corridor of vegetation between an access track and the rail corridor. It grows underneath other plants and can be very obscure. Care was taken by walking meandering transects 10-20 m apart slowly. The species was in flower at the time of the survey which assisted in confident identification. Individuals could be easily overlooked if not in flower.

A 50 m buffer is applicable for any species listed as Threatened under the EPBC Act and BC Act. No collection was made as it was recognised as a Threatened species and collecting Threatened flora without a permit is not allowed.

*Acacia lirellata* subsp. *compressa* is listed as Priority 2 by DBCA and was recorded at three locations comprising 10 individuals. It preferred yellow sandplain community AcBs (eight individuals). This population is likely to represent population #1 on the Threatened and Priority Flora List (TPFL) known to occur 100 m west of the survey area along the Northam-Pithara Road. There are six unverified locations on the WA Herbarium database nearby. This implies that this species is locally common within remnant native vegetation at Ballidu.

*Acacia scalena* is listed as Priority 3 by DBCA and was recorded throughout the survey area across various vegetation communities including EpAcTp, McEm and McGdWa. There are seven WA Herbarium records including four that are within 1 km of the survey area, and one that is inside the survey area boundary. The record within the boundary is from 2014 and described the species as being in the road verge within degraded area. This coincides with the survey results where several individuals were recorded within an isolated area of vegetation along the road verge near the northern extent of the survey area (Figure 8). There are no verified records on the TPFL within 50 km. The number of records and dates that they were recorded implies that this species may be locally common in native vegetation at Ballidu, however DBCA have not yet had the time to verify any of these.

*Dampiera glabrescens* is listed as Priority 1 by DBCA and is known from the survey area in the TPFL database (population #1) and WA Herbarium list. There are seven records of this species within 1 km of the survey area. It is a disturbance opportunist that was considered locally common along Northam-Pithara Road, and the rail access track. The estimated count of population #1 was 320 plants in 2000. During this survey 190 individuals were recorded, representing the southern extent of the population.

This was evident in the lack of records in the southern 300 m of the survey area (Figure 8). More individuals may be present along Northam-Pithara road outside the survey area.

*Grevillea rosieri* was recorded at Quadrat 1. It was not recognised as a Priority flora at the time of the survey so no population information is available. There are no known records of this species within 50 km of the survey area and therefore was not identified in the desktop study. The nearest record on Florabase (WAH, 1998-) is ~70km east from Wongan Hills where it was recorded on sandy clay in 1957, and one record in Xantippe Rock Reserve from 2002. This individual represents a significant range extension. It will be lodged with the WA Herbarium.

*Verticordia venusta* is listed as Priority 3 by DBCA. Two individuals were recorded on yellow Sandplains AcBs. There are no recent records nearby. The nearest verified population (population #10) is 16 km south of the survey area within Reynoldson Reserve. The WA Herbarium records within 10 km of the survey area pre-date GPS years (1982 and older).

Significant flora species that were considered 'Likely' to occur but not recorded are discussed below.

*Daviesia euphorbioides* is listed as Endangered under the EPBC Act and Critically Endangered under the BC Act. It was considered likely to occur due to the presence of suitable habitat, described as sandplains with heath dominated by *Casuarina* and *Actinostrobus* spp. (TSSC, 2016a). The nearest verified location, i.e. on the Threatened and Priority Flora List (TPFL), is 27 km south of the survey area. This perennial species was targeted during the survey but not recorded. Its likelihood has been reduced to 'Unlikely'.

*Eremophila viscida* is listed as Endangered under the EPBC Act and BC Act and is known to occur <100 m from the survey area (WA Herbarium record). This record is from 1934 and unlikely to be an accurate representation of location. There are four verified populations on the TPFL, the closest being 6 km north of the survey area. *Eremophila viscida* was considered likely to occur in the desktop study based on the proximity of nearby records. It is associated with brown, sandy-loam or red brown clay-loam soils in open woodland of *Eucalyptus loxophleba* (TSSC, 2017). The survey area is dominated by Tall Shrubland of *Allocasuarina* spp. with some pockets of Low Open Woodland of *Eucalyptus*. The species was targeted during the survey and no individuals recorded. Its likelihood has been reduced to 'Unlikely'.

*Gompholobium wonganense* is listed as Priority 3 and is known from one record 100 m from the survey area. the record is from 1934 and is unlikely to represent an accurate location. There are no verified populations within 50 km of the survey area. It was considered 'Likely' to occur based on habitat presence and proximity of record (despite the age). This perennial species was not recorded and habitat (sand, laterite, amongst hills) was absent. The likelihood was reduced to 'Unlikely' following the field survey.

*Goodenia perryi* is a Priority 3 species known to occur on yellow sand (WAH, 1998). There is a record 800 m from the survey area and as such was considered 'Likely' to occur. There are no verified TPFL populations of *Goodenia perryi* within 50 km of the survey area. The nearby record is from 1977 and has not been recorded here since. The likelihood has been reduced to 'Unlikely'.

*Rhodanthe chlorocephala* subsp. *chlorocephala* is a Priority 1 species that is associated with sandy soils. There is a record 4.7 km from the survey area from 2020. It has been associated with tall shrublands along salt lakes. There are no salt lakes near the survey area, therefore it is considered that no suitable habitat is present. This species likelihood has been reduced to 'Unlikely'.

*Synaphea constricta* is a Priority 3 species associated with sand or sandy clay-loam over laterite (WAH, 1998). There is a verified TPFL population (#5) within 500 m of the survey area, recorded in 1998. A collection of a *Synaphea* was made (FdW221118-163) from the survey area and identified by Mike Hislop (accession 9925) as *Synaphea spinulosa* subsp. *major*. No other *Synaphea* species were recognised. It should be mentioned that suitable habitat is present and *Synaphea* individuals can look very similar in the field. The likelihood has been reduced to 'Possible'.

## 9.0 Conclusion

A detailed flora and vegetation assessment as undertaken for the Ballidu Project on behalf of CBH. Two people traversed the survey area on foot to undertake systematic targeted flora searches and record floristic data from quadrats and relevés. A summary of results is presented below:

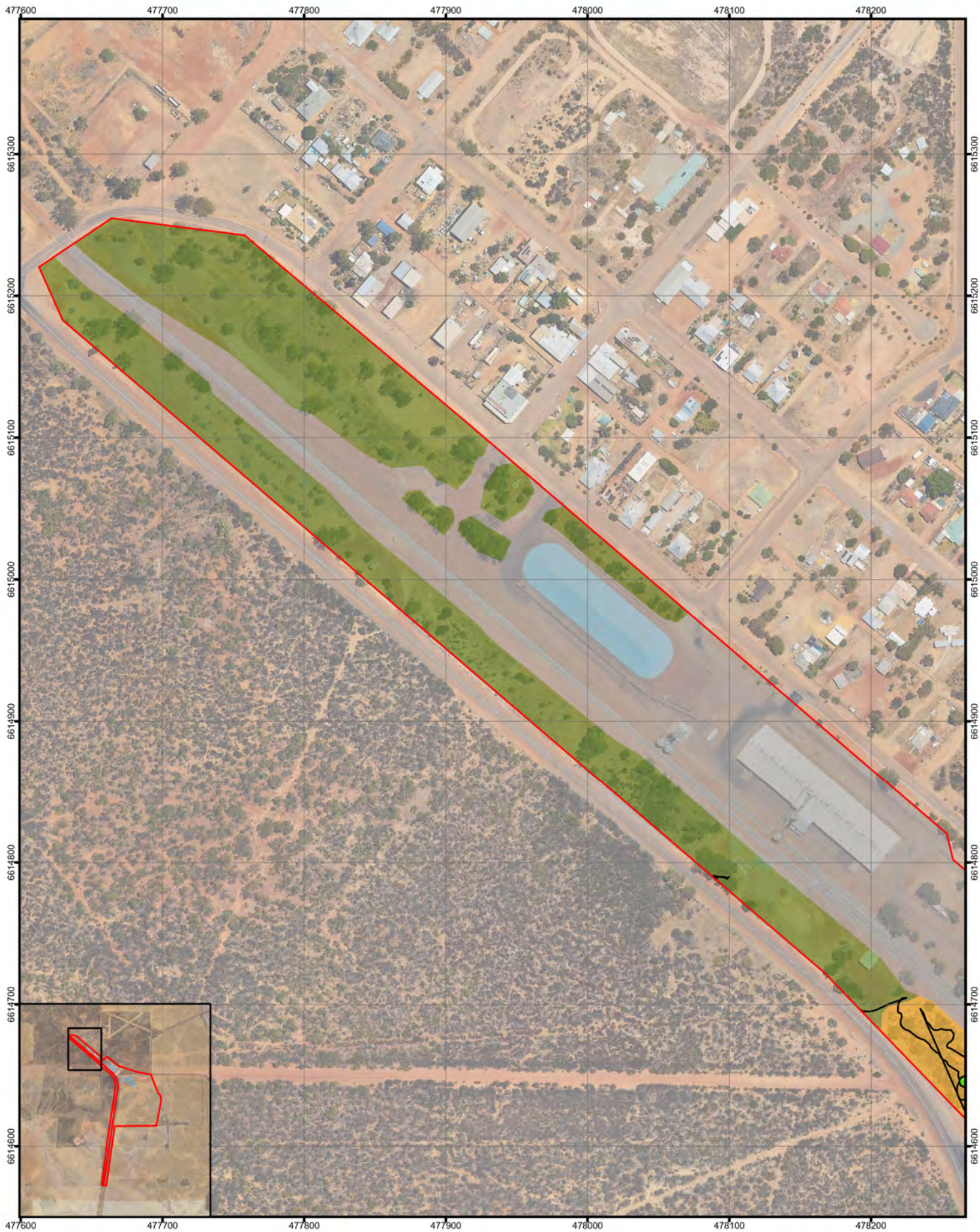
- The desktop assessment identified:
  - three TECs, none of which intersect with the survey area
  - 95 significant flora species occur in the vicinity, of which four were known to occur, and nine were considered 'Likely' to occur based on habitat presence
- Six native vegetation communities were mapped comprising three Shrublands, two Mallee Woodlands and one Heathland. The most dominant of these was an *Allocasuarina campestris* shrubland.
- Native vegetation comprises 22% of the total survey area extent. Of this, the majority was considered Very Good (13.38 ha, 35%) and Good (11.74 ha, 31%). Degradation was caused by earthworks, partial clearing, and edge effects
- Six significant flora species were recorded:
  - *Acacia liellata* subsp. *compressa* (DBCA Priority 2) 10 individuals
  - *Acacia scalena* (DBCA Priority 3) 36 individuals
  - *Dampiera glaberrima* (DBCA Priority 1) 190 individuals
  - *Grevillea dryandroides* subsp. *dryandroides* (EPBC Act Endangered, BC Act Critically Endangered) 1 individual
  - *Grevillea rosieri* (DBCA Priority 2) no population information available. Represents significant range extension.
  - *Verticordia venusta* (DBCA Priority 3) two individuals

The survey was successful with no significant limitations identified that may influence the results of the survey.

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**AECOM**  
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Datum: GDA2020 MGA Zone 50

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(when printed at A4)

0 30 60  
metres

Data sources:  
Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010)  
Service Layer Credits: WMS:  
World Hillshade: Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, MMA, Copernicus, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

LEGEND  
Survey Area  
Tracklog

Priority Flora  
● *Acacia scalena*, P3

Vegetation Communities  
Cleared  
McGdWa  
Trees

## Vegetation Communities, Survey Effort and Significant Flora

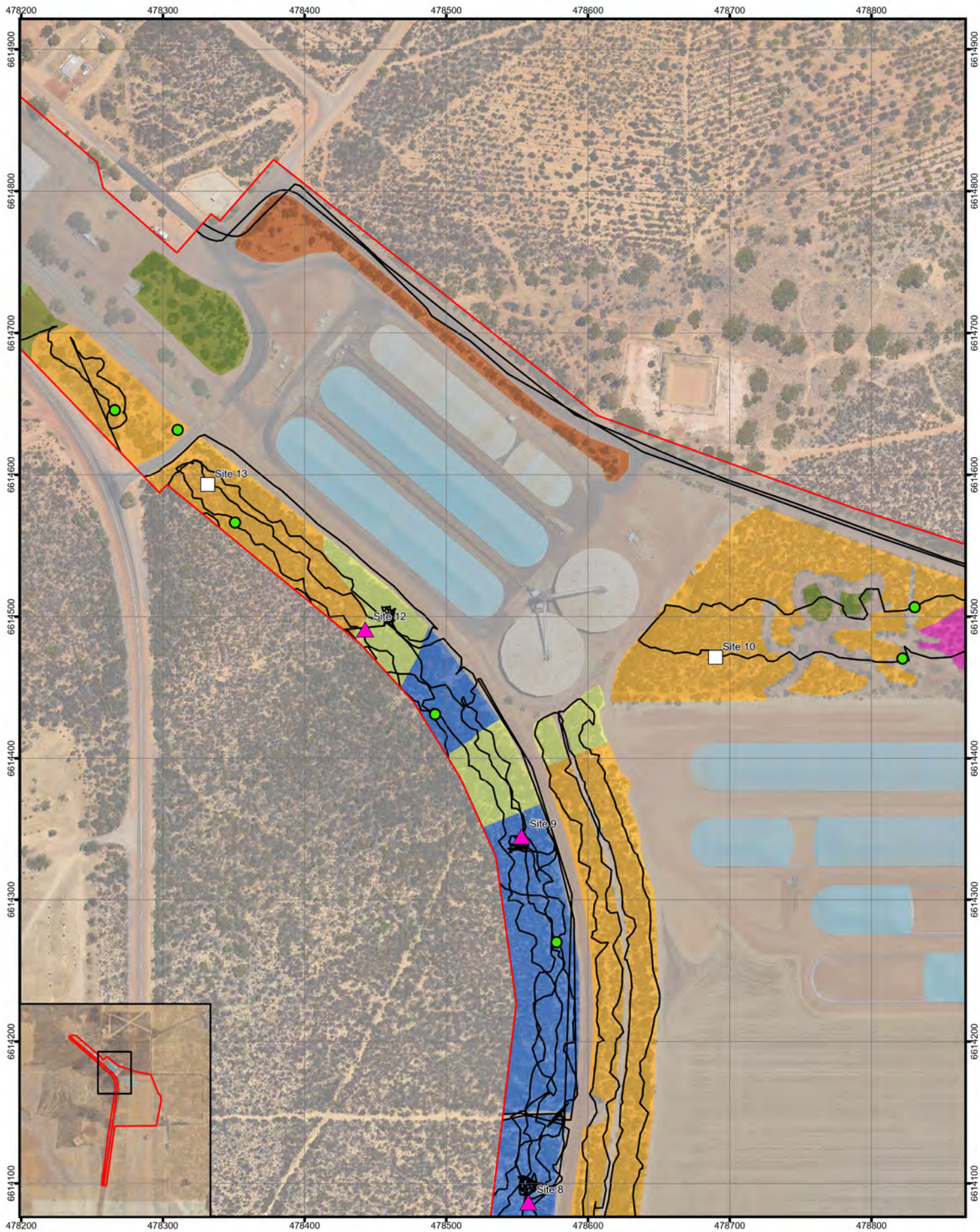
CBH

BALLIDU DETAILED FLORA AND  
VEGETATION ASSESSMENT

BALLIDU

Figure  
8.1





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**LEGEND**

Survey Area  
Tracklog  
Quadrat  
Releve

**Priority Flora**

Acacia scalena, P3

**Vegetation Communities**

AcDr  
Cleared  
EwMhAs  
McEm  
McGdWa  
Planted  
Trees

**Vegetation Communities, Survey Effort and Significant Flora**

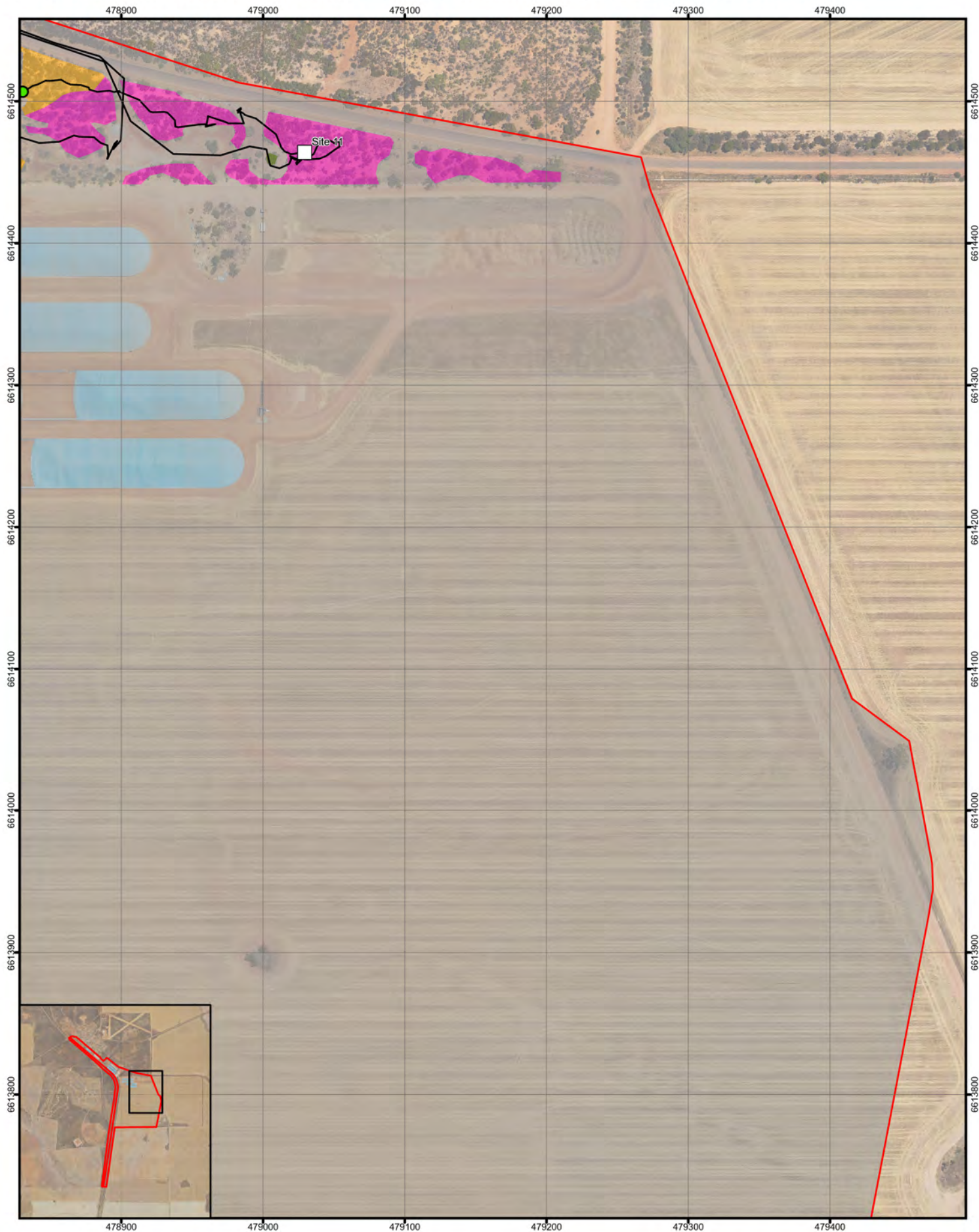
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**BALLIDU DETAILED FLORA AND VEGETATION ASSESSMENT**

**BALLIDU**

**Figure 8.2**





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Datum: GDA2020 MGA Zone 50

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0 30 60  
metres

Data sources:  
Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010)  
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- LEGEND
- Survey Area
  - Tracklog
  - Releve

Priority Flora

- Acacia scalena, P3

Vegetation Communities

- Cleared
- EwMhAs
- McGdWa
- Trees

### Vegetation Communities, Survey Effort and Significant Flora

CBH

BALLIDU DETAILED FLORA AND  
VEGETATION ASSESSMENT

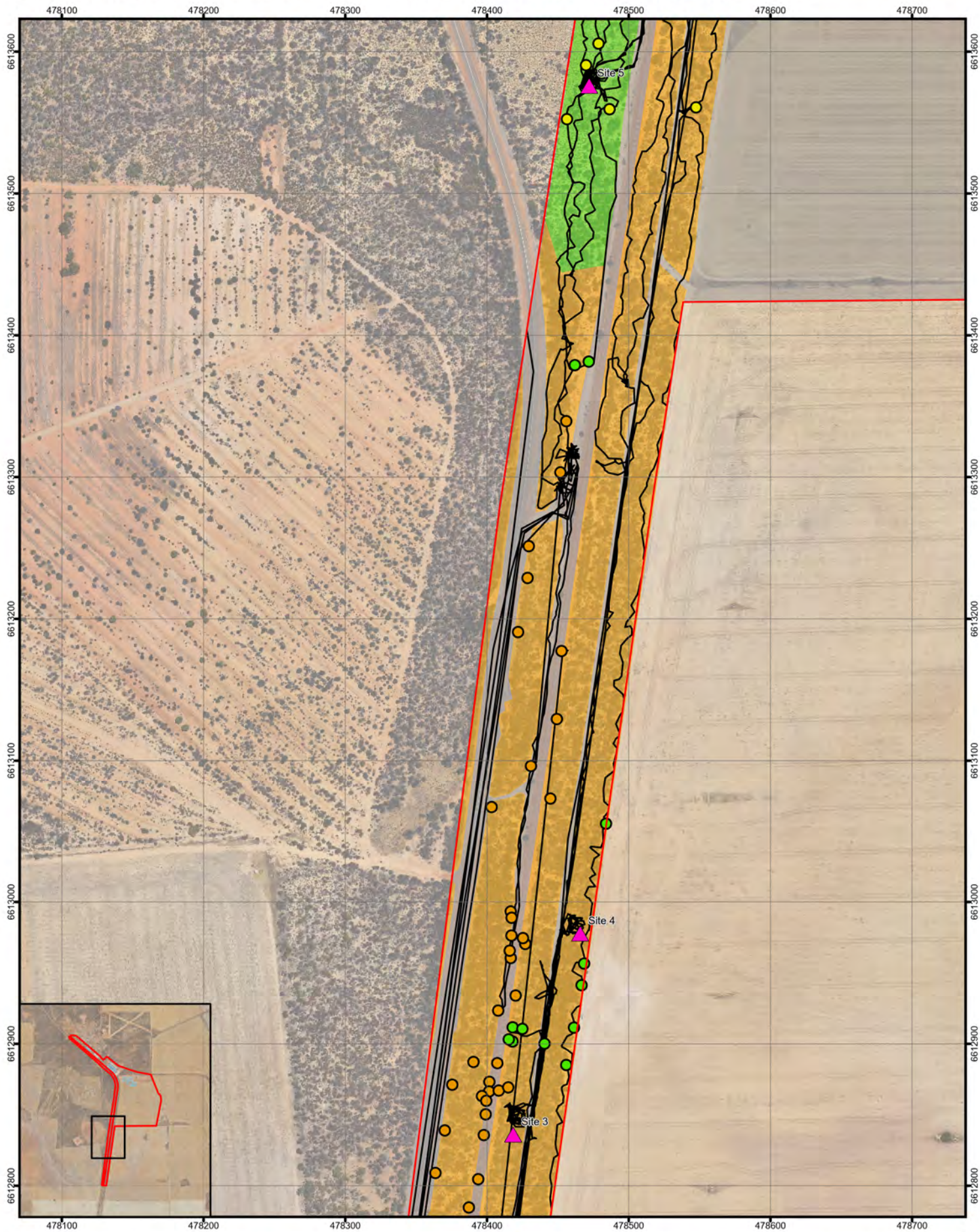
BALLIDU

Figure  
**8.3**









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 (when printed at A4)

0 30 60  
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Data sources:  
 Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010)  
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 World Hillshade: Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NOAA, Copernicus, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

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**LEGEND**

Survey Area  
 Tracklog  
 Quadrat

**Priority Flora**

- *Dampiera glaberrima*, P1
- *Acacia liellata* subsp. *compressa*, P2
- *Acacia scalena*, P3

**Vegetation Communities**

- AcBs
- Cleared
- McGdWa

**Vegetation Communities, Survey Effort and Significant Flora**

**CBH**

BALLIDU DETAILED FLORA AND VEGETATION ASSESSMENT

BALLIDU

**Figure 8.5**

A4 size





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- LEGEND**
- Survey Area
  - Tracklog
  - Quadrat
- Priority Flora**
- Dampiera glaberrima*, P1
  - Acacia scalena*, P3
- Vegetation Communities**
- Cleared
  - EpAcTp
  - McGdWa

## Vegetation Communities, Survey Effort and Significant Flora

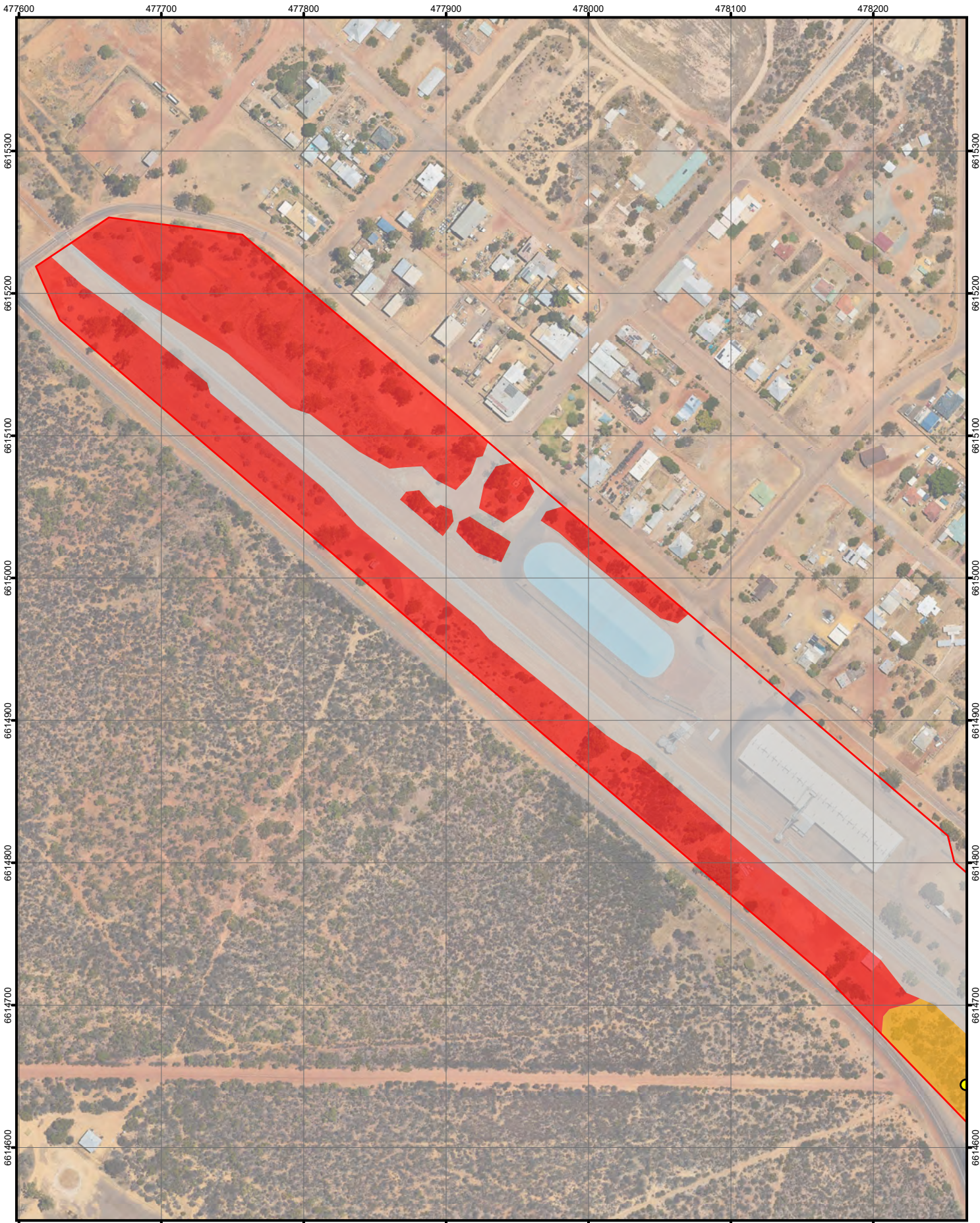
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BALLIDU DETAILED FLORA AND VEGETATION ASSESSMENT

BALLIDU

Figure  
 8.6





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#### LEGEND

Survey Area

Priority Flora

Acacia scalena, P3

Vegetation Condition

Degraded

Completely Degraded

Cleared



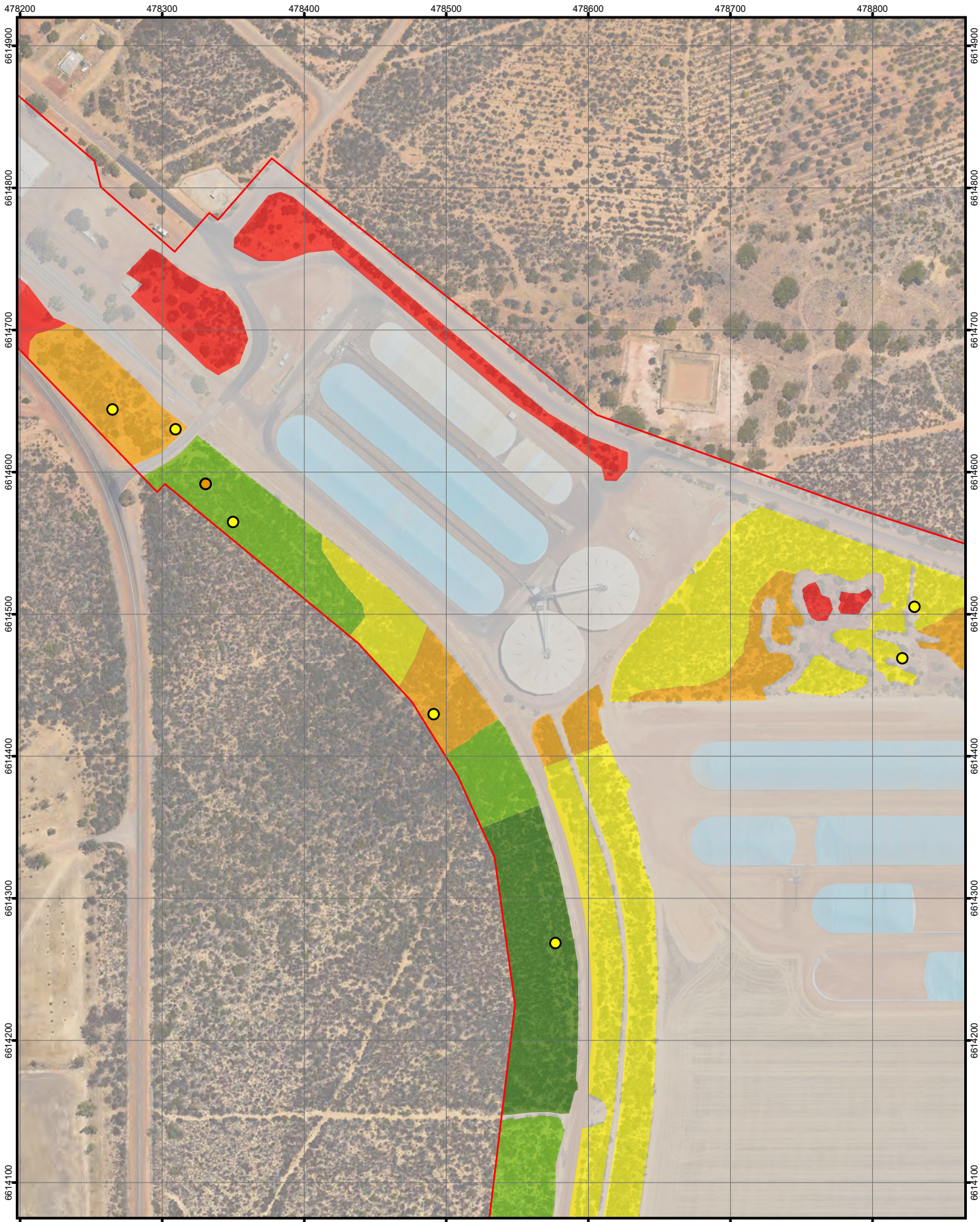
#### Vegetation Condition & Priority Flora

CBH

BALLIDU DETAILED FLORA AND  
VEGETATION ASSESSMENT  
BALLIDU

Figure  
9.1







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OS, MMA, Geodatasystems, Rijkswaterstaat, GSA, GeoLand, FEMA, Intermap and the GIS user


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LEGEND


 Survey Area

Priority Flora


 *Dampiera glaberrima*, P1


 *Acacia scalena*, P3


 *Verticordia venusta*, P3


 *Grevillea dryandroides* subsp. *dryandroides*, Critically Endangered


Vegetation Condition


 Excellent

 Very Good

 Good

 Degraded

 Completely Degraded

 Cleared



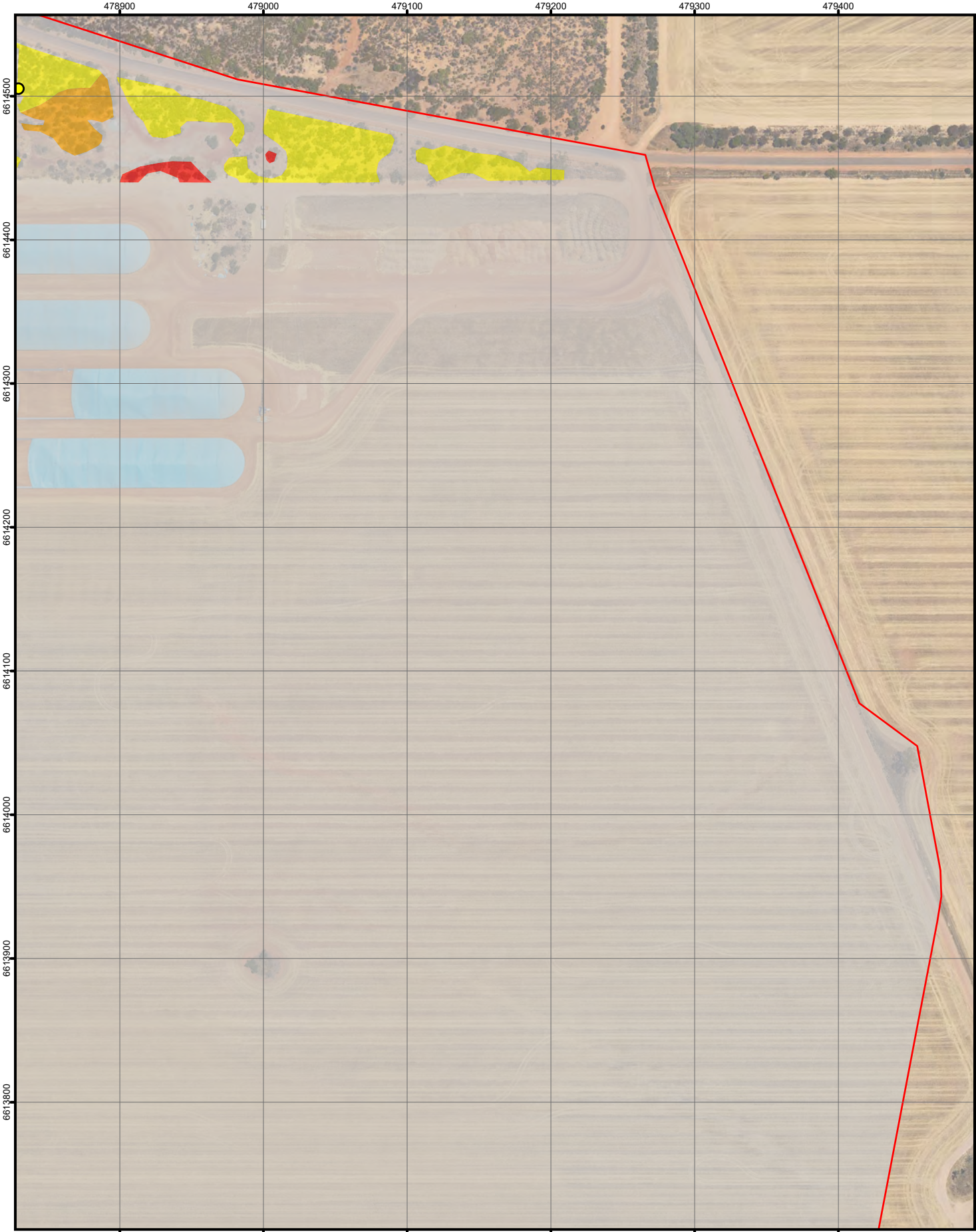
Vegetation Condition & Priority Flora

CBH

BALLIDU DETAILED FLORA AND VEGETATION ASSESSMENT  
BALLIDU

Figure  
9.2





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Datum: GDA 1994 MGA Zone 50

0

25

50

75

metres

Data sources:  
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LEGEND

Survey Area

Priority Flora

Acacia scalena, P3

Vegetation Condition

Good

Degraded

Completely Degraded

Cleared

Vegetation Condition & Priority Flora

CBH

BALLIDU DETAILED FLORA AND VEGETATION ASSESSMENT

BALLIDU

Figure

9.3

A4 size







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Datum: GDA 1994 MGA Zone 50  
  
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Data sources:  
Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010)  
Service Layer Credits: World Hillshade: Esri, Geoscience Australia, NASA, NGA, USGS  
WMS:


LEGEND


 Survey Area

Priority Flora


 *Acacia lirellata* subsp. *compressa*, P2


 *Acacia scalena*, P3


 *Verticordia venusta*, P3


 *Grevillea dryandroides* subsp. *dryandroides*, Critically Endangered


Vegetation Condition

 Excellent

 Very Good

 Good

 Degraded

 Cleared



Vegetation Condition & Priority Flora

CBH

BALLIDU DETAILED FLORA AND VEGETATION ASSESSMENT  
BALLIDU

Figure

9.4






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Datum: GDA 1994 MGA Zone 50


0255075


metres


Data sources:  
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LEGEND

 Survey Area


 Priority Flora


 *Dampiera glaberrima*, P1


 *Acacia lirellata subsp. compressa*, P2

 *Acacia scalena*, P3

Vegetation Condition

 Very Good

 Good

 Cleared



Vegetation Condition & Priority Flora

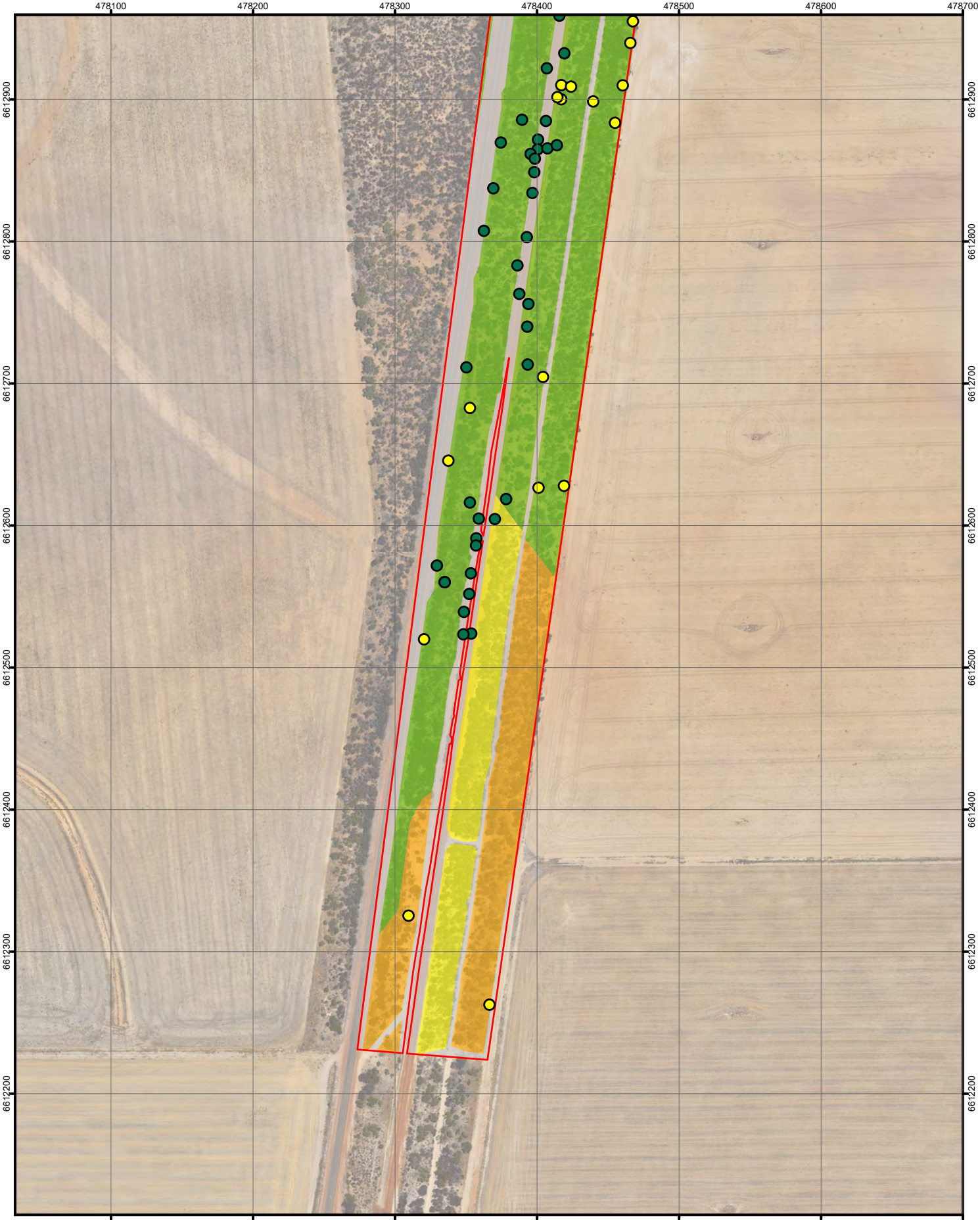
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BALLIDU DETAILED FLORA AND VEGETATION ASSESSMENT  
BALLIDU

Figure

9.5





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(when printed at A4)

Datum: GDA 1994 MGA Zone 50

0

25

50

75

metres

Data sources:  
Base Data: (c) Based on information provided by and with the permission of the Western Australian Land Information Authority trading as Landgate (2010).  
Service Layer Credits: World Hillshade: Esri, Geoscience Australia, NASA, NGA, USGS  
WMS:

LEGEND

Survey Area

Priority Flora

Dampiera glaberrima, P1

Grevillea rosieri, P2

Acacia scalena, P3

Vegetation Condition

Very Good

Good

Degraded

Cleared



Vegetation Condition & Priority Flora

CBH

BALLIDU DETAILED FLORA AND VEGETATION ASSESSMENT

BALLIDU

Figure

9.6



# Appendix A

## Significant Flora Desktop Results

Appendix A Flora Desktop Assessment

Taxon	Habitat	Cons. Code		Distance from Survey Area		Date of Record		PMST	Likelihood Assessment					Total Score	Likelihood	
		EPBC Act	BC Act / DBCA	WA Herb	TPFL	WA Herb	TPFL		Recorded in survey area	Known nearby (5km)	Recent Record (Last 20 years)	Known within LGA	Presence of suitable habitat (0,1,2)		Pre-Survey	Post-Survey
<i>Acacia ataxiphylla</i> subsp. <i>magna</i>	Sandy soils. Lateritic ironstone rises, flats.	E	EN	-	-			Yes	0	0	0	0	2	2	Unlikely	Unlikely. Not recorded during survey.
<i>Acacia botrydion</i>	Gravelly lateritic soils. Hillslopes.	-	P4	23.1	-	5/09/1985			0	0	0	1	2	3	Possible	Unlikely. No hillslops in survey area, not recorded.
<i>Acacia cochlocarpa</i> subsp. <i>cochlocarpa</i>	Clayey, sandy, often gravelly soils.	E	CR	-	-			Yes	0	0	0	0	2	2	Unlikely	Unlikely. Not recorded during survey.
<i>Acacia cochlocarpa</i> subsp. <i>velutinos</i>	Sandy clay or laterite.	CE	CR	19.7	19.65	29/03/2007	3/07/2017	Yes	0	0	1	1	2	4	Possible	Unlikely. Not recorded during survey.
<i>Acacia congesta</i> subsp. <i>wonganensis</i>	Rocky clay, laterite.	-	P2	20.9	23.27	23/07/1981	5/08/2000		0	0	0	1	0	2	Negligible	Negilgible. No suitable habitat.
<i>Acacia denticulosa</i>	Grows in shallow sandy soils or in loams, silts or clay and is sometimes associated with granite hills and outcrops (DEWHA, 2008a). It rarely grows on sandplains.	V	VU	20.9	20.47	23/11/2009	24/08/2001	Yes	0	0	1	1	1	3	Possible	Negilgible. No suitable habitat.
<i>Acacia dissona</i> var. <i>indoloria</i>	Sand, sandy loam. Undulating plains.	-	P3	1.3	1.30	23/02/2000	23/02/2000		0	1	0	1	2	4	Possible	Unlikely. Not recorded during survey.
<i>Acacia dura</i>	Sand, sandy loam, laterite.	-	P2	23.9	-	11/09/2008			0	0	1	1	2	4	Possible	Unlikely. Not recorded during survey.
<i>Acacia filifolia</i>	Yellow sand, gravelly lateritic sand. Sandplains.	-	P3	24.2	24.49	24/07/1981	22/08/2001		0	0	0	1	2	3	Possible	Unlikely. Not recorded during survey.
<i>Acacia lirellata</i> subsp. <i>compressa</i>	Yellow sand, clayey loam. Sandplains.	-	P2	0.1	0.11	4/07/2006	4/07/2006		1	1	1	1	2	6	Known	Known, recorded during survey
<i>Acacia phaeocalyx</i>	Yellow or white sand, often over laterite. Flats, hillsides.	-	P3	24.5	-	22/01/1971			0	0	0	1	2	3	Possible	Unlikely. Not recorded during survey.
<i>Acacia pharangites</i>	Red-brown clay, greenstone. Gullies.	E	CR	23.8	23.81	11/09/2004	12/07/2005	Yes	0	0	1	1	0	2	Negligible	Negilgible. No suitable habitat.
<i>Acacia pygmaea</i>	Laterite. In crevices, summit of ridges.	E	EN	21.9	24.23	24/11/2009	3/01/2020	Yes	0	0	1	1	0	2	Negligible	Negilgible. No suitable habitat.
<i>Acacia scalena</i>	Yellow or yellow gravelly sand, loam.	-	P3	0.0	-	25/09/2014			1	1	1	1	2	6	Known	Known, recorded during survey
<i>Acacia semicircularis</i>	Gravelly soils, laterite. Hillslopes.	-	P4	20.9	13.04	6/06/1986	25/10/2004		0	0	1	1	2	4	Possible	Unlikely. Not recorded during survey.
<i>Acacia</i> sp. Manmanning (B.R. Maslin 7711)	Yellow gravelly sand towards base of low rise. Disturbed land near road verges, gravel pits.	-	P1	20.0	-	21/11/2013			0	0	1	1	2	4	Possible	Unlikely. Not recorded during survey.
<i>Acacia</i> sp. Petrudor Rocks (B.R. Maslin 7714)	Loam or clayey loam over granite. Upper slopes of catchment area, under Eucalyptus low mallee.	-	P1	2.1	-	10/12/2010			0	1	1	1	0	3	Possible	Negilgible. No suitable habitat.
<i>Acacia trinalis</i>	Brown sand, clay loam. Salt lakes & flats, swampy areas.	-	P1	-	16.73		15/09/1987		0	0	0	0	1	1	Unlikely	Negilgible. No suitable habitat.
<i>Acacia vassalii</i>	Grey/brown or yellow sand, sandy loam.	E	CR	-	-			Yes	0	0	0	0	2	2	Unlikely	Unlikely. Not recorded during survey.
<i>Acacia volubilis</i>	Gravelly sand, sandy clay.	E	CR	-	-			Yes	0	0	0	0	2	2	Unlikely	Unlikely. Not recorded during survey.
<i>Andersonia gracilis</i>	White/grey sand, sandy clay, gravelly loam. Winter-wet areas, near swamps.	E	VU	-	-			Yes	0	0	0	0	2	2	Unlikely	Unlikely. Not recorded during survey.
<i>Angianthus micropodioides</i>	Saline sandy soils. River edges, saline depressions, claypans.	-	P3	15.9	-	19/11/2008			0	0	1	0	1	2	Unlikely	Unlikely. Not recorded during survey.
<i>Balaustion baiocalyx</i>	Records found on westerly facing, moderate midslope. Yellow sand, light grey loamy sand.	-	P1	21.0	-	19/11/2013			0	0	1	1	1	3	Possible	Unlikely. Not recorded during survey.
<i>Banksia wonganensis</i>	Gravelly loam. Lateritic rises.	-	P4	24.8	-	23/08/1965			0	0	0	1	1	2	Unlikely	Unlikely. Not recorded during survey.
<i>Boronia ericifolia</i>	Sandy loam, clay, laterite. Low-lying spots.	-	P2	8.6	18.07	11/09/2008	11/06/1992		0	0	1	1	1	3	Possible	Unlikely. Not recorded during survey.
<i>Caladenia cristata</i>	Sandy clay. Sandy rise above salt flats, freshwater.	-	P1	11.7	10.69	10/09/1998	15/09/1991		0	0	0	1	1	2	Unlikely	Unlikely. Not recorded during survey.
<i>Caladenia drakeoides</i>	Grey clayey sand, red sandy loam, in damp situations. Margins of salt lakes.	E	CR	-	3.42		8/09/2021	Yes	0	1	1	1	1	4	Possible	Negilgible. No suitable habitat.
<i>Caladenia x hopperi</i>	No habitat information available. Record collected from Pithara, north of Ballidu	E	P1	24.6	-	9/09/1988			0	0	0	0	0	0	Negligible	Negilgible. No suitable habitat.
<i>Calothamnus quadrifidus</i> subsp. <i>asper</i>	No habitat information available - records from Wongan Hills	-	P2	24.6	-	17/02/1980			0	0	0	1	2	3	Possible	Unlikely. Not recorded during survey.



Appendix A Flora Desktop Assessment

Taxon	Habitat	Cons. Code		Distance from Survey Area		Date of Record		PMST	Likelihood Assessment					Total Score	Likelihood	
		EPBC Act	BC Act / DBCA	WA Herb	TPFL	WA Herb	TPFL		Recorded in survey area	Known nearby (5km)	Recent Record (Last 20 years)	Known within LGA	Presence of suitable habitat (0,1,2)		Pre-Survey	Post-Survey
<i>Chamelaucium</i> sp. Wongan Hills (B.H. Smith 1140)	Gently undulating terrain, loamy sand with lateritic gravel.	-	P3	16.1	-	24/11/1988			0	0	0	1	2	3	Possible	Unlikely. Not recorded during survey.
<i>Chorizema humile</i>	Sandy clay or loam. Plains.	E	CR	-	-			Yes	0	0	0	0	1	1	Unlikely	Negilgible. No suitable habitat.
<i>Comesperma griffinii</i>	Yellow or grey sand. Plains.	-	P2	24.9	-	7/11/1999			0	0	0	0	2	2	Unlikely	Unlikely. Not recorded during survey.
<i>Conospermum densiflorum</i> subsp. <i>Unicephalatum</i>	Clay soils. Low-lying areas.	E	EN	-	-			Yes	0	0	0	0	0	0	Negligible	Negilgible. No suitable habitat.
<i>Conostylis wonganensis</i>	Grows in yellow sand over clay or laterite on gradual slopes, found in areas with species-rich heath with emergent mallees (DotE, 2014).	E	EN	-	24.07		27/08/2019	Yes	0	0	1	1	2	4	Possible	Unlikely. Not recorded during survey.
<i>Dampiera glabrescens</i>	White or grey/yellow sand. Gravel pits, roadsides.	-	P1	0.0	0.00	24/09/2014	11/09/2002		1	1	1	1	2	6	Known	Known, recorded during survey
<i>Dasymalla axillaris</i>	Native Foxglove grows in sandy soils (Western Australian Herbarium, 2006). The species is thought to be a disturbance opportunist.	CE	CR	24.6	-	2/10/1961		Yes	0	0	0	0	2	2	Unlikely	Unlikely. Not recorded during survey.
<i>Daviesia debilior</i> subsp. <i>sinuans</i>	Gravelly lateritic clay.	-	P3	24.6	-	17/07/1980			0	0	0	1	1	2	Unlikely	Unlikely. Not recorded during survey.
<i>Daviesia dielsii</i>	Sandy, often gravelly soils.	E	EN	-	-			Yes	0	0	0	0	2	2	Unlikely	Unlikely. Not recorded during survey.
<i>Daviesia euphorbioides</i>	Occurs in sandplain habitat with heath dominated by <i>Casuarina</i> and <i>Actinostrobos</i> (TSSC, 2016a). The species is often found growing with <i>Hemigenia viscida</i> (TSSC, 2016a). Other associated species include <i>Conospermum brownii</i> , <i>Boronia coerulescens</i> , <i>Glischrocaryon aureum</i> , <i>Lysinema ciliatum</i> , <i>Verticordia chrysantha</i> and <i>Calytrix</i> species (TSSC, 2016a).	E	CR	21.3	24.53	22/01/1971	6/09/2012	Yes	0	0	1	1	2	4	Likely	Unlikely. Not recorded during survey.
<i>Daviesia spiralis</i>	Gravelly lateritic clay & sand.	-	P4	24.6	24.86	6/09/2013	1/10/1999		0	0	1	1	1	3	Possible	Unlikely. Not recorded during survey.
<i>Dicrastylis reticulata</i>	Sandy soils, often over granite. Amongst granite rock, hills, flats.	-	P3	17.0	-	26/08/1971			0	0	0	1	2	3	Possible	Unlikely. Not recorded during survey.
<i>Eremophila pinnatifida</i>	Loam. s grows in red or brown clay loam in tall open woodland and shrubland	E	CR	-	-			Yes	0	0	0	0	0	0	Negligible	Negilgible. No suitable habitat.
<i>Eremophila rarissima</i>	Edge of salt flat. Road verge, grey loam.	-	P1	7.5	-	15/02/2009			0	0	1	1	0	2	Negligible	Negilgible. No suitable habitat.
<i>Eremophila resinosa</i>	Clay loam, gravelly sandy clay. Road verges.	E	EN	-	-			Yes	0	0	0	0	2	2	Unlikely	Unlikely. Not recorded during survey.
<i>Eremophila viscida</i>	Preferred habitat is brown, sandy-loam or red brown clay-loam soils, in open woodland in association with <i>Eucalyptus loxophleba</i> (York gum) and scrub vegetation (TSSC, 2017).	E	EN	0.1	5.03	25/09/2014	24/09/2014	Yes	1	1	1	1	2	6	Likely	Unlikely. Not recorded during survey, no suitable habitat present.
<i>Eucalyptus caesia</i> subsp. <i>caesia</i>	Granite outcrops.	-	P4	24.5	-	18/08/2000			0	0	0	1	1	2	Unlikely	Negilgible. No suitable habitat.
<i>Eucalyptus recta</i>	Sandy laterite.	E	VU	-	-			Yes	0	0	0	0	2	2	Unlikely	Unlikely. Not recorded during survey.
<i>Eucalyptus subangusta</i> subsp. <i>virescens</i>	Yellow sand, white clay.	-	P3	21.0	20.61	23/10/1986	23/10/1986		0	0	0	0	2	2	Unlikely	Unlikely. Not recorded during survey.
<i>Eucalyptus x camabyi</i>	Grey sand, sandy loam. Lateritic ridges.	-	P4	17.7	-	9/06/1987			0	0	0	1	2	3	Possible	Negilgible. No suitable habitat.
<i>Frankenia conferta</i>	The preferred habitat is around the high water mark of lake shorelines to the tops of low mounds within saline pans	E	VU	10.5	10.58	4/11/2003	25/09/2014	Yes	0	0	1	0	0	1	Negligible	Negilgible. No suitable habitat.
<i>Frankenia glomerata</i>	White sand. Records found to occur on light brown loamy sand.	-	P4	11.7	-	18/11/2008			0	0	1	1	2	4	Possible	Negilgible. No suitable habitat.
<i>Gastrolobium glaucum</i>	Sandy, often gravelly soils over laterite. Slopes, breakaways.	E	CR	22.5	24.61	18/09/2006	19/09/2006	Yes	0	0	1	1	0	2	Negligible	Negilgible. No suitable habitat.
<i>Gastrolobium hamulosum</i>	Sandy, often gravelly soils or clay. Flats, slopes, ridges.	E	CR	24.1	23.89	18/09/2006	3/09/2015	Yes	0	0	1	1	1	3	Possible	Unlikely. Not recorded during survey.

Appendix A Flora Desktop Assessment

Taxon	Habitat	Cons. Code		Distance from Survey Area		Date of Record		PMST	Likelihood Assessment					Total Score	Likelihood	
		EPBC Act	BC Act / DBCA	WA Herb	TPFL	WA Herb	TPFL		Recorded in survey area	Known nearby (5km)	Recent Record (Last 20 years)	Known within LGA	Presence of suitable habitat (0,1,2)		Pre-Survey	Post-Survey
<i>Gompholobium wonganense</i>	Sand, laterite. Among hills.	-	P3	0.1	-	0/01/1900			0	1	0	1	1	3	Possible	Unlikely. Not recorded during survey.
<i>Goodenia perryi</i>	Yellow sand.	-	P3	0.8	-	9/11/1977			0	1	0	1	2	4	Likely	Unlikely. Not recorded during survey.
<i>Grevillea asparagoides</i>	Gravelly loam, white or yellow sand.	-	P3	22.1	-	29/06/2007			0	0	1	1	2	4	Possible	Unlikely. Not recorded during survey.
<i>Grevillea dryandroides</i> subsp. <i>dryandroides</i>	Found in open heath on grey sandy loam and yellow gravelly sand, with shrubs of <i>Allocasuarina</i> and <i>Melaleuca</i> (TSSC, 2016b). Species is endemic to WA	E	CR	0.1	0.00	4/11/2009	5/07/2017	Yes	1	1	1	1	2	6	Known	Known, recorded during survey
<i>Grevillea dryandroides</i> subsp. <i>hirsuta</i>	White or yellow sand, laterite.	E	VU	-	-			Yes	0	0	0	0	2	2	Unlikely	Unlikely. Not recorded during survey.
<i>Grevillea haplantha</i> subsp. <i>recedens</i>	Sand, sandy loam.	-	P3	19.8	-	13/09/1946			0	0	0	1	2	3	Possible	Unlikely. Not recorded during survey.
<i>Grevillea kenneallyi</i>	Gravelly loam, laterite.	-	P2	0.1	21.95	22/09/1991	5/08/1985		1	1	0	1	2	5	Likely	Unlikely. Not recorded during survey.
<i>Grevillea pinifolia</i>	Yellow sand, gravel.	-	P1	22.7	-	12/08/1972			0	0	0	0	2	2	Unlikely	Unlikely. Not recorded during survey.
<i>Grevillea pythara</i>	Sand or sandy loam with gravel.	E	CR	23.5	-	11/07/1995		Yes	0	0	0	0	2	2	Unlikely	Unlikely. Not recorded during survey.
<i>Grevillea roycei</i>	White or yellow sand.	-	P3	24.6	-	15/09/2005			0	0	1	1	2	4	Possible	Unlikely. Not recorded during survey.
<i>Gyrostemon reticulatus</i>	The Net-veined Gyrostemon grows in dense shrubland in brown/yellow loamy sand on sloping topography.	CE	CR	-	-			Yes	0	0	0	0	2	2	Unlikely	Unlikely. Not recorded during survey.
<i>Hemiandra coccinea</i>	White or grey, often gravelly sand. Sandplains, gravel pits.	-	P3	22.3	-	8/07/1983			0	0	0	1	2	3	Possible	Unlikely. Not recorded during survey.
<i>Hemiandra gardneri</i>	Grey or yellow sand, clayey sand. Sandplains.	E	CR	-	-			Yes	0	0	0	0	2	2	Unlikely	Unlikely. Not recorded during survey.
<i>Lepidium pseudotasmanicum</i>	Loam, sand.	-	P4	-	19.43		27/09/1978		0	0	0	1	2	3	Possible	Unlikely. Not recorded during survey.
<i>Lepidobolus densus</i>	Yellow lateritic sand, lateritic gravel. Dry kwongan.	-	P4	0.4	-	9/09/1947			1	1	0	1	2	5	Likely	Unilkely. Not recorded during survey. Old record.
<i>Lysiosepalum abollatum</i>	Red clay.	CE	CR	-	24.26		21/06/2017	Yes	0	0	1	1	0	2	Negligible	Negilgible. No suitable habitat.
<i>Melaleuca sciostyla</i>	Orange clayey sand with lateritic pebbles. Scree slopes.	E	EN	-	-			Yes	0	0	0	0	0	0	Negligible	Negilgible. No suitable habitat.
<i>Microcorys eremophiloides</i>	Shallow soils over massive laterite, granite.	V	VU	-	22.59		21/11/2002	Yes	0	0	1	1	1	3	Possible	Negilgible. No suitable habitat.
<i>Mirbelia</i> sp. <i>Cordifolia</i> (C.A. Gardner 2712)	No photo or habitat information available.	-	P1	23.6	-	7/10/2019			0	0	1	0	0	1	Negligible	Negilgible. No suitable habitat.
<i>Petrophile globifera</i>	Brown sandy loam over reddish yellow sandy clay loam at 0.5 m.	-	P3	23.5	-	15/09/1993			0	0	0	0	1	1	Unlikely	Negilgible. No suitable habitat.
<i>Petrophile trifurcata</i>	Yellow, Sep. Sand.	-	P2	23.5	-	23/02/2000			0	0	0	0	2	2	Unlikely	Unlikely. Not recorded during survey.
<i>Phebalium brachycalyx</i>	Sand, gravelly soils. Lateritic uplands, hills.	-	P3	24.6	-	6/08/1985			0	0	0	1	2	3	Possible	Negilgible. No suitable habitat.
<i>Philotheca wonganensis</i>	Red sandy soils.	E	EN	23.9	-	11/09/2008		Yes	0	0	1	1	2	4	Possible	Unlikely. Not recorded during survey.
<i>Podotheca pritzelii</i>	Sand. Sand ridges in salt flats.	-	P3	24.8	-	13/10/1903			0	0	0	1	2	3	Possible	Negilgible. No suitable habitat.
<i>Podotheca uniseta</i>	White/grey sand, sandy loam. Samphire flats.	-	P3	10.6	-	25/09/2014			0	0	1	1	2	4	Possible	Negilgible. No suitable habitat.



Appendix A Flora Desktop Assessment

Taxon	Habitat	Cons. Code		Distance from Survey Area		Date of Record		PMST	Likelihood Assessment					Total Score	Likelihood	
		EPBC Act	BC Act / DBCA	WA Herb	TPFL	WA Herb	TPFL		Recorded in survey area	Known nearby (5km)	Recent Record (Last 20 years)	Known within LGA	Presence of suitable habitat (0,1,2)		Pre-Survey	Post-Survey
<i>Rhagodia acicularis</i>	Red lateritic gravel. Slopes.	V	VU	20.9	21.71	6/12/2012	30/10/2019	Yes	0	0	1	1	1	3	Possible	Negilgible. No suitable habitat.
	Sandy soils. Near salt lake.	-	P1	4.7	-	3/09/2020			0	1	1	1	2	5	Likely	Unlikely. No suitable habitat.
<i>Roycea pycnophylloides</i>	Sandy soils, clay. Saline flats.	E	VU	-	-			Yes	0	0	0	0	2	2	Unlikely	Negilgible. No suitable habitat.
<i>Stylidium coroniforme</i> subsp. <i>coroniforme</i>	Shallow sand over laterite. Upland habitats. Allocasuarina and Dryandra shrubland, mallee woodland.	E	EN	-	-			Yes	0	0	0	0	2	2	Unlikely	Unlikely. Not recorded during survey.
<i>Styphelia caudata</i>	Plain. High in landscape. White/grey sand/loam.	-	P3	24.3	-	12/06/2008			0	0	1	1	2	4	Possible	Negilgible. No suitable habitat.
<i>Synaphea constricta</i>	Sand or sandy clay-loam over laterite.	-	P3	0.4	0.63	4/09/1998	4/09/1998		1	1	0	1	2	5	Likely	Possible. Suitable habitat present, could have been missed due to similarity to common <i>Synaphea spinulosa</i> subsp. <i>major</i> .
<i>Tecticornia fimbriata</i>	Clay, loam. Margins of salt & gypsum lakes.	-	P3	1.9	-	14/03/1968			0	1	0	1	1	3	Possible	Negilgible. No suitable habitat.
<i>Tetratheca retrorsa</i>	Lateritic breakaways.	-	P3	21.4	-	9/09/1975			0	0	0	1	0	1	Negligible	Negilgible. No suitable habitat.
<i>Thysanotus</i> sp. Badgingarra (E.A. Griffin 2511)	Grey sand with lateritic gravel.	-	P2	3.0	-	0/01/1900			0	1	0	1	1	3	Possible	Unlikely. Not recorded during survey.
<i>Tricoryne</i> sp. Wongan Hills (B.H. Smith 794)	Yellow to grey sand, gravelly clay quartz, laterite, limestone. Midslopes and uplands.	-	P2	23.8	-	27/10/1986			0	0	0	1	2	3	Possible	Negilgible. No suitable habitat.
<i>Urodon capitatus</i>	Sandy gravelly soils. Plains.	-	P3	0.4	-	13/10/1934			1	1	0	1	2	5	Likely	Unilkely. Not recorded during survey. Old record.
<i>Verticordia staminosa</i> subsp. <i>staminosa</i>	Soil pockets. Granite outcrops.	E	CR	20.9	24.07	7/07/1981	31/10/2014	Yes	0	0	1	1	2	4	Possible	Negilgible. No suitable habitat.
<i>Verticordia venusta</i>	Yellow sand, sandy gravel. Sandplains.	-	P3	2.1	13.99	6/11/2007	6/11/2007		0	1	1	1	2	5	Likely	Known, recorded during survey
<i>Verticordia wonganensis</i>	Yellow or white sand.	-	P2	14.0	-	6/11/2007			0	0	1	1	2	4	Possible	Unlikely. Not recorded during survey.

# Appendix B

Flora by Family by Site  
Matrix



## Appendix B Flora by Community by Site

Family	Species	Oppo	AcBs			McGdWa					EpAcTp	EwMhAs	AcDr	McEm	
			5	6	7	1	3	4	10	13	2	11	12	8	9
Amaranthaceae															
	<i>Ptilotus polystachyus</i>	x													
Apiaceae															
	<i>Daucus glochidiatus</i>			x											
	<i>Platysace maxwellii</i>											x			
	<i>Platysace trachymenioides</i>		x	x	x		x	x		x				x	x
Apocynaceae															
	<i>Alyxia buxifolia</i>											x			
Asparagaceae															
	<i>Thysanotus manglesianus</i>					x		x			x		x		
Asparagaceae															
	<i>Chamaexeros fimbriata</i>			x	x										
Asteraceae															
	<i>Asteraceae</i> sp.												x		
	<i>Gilberta tenuifolia</i>										x				
	<i>Gnephosis tenuissima</i>			x											
	<i>Podotheca gnaphalioides</i>				x										
	<i>Trachymene pilosa</i>				x	x	x	x			x	x	x		
	<i>Waitzia acuminata</i> var. <i>acuminata</i>		x	x	x	x	x	x		x	x	x	x	x	x
Boryaceae															
	<i>Borya sphaerocephala</i>		x	x	x			x							
Brassicaceae															
	* <i>Brassica tournefortii</i>										x				
Campanulaceae															
	<i>Wahlenbergia preissii</i>							x							
Casuarinaceae															
	<i>Allocasuarina campestris</i>		x	x	x	x	x	x	x	x	x		x	x	x
Chenopodiaceae															
	<i>Chenopodium gaudichaudianum</i>											x			
	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>										x	x			
Crassulaceae															
	<i>Crassula colorata</i>														
Cupressaceae															
	<i>Callitris arenaria</i>	x													
Cyperaceae															
	?Cyperaceae sp.		x	x											
	<i>Gahnia drummondii</i>		x				x	x	x		x			x	x
	<i>Schoenus hexandrus</i>		x	x	x										
	<i>Mesomelaena preissii</i>		x	x	x										
Cyperaceae															
	<i>Schoenus hexandrus</i>													x	x
Dilleniaceae															
	<i>Hibbertia drummondii</i>						x	x							
	<i>Hibbertia exasperata</i>										x		x	x	
	<i>Hibbertia subvaginata</i>						x			x					
Droseraceae															
	<i>Drosera macrantha</i>							x		x					
Ecdeiocoleaceae															
	<i>Ecdeiocolea monostachya</i>		x	x	x									x	x
Ericaceae															
	<i>Leucopogon cinereus</i>						x								
	<i>Leucopogon</i> sp. outer Wheatbelt (M. Hislop 30)						x							x	
	<i>Styphelia crassiflora</i>		x	x	x										
	<i>Styphelia serratifolia</i>					x		x			x				
Euphorbiaceae															
	<i>Ricinocarpos undulatus</i>												x		
Fabaceae															
	<i>Acacia acuaria</i>											x			
	<i>Acacia acuminata</i>									x			x		
	<i>Acacia burkittii</i>					x			x	x					
	<i>Acacia lirellata</i> subsp. <i>compressa</i> (P2)			x											
	<i>Acacia nigripilosa</i> subsp. <i>nigripilosa</i>	x													
	<i>Acacia restiacea</i>							x							
	<i>Acacia rostellifera</i>											x			
	<i>Acacia yorkrakinensis</i> subsp. <i>acrita</i>			x	x							x			
	<i>Daviesia triflora</i>			x											
	<i>Gastrolobium calycium</i>							x							
	<i>Jacksonia foliosa</i>											x			
	<i>Jacksonia macrocalyx</i>				x										
	<i>Acacia scalena</i> (P3)	x													
Goodeniaceae															
	<i>Dampiera glaberrima</i> (P1)	x				x									
	<i>Goodenia pinifolia</i>	x													
	<i>Goodenia rosea</i>			x	x	x					x				
	<i>Dampiera lavandulacea</i>				x										
Hemerocallidaceae															
	<i>Dianella revoluta</i>			x	x						x	x	x		
	<i>Stypandra glauca</i>	x													
	<i>Tricoryne tenella</i>		x	x											
Iridaceae															

Appendix B Flora by Community by Site

Family	Species	Oppo	AcBs			McGdWa					EpAcTp	EwMhAs	AcDr	McEm	
			5	6	7	1	3	4	10	13	2	11	12	8	9
	<i>Patersonia graminea</i>		x	x											
Lamiaceae															
	<i>Hemigenia westringioides</i>												x		
Lauraceae															
	<i>Cassytha nodiflora</i>				x		x				x		x		x
Loganiaceae															
	<i>Orianthera flaviflora</i>				x								x	x	
Montiaceae												x			
	<i>Calandrinia eremaea</i>											x			
Myrtaceae															
	<i>Calothamnus quadrifidus</i> subsp. <i>angustifolius</i>			x	x				x						
	<i>Darwinia purpurea</i>					x	x		x	x			x		
	<i>Ericomyrtus serpyllifolia</i>					x	x			x					
	<i>Eucalyptus phenax</i> subsp. <i>phenax</i>										x				
	<i>Eucalyptus rigidula</i>					x								x	x
	<i>Melaleuca conothamnoides</i>					x	x	x	x	x	x		x		x
	<i>Melaleuca cordata</i>		x						x					x	x
	<i>Melaleuca hamata</i>											x			
	<i>Pileanthus peduncularis</i>		x												
	<i>Verticordia chrysantha</i>												x		
	<i>Baekkea muricata</i>						x						x		
	<i>Myrtaceae</i> sp.				x			x					x		
	<i>Eucalyptus wubinensis</i>									x		x			
	<i>Eucalyptus moderata</i>											x			
	<i>Chamelaucium brevifolium</i>										x				
	<i>Melaleuca orbicularis</i>			x	x									x	
	<i>Melaleuca trichophylla</i>													x	
	<i>Balaustion interruptum</i>			x						x				x	
	<i>Verticordia venusta</i>	x													
	<i>Calytrix</i> sp.												x		
Poaceae															
	? <i>Austrostipa</i> sp.				x										
	<i>Amphipogon amphipogonoides</i>				x	x	x	x		x	x		x	x	
	<i>Amphipogon caricinus</i> var. <i>caricinus</i>		x	x	x			x		x	x				
	<i>Austrostipa elegantissima</i>				x			x			x		x		
	<i>Austrostipa eremophila</i>				x		x						x		
	<i>Austrostipa scabra</i>											x			
	<i>Austrostipa</i> sp.					x					x	x	x		
	* <i>Avena barbata</i>										x				
	* <i>Ehrharta calycina</i>												x		
	<i>Monachather paradoxus</i>			x											
	* <i>Pentameris airoides</i>			x								x			
	<i>Thyridolepis multiculmis</i>			x				x			x				
	* <i>Vulpia muralis</i>			x				x				x			
Proteaceae															
	<i>Banksia purdieana</i>													x	
	<i>Conospermum stoechadis</i>		x		x										
	<i>Grevillea armigera</i>				x										
	<i>Grevillea didymobotrya</i> subsp. <i>didymobotrya</i>			x											
	<i>Grevillea huegelii</i>											x			
	<i>Grevillea paradoxa</i>		x			x	x		x	x				x	x
	<i>Grevillea petrophiloides</i> subsp. <i>petrophiloides</i>					x	x			x	x				
	<i>Hakea meisneriana</i>						x						x		
	<i>Hakea stenopetala</i>	x													
	<i>Isopogon scabriusculus</i> subsp. <i>stenophyllus</i>	x													
	<i>Petrophile incurvata</i>								x				x		
	<i>Grevillea rosieri</i> (P2)					x									
	<i>Acacia mackeyana</i>											x			
	<i>Grevillea dryandroides</i> subsp. <i>dryandroides</i>	x													
	<i>Hakea scoparia</i> subsp <i>scoparia</i>									x					
Proteaceae															
	<i>Petrophile seminuda</i>												x		
Restionaceae															
	<i>Lepidobolus preissianus</i>		x	x	x									x	
Rhamnaceae															
	<i>Stenanthemum pomaderroides</i>					x		x					x		
Rubiaceae															
	<i>Opercularia vaginata</i>		x	x											
Rutaceae															
	<i>Cyanothamnus coerulescens</i> subsp. <i>spinescens</i>		x		x										
Santalaceae															
	<i>Leptomeria preissiana</i>			x			x								
	<i>Santalum acuminatum</i>							x		x	x			x	x
Sapindaceae															
	<i>Dodonaea bursariifolia</i>										x				
Stylidiaceae							x								
	<i>Stylidium rigidulum</i>						x								
Thymelaeaceae															
	<i>Pimelea imbricata</i> var. <i>piligera</i>												x		



# Appendix C

## Site Data

## Appendix D Site Data

Site No: Q1	Date: 19/11/2022	Longitude: 116.773964	Latitude: -30.619341
<b>Type:</b> Quadrat	<b>Soil Types:</b> Light brown to yellowy clay loam		
<b>Topography:</b> Flat	<b>Surface Water:</b> 50 pc bar		
<b>Vegetation Type:</b> -	<b>Vegetation Condition:</b> Very good		
<b>Fire:</b> 10+ years	<b>Condition Notes:</b>		



Cons. Status	Taxon	Height (cm)	% Cover	Comment
	<i>Acacia burkittii</i>	220	6	FdW221119-166
	<i>Allocasuarina campestris</i>	380	10	
	<i>Amphipogon amphipogonoides</i>	4	0.1	
	<i>Austrostipa</i> sp.	50	0.1	
P1	<i>Dampiera glaberrima</i>	30		FdW221119-160
	<i>Darwinia purpurea</i>	40	0.1	FdW221119-168
	<i>Ericomyrtus serpyllifolia</i>	60		
	<i>Eucalyptus rigidula</i>	400		FdW221119-165



Cons. Status	Taxon	Height (cm)	% Cover	Comment
	<i>Goodenia rosea</i>	10	0.5	
	<i>Grevillea paradoxa</i>	220	8	
	<i>Grevillea petrophiloides</i> subsp. <i>petrophiloides</i>	150	6	FdW221119-167
P2	<i>Grevillea rosieri</i>	120	0	FdW221119-170
	<i>Melaleuca conothamnoides</i>	150	8	
	<i>Stenanthemum pomaderroides</i>	100	0.5	
	<i>Styphelia serratifolia</i>	120	0.1	FdW221119-169
	<i>Thysanotus manglesianus</i>	30	0.1	
	<i>Trachymene pilosa</i>	10	0.5	
	<i>Waitzia acuminata</i> var. <i>acuminata</i>	15	0.5	

Site No: Q2	Date: 20/11/2022	Longitude: 116.774687	Latitude: -30.618655
Type: Quadrat		Soil Types: Yellowy light brown clay	
Topography: Flat		Surface Water: 30 pc bare	
Vegetation Type: -		Vegetation Condition: Very good	
Fire: 10+		Condition Notes:	



Cons. Status	Taxon	Height (cm)	% Cover	Comment
	<i>Allocasuarina campestris</i>	300	25	
	<i>Amphipogon amphipogonoides</i>	40	0.1	
	<i>Amphipogon caricinus</i> var. <i>caricinus</i>	20	1	
	<i>Austrostipa elegantissima</i>	30	0.5	
	<i>Austrostipa</i> sp.	40	1	
*	<i>Avena barbata</i>	50	oppo	
*	<i>Brassica tournefortii</i>	50	0.1	
	<i>Cassytha nodiflora</i>	0	0.1	
	<i>Chamelaucium brevifolium</i>	30	0.5	FdW221120-177
	<i>Crassula colorata</i>	10	0.1	
	<i>Dianella revoluta</i>	50	0.5	



Cons. Status	Taxon	Height (cm)	% Cover	Comment
	<i>Dodonaea bursariifolia</i>	120	0.1	FdW221120-172
	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	20	0.1	
	<i>Eucalyptus phenax</i> subsp. <i>phenax</i>	400	20	FdW221120-175
	<i>Gahnia drummondii</i>	60	4	
	<i>Gilberta tenuifolia</i>	10	0.1	
	<i>Goodenia rosea</i>	10	0.1	
	<i>Grevillea petrophiloides</i> subsp. <i>petrophiloides</i>	200	oppo	
	<i>Hibbertia exasperata</i>	60	1	FdW221120-173
	<i>Melaleuca conothamnoides</i>	50	oopo	
	<i>Santalum acuminatum</i>	250	0.5	
	<i>Styphelia serratifolia</i>	80	oppo	
	<i>Thyridolepis multiculmis</i>	50	0.1	
	<i>Thysanotus manglesianus</i>	0	0.1	
	<i>Trachymene pilosa</i>	5	1	
	<i>Waitzia acuminata</i> var. <i>acuminata</i>	30	0.5	

Site No: Q3	Date: 20/11/2022	Longitude: 116.774830	Latitude: -30.616859
<b>Type:</b> Quadrat		<b>Soil Types:</b> Yellowy brown clay gravel	
<b>Topography:</b> Flat		<b>Surface Water:</b> 60 pc bare.	
<b>Vegetation Type:</b> -		<b>Vegetation Condition:</b> Good	
<b>Fire:</b> 10+		<b>Condition Notes:</b> Earth/soil disturbance	



Cons. Status	Taxon	Height (cm)	% Cover	Comment
	<i>Allocasuarina campestris</i>	200	30	FdW221120-181
	<i>Allocasuarina campestris</i>	250	6	
	<i>Amphipogon amphipogonoides</i>	10	0.1	
	<i>Austrostipa eremophila</i>	60	0.1	
	<i>Baeckea muricata</i>	80	0.5	FdW221120-177
	<i>Cassylia nodiflora</i>	0	0.1	
	<i>Darwinia purpurea</i>	20	0.5	
	<i>Ericomyrtus serpyllifolia</i>	60	0.5	
	<i>Gahnia drummondii</i>	60	6	
	<i>Grevillea paradoxa</i>	50	0.5	



Cons. Status	Taxon	Height (cm)	% Cover	Comment
	<i>Grevillea paradoxa</i>	90	1	
	<i>Grevillea petrophiloides</i> subsp. <i>petrophiloides</i>	200		
	<i>Hakea meisneriana</i>	300	0.5	FdW221120-180
	<i>Hibbertia drummondii</i>	50	2	FdW221120-176
	<i>Hibbertia subvaginata</i>	60	0.5	
	<i>Leptomeria preissiana</i>	40	0.1	
	<i>Leucopogon cinereus</i>	30	0.1	FdW221120-183
	<i>Leucopogon</i> sp. outer wheatbelt (M. Hislop 30)	100		FdW221120-182
	<i>Melaleuca conothamnoides</i>	80	4	
	<i>Platysace trachymenioides</i>	30	0.1	
	<i>Stylidium rigidulum</i>	30	0.1	FdW221120-179
	<i>Trachymene pilosa</i>	15	0.1	
	<i>Waitzia acuminata</i> var. <i>acuminata</i>	20	0.1	

Site No: Q4	Date: 20/11//2022	Longitude: 116.775326	Latitude: -30.615581
<b>Type:</b> Quadrat		<b>Soil Types:</b> Yellowy brown sandy clay	
<b>Topography:</b> Flat		<b>Surface Water:</b> 15 pc bare	
<b>Vegetation Type:</b> -		<b>Vegetation Condition:</b> Very good	
<b>Fire:</b> 10+		<b>Condition Notes:</b>	



Cons. Status	Taxon	Height (cm)	% Cover	Comment
	<i>Acacia restiacea</i>	60	0.5	FdW221120-185
	<i>Allocasuarina campestris</i>	220	5	
	<i>Allocasuarina campestris</i>	300	5	
	<i>Amphipogon amphipogonoides</i>	20	0.1	
	<i>Amphipogon caricinus</i> var. <i>caricinus</i>	30	0.1	
	<i>Austrostipa elegantissima</i>	60	1	
	<i>Borya sphaerocephala</i>	10	0.1	
	<i>Drosera macrantha</i>	40	0.1	
	<i>Gahnia drummondii</i>	30	20	
	<i>Gastrolobium calycium</i>	100		FdW221120-184



Cons. Status	Taxon	Height (cm)	% Cover	Comment
	<i>Hibbertia drummondii</i>	50	0.5	
	<i>Melaleuca conothamnoides</i>	120	15	
	<i>Myrtaceae sp.</i>	60	0.1	FdW221120-187
	<i>Platysace trachymenioides</i>	50	0.1	
	<i>Santalum acuminatum</i>	300	1	
	<i>Stenanthemum pomaderroides</i>	60	0.2	FdW221120-186
	<i>Styphelia serratifolia</i>	100	0.1	
*	<i>Vulpia muralis</i>	30	0.1	FdW221120-188
	<i>Thyridolepis multiculmis</i>	30	0.1	
	<i>Thysanotus manglesianus</i>	0	0.1	
	<i>Trachymene pilosa</i>	10	0.1	
	<i>Wahlenbergia preissii</i>	15	0.1	
	<i>Waitzia acuminata</i> var. <i>acuminata</i>	30	0.1	

Site No: Q5	Date: 20/11/2022	Longitude: 116.775405	Latitude: -30.610183
Type: Quadrat		Soil Types: Yellow sand. sand plains	
Topography: Flat		Surface Water: 40 pc	
Vegetation Type: Heathland		Vegetation Condition: Very god	
Fire: 10+ yrs		Condition Notes:	
Veg Description: <i>Allocasuarina campestris</i> , <i>Melaleuca orbicularis</i> and <i>Styphelia crassiflora</i> tall open heathland over <i>Borya sphaerocephala</i> , <i>Ecdeiocolea monostachya</i> and <i>Mesomelaena preissii</i> tall sedgeland.			



Cons. Status	Taxon	Height (cm)	% Cover	Comment
	?Cyperaceae sp.	10	0.1	
	<i>Allocasuarina campestris</i>	280	5	
	<i>Allocasuarina campestris</i>	300	2	
	<i>Amphipogon caricinus</i> var. <i>caricinus</i>	30	0.1	
	<i>Borya sphaerocephala</i>	10	20	
	<i>Conospermum stoechadis</i>	160	oppo	FdW221120-195
	<i>Cyanothamnus coerulescens</i> subsp. <i>spinescens</i>	80		FdW221120-196
	<i>Ecdeiocolea monostachya</i>	60	8	



Cons. Status	Taxon	Height (cm)	% Cover	Comment
	<i>Gahnia drummondii</i>	30	0.1	
	<i>Grevillea paradoxa</i>	60	1	
	<i>Lepidobolus preissianus</i>	30	4	
	<i>Melaleuca cordata</i>	70	1	
	<i>Mesomelaena preissii</i>	30	20	FdW221120-189
	<i>Opercularia vaginata</i>	10		FdW221120-194
	<i>Patersonia graminea</i>	20	0.1	
	<i>Pileanthus peduncularis</i>	60	0.5	FdW221120-190
	<i>Platysace trachymenioides</i>	40	0.1	
	<i>Schoenus hexandrus</i>	10	0.1	FdW221120-193
	<i>Styphelia crassiflora</i>	20	1	FdW221120-191
	<i>Tricoryne tenella</i>	30	0.1	FdW221120-192
	<i>Waitzia acuminata</i> var. <i>acuminata</i>	15	0.1	

Site No: Q6	Date: 20/11/2022	Longitude: 116.775588	Latitude: -30.609336
Type: Quadrat		Soil Types: Yellow sand. sand plains	
Topography: Flat		Surface Water: 50 pc bare	
Vegetation Type: -		Vegetation Condition: Very good	
Fire: 10+		Condition Notes:	
Veg Description: <i>Allocasuarina campestris</i> , <i>Melaleuca orbicularis</i> and <i>Styphelia crassiflora</i> tall open heathland over <i>Borya sphaerocephala</i> , <i>Ecdeiocolea monostachya</i> and <i>Mesomelaena preissii</i> tall sedgeland.			



Cons. Status	Taxon	Height (cm)	% Cover	Comment
	?Cyperaceae sp.		0.1	
P2	<i>Acacia lirellata</i> subsp. <i>compressa</i>	50	0.5	
	<i>Acacia yorkrakinensis</i> subsp. <i>acrita</i>	250		FdW221120-200
	<i>Allocasuarina campestris</i>	150	6	
	<i>Amphipogon caricinus</i> var. <i>caricinus</i>		0.1	
	<i>Balaustion interruptum</i>	30	0.5	FdW221120-202
	<i>Borya sphaerocephala</i>	10	5	
	<i>Calothamnus quadrifidus</i> subsp. <i>angustifolius</i>	280		FdW221120-201
	<i>Chamaexeros fimbriata</i>	10	0.1	FdW221120-199



Cons. Status	Taxon	Height (cm)	% Cover	Comment
	<i>Daucus glochidiatus</i>	5	0.1	
	<i>Daviesia triflora</i>	60	6	FdW221120-197
	<i>Dianella revoluta</i>	50	0.5	
	<i>Ecdeiocolea monostachya</i>	60	5	
	<i>Gnephosis tenuissima</i>	5	0.1	
	<i>Goodenia rosea</i>	5	0.1	
	<i>Grevillea didymobotrya</i> subsp. <i>didymobotrya</i>	500	1	
	<i>Lepidobolus preissianus</i>		6	
	<i>Leptomeria preissiana</i>	20	0.1	
	<i>Melaleuca orbicularis</i>	100	5	FdW221120-198
	<i>Mesomelaena preissii</i>	30	8	
	<i>Monachather paradoxus</i>	20	0.1	FdW221120-203
	<i>Opercularia vaginata</i>	10	0.1	FdW221120-194
	<i>Patersonia graminea</i>	15	0.1	
*	<i>Pentameris airoides</i>	5	0.1	
	<i>Platysace trachymenioides</i>	15	1	
	<i>Schoenus hexandrus</i>	20	0.1	
	<i>Styphelia crassiflora</i>	20	2	
	<i>Thyridolepis multiculmis</i>	30	0.5	
	<i>Tricoryne tenella</i>	15	0.1	
	<i>Waitzia acuminata</i> var. <i>acuminata</i>	20	0.1	

Site No: Q7	Date: 20/11/2022	Longitude: 116.775914	Latitude: -30.608296
Type: Quadrat		Soil Types: Yellow sand. sand plains	
Topography: Flat		Surface Water: 40 pc bare	
Vegetation Type: -		Vegetation Condition: Very good	
Fire: 10+		Condition Notes:	
Veg Description: <i>Allocasuarina campestris</i> , <i>Melaleuca orbicularis</i> and <i>Styphelia crassiflora</i> tall open heathland over <i>Borya sphaerocephala</i> , <i>Ecdeiocolea monostachya</i> and <i>Mesomelaena preissii</i> tall sedgeland.			



Cons. Status	Taxon	Height (cm)	% Cover	Comment
	? <i>Austrostipa</i> sp.	50	0.1	FdW221120-208
	<i>Acacia yorkrakinensis</i> subsp. <i>acrita</i>	100	2	
	<i>Allocasuarina campestris</i>	150	1	
	<i>Amphipogon amphipogonoides</i>	15	0.1	
	<i>Amphipogon caricinus</i> var. <i>caricinus</i>	30	0.1	
	<i>Austrostipa elegantissima</i>	50	0.1	
	<i>Austrostipa eremophila</i>	30	0.1	
	<i>Borya sphaerocephala</i>	10	8	



Cons. Status	Taxon	Height (cm)	% Cover	Comment
	<i>Calothamnus quadrifidus</i> subsp. <i>angustifolius</i>	320	2	
	<i>Cassytha nodiflora</i>	0	0.1	
	<i>Chamaexeros fimbriata</i>	10	0.1	
	<i>Conospermum stoechadis</i>	160	1	
	<i>Cyanothamnus coerulescens</i> subsp. <i>spinescens</i>	60	0.1	
	<i>Dampiera lavandulacea</i>	10	0.1	FdW221120-207
	<i>Dianella revoluta</i>	60	1	
	<i>Ecdeiocolea monostachya</i>	60	8	
	<i>Goodenia rosea</i>	30	0.1	
	<i>Grevillea armigera</i>	190	1	FdW221120-205
	<i>Jacksonia macrocalyx</i>	30	0.1	FdW221120-206
	<i>Lepidobolus preissianus</i>	20	5	
	<i>Melaleuca orbicularis</i>	140	4	
	<i>Mesomelaena preissii</i>	30	6	
	<i>Myrtaceae</i> sp.	60	0.5	
	<i>Orianthera flaviflora</i>	10	0.1	
	<i>Platysace trachymenioides</i>	30	2	
	<i>Podotheca gnaphalioides</i>	5	0.1	
	<i>Schoenus hexandrus</i>	10	0.1	
	<i>Styphelia crassiflora</i>	30	0.5	
	<i>Trachymene pilosa</i>	10	0.1	
	<i>Waitzia acuminata</i> var. <i>acuminata</i>	15	1	

Site No: Q8	Date: 11/20/2022	Longitude: 116.776310	Latitude: -30.605577
<b>Type:</b> Quadrat		<b>Soil Types:</b> Yellow sandy clay. gravel on surface.	
<b>Topography:</b> Flat		<b>Surface Water:</b> 40 pc	
<b>Vegetation Type:</b> -		<b>Vegetation Condition:</b> Very good	
<b>Fire:</b> 10+		<b>Condition Notes:</b>	



Cons. Status	Taxon	Height (cm)	% Cover	Comment
	<i>Allocasuarina campestris</i>	300	16	
	<i>Amphipogon amphipogonoides</i>	20	1	
	<i>Balaustion interruptum</i>	40	0.1	
	<i>Banksia purdieana</i>	120	2	
	<i>Ecdeiocolea monostachya</i>	80	3	
	<i>Eucalyptus rigidula</i>	400	2	
	<i>Gahnia drummondii</i>	20	0.1	
	<i>Grevillea paradoxa</i>	190	2	
	<i>Hibbertia exasperata</i>	60	0.1	
	<i>Lepidobolus preissianus</i>	15	0.1	
	<i>Leucopogon</i> sp. outer wheatbelt (M. Hislop 30)	15	0.1	FdW221120-210



Cons. Status	Taxon	Height (cm)	% Cover	Comment
	<i>Melaleuca cordata</i>	60	8	
	<i>Melaleuca orbicularis</i>	80	1	
	<i>Melaleuca trichophylla</i>		1	FdW221120-209
	<i>Orianthera flaviflora</i>	10	0.1	
	<i>Platysace trachymenioides</i>	20	1	
	<i>Santalum acuminatum</i>	300	2	
	<i>Schoenus hexandrus</i>	20	0.1	
	<i>Waitzia acuminata</i> var. <i>acuminata</i>	10	0.2	

Site No: Q9	Date: 11/20/2022	Longitude: 116.776265	Latitude: -30.603250
Type: Quadrat		Soil Types: Yellow sandplain	
Topography: Flat		Surface Water: 15 pc bare	
Vegetation Type: -		Vegetation Condition: Very good	
Fire: 10+		Condition Notes:	



Cons. Status	Taxon	Height (cm)	% Cover	Comment
	<i>Allocasuarina campestris</i>	260	25	
	<i>Allocasuarina campestris</i>	180	4	
	<i>Cassytha nodiflora</i>	0	2	
	<i>Ecdeiocolea monostachya</i>	110	6	
	<i>Eucalyptus rigidula</i>	250		
	<i>Gahnia drummondii</i>	60	1	
	<i>Grevillea paradoxa</i>	140		
	<i>Melaleuca conothamnoides</i>	100	15	
	<i>Melaleuca cordata</i>	120	8	
	<i>Platysace trachymenioides</i>	40	1	



Cons. Status	Taxon	Height (cm)	% Cover	Comment
	<i>Santalum acuminatum</i>	160	2	
	<i>Schoenus hexandrus</i>	20	1	
	<i>Waitzia acuminata</i> var. <i>acuminata</i>		0.1	

Site No: R10 Date: 20/11/2022 Longitude: 116.777696 Latitude: -30.602114

Type: Revele

Topography: Flat

Vegetation Type: -

Fire: 10+

Soil Types: Clay loam sand cream

Surface Water: 80 pc bare

Vegetation Condition: Good

Condition Notes:



Cons. Status	Taxon	Height (cm)	% Cover	Comment
	<i>Acacia burkittii</i>	150	0.1	
	<i>Allocasuarina campestris</i>	200	40	
	<i>Allocasuarina campestris</i>	250	1	
	<i>Calothamnus quadrifidus</i> subsp. <i>angustifolius</i>	250	1	
	<i>Darwinia purpurea</i>	20	0.1	
	<i>Gahnia drummondii</i>	30	1	
	<i>Grevillea paradoxa</i>	150	1	
	<i>Melaleuca conothamnoides</i>	100	15	
	<i>Melaleuca cordata</i>	100	4	
	<i>Petrophile incurvata</i>	200	2	



Site No: R11	Date: 20/11/2022	Longitude: 116.781236	Latitude: -30.602186
<b>Type:</b> Releve		<b>Soil Types:</b> Sand clay	
<b>Topography:</b> Flat		<b>Surface Water:</b> 75 pc bare	
<b>Vegetation Type:</b> -		<b>Vegetation Condition:</b> Good	
<b>Fire:</b> 10+		<b>Condition Notes:</b> clearing	



Cons. Status	Taxon	Height (cm)	% Cover	Comment
	<i>Acacia acuarria</i>	100	4	FdW221120-216
	<i>Acacia acuarria</i>	200	4	FdW221120-216
	<i>Acacia mackeyana</i>	150	4	FdW221120-217
	<i>Acacia rostellifera</i>	200	0.5	FdW221120-223
	<i>Acacia yorkrakinensis</i> subsp. <i>acrita</i>	200	0.5	
	<i>Alyxia buxifolia</i>	50	0.5	
	<i>Austrostipa scabra</i>	50	0.5	
	<i>Austrostipa</i> sp.	50	0.1	
	<i>Calandrinia eremaea</i>	10	0.1	
	<i>Chenopodium gaudichaudianum</i>	50	0.5	
	<i>Dianella revoluta</i>	50	0.1	

Cons. Status	Taxon	Height (cm)	% Cover	Comment
	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	30	0.1	
	<i>Eucalyptus moderata</i>	1600	6	FdW221120-218
	<i>Eucalyptus wubinensis</i>	400	10	FdW221120-215
	<i>Grevillea huegelii</i>	100	2	FdW221120-220
	<i>Jacksonia foliosa</i>	150	1	FdW221120-221
	<i>Melaleuca hamata</i>		10	FdW221120-222
*	<i>Pentameris airoides</i>	10	0.1	
	<i>Platysace maxwellii</i>	50	0.1	FdW221120-219
*	<i>Vulpia muralis</i>	20	0.1	
	<i>Trachymene pilosa</i>	10	0.1	
	<i>Waitzia acuminata</i> var. <i>acuminata</i>	10	1	



Site No: Q12	Date: 20/11/2022	Longitude: 116.775117	Latitude: -30.601926
<b>Type:</b> Quadrat		<b>Soil Types:</b> Gravelly brown dirt	
<b>Topography:</b> Flat		<b>Surface Water:</b> 20 pc bare	
<b>Vegetation Type:</b> -		<b>Vegetation Condition:</b> Good	
<b>Fire:</b> 10+		<b>Condition Notes:</b> Rubbish. earth moved.	



Cons. Status	Taxon	Height (cm)	% Cover	Comment
	<i>Acacia acuminata</i>	300	2	
	<i>Allocasuarina campestris</i>	160	4	
	<i>Allocasuarina campestris</i>	300	30	
	<i>Amphipogon amphipogonoides</i>	20	0.1	
	<i>Asteraceae sp.</i>	10	0.1	
	<i>Austrostipa elegantissima</i>	50	0.1	
	<i>Austrostipa eremophila</i>	20	0.1	
	<i>Austrostipa sp.</i>	40	0.1	
	<i>Baeckea muricata</i>	80	1	
	<i>Calytrix sp.</i>	30	0.1	FdW221121-225
	<i>Cassytha nodiflora</i>	0	0.1	

Cons. Status	Taxon	Height (cm)	% Cover	Comment
	<i>Darwinia purpurea</i>	15	0.1	
	<i>Dianella revoluta</i>	40	1	
*	<i>Ehrharta calycina</i>	30	0.1	
	<i>Hakea meisneriana</i>	300	15	
	<i>Hemigenia westringioides</i>	60	0.1	FdW221121-226
	<i>Hibbertia exasperata</i>	30	0.1	
	<i>Melaleuca conothamnoides</i>	80	10	
	<i>Myrtaceae sp.</i>	60	0.1	
	<i>Orchidaceae</i>	15	0.01	
	<i>Orianthera flaviflora</i>	10	0.1	
	<i>Petrophile incurvata</i>	80	0.5	
	<i>Petrophile seminuda</i>	180	0.5	FdW221121-227
	<i>Pimelea imbricata</i> var. <i>piliger</i>	30	0.5	FdW221121-224
	<i>Ricinocarpus undulatus</i>	40	0.5	FdW221121-228
	<i>Stenanthemum pomaderroides</i>	60	0.1	
	<i>Thysanotus manglesianus</i>	0	0.1	
	<i>Trachymene pilosa</i>	20	0.1	
	<i>Verticordia chrysantha</i>	80	0.5	
	<i>Waitzia acuminata</i> var. <i>acuminata</i>	20	0.1	



Site No: R13 Date: 20/11/2022 Longitude: 116.773961 Latitude: -30.601008

Type: Releve

Topography: Flat

Vegetation Type: -

Fire: 10+

Soil Types: Clay sand, pebbles on surface

Surface Water: 50 pc bare

Vegetation Condition: Very good

Condition Notes: no weeds, maybe earthworks



Cons. Status	Taxon	Height (cm)	% Cover	Comment
	<i>Acacia acuminata</i>	200	0.5	
	<i>Acacia burkittii</i>	230	1	
	<i>Allocasuarina campestris</i>	200	15	
	<i>Allocasuarina campestris</i>	300	2	
	<i>Amphipogon amphipogonoides</i>	20	0.1	
	<i>Amphipogon caricinus var. caricinus</i>	15	0.5	
	<i>Balaustion interruptum</i>	60	0.5	FdW221121-229
	<i>Darwinia purpurea</i>	30	0.1	
	<i>Drosera macrantha</i>	0	0.1	
	<i>Ericomyrtus serpyllifolia</i>	160	6	
	<i>Eucalyptus wubinensis</i>	280	8	

Cons. Status	Taxon	Height (cm)	% Cover	Comment
	<i>Grevillea paradoxa</i>	220	4	
	<i>Grevillea petrophiloides</i> subsp. <i>petrophiloides</i>	180	4	
	<i>Hakea scoparia</i> subsp <i>scoparia</i>	190	1	FdW221121-230
	<i>Hibbertia subvaginata</i>	60	0.1	
	<i>Melaleuca conothamnoides</i>	120	15	
	<i>Platysace trachymenioides</i>	60	0.1	
	<i>Santalum acuminatum</i>	250	1	
	<i>Waitzia acuminata</i> var. <i>acuminata</i>	15	0.5	



## **APPENDIX 4**

### **CBH BALLIDU – LEVEL 1 FAUNA ASSESSMENT, BLACK-COCKATOO AND TARGETED SPIDER ASSESSMENT**

**(Source: Bamford Ecological Consultants 2024)**

**CBH Ballidu**  
**Level 1 Fauna Assessment, Black-Cockatoo and Targeted Trapdoor**  
**Spider Assessment**



A flowering hakea in complex shrubland VSA 2 (Photo: J. Wadey)

Prepared for: CBH Group  
Level 6/240 St Georges Terrace  
PERTH WA 6000

Prepared by: E.J. Mellersh, A. Kristancic, N. Huang and M. Bamford  
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26<sup>th</sup> June 2024



## Executive Summary

### Introduction

Co-Operative Bulk Handling Limited (CBH) manages grain storage facilities across the Wheatbelt region of Western Australia, extending from Geraldton to Esperance. At many of these sites, CBH is considering the potential for expansion of roads and/or infrastructure into undeveloped areas. Therefore, as part of understanding the environmental values of their properties and immediate surrounds, Bamford Consulting Ecologists (BCE) was commissioned by CBH to conduct a Basic (sensu EPA, 2020) fauna assessment (desktop review, fauna habitat identification and a site inspection), including targeted black-cockatoo and trapdoor spider assessments, of the site at Ballidu. This report presents the results of that desktop review, site inspection and targeted assessments. The survey area and surrounds were visited on the 9<sup>th</sup> November 2022 for the site inspection and black-cockatoo assessment, and 7<sup>th</sup> November 2023 and 22-23<sup>rd</sup> February 2024 for the targeted trapdoor spider assessment.

Although the current report does not include impact assessment, the methods used throughout this report are standard methods used by BCE when preparing impact assessments. BCE uses a 'values and impacts' assessment process including the following components:

- The identification of **fauna values** (covered in this report):
  - Assemblage characteristics: uniqueness, completeness and richness;
  - Species of conservation significance;
  - Recognition of ecotypes or vegetation/substrate associations (VSAs) that provide habitat for fauna, particularly those that are rare, unusual and/or support significant fauna;
  - Patterns of biodiversity across the landscape; and
  - Ecological processes upon which the fauna depend.

### Survey area description

The survey area is c. 122 ha in size and located in the wheatbelt, approximately 210 km north-east of Perth. The survey area and surrounding landscape are characterized by cleared paddocks with isolated patches of vegetation (remnant and planted). Some threatened and priority ecological communities (TECs/PECs) are located within the 40 km buffer zone of the survey area.

### Key fauna values

Vegetation and Substrate Associations (VSAs). The survey area encompasses four VSAs which are typical of the Western Australian wheatbelt. The majority of the survey area consists of paddocks (VSA 1; weedy grasses and oats, with a ground cover of shrubs and herbs over red loam). Other VSAs include Complex shrubland (VSA 2; low vegetation of sedges, small shrubs of *Hakea*, *Melaleuca*, *Conospermum* (smoke bush), *Calothamnus* with emergent Sheoak and *Grevillea* on shallow sandy clay soils.); Eucalypt open woodland (VSA 3; *Eucalyptus salmonphloia* (Salmon Gum) and Gimlet over salt bush, occasional *Acacia* and weedy grasses on red loam;) and Planted trees (VSA 4; Planted species in open areas of township, *Eucalyptus camaldulensis* & *Eucalyptus* sp. (unidentified) over grassy weeds and red loam sand).

Fauna assemblage. The desktop study identified 212 vertebrate fauna species as potentially occurring in the survey area: eight frogs, 44 reptiles, 142 birds (including six introduced), 12 native mammals and six introduced mammals. This does not include several domesticated species that will be present in the survey area. Sixty native vertebrate species that would have once been present in the survey area are now either extinct (11 mammals) or considered locally extinct (four reptiles, 16 birds, and 29 mammals). The presence of 18 species of birds was confirmed during the November 2022 site inspection. Overall, the assemblage of vertebrate fauna expected in the survey area is typical of degraded and fragmented vegetation in the Wheatbelt region, characterised by species loss (particularly mammals), a higher proportion of species expected only irregularly, and uncertainty as to the status of many species (likely to be irregular visitors or absent). Due to the scarcity of vegetation in and around the survey area, several species that would typically be expected as residents in wheatbelt locations are probably absent from the survey area.

Species of conservation significance. Three broad levels of conservation significance are used in this report:

- Conservation Significance 1 (CS1) – species listed under State or Commonwealth Acts.
- Conservation Significance 2 (CS2) – species listed as Priority by DBCA but not listed under State or Commonwealth Acts.
- Conservation Significance 3 (CS3) – species not listed under Acts or in publications but considered of at least local significance because of their pattern of distribution.

Species of conservation significance. There are 106 vertebrate species of conservation significance expected to occur in the survey area: four CS1, two CS2, and 100 CS3. The majority of species that are still present are considered to be of local conservation significance (CS3) because of the extensive clearing and degraded nature of remnant vegetation. An additional 49 species (4 reptiles, 16 birds, and 29 mammals) of conservation significance are locally extinct. There were four conservation significant trapdoor spiders returned from database searches (recorded between 20 and 60 km from survey area); two of these were confirmed present in the survey area: Shield-backed Trapdoor Spider (CS1) and Tree-stem Trapdoor Spider (CS2).

Black-cockatoo assessment. Carnaby's Black-Cockatoo was not recorded during the site inspection and there was no evidence of foraging by this species. The survey area is within the range of the species and it is expected as a regular visitor to the survey area. The survey area is out of range for the Forest Red-tailed and Baudin's Black-Cockatoos.

Foraging value – overall the foraging value of the survey area is moderate to low. VSA 2 (complex shrubland) provides the highest foraging value at 4/10.

Breeding value – Twenty-three trees were assessed as potential nesting trees for black-cockatoos; one was assigned a rank of 3 and one was assigned a rank of 4, with the remainder given a rank of 5. Three confirmed breeding sites have been identified within 40 km of the study area. The closest known record of breeding for Carnaby's Black-Cockatoo is c. 18 km south-west of the survey area.



**Roosting value** – In the north of the survey area several tall trees have been identified as suitable for roosting. There are no known roosting sites within 40 km of the Ballidu site, with the closest known roosting site 74 km to the south-west.

**Trapdoor spider assessment.** Two conservation significant trapdoor spiders were confirmed within the survey area: Shield-backed Trapdoor Spider and Tree-stem Trapdoor Spider. An additional two trapdoor spider species have been recorded within 60 km of Ballidu. Suitable habitat for trapdoor spiders was present within the survey area in the Complex Shrubland of VSA 2; two Shield-backed Trapdoor Spiders and one Tree-stem Trapdoor Spider burrow were found in this habitat during the first targeted survey in November 2023. Two Shield-backed Trapdoor Spider burrows were recorded within surrounding bushland in the February 2024 survey. Despite extensive survey effort in the survey area and in the surrounding bushland, spider burrows were only recorded in two areas within and adjacent to the survey area, with these areas being 1 km apart. It is likely that additional trapdoor spider burrows exist in the general area given the camouflaged nature of the lids which make them hard to detect. However, the results suggest that the spiders are not in high abundance and therefore any locations where they occur are likely to be important for the local populations. This includes locations where empty burrows were found.

**Patterns of biodiversity.** The complex shrubland of VSA 2 is likely to support the highest levels of biodiversity in the survey area; trapdoor spiders are likely to be restricted to this VSA. Although areas of VSA 2 are small, they are generally reasonably well connected to larger areas of remnant vegetation outside the survey area. The Eucalypt open woodland and planted trees of VSA 3 and 4 may provide some shelter and resources for fauna, as well as function as connectivity to facilitate movement of fauna between patches of remnant vegetation. VSA 1 has low value for fauna and tends to support species that are favoured in the cleared agricultural landscape, and that therefore are widespread and abundant in the Wheatbelt.

**Key ecological processes.** The ecological processes that currently have major effects upon the fauna assemblage include existing habitat loss, landscape connectivity, the presence of feral species and the presence of over-abundant native species. Hydrology may be a significant factor as in at least some parts of the Wheatbelt, changing levels and salinity in groundwater has led to vegetation degradation. Fire could also be a factor that has affected the fauna assemblage. The extent of habitat loss means that the small remnant in the survey area supports almost relictual populations of some species that would not be present otherwise, while the connectivity provided by native vegetation in the survey area may be essential for some local populations.

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# 1 Introduction

Co-Operative Bulk Handling Limited (CBH) manages grain storage facilities across the Wheatbelt region of Western Australia, extending from Geraldton to Esperance. At many of these sites, CBH is considering the potential for expansion of roads and/or infrastructure into undeveloped areas. Therefore, as part of understanding the environmental values of their properties and immediate surrounds, Bamford Consulting Ecologists (BCE) was commissioned by CBH to conduct a Basic (sensu EPA, 2020) fauna assessment (desktop review, fauna habitat identification and a site inspection), including targeted black-cockatoo and trapdoor spider assessments, of the site at Ballidu. The survey area and surrounds were visited three times: 9<sup>th</sup> November 2022 to conduct a targeted black-cockatoo assessment and identify fauna habitats (site inspection), 7<sup>th</sup> November 2023 for a targeted trapdoor spider assessment within the survey area, and 22-23<sup>rd</sup> February 2024 to search for evidence of trapdoor spiders in bushland surrounding the survey area. This report presents the results of the desktop review, site inspection and targeted assessments.

The purpose of these assessments and the following report is to provide information regarding the fauna values of the Ballidu site, to be used by CBH to guide future decisions regarding potential developments.

## 1.1 Carnaby's Black-Cockatoo

The survey area is out of range for the Forest Red-tailed Black-Cockatoo and Baudin's Black-Cockatoo and, as such, Carnaby's Black-Cockatoo is the only black-cockatoo expected to occur in the survey area. All references to 'black-cockatoo' from hereon (within the main text) refer to Carnaby's Black-Cockatoo. Carnaby's Black-Cockatoo is listed as Endangered under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* (EPBC Act) and falls under Schedule 2 Division 2 (Endangered) of the Western Australian *Biodiversity Conservation Act 2016* (BC Act). See Appendix 1 and 2 for conservation significance categories and descriptions. The survey area is within the species' range, and there several records within 15-40 km of the survey area (see Section 3.3.1); the most recent of these is from 2013. The species is expected to occur as a regular visitor to the survey area.

## 1.2 Trapdoor spiders

Several conservation significant trapdoor spiders are present in the Wheatbelt region of Western Australia, as indicated in the DBCA Threatened and Priority fauna list (DBCA, 2023h). The target species for assessment in the current report was *Idiosoma nigrum*, the Shield-backed Trapdoor Spider (listed as Vulnerable under the EPBC Act and Schedule 2 Division 2 (Endangered) under the Western Australian BC Act), although the Tree-stem Trapdoor Spider *Idiosoma castellum* was also recorded in the present survey; details are presented below. The former species is endemic to WA and is significant due to the restricted geographic distribution and the nature of ongoing threats towards its survival (DSEWPac, 2013b). The Shield-backed Trapdoor Spider is adapted for living in semi-arid habitats such as those found in the wheatbelt, and makes burrows with a lightweight trapdoor (DSEWPac, 2013b); the spider builds a distinctive trapdoor which makes it conspicuous during surveys. This spider usually inhabits clay soils and requires leaf litter and twigs to build its burrow; these typically come from *Eucalypt* woodlands and *Acacia* vegetation (DSEWPac, 2013b). Documented threats to the Shield-backed Trapdoor Spider include land clearing and habitat fragmentation,



degradation of habitat via grazing by livestock and feral animals, and inappropriate fire regimes (DSEWPac, 2013b). Three additional trapdoor spider species were returned from database searches and these are detailed in Section 3.4.1.

### **1.3 Background information: fauna impact assessment**

The purpose of impact assessment is to provide government agencies with the information they need to decide upon the significance of impacts of a proposed development, and to provide information to proponents to help them to develop appropriate strategies for avoiding and minimising impacts of their activities. This relies on information on the fauna assemblage and its environment, and BCE uses an approach with the following components:

- The identification of **fauna values** (covered in this report):
  - Assemblage characteristics: uniqueness, completeness and richness;
  - Species of conservation significance;
  - Recognition of ecotypes or vegetation/substrate associations (VSAs) that provide habitat for fauna, particularly those that are rare, unusual and/or support significant fauna;
  - Patterns of biodiversity across the landscape; and
  - Ecological processes upon which the fauna depend.

The objectives of the current assessment and report are as follows:

1. Conduct a literature review and searches of Commonwealth and State fauna databases to compile a comprehensive list of fauna expected to occur in the survey area;
2. Review the list of fauna expected to occur in the survey area in the light of fauna habitats present, with a focus on investigating the likelihood of significant species being present;
3. Identify significant or fragile fauna habitats within the survey area;
4. Conduct targeted black-cockatoo and targeted trapdoor spider assessments;
5. Identify general patterns of biodiversity within or adjacent to the survey area; and
6. Identify any ecological processes in the survey area upon which fauna may depend.

Descriptions and more background information on these values and processes can be found in Appendices 1 and 2.

### **1.4 Description of survey area and background environmental information**

#### **1.4.1 Survey area**

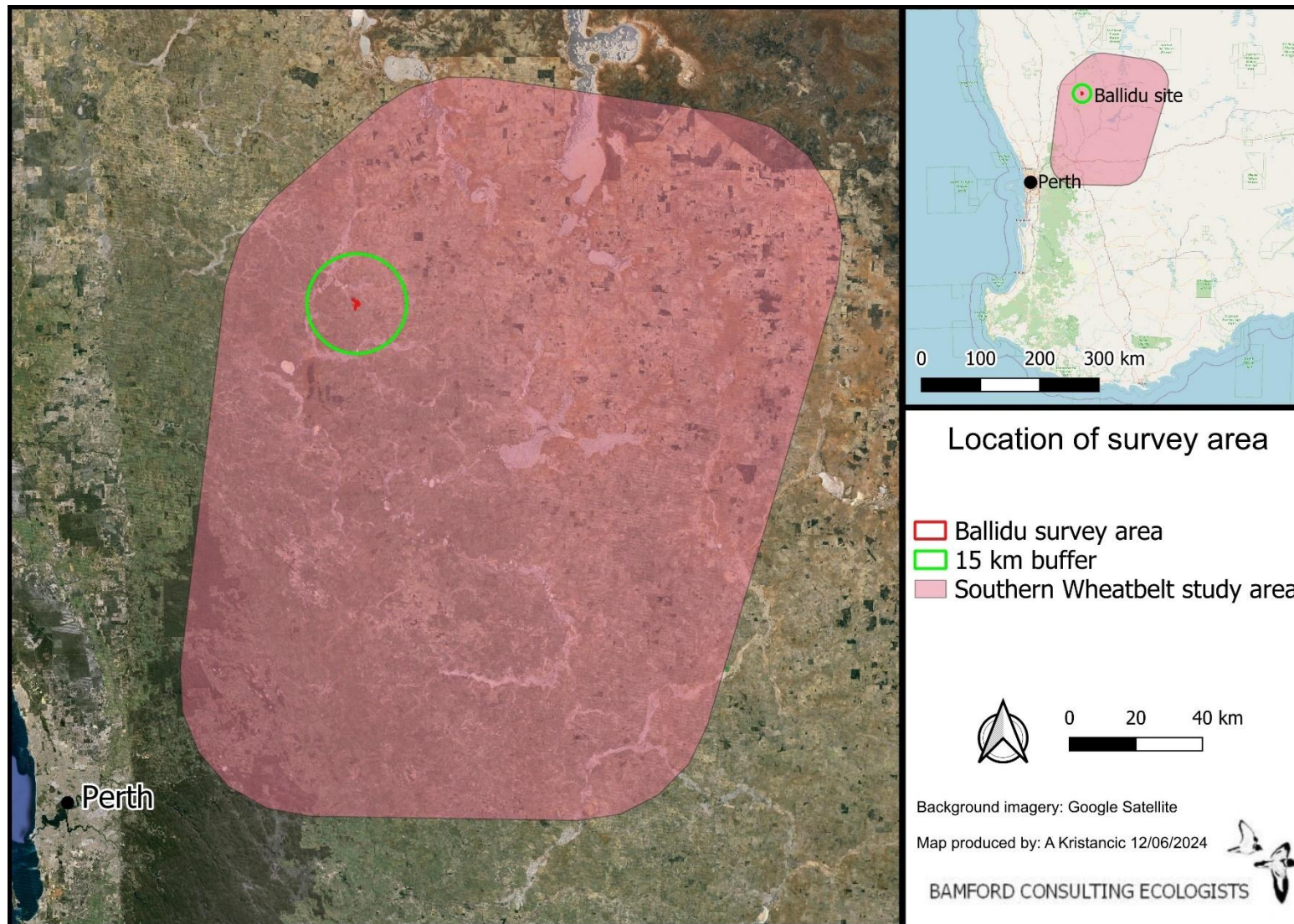
The survey area is located in Western Australia's Wheatbelt region (DBCA, 2023a), located within the townsite of Ballidu and approximately 210 km north-east of Perth (Figure 1-1). It is approximately 122 ha in size, and consists of remnant native vegetation, planted native trees, roads, paddocks and CBH infrastructure. The surrounding landscape is predominantly paddocks, with some areas of vegetation which are isolated and heavily fragmented because of agricultural practices. These patches of vegetation include remnant native vegetation and plantations/rehabilitation.

A range of terms is used through this report to refer to the spatial environment including and around the Ballidu survey area; these are defined below and illustrated in Figure 1-1 and Figure 1-2:

- Survey area – the survey area boundary was provided by CBH and is comprised of a mixture of land over which CBH has tenure (including land containing existing CBH infrastructure) and private property adjacent to CBH land. It is the area to which the results of the desktop analysis are directed and the area within which field investigations in November 2022 and October 2023 were conducted. The second survey for trapdoor spiders (February 2024) was conducted in areas of bushland surrounding the survey area.
- Study area – the outermost boundary of the desktop assessment area that is almost always a specified buffer distance (see Section 2.3.1 below) around the *survey area*. The study area thus encompasses the *survey area* but includes the area from which database records are sourced for the desktop assessment. For the current report, this is a large area encompassing a 40 km buffer around Ballidu. This large study area was used to simplify the desktop review, with records then being interpreted within the environmental context of the survey area.

Note that for the purposes of context and mapping, a 15 km buffer from the centre of the survey area is used; this is based upon guidance for regional context from the EPA (EPA, 2016c).





**Figure 1-1. Locations of the survey area and the study area (used for desktop assessment for southern wheatbelt sites).**



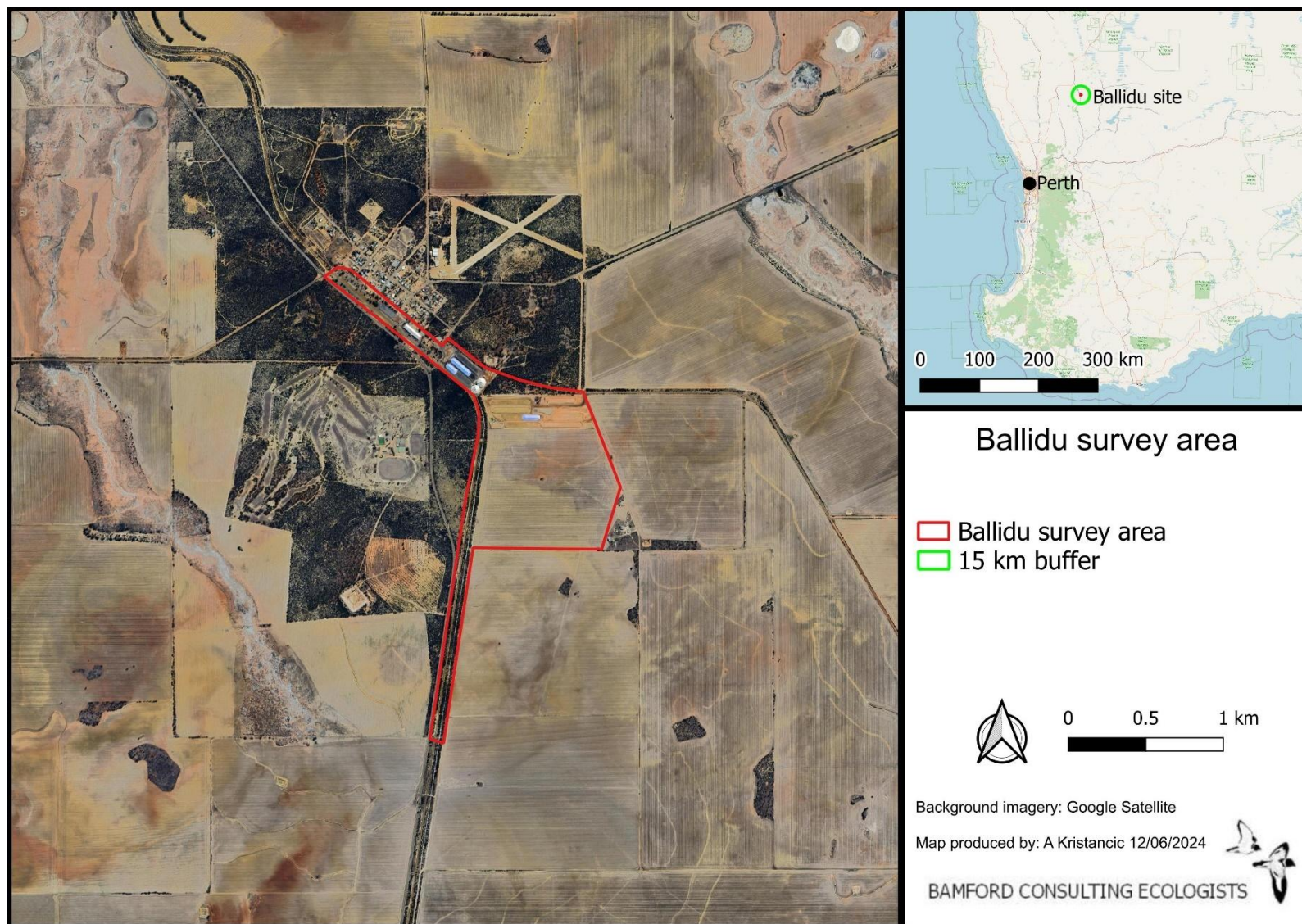


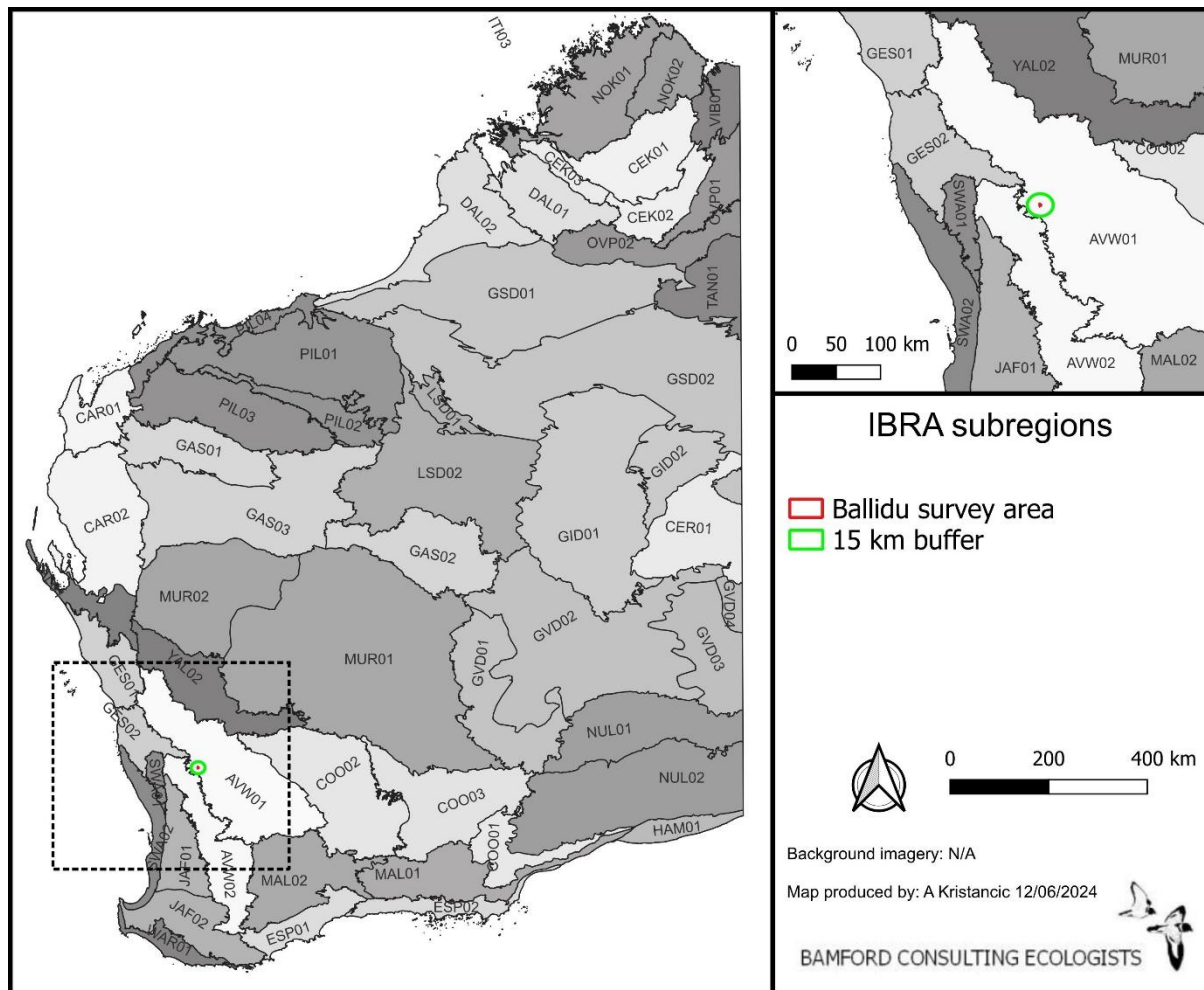
Figure 1-2. Location of Ballidu survey area.



#### 1.4.2 *Interim Biogeographic Regionalisation of Australia (IBRA) and landscape characteristics*

The Interim Biogeographic Regionalisation of Australia (IBRA) has identified 26 bioregions in Western Australia which are further divided into subregions (DCCEEW, 2023b). Bioregions are classified on the basis of climate, geology, landforms, vegetation and fauna (Thackway & Cresswell, 1995). IBRA Bioregions are affected by a range of different threatening processes and have varying levels of sensitivity to impact (EPA, 2016c). The survey area lies within the Ancient Drainage (AVW01) subregion of the Avon Wheatbelt bioregion (Figure 1-3).

The Ancient Drainage subregion was described by Beecham (2001) and a summary of their work follows here. The Avon Wheatbelt bioregion is a gently undulating landscape of low relief, consisting of proteaceous scrub heaths on residual lateritic uplands and sandplains, and mixed eucalypt, *Allocasuarina huegeliana*, and Jam-York woodlands on Quaternary alluvials and eluvials. The Ancient Drainage subregion is an ancient peneplain with no connected drainage. Chains of salt lakes represent the remnants of ancient drainage systems, which may function in very wet years. The Avon Wheatbelt bioregion falls into the Southern Climatic Region (EPA, 2020). The climate is Semi-arid (Dry) Warm Mediterranean (Beecham, 2001), with annual rainfall averaging 358 mm (for Station: Wongan Hills Res. Station, Number 8138, BOM, 2023).



**Figure 1-3. Survey area location within the Interim Biogeographic Regionalisation for Australia (IBRA) subregions.**



### 1.4.3 Pre-European Vegetation and Soil-Landscape Mapping

Mapping of a survey area in relation to broad scale datasets can provide useful context regarding the current and historical landscape of the survey area and surrounds. Beard *et al.* (2013) have described and mapped the original vegetation presumed to have existed across Western Australia prior to European settlement and this dataset is provided by DPIRD (2023b). A dataset of soil-landscape mapping across Western Australia is provided by DPIRD (2023c). The survey area in relation to these datasets is shown in Figure 1-4 and Figure 1-5.

There are 15 soil-landscape subsystems in the 15 km buffer surrounding the survey area (DPIRD, 2023c) (Figure 1-4); details are provided only for the two subsystems that overlap with the survey area. The majority of the survey area lies within Ballidu 3 subsystem (Undulating plain, crests and upper slopes from weathered granite. Mainly loamy gravel, yellow deep sand, sandy and loamy earth, Red shallow loamy duplex, minor of sandy loamy duplex), with very small areas in the south and east overlapping with the Ballidu 4 subsystem (Gently undulating sandplain to gently undulating sandy rises with long gentle slopes from weathered granite. Yellow deep sands and earths, often acid, some gravels and sandy duplexes).

Prior to European arrival, the landscape within 15 km of the survey area is thought to have comprised four vegetation types as well as scattered salt lakes (Beard *et al.*, 2013; DPIRD, 2023b) (Figure 1-5). Details are provided only for vegetation types in the survey area and immediate vicinity (c. 2 km radius). The survey area lies entirely in vegetation type 14 (Thicket) of Beard *et al.* (2013). Historically, this area would have been covered by a thicket of *Acacia*, *Allocasaurina* and *Melaleuca* shrubland. In the nearby surrounding landscape, there are also some scattered areas of vegetation type 47 and 4, which historically would have comprised of thickets and scrub of *Tecticornia* under *Melaleuca* and *Acacia* and woodland dominated by York Gum (*Eucalyptus loxophleba*) and Salmon Gum (*E. salmonophloia*). Some remnants of these vegetation types may remain, although the survey area itself largely consists of cleared land or modified vegetation.

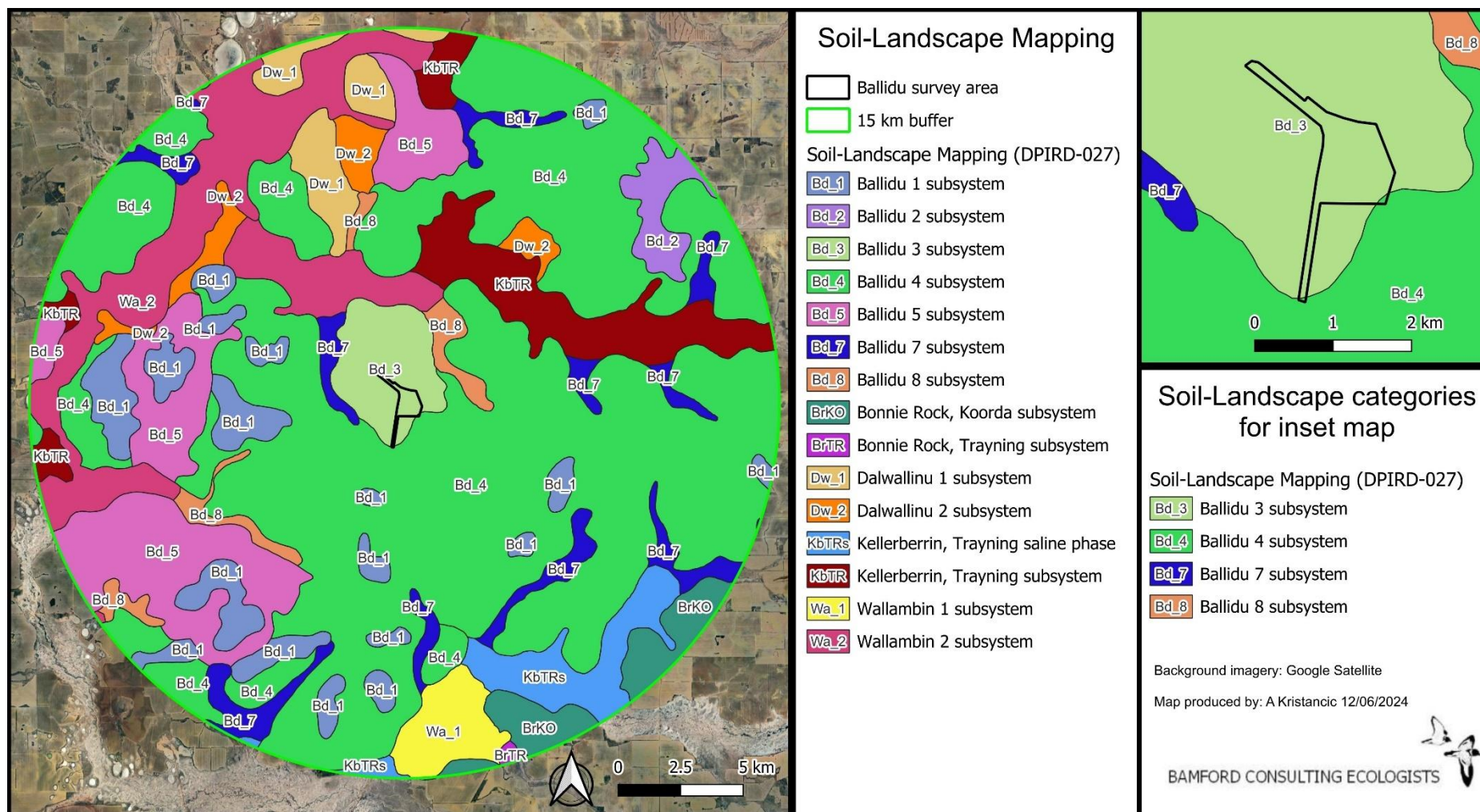


Figure 1-4. Soil-landscape mapping (DPIRD, 2023c) within 15 km of the survey area.



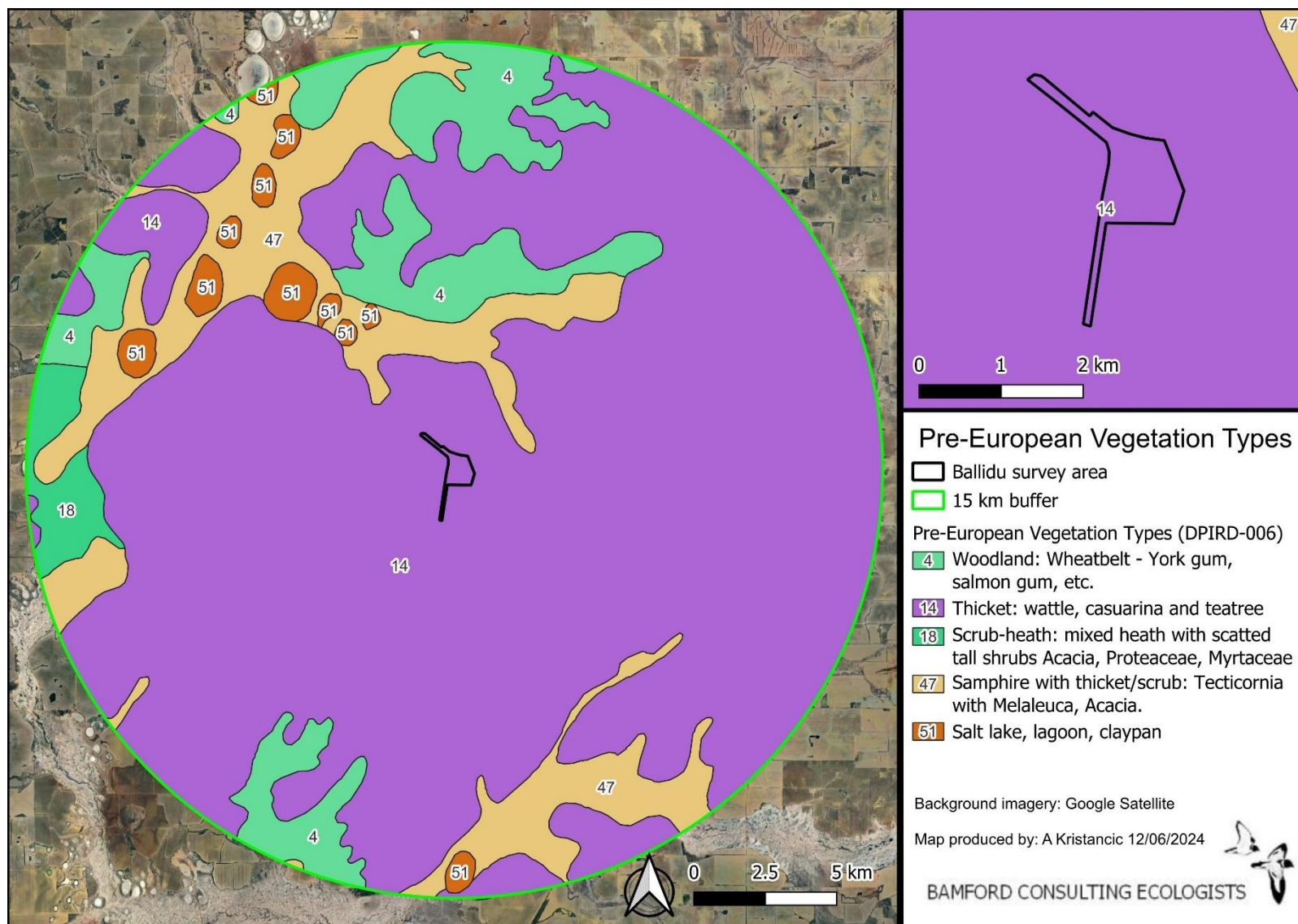


Figure 1-5. Pre-European vegetation types (DPIRD, 2023b) within 15 km of the survey area.

#### 1.4.4 *Land use and tenure*

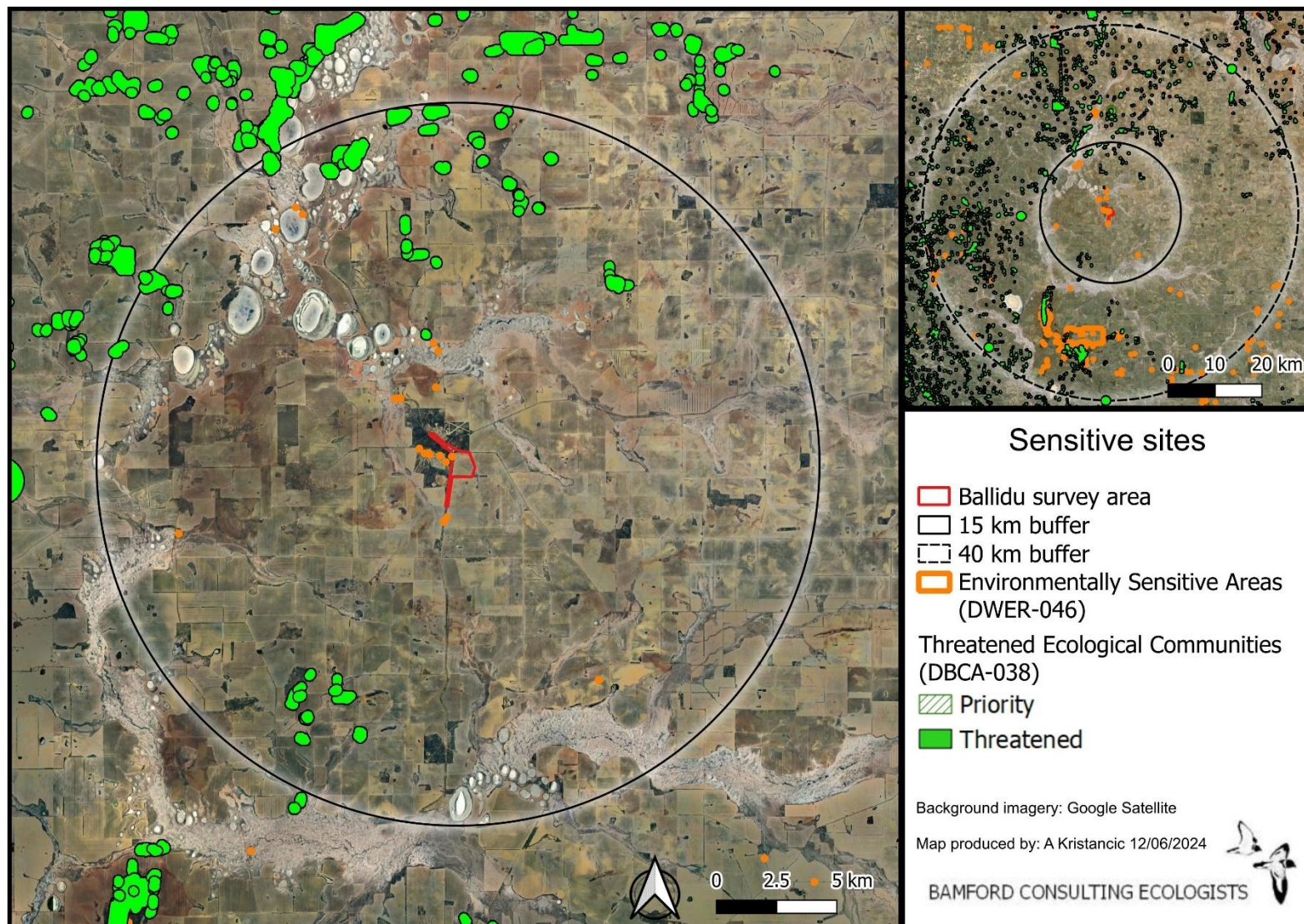
The dominant land uses within the Ancient Drainage (AW1) subregion are cultivation (dry land agriculture) and grazing (improved pastures), and the entire subregion is extensively cleared. Other land uses include UCL and Crown reserves, conservation, rural residential and mining (Beecham, 2001). The survey area lies in north of the subregion. At the local scale, the survey area is surrounded by areas of agriculture/grazing, with isolated patches of remnant native vegetation and planted trees/plantations/rehabilitation.

#### 1.4.5 *Recognised sensitive sites*

There are no known Bush Forever sites (Dell & Banyard, 2000), Key Biodiversity Areas (KBA, 2023), Ramsar Sites (DBCA, 2023d) or Important Wetlands (DBCA, 2023b) within 40 km of the survey area. There are several areas within 40 km that are categorised as Environmentally Sensitive Areas (DWER, 2023b, 2023a) or Priority Ecological Communities (DBCA, 2023g, 2023f), the closest of which is on the western boundary of the survey area (Figure 1-6). Many small areas of Threatened Ecological Communities (TECs) are scattered throughout the 15 km buffer, and between 15-40 km of the survey area, and coincide with areas of remnant vegetation (Figure 1-6); these are most likely patches of the 'Eucalypt Woodlands of the Western Australian Wheatbelt' TEC (DCCEEW, 2023f). Any fragments of remnant vegetation within the Wheatbelt are considered to be significant because they occur within a vast agricultural landscape.

There is one 'protected nature reserve' (DCCEEW, 2020) within 15 km of the survey area (Damboring Nature Reserve, see Figure 1-7) and several more within 15-40 km of the survey area (not shown).





**Figure 1-6. Environmentally Sensitive Areas (DWER, 2023a), and Priority and Threatened Ecological Communities (DBCA, 2023g) within 15 km (and 40 km in inset map) of the survey area.**



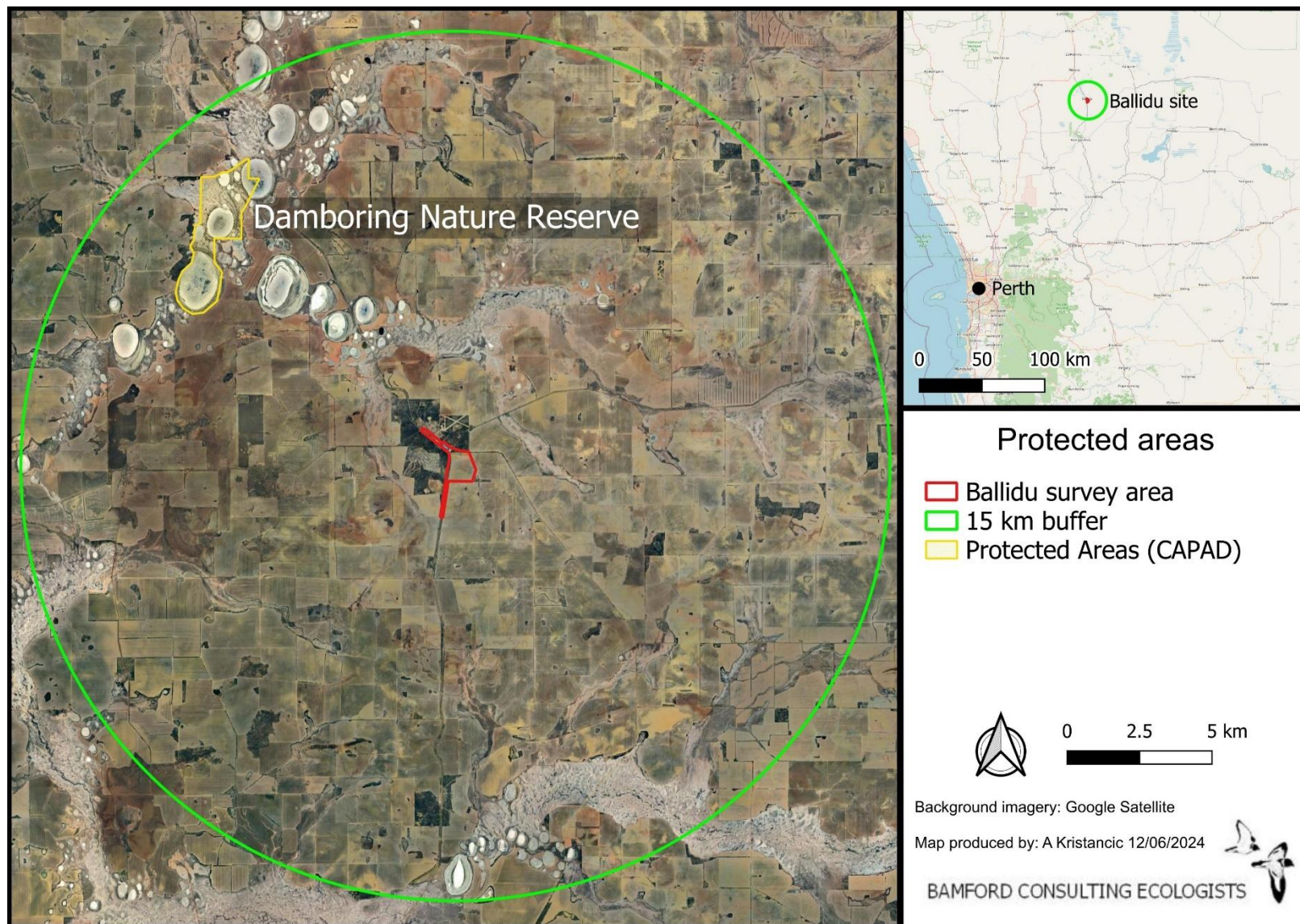


Figure 1-7. Protected areas within 15 km of the survey area, as per the Collaborative Australian Protected Areas Database (CAPAD; DCCEW, 2020).



#### *1.4.6 Regional development*

The survey area is surrounded by a highly fragmented landscape that has been largely cleared for agriculture and grazing, and includes a network of sealed and unsealed roads. Figure 1-8 illustrates the existing extent of land clearing and development in a 15 km buffer around the survey area. Within this buffer, c. 3000 ha of native vegetation remains; therefore existing land clearing or development (c. 67,686 ha) impacts c. 96% of the total land area (c. 70,686 ha) within 15 km of the survey area. Within the survey area, there is c. 6 ha of native vegetation remaining. This represents less than 0.01% of the remaining native vegetation within 15 km. Of note is the retained native vegetation around the town of Ballidu and therefore adjacent to the survey area. The majority of the survey area (c. 116 ha, 95%) is cleared or developed land.

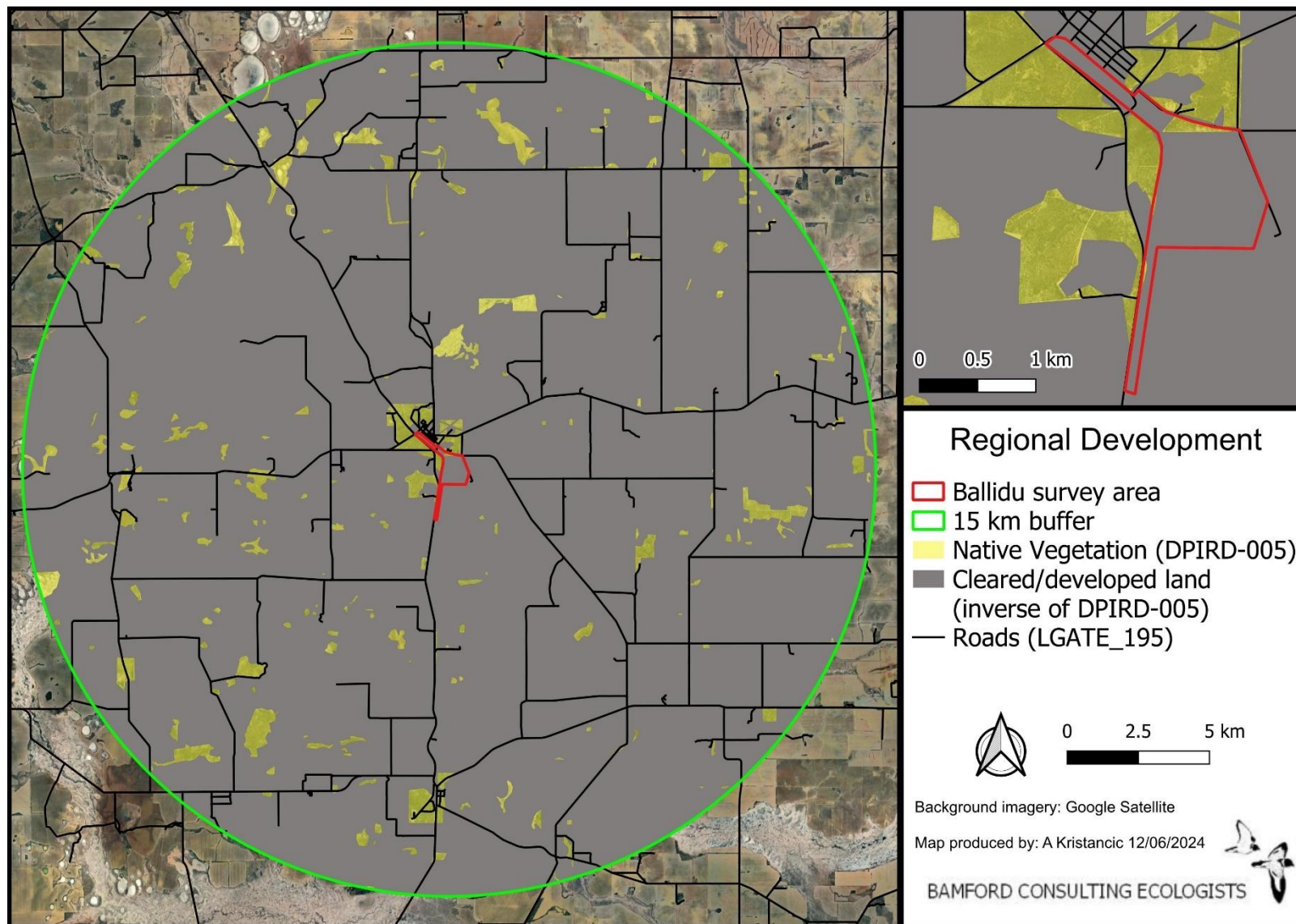


Figure 1-8. Estimated existing development within the region. Native vegetation extent is from DPIRD (2023a).



## 2 Methods

### 2.1 Overview

Although impact assessment does not form part of this report, the methodology used for the assessment of fauna values at the CBH Ballidu site is part of the standard approach that BCE uses for fauna assessment studies, which includes impact assessment when required. This approach has been developed with reference to guidelines and recommendations set out by the Western Australian Environmental Protection Authority (EPA) on fauna surveys and environmental protection (EPA, 2002, 2016a, 2016b, 2020), and Commonwealth biodiversity legislation (DotE, 2013; DSEWPoC, 2013a). The EPA (2020) recommends three levels of investigation that differ in their approach for field investigations:

- Basic – a low-intensity survey, conducted at the local scale to gather broad fauna and habitat information (formerly referred to as ‘Level 1’). The primary objectives are to verify the overall adequacy of the desktop study, and to map and describe habitats. A basic survey can also be used to identify future survey site locations and determine site logistics and access. The results from the basic survey are used to determine whether a detailed and/or targeted survey is required. During a basic survey, opportunistic fauna observations should be made and low-intensity sampling can be used to gather data on the general faunal assemblages present. While referred to as ‘basic’, this level of survey is involved and powerful, and should be considered the primary level of assessment. Other levels of assessment (where deemed necessary) add information to inform this primary level.
- Detailed – a detailed survey to gather quantitative data on species, assemblages and habitats in an area (formerly referred to as ‘Level 2’). A detailed survey requires comprehensive survey design and should include at least two survey phases appropriate to the biogeographic region (bioregion). Surveys should be undertaken during the seasons of maximum activity of the relevant fauna and techniques should be selected to maximise the likelihood that the survey will detect most of the species that occur, and to provide data to enable some community analyses to be carried out.
- Targeted – to gather information on significant fauna and/or habitats, or to collect data where a desktop study or field survey has identified knowledge gaps. Because impacts must be placed into context, targeted surveys are not necessarily confined to potential impact areas. A targeted survey usually requires one or more site visits to detect and record significant fauna and habitats. For areas with multiple significant species there may not be a single time of year suitable to detect all species. In these cases, multiple visits, each targeting different species or groups, should be conducted.

The level of assessment recommended by the EPA (2020) is determined by geographic position, with a generic statement that detailed surveys are expected across all of the state except the south-west, but also recommending that site and project characteristics be considered, such as the survey objectives, existing available data, information required, the scale and nature of the potential impacts of the proposal and the sensitivity of the surrounding environment in which the disturbance is planned. These aspects should be considered in the context of the information acquired by the desktop study. When determining the type of survey required, the EPA (2020) suggested that the following be considered:

- level of existing regional knowledge;

- type and comprehensiveness of recent local surveys;
- degree of existing disturbance or fragmentation at the regional scale;
- extent, distribution and significance of habitats;
- significance of species likely to be present;
- sensitivity of the environment to the proposed activities; and
- scale and nature of impact.

The survey area lies in a region where the fauna assemblage is well-documented and where very extensive clearing for agriculture means that effectively any remaining native vegetation is of high biodiversity value, although a high level of species loss can be expected. At present there is no detailed information on the scale and nature of the proposed impact, as this will be influenced by the current assessment. As a result, a 'basic' level survey (desktop review, fauna habitat identification and a site inspection) with targeted investigations for relevant significant species is consistent with the requirements for the current report, which aims to summarise the fauna values of the survey area and does not include an impact assessment. Guidance for field investigation methods for vertebrate fauna is provided by the EPA (2016c, 2020) and by Bamford *et al.* (2013).

The approach and methods utilised in this report for the Basic assessment are divided into two sections, which differ in their objectives, and are used in combination to summarise the fauna values of the survey area:

- **Desktop assessment.** The purpose of the desktop assessment is to produce species lists that can be considered to represent the vertebrate fauna assemblage of the survey area, and the conservation significant invertebrate species likely to occur in the survey area, based on unpublished and published data and using a precautionary approach.
- **Field investigations.** The purpose of the field investigations is to gather information on the vegetation and substrate associations ('VSAs') that support the fauna assemblage and place the list generated by the desktop assessment into the context of the environment of the survey area. The brief field investigations that form part of a Basic assessment also allow for some fauna observations to be made and assist the consultant to develop an understanding of the ecological processes that may be operating in the survey area.

## 2.2 Identification of vegetation and substrate associations (VSAs)

Vegetation and substrate associations (VSAs) combine vegetation types, the soils or other substrate with which they are associated, and the landform. In the context of fauna assessment, VSAs are the environments that provide habitats for fauna.

BCE deliberately makes the distinction between 'habitat' (a species-specific term that may encompass the whole or part of one or more VSAs and is the physical subset of an ecosystem that a given species, or species group, utilises) and 'VSA' (a general, discrete and mutually exclusive spatial division of a target area, based on soil, vegetation and topography). It is recognised, however, that, within the broader EIA literature/guidance, the former term is used more or less synonymously to indicate the latter (e.g. 'habitat assessment' used by EPA, 2020). Further discussion is provided in Appendix 1.



## 2.3 Desktop assessment of expected species

### 2.3.1 Sources of information

As per the recommendations of EPA (2020), information on the fauna assemblage of the survey area was drawn from a range of sources including databases (as listed in Table 2-1) and previous reports (Table 2-2). Information from these sources was supplemented with species expected in the area based on general patterns of distribution. Sources of information used for these general patterns are listed in Table 2-3.

### 2.3.2 Previous fauna surveys

There were seven previous fauna surveys listed within 40 km of the survey area in the Index of Biodiversity Surveys for Assessments (IBSA) (DWER, 2023c). These are presented in Table 2-2. Resources were only available via IBSA for one of these reports, which was a black-cockatoo breeding habitat assessment (360 Environmental, 2020).

**Table 2-1. Databases searched for the desktop review; accessed January/February 2023.**

Database	Type of records held in database	Area searched
BCE Database	Fauna recorded by BCE in the vicinity of the survey area.	Wheatbelt region
Atlas of Living Australia (ALA, 2023)	Fauna records from Australian museums and conservation/research bodies.	Search area encompassing 40 km buffer around CBH site Ballidu
NatureMap (DBCA, 2023c)	Records from the Western Australian Museum (WAM) and Department of Biodiversity, Conservation and Attractions (DBCA) databases, including historical data.	Search area encompassing 40 km buffer around CBH site Ballidu
DBCA Threatened and Priority Fauna (DBCA, 2023e)	Records from the DBCA Threatened and Priority species database, including black-cockatoo nesting/roosting data.	Search area encompassing 40 km buffer around CBH site Ballidu
BirdLife Australia databases (BirdLife Australia, 2023c, 2023a, 2023b)	Records from Bird Life Australia, including birddata and black-cockatoo datasets	Search area encompassing 40 km buffer around CBH site Ballidu

Database	Type of records held in database	Area searched
EPBC Protected Matters Search Tool (DCCEEW, 2023f)	Records on MNES protected under the EPBC Act.	Search area encompassing 40 km buffer around CBH site Ballidu
Index of Biodiversity Surveys for Assessment (IBSA) (DWER, 2023c)	Flora and fauna data contained in EIA biodiversity survey reports.	40 km buffer around Ballidu townsite

**Table 2-2. Terrestrial fauna survey reports returned from IBSA search during desktop review, for 40 km radius around the CBH Ballidu site. Reports that are in italics did not have any resources available to download.**

Author	Title	Distance to site
360 Environmental (2020)	St Leonards Black-Cockatoo Breeding Habitat Survey. Unpublished report for Lawson Grains Pty Ltd.	c. 25 km
<i>Western Ecological (2020)</i>	<i>Fauna Assessment Wongan Hills Road, Shire of Wongan – Ballidu.</i>	
<i>Main Roads (2019)</i>	<i>Environmental Site Inspection Report: Northam Pithara Road Truck Bays 109.73 SLK</i>	
<i>Phoenix Environmental (2016b)</i>	<i>Flora and Fauna Assessment for the Calingiri to Wubin Study Areas – Report Addendum. Unpublished report prepared for Main Roads Western Australia (Mucnea to Wubin Integrated Project Team).</i>	
<i>Phoenix Environmental (2016a)</i>	<i>Flora and Fauna and Fauna Assessment for the Lyons East Road to Gatti Road Study Area – Report Addendum. Unpublished report prepared for Main Roads Western Australia (Mucnea to Wubin Integrated Project Team).</i>	
<i>Phoenix Environmental (2015)</i>	<i>Flora and Fauna Assessment for Lyons East Road to Gatti Road Study Area. Unpublished report prepared for Main Roads Western Australia (Mucnea to Wubin Integrated Project Team).</i>	
<i>Aecom (2012)</i>	<i>Northam - Pithara Road Biological Assessment. Unpublished report prepared for Main Roads Western Australia.</i>	



**Table 2-3. Sources of information used for general patterns of fauna distribution.**

Taxa	Sources
Fish	Morgan <i>et al.</i> (1998), Allen <i>et al.</i> (2003), Morgan <i>et al.</i> (2014), DoF (2023).
Frogs	Tyler and Doughty (2009), Anstis (2017).
Reptiles	Storr <i>et al.</i> (1983, 1990, 1999, 2002) , Bush <i>et al.</i> (2010), Wilson and Swan (2021).
Birds	Johnstone and Storr (1998, 2005), Menkhorst <i>et al.</i> (2017).
Mammals	Van Dyck and Strahan (2008), Churchill (2009), Menkhorst and Knight (2011).

### 2.3.3 Nomenclature and taxonomy

As per the recommendations of the EPA (2020), the nomenclature and taxonomic order presented in this report are generally based on the Western Australian Museum's (WAM) Checklist of the Fauna of Western Australia 2020. The authorities used for each vertebrate group were: fish (Morgan *et al.*, 2014), frogs (Doughty, 2022a), reptiles (Doughty, 2022b), birds (Gill *et al.*, 2023), and mammals (Travouillon, 2022). In some cases, more widely-recognised names and naming conventions have been followed, particularly for birds where there are national and international naming conventions in place (e.g. the BirdLife Australia working list of names for Australian Birds (BirdLife Australia, 2022), and the International Ornithological Congress' 'World Bird List'). Similarly, the group name 'black-cockatoo' is consistently used for all three taxa in the South-West. English common names of species, where available, are used throughout the text; Latin names are presented with corresponding English names in tables in the appendices. The use of subspecies is limited to situations where there is an important (and relevant) geographically distinct population, or where the taxonomic distinction has direct relevance to the conservation status or listing of a taxon.

### 2.3.4 Interpretation of species lists

#### 2.3.4.1 Expected occurrence

Species lists generated from the review of sources of information are generous as they include records drawn from a large region (the study area, see FIG 1-1 and possibly from environments not represented in the survey area. Therefore, some species that were returned by one or more of the database and literature searches have been excluded because their ecology, or the environment within the survey area, determined that it is highly unlikely that these species will be present. Such species can include, for example, seabirds that might occur as extremely rare vagrants at a terrestrial, inland site, but for which the site is of no importance. Species returned from the databases and not excluded on the basis of ecology or environment are therefore considered potentially present or expected to be present in the survey area at least occasionally, whether or not they were recorded during field surveys, and whether or not the survey area is likely to be important for them. This list of

expected species is therefore subject to interpretation by assigning each a predicted status, the expected occurrence, in the survey area. The status categories used are:

- **Resident:** species with a population permanently present in the survey area.
- **Regular visitor:** species that occur within the survey area regularly in at least moderate numbers, such as part of an annual cycle (thus includes migrants).
- **Irregular Visitor:** species that occur within the survey area irregularly such as nomadic and irruptive species. The length of time between visitations could be decades but when the species is present, it uses the survey area in at least moderate numbers and for some time.
- **Vagrant:** species that occur within the survey area unpredictably, in small numbers and/or for very brief periods. Therefore, the survey area is unlikely to be of importance for the species.
- **Locally extinct:** species that would have been present but has not been recently recorded in the local area and therefore is almost certainly no longer present in the survey area.
- **Probably absent:** species that would be expected as residents based on the location of the survey area, but are considered likely to be absent in the actual survey area because the available habitat is highly degraded.

These status categories make it possible to distinguish between vagrant species, which may be recorded at any time but for which the survey area is not important in a conservation sense, and species which use the survey area in other ways but for which the site is important at least occasionally. This is particularly useful for birds that may naturally be migratory or nomadic, and for some mammals that can also be mobile or irruptive, and further recognises that even the most detailed field survey can fail to record species which will be present at times. The status categories are assigned conservatively based on the precautionary principle. For example, a lizard known from the general area is assumed to be a resident unless there is very good evidence the survey area will not support it, and even then, it may be classed as a vagrant rather than assumed to be absent if the site might support dispersing individuals. It must be stressed that these status categories are predictions only and that often very intensive sampling would be required to confirm a species' status. It should be noted that the aim of the desktop assessment and field investigations is not to confirm the presence or absence of species in the survey area. By using a precautionary approach, the expected species assemblage represents a conservative estimate of the species assemblage that may use the survey area, with errors of inclusion rather than exclusion.

The results of the database searches were reviewed and interpreted, and obvious errors and out of date taxonomic names were deleted.

#### 2.3.4.2 Conservation significance

All expected species were assessed for conservation significance as detailed in Appendix 1. Three broad levels of conservation significance are used in this report:

- Conservation Significance 1 (CS1) – species listed under State or Commonwealth Acts such as the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the Western Australian *Biodiversity Conservation Act 2016* (BC Act);
- Conservation Significance 2 (CS2) – species listed as Priority by DBCA but not listed under State or Commonwealth Acts; and



- Conservation Significance 3 (CS3) – species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution. In the Ballidu region, a large proportion of what might otherwise be considered common species are of local significance as they are reliant on the very small areas of remnant native vegetation. In a different context, this principle was used by Dell and Banyard (2000) to recognise species of conservation significance in urban landscapes.

See Appendix 1 for an expanded discussion of these categories and Appendix 2 for a description of the categories used in the legislation (EPBC and BC Acts) and by the DBCA.

## **2.4 Field investigations**

### *2.4.1 Overview*

The site inspection on 9 November 2022 involved two personnel driving around and walking across as much of the survey area as possible. GPS tracks are indicated on Figure 2-1, and the following investigations were conducted:

- identification of VSAs (that provide fauna habitats);
- targeted black-cockatoo assessment; and
- opportunistic fauna observations (birds and other fauna, including signs such as diggings, scats and tracks.

The first part of a targeted assessment for trapdoor spiders was conducted on 7 October 2023, when two personnel examined suitable habitat within the survey area for trapdoor spider burrows.

On 22 and 23 February 2024, two personnel returned to examine bushland surrounding the survey area (including Crown Land and land managed by the Shire of Wongan-Ballidu) for trapdoor spider burrows, in order to better understand the significance of burrows recorded in the survey area during the October survey. GPS tracks for the two targeted investigations for trapdoor spiders are shown on Figure 2-2.

### *2.4.2 Dates and Personnel*

The survey area was visited on 9 November 2022, 7 October 2023 and 22 and 23 February 2024. Personnel involved in the field investigations and report preparation (including desktop review) are listed in Table 2-4.

**Table 2-4. Personnel involved in the field investigations and report preparation.**

Personnel	EIA/Wildlife Survey Experience	Field Investigations	Report Preparation
Dr Jamie Wadey <i>BSc (Zoology/Ecology), Hons (Ecology), PhD (Movement Ecology)</i>	7 years	+	+
Andy McCreery <i>BSc (Environmental Science)</i>	15 years	+	
Peter Smith <i>Dip Ag Sc</i>	40 years	+	
Sarah Smith <i>BSc (Biology)</i>	40 years	+	
Natalia Huang <i>BEnvSc (Zoology), Hons (Conservation Biology), MBA</i>	16 years		+
Dr Mike Bamford <i>BSc (Biology), Hons (Biology), PhD (Biology)</i>	40 years		+
Dr Amanda Kristancic <i>BSc (Zoology/Biochemistry), Hons (Zoology), PhD (Parasitology)</i>	3 years		+
Eliza-Joyce Mellersh <i>BSc (Biological/Conservation Biology)</i>	5 years		+



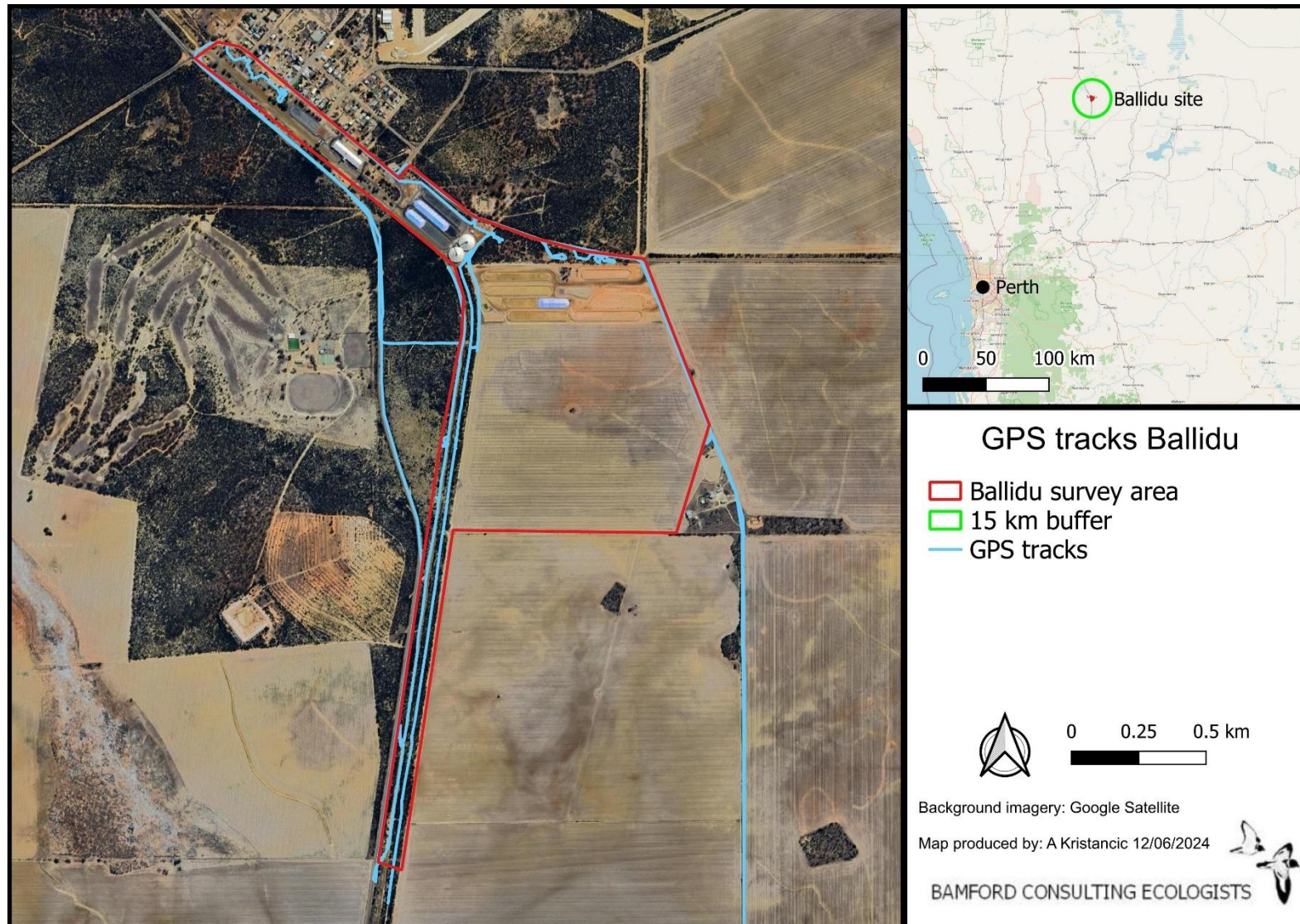


Figure 2-1. GPS tracks of BCE personnel during the site inspection (9 November 2022).



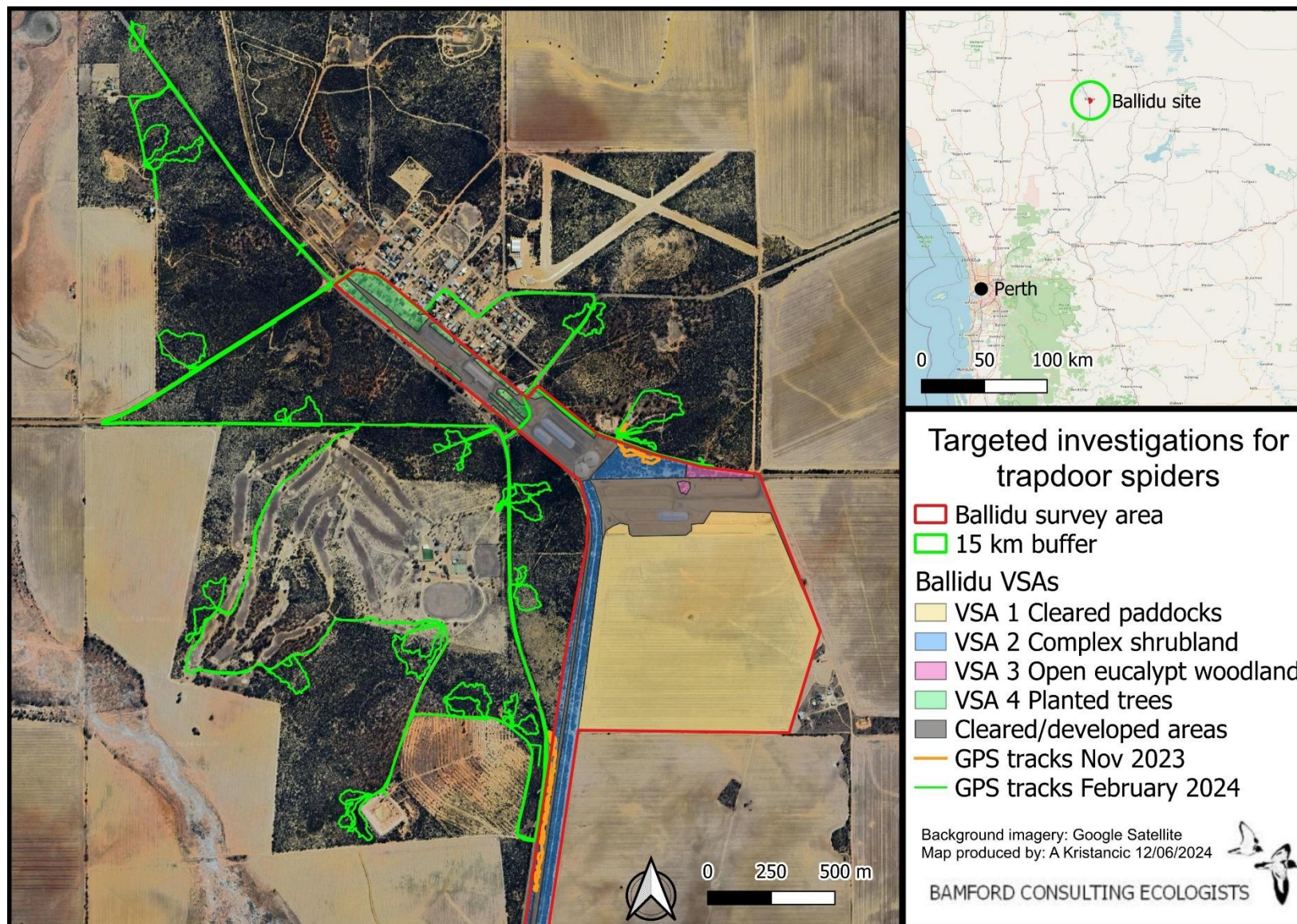


Figure 2-2. GPS tracks of BCE personnel during targeted field investigations for trapdoor spiders.



### 2.4.3 *Black-cockatoo habitat analysis*

#### 2.4.3.1 *Guidelines*

The Department of Climate Change, Energy, the Environment and Water (DCCEEW, formerly DAWE) provides guidelines for the referral of actions that may result in impacts to black-cockatoos (for assessment under the EPBC Act) (DAWE, 2022). The survey and analysis reported here have been conducted with reference to both the referral guidelines provided by DSEWPac (2012) and DAWE (2022) and recommendations listed on the DAWE's Species Profile and Threats Database (DCCEEW, 2023c, 2023e, 2023d). Ecological values for black-cockatoos within the site were based on the definitions of breeding, foraging and roosting habitat as per the EPBC Act referral guidelines for black-cockatoos (DSEWPac, 2012). Actual scoring of foraging value and assessment of potential breeding habitat was based on systems developed by BCE that are outlined below. The Department of Biodiversity, Conservation and Attractions (DBCA) has indicated that the methods developed and applied previously by BCE are an acceptable approach.

#### 2.4.3.2 *Foraging*

The foraging value of the survey area was assessed by calculating a foraging score for areas of similar vegetation type/condition (see Appendix 3). The foraging score provides a numerical value that reflects the significance of vegetation as foraging habitat for black-cockatoos, and this numerical value is designed to provide the sort of information needed by the federal DCCEEW, the state Department of Water and Environmental Regulation (DWER) and the WA Environmental Protection Authority (EPA) to assess impact significance and offset requirements. The foraging value of the vegetation depends upon the type, density and condition of trees and shrubs in an area and can be influenced by the context such as the availability of foraging habitat nearby. The BCE scoring system for value of foraging habitat has three components as detailed in Appendix 3. These three components are drawn from the DCCEW offset calculator (DCCEEW, undated) but with the scoring approach developed by BCE:

- A score out of six for the vegetation composition, condition and structure.
- A score out of three for the context of the site.
- A score out of one for species density.

Foraging value can thus be assigned a score out of six, based upon site vegetation characteristics, or a score out of 10 (the Habitat Quality core; HQS) if context and species density are also considered. A higher score represents better foraging value. A score out of 10 is presented for the purposes of aiding offset calculations. The approach to assigning scores for vegetation, context and species density are outlined in Appendix 3. Foraging value scores are calculated differently for the three black-cockatoo species (Appendix 3) depending upon the vegetation present; thus a separate score is given for each VSA for each species.

Black-cockatoo foraging signs were also recorded in conjunction with the breeding tree surveys and general site inspections. If foraging signs were observed, the location, tree species and approximate age of the foraging evidence were recorded. Black-cockatoo foraging evidence may persist for some months or years after the foraging event. There is currently no published evidence documenting the deterioration process of foraging evidence. Factors that help to establish the time since foraging include: the colour of nuts/foilage, the degree of weathering or decay of debris, the presence of small

fragments of nut debris, the position/compression of the foraging debris relative to surrounding vegetation and leaf litter, and the strength of the eucalypt smell emitted. Despite the absence of empirical data, four categories of foraging activity are recognised in the approach used by BCE, based on the time since foraging:

- (i) Active – where birds were observed in the act of foraging;
- (ii) Recent – foraging signs (e.g. chewed nuts or vegetation) were ‘fresh’ (i.e. foraging was likely to have occurred within days to weeks). Recent foraging signs were typically green and/or with very little sign of weathering. Approximately less than four weeks old;
- (iii) Intermediate – foraging was likely to have occurred within weeks to months previously. Approximately one to six months old; and
- (iv) Old – foraging was likely to have occurred months to years previously. Approximately more than six months old.

#### 2.4.3.3 *Breeding*

The aim of the breeding surveys was to record all potential hollow-bearing trees (suitable for black-cockatoo nesting) within the survey area. The following information was recorded for every suitable tree<sup>1</sup> with a diameter at breast height (DBH) equal to or greater than 500 mm (or 300 mm for Wandoo/Salmon Gum):

- tree location;
- tree species;
- life status;
- DBH; and
- nest-tree rank: trees were assessed (from the ground) for the potential presence/quality of nest-hollows and allocated a nesting rank (developed by BCE) as described in Table 2-5.

The DBCA threatened species database (DBCA, 2023e) was queried for black-cockatoo breeding sites and these are presented in the relevant section below. This database was queried in February 2023.

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<sup>1</sup> the draft revised EPBC Act study guidelines (DEE, 2017) stress that any tree species may provide suitable hollows.



**Table 2-5. Ranking system for the assessment of potential nest-trees for black-cockatoos.**

As per information from DCCEEW (2023e, 2023d, 2023c), a potential nest-tree is any tree with a diameter at breast height >500 mm (or >300 mm for *Eucalyptus salmonophloia* and *E. wandoo*). Note that black-cockatoos favour vertical hollows for the nest chamber, but the hollow entrance may be vertical (a chimney hollow), have a side entrance or have a horizontal spout entrance.

Rank	Description of tree and hollows/activity
1	Activity at hollow observed; adult (or immature) bird seen entering or emerging from hollow. Can also be used for a known nest tree active in the previous 12 months (although this should be noted in the description). Note that activity at a hollow does not absolutely mean that breeding is occurring unless a young bird in hollow is observed.
2	Hollow of suitable size visible with chew marks around entrance. Record if chew-marks are recent or old.
3	Potentially suitable hollow visible but no chew marks present at entrance; or potentially suitable hollow suspected to be present - as suggested by structure of tree, such as large, vertical trunk broken off at a height of >8m; but note that hollow height is contextual. Carnaby's Black-Cockatoo will nest in hollows <5m so in a Wheatbelt breeding site a lower criterion may be more appropriate.
4	Tree with large hollows or broken branches that might contain large hollows, but hollows or potential hollows (nest chamber) are not vertical or near-vertical; thus a tree with or likely to have hollows of sufficient size but not to have hollows of the angle preferred by black-cockatoos. Trees with low but otherwise suitable hollows can also be assigned a rank or 4, depending on the species of black-cockatoo likely to be present.
5	Tree lacking large hollows or broken branches that might have large hollows; a tree with more or less intact branches and a spreading crown.

#### 2.4.3.4 Roosting

As the breeding and foraging surveys were conducted, areas likely to be used as roosting sites (e.g. sites adjacent to watercourses with large trees) or areas that had black-cockatoo activity in the late-afternoon were noted. The DBCA threatened species database (DBCA, 2023e) and BirdLife Australia's black-cockatoo roosting dataset (BirdLife Australia, 2023c) were queried for black-cockatoo roosting sites and these are presented in the relevant section below.

### 2.4.4 Targeted trapdoor spider assessment

#### 2.4.4.1 Desktop assessment

As part of the desktop assessment, records were compiled from the NatureMap database to provide a details of trapdoor spider records in the immediate area.

#### 2.4.4.2 Survey 1 – November 2023

In November 2023, two areas of suitable habitat within VSA 2 (Complex shrubland) were examined for any signs of trapdoor spiders. Any burrows that were found were inspected with a milliscope to determine whether the burrow was occupied. Three burrows were found, two of which were confirmed to contain shield-backed trapdoor spiders (see Section 3.4 for full details).

#### 2.4.4.3 Survey 2 – February 2024

In order to better understand the significance of the spiders found within the survey area in November 2023, a second survey was conducted on 22 and 23 February 2024 to examine the bushland surrounding the survey area for evidence of trapdoor spiders. Within twelve parcels of Crown or Shire-owned land, areas of suitable habitat were searched. Suitable habitat comprised shrubland that was similar in structure and floristics to VSA 2 (Complex shrubland) within the survey area. Any burrows that were found were inspected with a milliscope to determine whether the burrow was occupied.

## 2.5 Survey limitations

The EPA Guidance Statement 56 (2004) and the EPA (2020) outline a number of limitations that may arise during field investigations for Environmental Impact Assessment. These survey limitations are discussed in the context of the BCE investigation of the survey area in Table 2-6. No limitations were identified.

The lack of detailed survey (i.e. intensive sampling of the fauna assemblage) is not considered a limitation as this assemblage is well-understood in the area from previous field investigations in similar landscapes. Furthermore, EPA guidance does not consider limitations related to the effectiveness of field sampling for fauna but appears to make an assumption that the purpose of such sampling is to confirm the fauna assemblage. This is implicit in the EPA (2020) technical guidance that does provide suggestions for sampling techniques, but the level of field investigations suggested cannot confirm the presence of an entire assemblage, or confirm the absence of a species. This requires far more work than is possible (or recommended) for studies contributing to the EIA process because fauna assemblages vary seasonally and annually, and often have high levels of variation even over short distances (Beta diversity). For example, in an intensive trapping study, How and Dell (1990) recorded in any one year only about 70% of the vertebrate species found over three years. In a study spanning over two decades, Bamford *et al.* (2010) found that the vertebrate assemblage varies over time and space, meaning that even complete sampling at a set of sites only defines the assemblage of those sites at the time of sampling. In that study, it took 24 to 26 years of annual sampling for species richness of small, terrestrial vertebrates to asymptote (M. Bamford unpubl. analysis). The limited effectiveness of short periods of fauna sampling is not a limitation for assessing the fauna values of a survey area *per se*, as long as database information is interpreted effectively and field investigations are targeted appropriately. That is the approach taken by BCE.



**Table 2-6. Survey limitations as outlined by EPA (2020).**

<b>EPA Survey Limitations</b>	<b>BCE Comment</b>
Availability of data and information	Sufficient information from databases and previous studies (see Section 2.3.1). Not a limitation.
Competency/experience of the survey team, including experience in the bioregion surveyed	The ecologists have had extensive experience in conducting desktop reviews, Basic level field investigation and site inspections, and targeted assessments, and have undertaken multiple studies within the region. Not a limitation.
Scope of the survey (e.g. were faunal groups excluded from the survey)	The survey focused on terrestrial vertebrate fauna and fauna values, with targeted assessments for black-cockatoos and trapdoor spiders. Some information on other threatened invertebrates was available from databases. Not a limitation.
Timing, weather and season	Timing is not of great importance in this region for the type of investigations conducted. Not a limitation.
Disturbance that may have affected results	None. Not a limitation.
The proportion of fauna identified, recorded or collected	All fauna observed were identified. Not a limitation.
Adequacy of the survey intensity and proportion of survey achieved (e.g. the extent to which the area was surveyed)	The site was adequately surveyed to the level appropriate for a Basic level assessment and the targeted assessments. Fauna database searches covered a 40 km radius around the survey area. The assessments were completed. Not a limitation.
Access problems	There were no access problems encountered. Not a limitation.
Problems with data and analysis, including sampling biases	There were no data problems. Not a limitation.

### 3 Fauna values

This section presents the results of the desktop and field investigations in terms of key fauna values (described in detail in Appendix 1) and includes:

- Recognition of ecotypes or vegetation/substrate associations (VSAs);
- Assemblage characteristics (uniqueness, completeness and richness);
- Species of conservation significance;
- Results of targeted black-cockatoo assessment;
- Results of targeted trapdoor spider assessment;
- Patterns of biodiversity across the landscape; and
- Ecological processes affecting fauna.

#### 3.1 Vegetation and substrate associations (VSAs) ['Habitat assessment']

Four major vegetation and substrate associations (VSAs) were identified in relation to fauna in the survey area. Their distribution across the survey area is shown in Figure 3-1. The VSAs identified are as follows:

**VSA 1. Cleared paddocks.** Weedy grasses and oats, with a ground cover of shrubs and herbs over red loam. This VSA covers approximately 55% of the survey area. See Plate 1.

**VSA 2. Complex shrubland.** Low vegetation of sedges, small shrubs of *Hakea*, *Melaleuca*, *Conospermum* (smoke bush), *Calothamnus* with emergent Sheoak and *Grevillea* on shallow sandy clay soils. This VSA covers approximately 16% of the survey area. See Plate 2.

**VSA 3. Eucalypt open woodland.** *Eucalyptus salmonophloia* (Salmon gum) and Gimlet over salt bush, occasional *Acacia* and weedy grasses on red loam. This VSA covers approximately 1% of the survey area. See Plate 3.

**VSA 4. Planted trees.** Planted species in open areas of township, *Eucalyptus camaldulensis* and *Eucalyptus sp* (unidentified) over grassy weeds and red loam sand. This VSA covers approximately 5% of the survey area. See Plate 4.

The remainder of the survey area (c. 23%) is made up of built environments such as roads and buildings.





**Plate 1. VSA 1: Cleared Paddocks.**



**Plate 2. VSA 2: Complex shrubland.**





**Plate 3. VSA 3: Eucalypt open woodland.**



**Plate 4. VSA 4: Planted trees.**



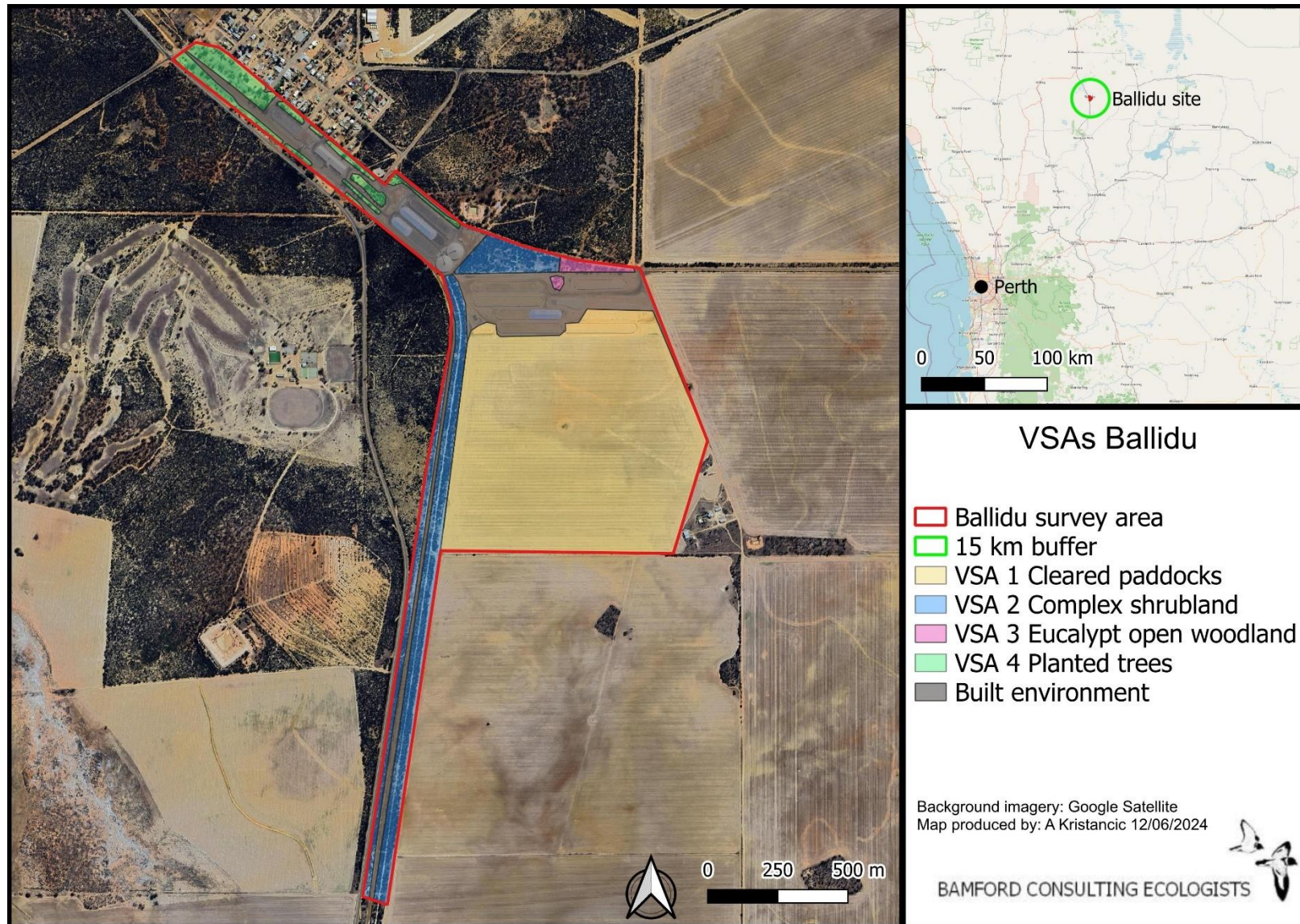


Figure 3-1. The distribution of VSAs in the survey area.

## 3.2 Fauna assemblage

### 3.2.1 Overview of vertebrate fauna assemblage

The desktop assessment identified 212 vertebrate fauna species as potentially occurring in the survey area: eight frogs, 44 reptiles, 142 birds (including six introduced), 12 native mammals and six introduced mammals. These species are listed in Appendix 4 and the composition of the expected vertebrate fauna assemblage is summarised in Table 3-1. The presence of 18 species of birds was confirmed during the November 2022 site inspection (as presented in Appendix 5. and indicated in bold in Appendix 4). Note that several domesticated animals, particularly sheep and goats, may be present in the survey area. These domesticated species are listed in Appendix 7, and are not included in the expected species counts.

Sixty species have been omitted from the expected species list because they are extinct (11 mammal species), or considered locally extinct (four reptiles, 16 birds and 29 mammals). These species are listed in Appendix 6. An additional 280 species were omitted due to habitat or range limitations, or because they are domesticated species. These species are listed in Appendix 7.

**Table 3-1. Composition of expected vertebrate fauna assemblage of the survey area.**

Taxon	Total	Number of species in each status category					
		Resident	Probably absent	Regular visitor	Irregular visitor	Vagrant	Extinct or locally extinct
Frogs	8	0	1	4	3	0	0
Reptiles	44	31	12	0	1	0	4
Birds – Native	136	21	0	51	54	10	16
Birds – Introduced	6	0	0	1	5	0	0
Mammals – native	12	1	1	5	5	0	40
Mammals – introduced	6	4	0	1	0	1	0
Total	212	57	14	62	68	11	60

Extinct or locally extinct species are not included in the number of expected vertebrate fauna species.

### 3.2.2 Expected vertebrate fauna

The expected fauna assemblage presented in the expected species list and described here is a conservative estimate of the fauna that may use the site, taking a very precautionary approach. Given the scarcity of vegetation in the survey area and surrounding landscape, several species that would have been designated as ‘residents’ (as they are typically residents in other wheatbelt locations), have been classified as ‘probably absent’, reflecting that in reality populations of these species may no longer be present the survey area.

The key features of the fauna assemblage expected in the survey area are:

- **Uniqueness:** The fauna assemblage is typical of that expected in the wheatbelt region of Western Australia. The assemblage is likely to be represented elsewhere in the region.



- **Completeness:** The assemblage is likely to be incomplete for frogs, reptiles and birds, and depauperate for mammals due to the extent of historical clearing in the immediate area and region. The status of many species in the survey area will have been altered with a reduced proportion of resident species.
- **Richness:** The expected assemblage is likely to be relatively poor in a regional context, due to the scarcity of vegetation in the survey area.

### Frogs

The eight frog species include none that is resident; four are expected to be regular visitors, one is probably absent and three are expected as irregular visitors. All frog species are terrestrial frogs that spend most, or all, of their life-cycle away from wetlands/damplands. One species, the Turtle Frog, is of local conservation significance (CS3), but is probably absent from the Ballidu survey area.

### Reptiles

The majority of the 44 reptile species are considered to be residents (31 species), while 12 species are probably absent and one (the Barking Gecko, *Underwoodisaurus milli*) is expected to be an irregular visitor. Twenty-six species are of conservation significance (all locally significant; CS3) and are discussed in Section 3.2.6. Recognising the majority of reptile species as resident is almost certainly conservative and there may be more locally extinct species than the three listed, and some species may only be irregular visitors from the fragmented native vegetation surrounding the survey area. However, reptiles are known to persist in small patches of remnant native vegetation - Bamford and Calver (2012) have documented the persistence of some species (about 25% of the original assemblage) at the level of the urban garden, but also found that some species disappear from small reserves due to cat predation.

### Birds

The expected bird assemblage of 142 species is relatively rich but less than 15% of these species are expected as residents (21 species). Fifty-two species are expected as regular visitors and 59 as irregular visitors. Ten species are expected as vagrants. In addition to the 142 bird species expected, 16 species are considered locally extinct. The bird assemblage is therefore incomplete, reflecting the high levels of land clearing and habitat fragmentation that exist in the landscape of the wheatbelt, and the resultant scarcity of food, shelter, and nesting resources for birds. Six species are introduced and are expected as regular visitors (Rock Dove) or irregular visitors (Laughing Dove, Spotted Dove, Laughing Kookaburra, Long-billed Corella and Rainbow Lorikeet). Seventy-three bird species are of conservation significance (four CS1, two CS2 and 67 CS3). Twelve of these are expected as residents (all CS3 species), 22 are expected as regular visitors, 33 as irregular visitors, and six as vagrants. None of the species listed under federal legislation (CS1 and CS2 species) are expected as residents; three are expected as regular visitors, one as irregular visitor and 2 as vagrants. All conservation significant birds are discussed in Section 3.2.6.

### Mammals

The mammal assemblage is substantially incomplete, with only 12 native mammals expected in the survey area, and only one of these (Western Grey Kangaroo) expected as a resident. One species (Short-beaked Echidna) is probably absent, while five are expected as regular visitors and five as

irregular visitors. In addition to the 12 native species in the expected mammal assemblage, a very large number of mammals are considered extinct or locally extinct (40 species in total). This reflects the high level of habitat loss and fragmentation that exists in the wheatbelt, as well as the impacts of predation by and competition with feral/introduced species. Six introduced species are expected in the survey area (four as residents, one a regular visitor and one vagrant), and an additional five introduced mammals may be present in the survey area but are not included in species counts as they are domestic species. Six expected species are of conservation significance (all CS3) and are discussed in Section 3.2.6. Locally extinct species are discussed in Section 3.2.3.

### 3.2.3 *Locally extinct vertebrate fauna*

There are 49 vertebrate species (four reptiles, 16 birds and 29 mammals) that would be expected to be present in the survey area if they were not considered locally extinct (Appendix 6). These are species that are still present in other areas of Western Australia and would have once been present in the survey area but have not been recently recorded in the local area and therefore are almost certainly no longer present in the survey area. There are also eleven species that are fully extinct; these species would also have once been present in the survey area but have not been recorded anywhere in the wild in the last 50 years.

For the majority of species, the likely causes of extinction or local extinction are habitat loss and introduced predators (e.g. cats and foxes). It is possible that some locally extinct species may benefit from feral predator control and/or rehabilitation of habitat in or near to the survey area, depending on the level of connectivity with existing populations.

### 3.2.4 *Invertebrate fauna of conservation significance*

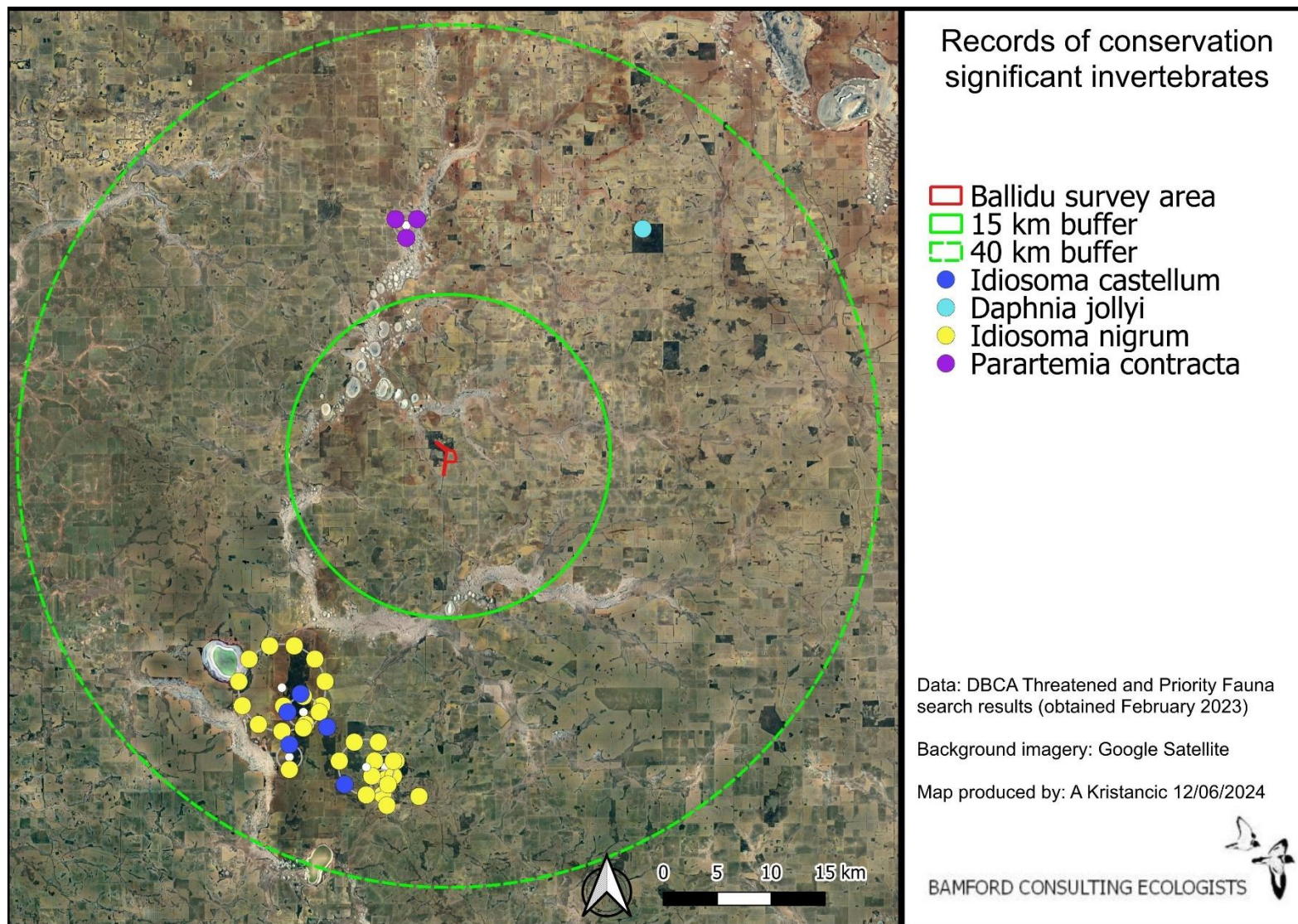
The survey area sits within DBCA's Wheatbelt management region (DBCA, 2023a), within which DBCA has listed 21 threatened or priority invertebrate fauna (DBCA, 2023e). An additional five listed invertebrate species were returned from other databases, giving a total of 26 conservation significant invertebrates potentially present in the survey area. Twenty-three species were excluded as they were considered unlikely to be present based on distance from known population and absence of suitable habitat. One species (*Bothriembryon praecelsus*, a land snail) was excluded as it is listed as extinct under the WA Biodiversity Conservation Act.

The Ballidu site is within 15 km of the presumed range of the host ant of the Arid Bronze Azure Butterfly, *Ogyris subterrestris petrina* (DBCA, 2020). This butterfly is a threatened species listed as Critically Endangered under both the EPBC Act 1999 and WA BC Act 2016 (DBCA, 2020). The butterfly has an obligate association with a host ant (a sugar ant, *Camponotus* sp. nr. *terebrans*). Larvae of the butterfly live within the ant's nest during development, therefore the butterfly can only persist in the presence of large colonies of the host ant. However, the survey area is not within the known range of the butterfly species, with the closest record 130 km east (DBCA, 2023e) so it is not expected to occur within the survey area. These excluded species and the justifications for their exclusion are presented in Appendix 8.



This leaves a total of two conservation significant invertebrate species considered likely to occur in the survey area. One species, the Shield-backed Trapdoor Spider (*Idiosoma nigrum*, CS1 – V, S2D2) is expected as a resident in the survey area, and there is a cluster of records near Wongan Hills, c. 25-30 km away (Figure 3-2). In addition, the Tree-stem Trapdoor Spider, *Idiosoma castellum* (CS2 – P4) may be present in the survey area, also with records around Wongan Hills (Figure 3-2). Given the likely presence of trapdoor spiders within the survey area, a targeted assessment was conducted, and results are provided below in Section 3.4.

It should be noted that the ecology and distribution of short-range endemic invertebrates is often poorly understood or documented. Thus there may be undetected SRE species present.



**Figure 3-2. Records of conservation significant invertebrates within a 40 km radius of Ballidu survey area.**



### 3.2.5 Vertebrate fauna of conservation significance

Of the 198 species of vertebrate fauna expected to occur in the survey area, 106 are considered to be of conservation significance: four CS1, two CS2 and 100 CS3. A summary of the numbers in each vertebrate class is presented in Table 3-2. The high number of CS3 (locally significant) species reflects the historical clearing and disturbance in the Wheatbelt; the result of which is that even tiny remnants of vegetation and any fauna they support are of local significance. These species of conservation significance are indicated in the complete species list (Appendix 4) but are also listed with details of their conservation significance in Table 3-3. The CS1 and CS2 species are expected as regular visitors (three species), vagrants (two species), or irregular visitors (one species), with none expected to be residents. The majority of the CS3 species are expected as visitors (36 irregular visitors and 21 regular visitors). Approximately one quarter are expected as residents (26 species) and the remainder are probably absent (13 species) or expected as vagrants (four species). Accounts on conservation significant species appear in Section 3.2.6.

Locations of CS1 and CS2 species records within 40 km of the survey area (from the DBCA threatened species database) are illustrated in Figure 3-3 (omitted species) and Figure 3-4 (expected species). These records include several species that are not expected to be present and have been omitted from the expected fauna assemblage list. These omitted species are:

- Suite of waterbirds/shorebirds (Hooded Plover, Common Sandpiper, Sharp-tailed Sandpiper, Red-necked Stint, Wood Sandpiper) – there are records from the region, but no suitable habitat for these birds in the survey area, hence they are omitted from the expected species assemblage.
- Western Spiny-tailed Skink – three records within 15 km. Records to the north and west are historical. One record (28 km north-east) is from 2017; an opportunistic sighting. Considered locally extinct.
- Malleefowl – lots of old records. Some more recent (2002-2006 in the north and east, 2008 and 2011 – about 30 km south-south-west and 2012 – about 35 km south-east). Considered locally extinct as recent records are from large reserves. Possibility occurs as vagrant individuals passing through survey area.
- Western Ground Parrot – historical record 28 km south-west. Locally extinct.
- Western Whipbird – historical record 28 km south-west. Locally extinct.
- Bilby – historical record 38 km south. Locally extinct.
- Quenda – records are from 1980 (based on secondary signs and uncertain, 12 km northwest) and 1977 (ID certain, opportunistic obs, 39 km south east). Locally extinct.
- Banded Hare-Wallaby – historical record ~40 km south. Locally extinct.
- Western Mouse – records from 2009 about 40 km to the south-east. One is from secondary signs (and low certainty). One is a night sighting and considered to be moderately certain, although the Western Mouse is not a particularly distinctive species until in the hand. It is therefore considered locally extinct.

The small number of expected species listed under state or federal legislation or publications (CS1 and CS2 categories) likely reflects the high level of local extinction in the region. For example, no CS1 or CS2 mammals are expected to occur in the survey area, due to the large number of mammals that are extinct or considered locally extinct and are therefore excluded from the expected species assemblage

(40 in total; See Appendix 6). Eleven mammal species are considered extinct but would have historically been present in the survey area. Of the 29 mammals considered *locally* extinct, 16 are listed under state or federal legislation or publications (11 CS1 and 5 CS2). There are also five birds (two CS1 and three CS2) and two reptiles (one CS1 and one CS2) that are of state or federal conservation significance but locally extinct.

**Table 3-2. The number of conservation significant species in each vertebrate class expected to occur within the survey area.**

See Appendix 1 for full explanation of Conservation Significance (CS) levels: CS1 = listed under WA State and/or Commonwealth legislation; CS2 = listed as Priority by DBCA; CS3 = considered locally significant. LE = locally extinct

CLASS	CONSERVATION SIGNIFICANCE				
	Total	CS1	CS2	CS3	Extinct or LE
Frogs	1	0	0	1	0
Reptiles	26	0	0	26	4
Birds	73	4	2	67	16
Mammals	6	0	0	6	40
<b>Total</b>	<b>106</b>	<b>4</b>	<b>2</b>	<b>100</b>	<b>60</b>

Extinct or locally extinct species are not included in the number of expected vertebrate fauna species.

**Table 3-3. Conservation significant fauna species expected to occur within the survey area.**

Species are listed in taxonomic order.

CS1, CS2, CS3 = (summary) levels of conservation significance. See Appendix 1 for full explanation.

EPBC Act listings: CR = Critically Endangered, E = Endangered, V = Vulnerable, M = Migratory (see Appendix 2).

Biodiversity Conservation Act 2016 listings: S1 to S3 = Schedules 1 to 3, D1 to D3 = Divisions 1 to 3 (see Appendix 2).

DBCA Priority species: P1 to P4 = Priority 1 to 4 (see Appendix 2).

Latin name	Common name	Status	Expected Occurrence
<b>FROGS</b>			
<i>Myobatrachus gouldii</i>	Turtle Frog	CS3	Probably absent
<b>REPTILES</b>			
<i>Underwoodisaurus milii</i>	Thick-tailed Gecko	CS3	Irregular visitor
<i>Crenadactylus ocellatus</i>	South-western Clawless Gecko	CS3	Probably absent
<i>Diplodactylus granariensis</i>	Wheat-belt Stone Gecko	CS3	Probably absent
<i>Diplodactylus pulcher</i>	Fine-faced Gecko	CS3	Probably absent
<i>Hesperoedura reticulata</i>	Reticulated Velvet Gecko	CS3	Resident
<i>Strophurus spinigerus</i>	South-western Spiny-tailed Gecko	CS3	Resident
<i>Delma fraseri</i>	Fraser's Delma	CS3	Resident
<i>Delma grayii</i>	Side-barred Delma	CS3	Probably absent
<i>Pygopus lepidopodus</i>	Common Scaly-foot	CS3	Probably absent
<i>Moloch horridus</i>	Thorny Devil	CS3	Probably absent
<i>Pogona minor</i>	Dwarf Bearded Dragon	CS3	Resident
<i>Ctenotus pantherinus</i>	Leopard Ctenotus	CS3	Probably absent



Latin name	Common name	Status	Expected Occurrence
<i>Ctenotus schomburgkii</i>	Schomburgk's Ctenotus	CS3	Probably absent
<i>Lerista gerrardii</i>	Bold-striped Robust Slider	CS3	Resident
<i>Lerista macropisthopus macropisthopus</i>	Southern Unpatterned Robust Slider	CS3	Resident
<i>Liopholis multiscutata</i>	Southern Sand-Skink	CS3	Probably absent
<i>Tiliqua occipitalis</i>	Western Blue-tongue	CS3	Resident
<i>Varanus gouldii</i>	Gould's Goanna	CS3	Resident
<i>Anilius australis</i>	Southern Blind Snake	CS3	Resident
<i>Anilius waitii</i>	Beaked Blind Snake	CS3	Resident
<i>Brachyurophis semifasciatus</i>	Southern Shovel-nosed Snake	CS3	Probably absent
<i>Demansia reticulata</i>	Yellow-faced Whip Snake	CS3	Resident
<i>Neelaps bimaculatus</i>	Black-naped Snake	CS3	Resident
<i>Pseudonaja modesta</i>	Ringed Brown Snake	CS3	Resident
<i>Suta fasciata</i>	Rosen's Snake	CS3	Resident
<i>Suta gouldii</i>	Gould's Hooded Snake	CS3	Probably absent
<b>BIRDS</b>			
<i>Dromaius novaehollandiae</i>	Emu	CS3	Irregular visitor
<i>Phaps chalcoptera</i>	Common Bronzewing	CS3	Regular visitor
<i>Phaps elegans</i>	Brush Bronzewing	CS3	Vagrant
<i>Podargus strigoides</i>	Tawny Frogmouth	CS3	Irregular visitor
<i>Apus pacificus</i>	Fork-tailed Swift	CS1 (M, S1D2)	Regular visitor
<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	CS3	Irregular visitor
<i>Chalcites basalis</i>	Horsfield's Bronze-Cuckoo	CS3	Regular visitor
<i>Chalcites lucidus</i>	Shining Bronze-Cuckoo	CS3	Irregular visitor
<i>Chalcites osculans</i>	Black-eared Cuckoo	CS3	Irregular visitor
<i>Heteroscenes pallidus</i>	Pallid Cuckoo	CS3	Regular visitor
<i>Turnix varius</i>	Painted Button-quail	CS3	Irregular visitor
<i>Ninox novaeseelandiae</i>	Southern Boobook	CS3	Irregular visitor
<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk	CS3	Regular visitor
<i>Accipiter fasciatus</i>	Brown Goshawk	CS3	Regular visitor
<i>Aquila audax</i>	Wedge-tailed Eagle	CS3	Regular visitor
<i>Circus approximans</i>	Swamp Harrier	CS3	Irregular visitor
<i>Circus assimilis</i>	Spotted Harrier	CS3	Regular visitor
<i>Elanus scriptus</i>	Letter-winged Kite	CS2 (P4)	Vagrant
<i>Haliastur sphenurus</i>	Whistling Kite	CS3	Regular visitor
<i>Hamirostra melanosternon</i>	Black-breasted Buzzard	CS3	Irregular visitor
<i>Hieraaetus morphnoides</i>	Little Eagle	CS3	Irregular visitor
<i>Lophoictinia isura</i>	Square-tailed Kite	CS3	Irregular visitor
<i>Merops ornatus</i>	Rainbow Bee-eater	CS3	Regular visitor
<i>Todiramphus sanctus</i>	Sacred Kingfisher	CS3	Regular visitor
<i>Falco peregrinus</i>	Peregrine Falcon	CS1 (S1D3)	Regular visitor
<i>Calyptorhynchus latirostris</i>	Carnaby's Black-Cockatoo	CS1 (E, S2D2)	Regular visitor
<i>Glossopsitta porphyrocephala</i>	Purple-crowned Lorikeet	CS3	Regular visitor

Latin name	Common name	Status	Expected Occurrence
<i>Platycercus icterotis xanthogenys</i>	Inland Western Rosella	CS2 (P4)	Irregular visitor
<i>Malurus assimilis</i>	Purple-backed Fairy-wren	CS3	Resident
<i>Malurus leucopterus</i>	White-winged Fairy-wren	CS3	Resident
<i>Malurus pulcherrimus</i>	Blue-breasted Fairy-wren	CS3	Resident
<i>Malurus splendens</i>	Splendid Fairy-wren	CS3	Resident
<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater	CS3	Regular visitor
<i>Acanthorhynchus superciliosus</i>	Western Spinebill	CS3	Irregular visitor
<i>Anthochaera carunculata</i>	Red Wattlebird	CS3	Irregular visitor
<i>Anthochaera lunulata</i>	Western Wattlebird	CS3	Irregular visitor
<i>Glyciphila melanops</i>	Tawny-crowned Honeyeater	CS3	Irregular visitor
<i>Manorina flavigula</i>	Yellow-throated Miner	CS3	Resident
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater	CS3	Irregular visitor
<i>Nesoptilotis leucotis</i>	White-eared Honeyeater	CS3	Vagrant
<i>Phylidonyris niger</i>	White-cheeked Honeyeater	CS3	Irregular visitor
<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater	CS3	Irregular visitor
<i>Ptilotula ornata</i>	Yellow-plumed Honeyeater	CS3	Regular visitor
<i>Purnella albifrons</i>	White-fronted Honeyeater	CS3	Irregular visitor
<i>Pardalotus punctatus</i>	Spotted Pardalote	CS3	Irregular visitor
<i>Pardalotus striatus</i>	Striated Pardalote	CS3	Regular visitor
<i>Acanthiza apicalis</i>	Inland Thornbill	CS3	Resident
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	CS3	Resident
<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill	CS3	Resident
<i>Aphelocephala leucopsis</i>	Southern Whiteface	CS3	Irregular visitor
<i>Gerygone fusca</i>	Western Gerygone	CS3	Regular visitor
<i>Sericornis frontalis</i>	White-browed Scrubwren	CS3	Irregular visitor
<i>Smicrornis brevirostris</i>	Weebill	CS3	Resident
<i>Pomatostomus superciliosus</i>	White-browed Babbler	CS3	Regular visitor
<i>Daphoenositta chrysoptera</i>	Varied Sittella	CS3	Irregular visitor
<i>Oreoica gutturalis</i>	Crested Bellbird	CS3	Regular visitor
<i>Cinclosoma clarum</i>	Copperback Quail-thrush	CS3	Irregular visitor
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	CS3	Irregular visitor
<i>Pachycephala fuliginosa</i>	Western Whistler	CS3	Irregular visitor
<i>Pachycephala rufiventris</i>	Rufous Whistler	CS3	Resident
<i>Psophodes occidentalis</i>	Chiming Wedgebill	CS3	Irregular visitor
<i>Cracticus torquatus</i>	Grey Butcherbird	CS3	Resident
<i>Strepera versicolor</i>	Grey Currawong	CS3	Irregular visitor
<i>Rhipidura albiscapa</i>	Grey Fantail	CS3	Regular visitor
<i>Myiagra inquieta</i>	Restless Flycatcher	CS3	Vagrant
<i>Eopsaltria griseogularis</i>	Western Yellow Robin	CS3	Irregular visitor
<i>Melanodryas cucullata</i>	Hooded Robin	CS3	Irregular visitor
<i>Microeca fascians</i>	Jacky Winter	CS3	Irregular visitor
<i>Petroica boodang</i>	Scarlet Robin	CS3	Vagrant
<i>Petroica goodenovii</i>	Red-capped Robin	CS3	Resident
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar	CS3	Irregular visitor
<i>Dicaeum hirundinaceum</i>	Mistletoebird	CS3	Regular visitor
<i>Motacilla cinerea</i>	Grey Wagtail	CS1 (M, S1D2)	Vagrant



Latin name	Common name	Status	Expected Occurrence
<b>MAMMALS</b>			
<i>Tachyglossus aculeatus</i>	Short-beaked Echidna	CS3	Probably absent
<i>Sminthopsis crassicaudata</i>	Fat-tailed Dunnart	CS3	Regular visitor
<i>Cercartetus concinnus</i>	Western Pygmy-possum	CS3	Irregular visitor
<i>Trichosurus vulpecula</i>	Brushtail Possum	CS3	Irregular visitor
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	CS3	Regular visitor
<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat	CS3	Irregular visitor

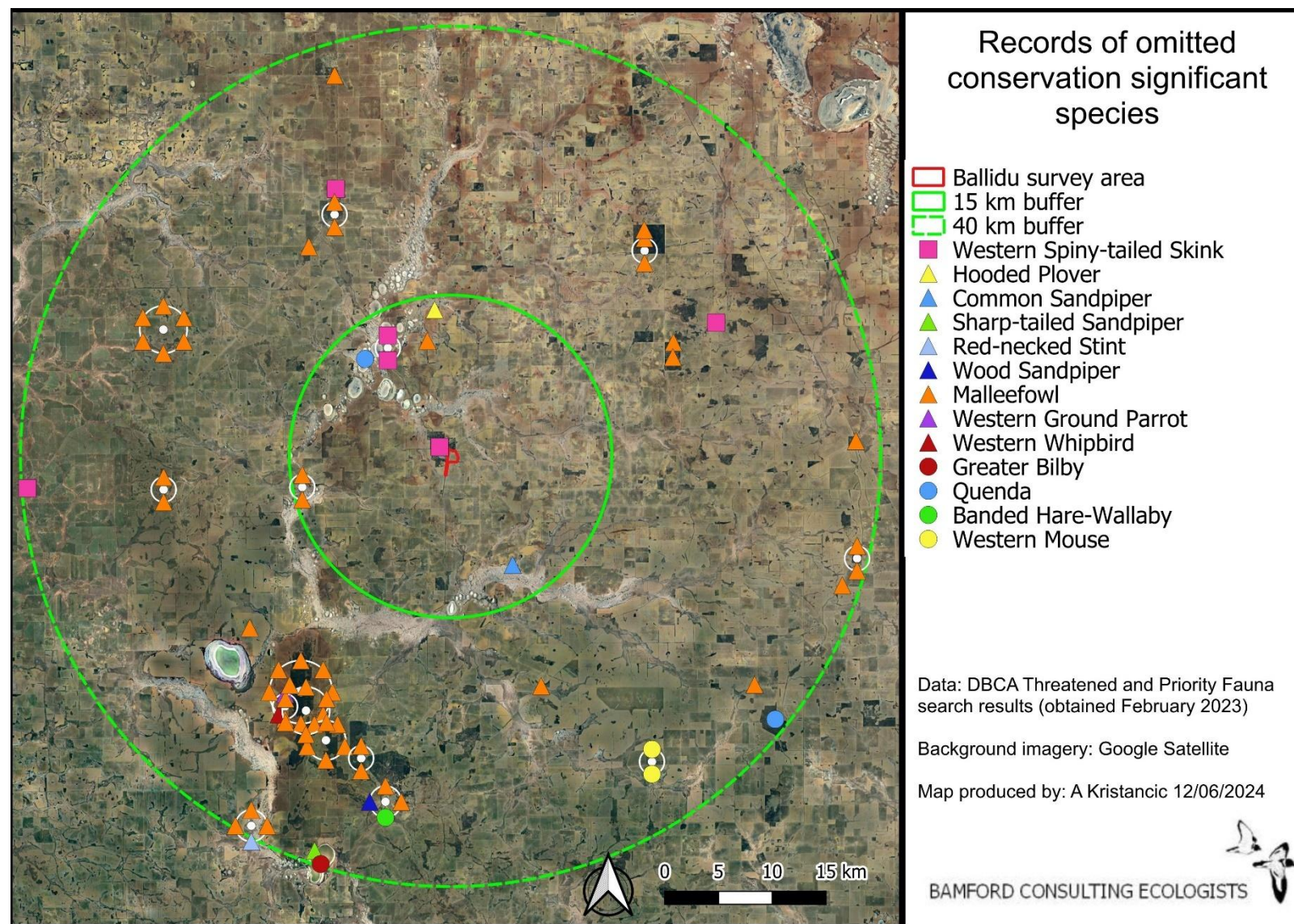


Figure 3-3. Locations of records of omitted conservation significant species within 15 km and 40 km of the survey area.



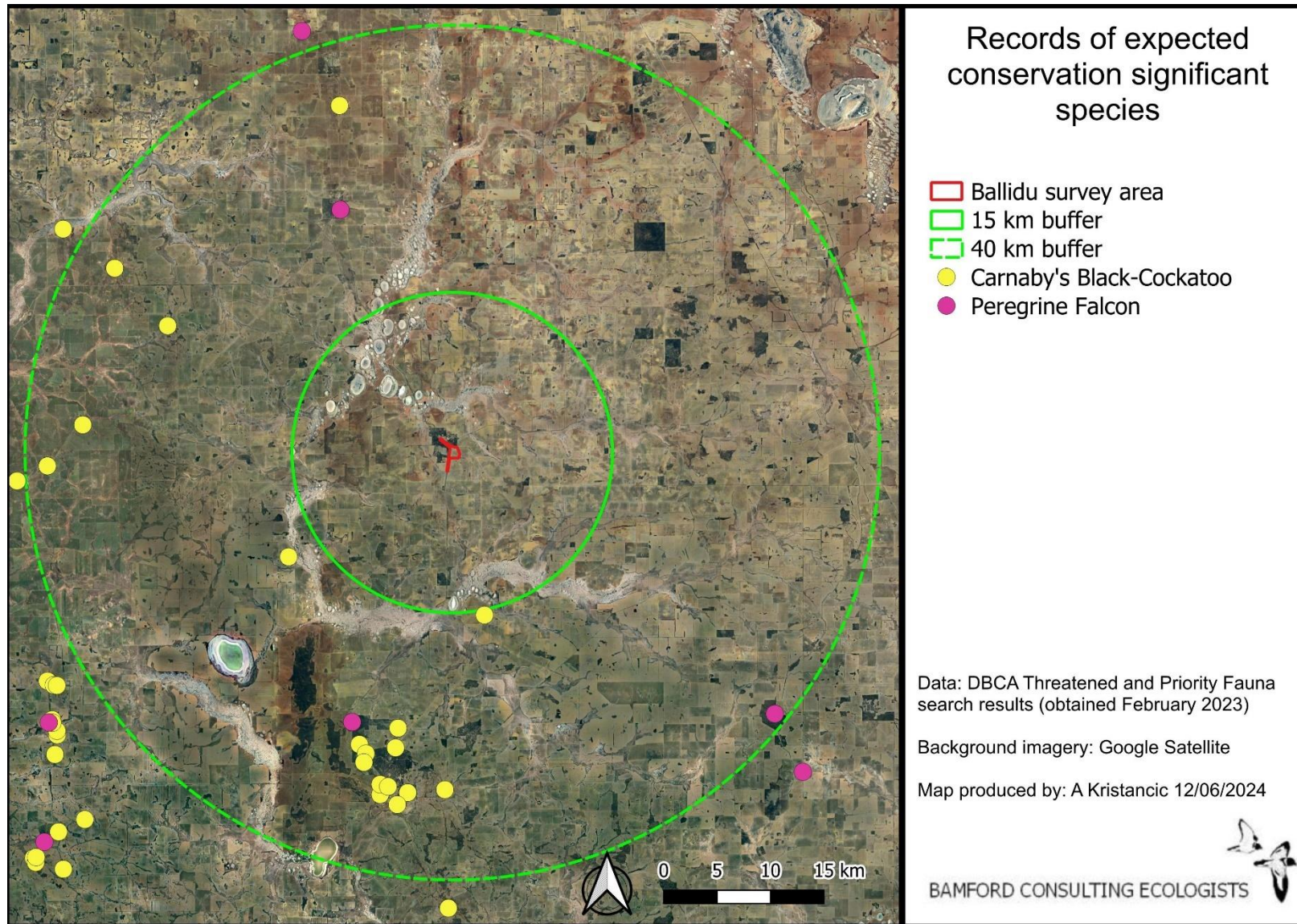


Figure 3-4. Locations of records of expected conservation significant species within 15 km and 40 km of the survey area.

### 3.2.6 Conservation significant species accounts

A list of all conservation significant vertebrate species expected within the survey area is provided in Table 3-3; these comprise 15 reptiles, 73 birds and five mammals (see Section 3.2.5). Information on the conservation status, distribution and habitat, salient ecology and expected occurrence within the survey area is provided below for CS1 and CS2 species (six bird species). A general discussion about CS3 species is provided in Section 3.2.6.3.

#### 3.2.6.1 Conservation Significance 1

##### Fork-tailed Swift (*Apus pacificus*)

CS1 (M,S5)

Conservation status:	Migratory under the EPBC Act and Schedule 5 under the BC Act.
Distribution and habitat:	The swift is a largely aerial species of unpredictable occurrence in Western Australia. There are scattered records from the south coast, widespread in coastal and subcoastal areas between Augusta and Carnarvon, scattered along the coast from south-west Pilbara to the north and east Kimberley region. Sparsely scattered inland records, especially in the Wheatbelt, but more common in the north and north-west Gascoyne Region, north through much of the Pilbara Region, and the south and east Kimberley (DCCEEW, 2023a; Higgins, 1999). Aerial, usually flying from as low as one metre to more than 300 m above the ground.
Ecology:	A diurnal, aerial insectivore, this species often forages along the edge of low pressure systems in flocks of ten to 1000 birds (DCCEEW, 2023a; Higgins, 1999). Breeds in Siberia (April to July) and spends the non-breeding season (October to mid-April) in Australia. Being aerial, it is effectively independent of terrestrial ecosystems when in Australia.
Expected occurrence:	<b>Regular visitor.</b> There are no records within 40 km of the survey area. Individuals may flyover the survey area but are unlikely to utilise it.

##### Peregrine Falcon (*Falco peregrinus*)

CS1 (S7)

Conservation status:	Schedule 7 under the BC Act.
Distribution and habitat:	More or less cosmopolitan throughout Australia (Menkhorst <i>et al.</i> 2017). This species occurs in a variety of habitats but is usually reliant on cliff faces or tall trees for nesting (Debus, 2019).
Ecology:	A highly adept aerial predator that predominantly forages on birds, although will also occasionally take invertebrates, fish, reptiles and mammals (Debus, 2019). Mostly diurnal or crepuscular.
Expected occurrence:	<b>Regular visitor.</b> The Peregrine Falcon is known from the general region (Figure 3-4) and the survey area is likely to be within the home range of a pair. The survey area has some tall trees that may be suitable for nesting.



Carnaby's Black-Cockatoo (*Zanda latirostris*)

CS1 (E,S2)

- Conservation status: Endangered under the EPBC Act and Schedule 2 under the BC Act.
- Distribution and habitat: Endemic to south-western Western Australia, from Kalbarri in the north, east to Merredin and Ravensthorpe, and then further east along the south coast to the Esperance area (DCCEEW, 2023e; Johnstone & Storr, 1998). Breeds (July to December) predominantly in the east of its range with a migration to coastal areas in the non-breeding period. In recent years, however, the species has expanded its breeding range westward and south into the Jarrah-Marri forests of the Darling Scarp and into the Tuart forests of the Swan Coastal Plain (DCCEEW, 2023e). Heavily reliant on areas of Banksia woodland and proteaceous shrubland/heath for foraging (DCCEEW, 2023e; Johnstone & Storr, 1998).
- Ecology: Diurnal granivore, feeding predominantly on the seeds of the Proteaceae (especially banksias) but also known to feed on a very wide variety of plants, including non-native ornamentals and plantation species such as pine (DCCEEW, 2023e; DPaW, 2013; Groom, 2011; Johnston et al., 2016; Valentine & Stock, 2008). Reliant on large tree-hollows in eucalypts (especially smooth-barked species such as Wandoo and Salmon Gum) for breeding (DCCEEW, 2023e; Johnstone & Storr, 1998; Saunders, 1974). Threatened by habitat loss, habitat degradation, nest hollow shortage, and competition for available nest hollows from other parrots and feral Honeybees, illegal shooting and illegal trade (Burbidge, 2004; DCCEEW, 2023e).
- Expected occurrence: **Regular visitor.** There is a cluster of records south of Ballidu and scattered records to the west and northwest in the DBCA threatened fauna database (Figure 3-4). There is limited foraging habitat and no nesting habitat in the survey area (discussed further below).

Grey Wagtail (*Motacilla cinerea*)

CS1 (M, S5)

- Conservation status: Migratory under the EPBC Act and Schedule 5 under the BC Act.
- Distribution and habitat: Breeding occurs in Asia/Siberia and small numbers may migrate as far south as northern Australia in the non-breeding season, generally confined to coastal areas (Johnstone & Storr, 2005; Menkhorst et al., 2017). Associated with wetland habitats and fast-flowing rocky waterways (Johnstone & Storr, 2005; Menkhorst et al., 2017). On migration this species may occur anywhere (Johnstone & Storr, 2005).
- Ecology: Diurnal insectivores (Johnstone & Storr, 2005; Menkhorst et al., 2017). These migrants may be present in Australia between October and April (Johnstone & Storr, 2005; Menkhorst et al., 2017).

Expected occurrence: **Vagrant.** The Grey Wagtail is a vagrant to the south-west region as a whole, and when reported tends to be close to the fringe of shallow wetlands or on irrigated grasslands. The survey area thus lacks habitat for a species that is not expected to occur regularly within the greater region.

### 3.2.6.2 Conservation Significance 2

#### Letter-winged Kite (*Elanus scriptus*)

CS2 (P4)

Conservation status: Listed as Priority 4 by DBCA.

Distribution and habitat: This species' core range is arid inland and northern Australia but it may be a casual occupier of other parts when suitable seasonal conditions prevail (Johnstone & Storr, 1998; Menkhorst *et al.*, 2017). Prefers open country and grasslands (Menkhorst *et al.*, 2017).

Ecology: A crepuscular or nocturnal predator, mostly targeting smaller mammals such as rodents (Johnstone & Storr, 1998; Menkhorst *et al.*, 2017). It is a boom-bust species that will move and breed opportunistically in response to rainfall events, and coincident prey-population increases (Menkhorst *et al.*, 2017). The Letter-winged Kite roosts communally, during the day, in leafy trees (Menkhorst *et al.*, 2017).

Expected occurrence: **Vagrant.** Does not normally occur in the broader region of the South-West, but the species can irrupt almost anywhere in Australia.

#### Western Rosella (inland) (*Platycercus icterotis xanthogenys*)

CS2 (P4)

Conservation status: Listed as Priority 4 by DBCA.

Distribution and habitat: Occurs in drier woodland with heath understory in the Wheatbelt region of Western Australia (Cork, 2020; Johnstone & Storr, 1998). The Western Rosella (inland) was formerly widely distributed throughout the wheatbelt region. Due to clearing for agriculture, the natural ecosystems in this region are heavily fragmented, disturbed and, generally, in very poor condition (Environment Australia, 2000). Therefore it is likely that the species no longer persists in some fragments of remnant vegetation.

Ecology: A diurnal ground and tree-foraging granivore, this species generally occurs singly, in pairs or small parties (Johnstone & Storr, 1998; Menkhorst *et al.*, 2017). It is quiet and easily overlooked (Cork, 2020).



Expected occurrence: **Probably absent.** The survey area is within the range for the species, and it would be expected as a resident in this region if sufficient habitat was available. While this species may persist in remnant vegetation in the survey area, it is considered unlikely to be present due to the highly fragmented and disturbed nature of the remnant native vegetation in and around the survey area. In support of this conclusion, there are no records of this species within 40 km of the survey area. However, this species is quiet and easily overlooked (Cork, 2020), and targeted surveys would be required to have more confidence in the status of this species in the survey area.

### 3.2.6.3 Conservation Significance 3

There are 100 species considered to be of local significance (CS3), consisting of one frog, 26 reptile, 67 bird and six mammal species. This is an unusually large number of CS3 species because of the location of the survey area within the Wheatbelt and reflects the historical clearing and disturbance in this region. As a result of this historical clearing and disturbance, even tiny remnants of vegetation and native fauna they support are of local significance. The CS3 species are mostly expected to be irregular visitors (36 species), with the remainder probably absent (13 species), or expected as residents (26 species), regular visitors (21 species) or vagrants (4 species).

### 3.3 Black-cockatoo habitat analysis

The expected occurrence of Carnaby's Black-Cockatoo in the Ballidu survey area is 'regular visitor', and the survey area is out of range for the Forest Red-tailed Black-Cockatoo and Baudin's Black-Cockatoo. Therefore, the following sections relate only to Carnaby's Black-Cockatoo.

#### 3.3.1 Black-cockatoo presence

Carnaby's Black-Cockatoo was not observed during field investigations. No evidence of foraging by Carnaby's Black-Cockatoos was observed during the field investigations. The survey area is on the margin of the species' range, but there are some records nearby (Figure 3-4); within the DBCA database there are 30 records within 15-40 km of the survey area, the most recent being from 2013.

#### 3.3.2 Black-Cockatoo foraging habitat assessment

The survey area in general is of low to moderate foraging value for the Carnaby's Black-Cockatoo; foraging value for each VSA is given in Table 3-4 and illustrated in Figure 3-5. The highest foraging score was 4/10; this was for the small area of VSA 2 (Complex shrubland). This VSA contains some proteaceous shrubs that are likely to be suitable for foraging by the species, so was given a 3 out of 6 for vegetation characteristics and a 1 out of 3 for context. This context score reflects the extent of regional clearing as even small areas of moderate foraging value vegetation can be important in such a landscape. VSA 3 (Eucalypt open woodland) and VSA 4 (Planted trees) received a 2 out of 6 for vegetation characteristics and also a 1 out of 3 for context due to the scarcity of foraging habitat in the region; thus a total habitat quality score of 3/10. Cleared paddocks were given a total score of just 1/10 as it is of low value based on vegetation characteristics and is very extensive throughout the region. A stocking rate (presence) score of zero was given as the species is only expected as a regular visitor in the survey area and was not recorded, nor was there any evidence of recent foraging.

**Table 3-4. Carnaby's Black-Cockatoo foraging scores for each VSA**

VSA	VSA Name	Site Condition (out of 6)	Site Context (out of 3)	Species Stocking Rate (0 or 1)	Total (out of 10)
1	Cleared paddocks	1	0	0	1
2	Complex shrubland	3	1	0	4
3	Eucalypt open woodland	2	1	0	3
4	Planted trees	2	1	0	3



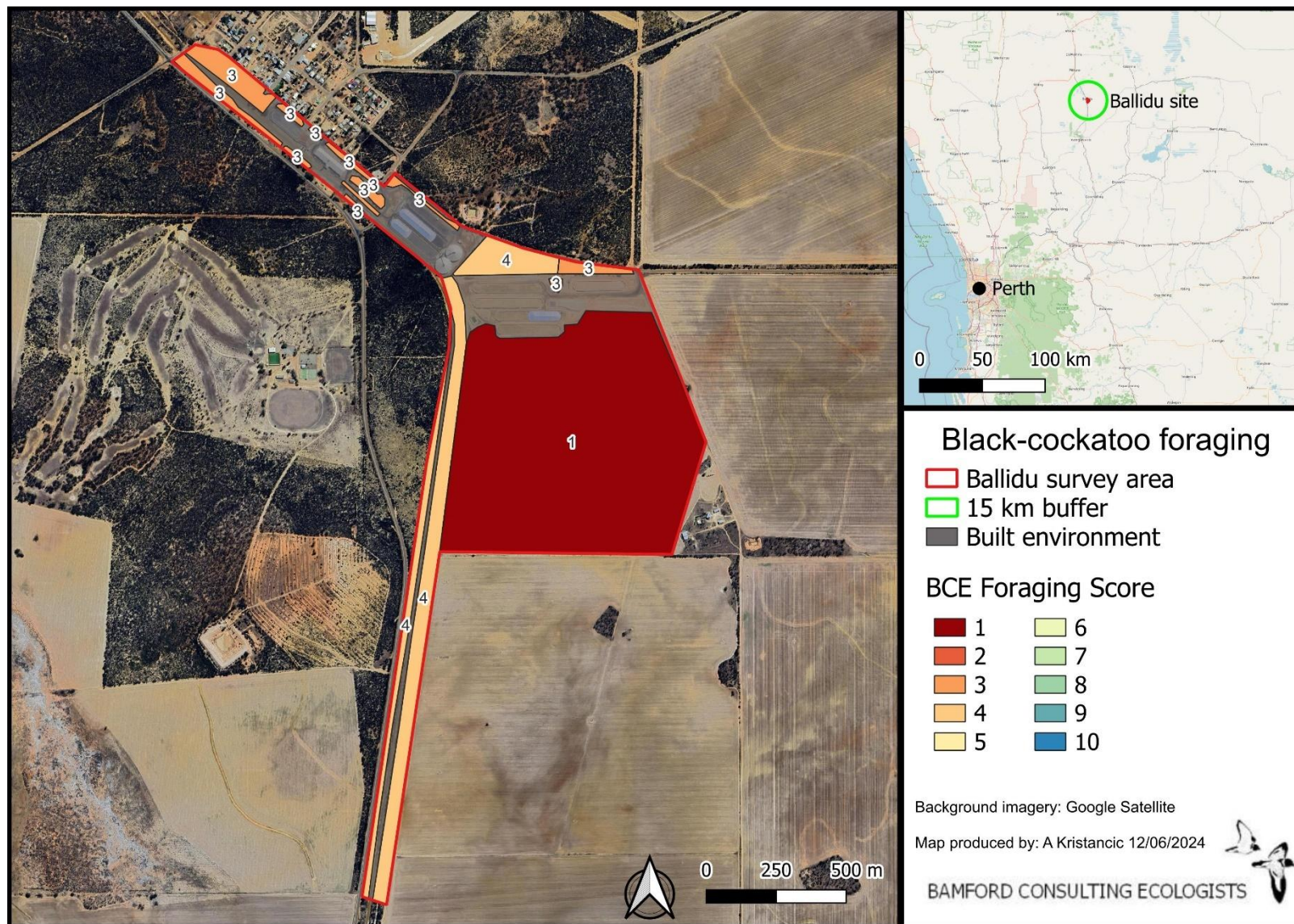


Figure 3-5. Distribution of Carnaby's Black-Cockatoo foraging scores within each VSA.

### 3.3.3 Black-Cockatoo breeding habitat

Within the survey area, 23 trees were identified that met the potential nest-tree criteria of DAWE and DEE (2017). These were all located in either VSA 3 or VSA 4 and are summarised in Table 3-5. The majority of the potential nest trees were assigned a rank of 5; they were of sufficient size to be assessed but lacked large hollows. One tree was assigned a rank of 4 (trees with large hollows, but they are not the size or shape preferred by black-cockatoos) and one was assigned a rank of 3 (trees with hollows suitable for use by black-cockatoos, but no sign of use by black-cockatoos). The rank 3 and rank 4 trees were both *Eucalyptus salmonophloia* and were located in VSA 3, very close to existing CBH infrastructure.

**Table 3-5. Summary of potential nest trees identified in the survey area.**

Tree species	Rank				
	1	2	3	4	5
<i>Eucalyptus camaldulensis</i>	0	0	0	0	12
<i>Eucalyptus salmonophloia</i>	0	0	1	1	5
Unknown <i>Eucalyptus</i>	0	0	0	0	4
<b>TOTAL</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>21</b>

There are no known breeding sites within 15 km of the survey area (BirdLife Australia, 2023b; DBCA, 2023e). There are three known breeding sites within 40 km of the survey area; these are located c. 18 km and c. 39 km south-west, and c. 36 km north-west of the survey area (DBCA, 2023e) (Figure 3-7). These were indicated as a 'confirmed white-tailed black-cockatoo natural hollow'; but would be Carnaby's rather than Baudin's Black-Cockatoo due to location and distribution. Approximately 39 km south-west of the survey area there is a cluster of potential breeding sites, all of which are described as natural hollows. Additional potential nest trees may exist in surrounding areas, as there are scattered examples of eucalypt woodland within 15 km and these may contain some large trees.

### 3.3.4 Black-Cockatoo roosting habitat

There are no known roosting sites within 40 km of the survey area (BirdLife Australia, 2023c; DBCA, 2023e). Tall trees in the north of the survey area (in VSA 4) were identified as suitable roosting trees.



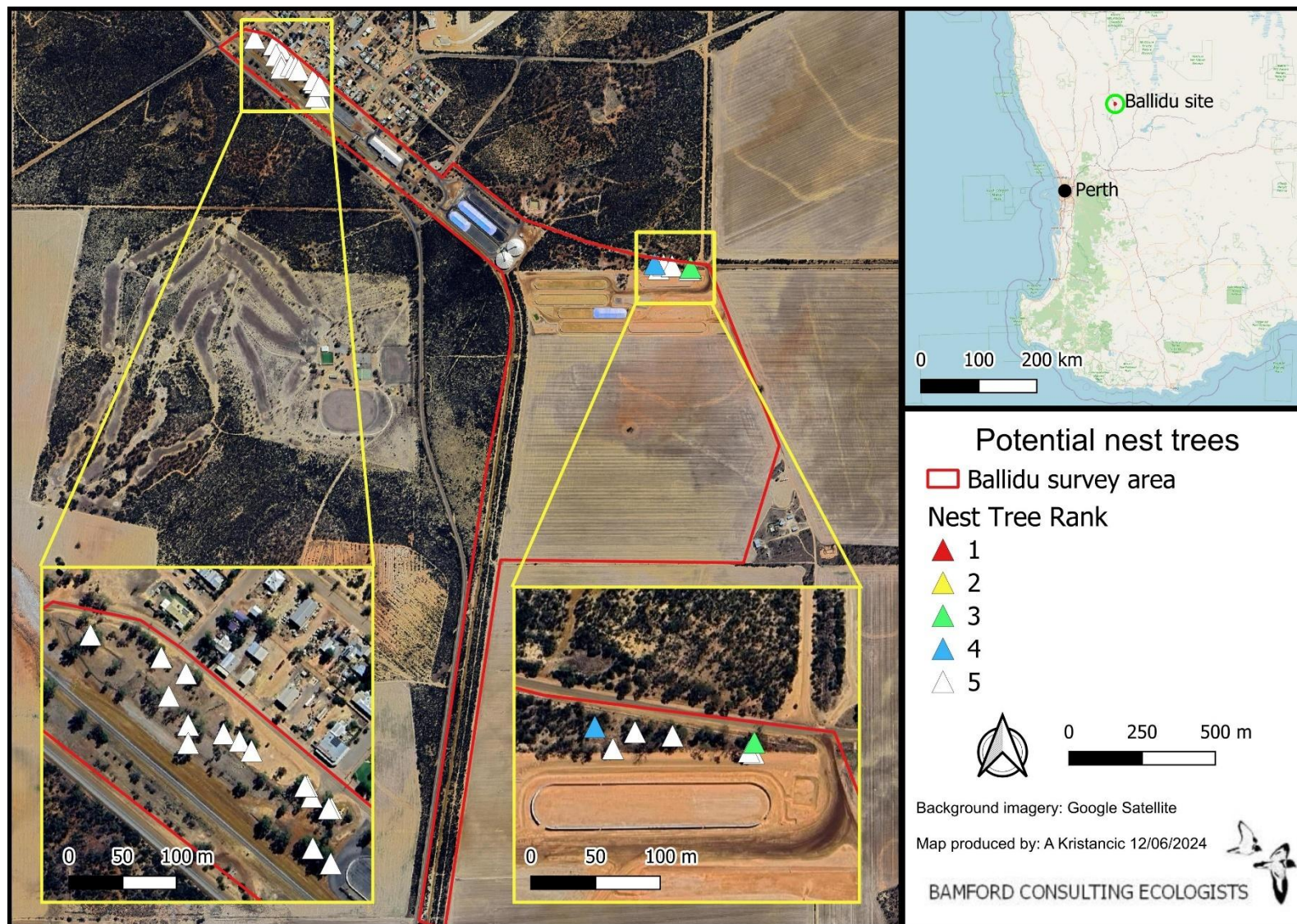


Figure 3-6. Location of potential nest trees assessed during the site visit.



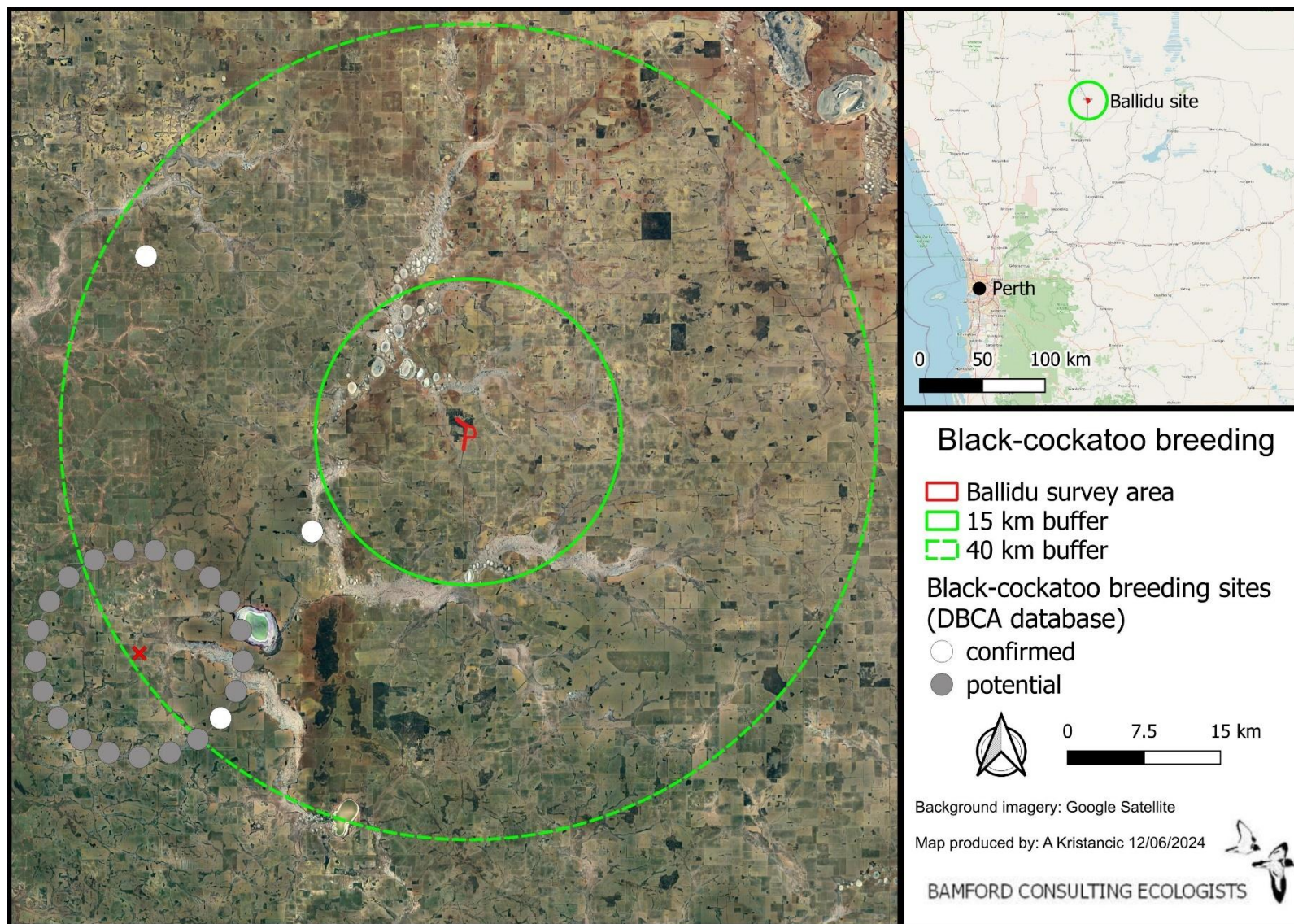


Figure 3-7. Known Carnaby's Black-Cockatoo breeding sites within 15 km and 40 km of the survey area (DBCA, 2023e).



### 3.4 Targeted trapdoor spider assessment

#### 3.4.1 Desktop assessment

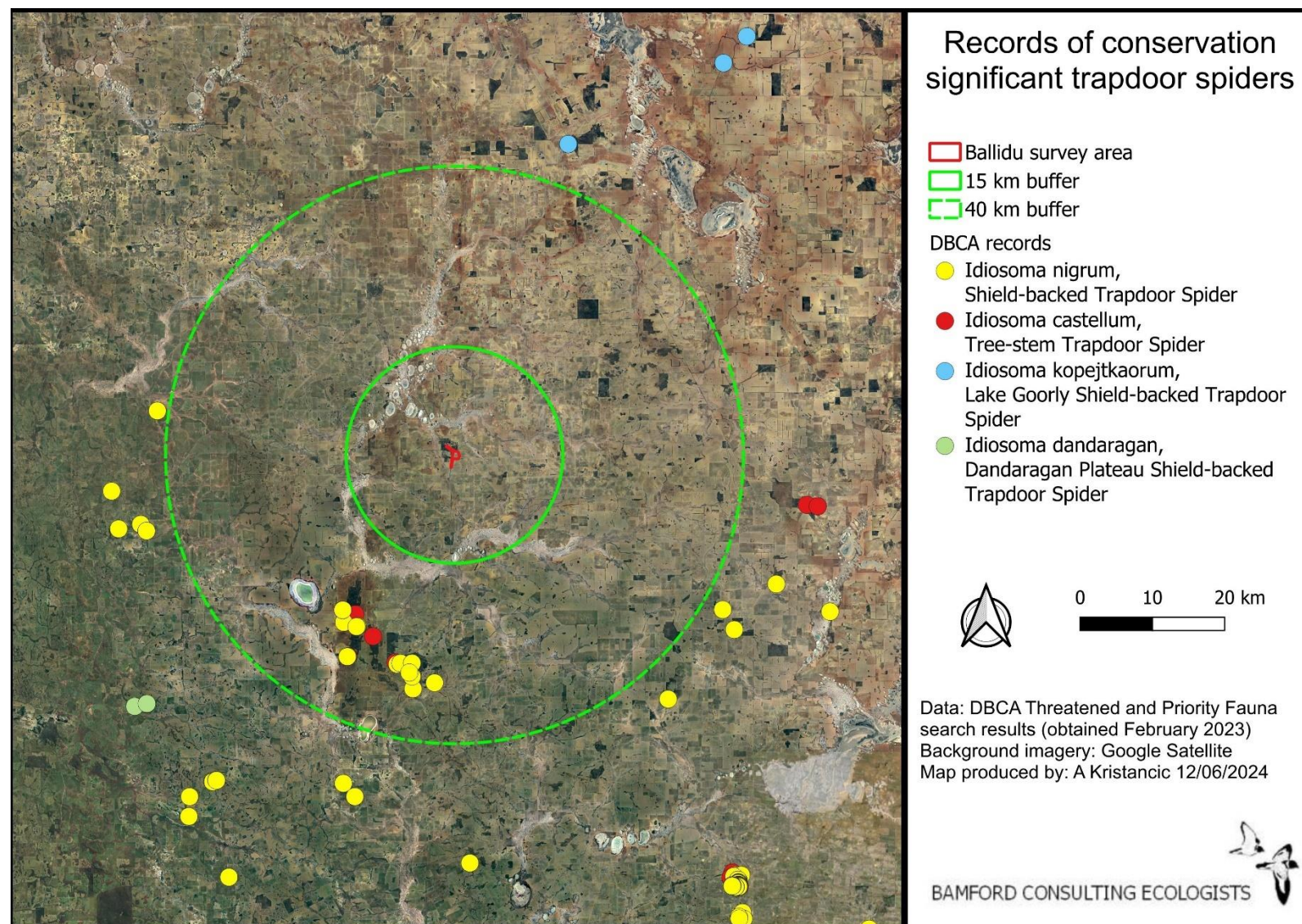
Four conservation significant trapdoor spiders were recorded within c. 20-60 km of Ballidu from the DBCA threatened species database (DBCA, 2023e):

- *Idiosoma nigrum*, Shield-backed Trapdoor Spider (listed as Vulnerable under the EPBC Act and Schedule 2 Division 2 (Endangered) under the Western Australian BC Act), records c. 25 km away.
- *Idiosoma castellum*, Tree-stem Trapdoor Spider (Priority 4, DBCA), records c. 24 km away.
- *Idiosoma kopejtkorum*, Lake Goorly Shield-backed Trapdoor Spider (Endangered (Schedule 2 Division 2), BC Act), records 45 km away.
- *Idiosoma dandaragan*, Dandaragan Plateau Shield-backed Trapdoor Spider (Priority 2, DBCA), records 55 km away.

Trapdoor spider records from a variety of databases are summarised in Table 3-6 and displayed in Figure 3-8.

**Table 3-6. Summary of database search results for relevant conservation significant trapdoor spiders.**

Species	DBCA database	ALA (closest record)
<i>Idiosoma nigrum</i>	30 records within 40 km. Closest 25 km away	35 km
PMST comments:	Species or species habitat likely to occur within 15 km buffer. Species or species habitat known to occur within 40 km buffer.	
<i>Idiosoma castellum</i>	5 records within 40 km. Closest 24 km away	88 km
<i>Idiosoma kopejtkorum</i>	None within 40 km. Closest 45 km away	45 km
<i>Idiosoma dandaragan</i>	None within 40 km. Closest 55 km away	75 km



**Figure 3-8. Location of records of conservation significant spiders from DBCA threatened species database (DBCA, 2023e).**

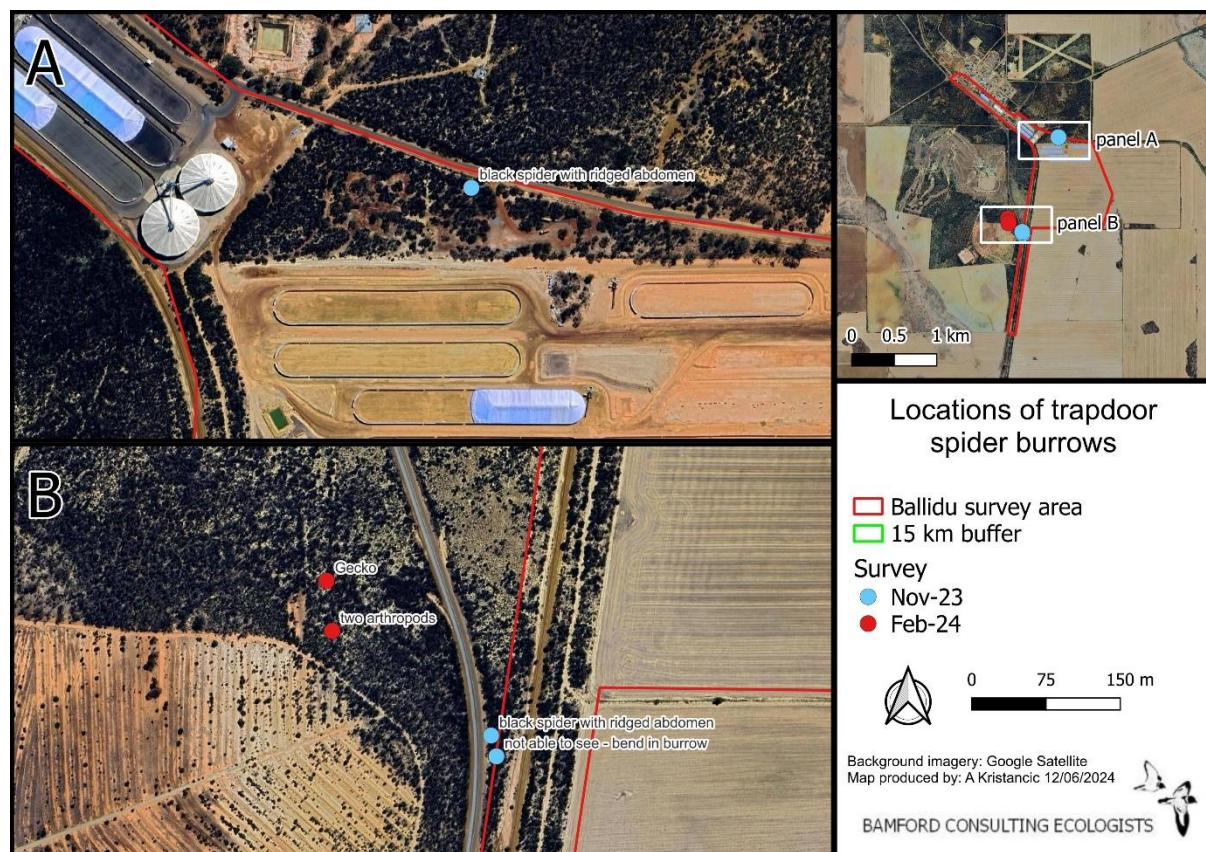


### 3.4.2 Field investigations

Locations and details of burrows found during November 2023 and February 2024 field investigations are provided in Table 3-7 and shown in Figure 3-9. Further details from each survey are provided in the relevant sections below. Across the two surveys, five burrows were found, with the Shield-backed Trapdoor Spider confirmed in two burrows, and one burrow found that was consistent in structure with a burrow of the Tree-stem Trapdoor Spider.

**Table 3-7. Details of trapdoor spider burrows found during targeted field investigations.**

Survey	Easting	Northing	Label	Comments
Nov-23	478872.5	6614514	SB TDS1	Shield-backed Trapdoor spider (black spider with ridged abdomen)
Nov-23	478451.8	6613382	TS TDS1	Tree-stem Trapdoor Spider burrow; not able to see occupant due to bend in burrow
Nov-23	478446.4	6613403	SB TDS2	Shield-backed Trapdoor spider (black spider with ridged abdomen)
Feb-24	478280	6613559	TDS2GECKO	Shield-backed Trapdoor Spider burrow (gecko taken up occupancy)
Feb-24	478286	6613509	TDS1ABD	Shield-backed Trapdoor Spider burrow (two arthropods present in burrow)



**Figure 3-9. Locations and details of trapdoor spider burrows found during targeted field investigations in November 2023 and February 2024.**

#### 3.4.2.1 Survey 1 – November 2023

There were three trapdoor spider burrows recorded in the November survey and all were recorded within VSA 2 (Complex shrubland); see Plate 5. Two of these burrows contained spiders which were identified as the Shield-backed Trapdoor Spider based on the ridged abdomens seen with a milliscope (Plate 6 and 7). The third burrow contained a bend and it was not possible to see the occupant, but the burrow structure is consistent with that of a Tree-stem Trapdoor Spider (Plate 8).



**Plate 5. Example of habitat searched for trapdoor spider burrows in November 2023.**





**Plate 6. Example of Shield-backed Trapdoor Spider burrow found in November 2023 (ID code SB TDS1). Top photograph shows fan shaped arrangement of leaves indicating the lid of a burrow. Bottom photo shows lid pulled open to expose burrow. This burrow contained a Shield-backed Trapdoor Spider.**





**Plate 7. Photographs of burrow SB TDS 2 found in November 2023. Top photo shows burrow with lid closed, while bottom photo shows burrow with lid open. This burrow contained a Shield-backed Trapdoor Spider.**





**Plate 8. Photographs of burrow TS TDS1 found in November 2023. Top photo shows burrow with lid closed, while bottom photo shows burrow with lid open. This burrow contained a bend and it was not possible to see the occupant, but the burrow structure is consistent with that of a Tree-stem Trapdoor Spider.**



#### 3.4.2.2 Survey 2 – February 2024

Despite extensive searching (see Figure 2-2 for GPS tracks showing survey coverage), only two trapdoor spider burrows were found in shrubland surrounding the survey area. Neither contained a spider: one was old and deteriorated (lid broken off but fan intact, see Plate 9) and had been taken over by two arthropods, while the other was in good condition with lid and fan intact (Plate 10), but was occupied by a gecko. The structure of both burrows was consistent with the Shield-backed Trapdoor Spider.



**Plate 9. Spider burrow with intact fan, but broken lid (TDS1ABD). This burrow was occupied by two arthropods.**





**Plate 10. Spider burrow in good condition, with intact lid (closed) and fan (TDS2GECKO). This burrow was occupied by a gecko.**

### *3.4.3 Significance of recorded burrows*

The spider surveys confirmed the presence of the Shield-backed Trapdoor Spider and the Tree-stem Trapdoor Spider. Despite extensive survey effort in the survey area and in the surrounding bushland, spider burrows were only recorded in two areas within and adjacent to the survey area, with these areas being 1 km apart. It is likely that additional trapdoor spider burrows exist in the general area given the camouflaged nature of the lids which make them hard to detect. However, the results suggest that the spiders are not in high abundance and therefore any locations where they occur are likely to be important for the local populations. This includes locations where empty burrows were found.

### **3.5 Patterns of biodiversity**

Investigating patterns of biodiversity can be complex and are often beyond the scope even of detailed or targeted investigations (see Section 2.1 above), but it is possible to draw some general conclusions based upon the different VSAs in the survey area.

The complex shrubland of VSA 2, in the centre end of the survey area and extending to the south, is expected to support the highest species richness of all groups of fauna due to its diversity of plant species and complex vegetation structure. Trapdoor spiders are likely to be restricted to this VSA. The small and narrow shape of these areas may limit species richness and may result in some species being only visitors rather than residents. However, there is some connectivity between areas of VSA 2 within the survey area and large areas of remnant vegetation outside the survey area boundary. The eucalypt open woodland of VSA 3 and planted native trees of VSA 4 would provide some resources and connectivity for some fauna. The cleared paddocks comprising VSA 1 provide limited value to fauna but provide more value than the built environment. The cleared paddocks also potentially present a barrier for the movement of many species (see below).

### **3.6 Ecological processes**

The nature of the landscape and the fauna assemblage indicate some of the ecological processes that may be important for ecosystem function (see Appendix 1 for descriptions and other ecological processes). The main ecological processes which have affected and continue to affect the fauna assemblage are likely to be: (i) existing habitat loss, as the region has experienced very high levels of land clearing historically, and very little habitat for fauna remains; (ii) landscape connectivity, because of the highly fragmented nature of vegetation in the area; and (iii) the presence and abundance of feral and some native species. These and additional ecological processes which are affecting fauna are discussed below.

#### Existing habitat loss

The survey area is located in the Wheatbelt where native vegetation has, historically, largely been cleared for agriculture and very little remnant vegetation remains. This has resulted in the loss and decline of many fauna species, while for any species persisting in the survey area itself, any additional loss or even degradation of remnant vegetation in the survey area has the potential to lead to population decline. Revegetation of cleared areas within the survey area and/or surrounding landscape has the potential to benefit fauna populations in the survey area and in other populations nearby.

#### Landscape connectivity

The survey area is mostly previously-cleared but contains small sections of shrubland (VSA 2, along the south-western boundary and extending south along the roadside, and to the north of the cleared paddock within the survey area), and a linear patch of planted native trees in the north-west of the survey area which may provide connectivity for fauna moving between patches of remnant vegetation. This function may be important for maintaining the current fauna assemblage.

#### Feral species and interactions with over-abundant native species



Feral species occur throughout Western Australia and are a considerable component of the expected mammal fauna of the survey area; 12 introduced/feral species may be present in the survey area (five irregular visitors, four are expected as residents, two regular visitors, and one as a vagrant, while an additional eight species may be present in the survey area but have been omitted from the expected species because they are domesticated). Feral species are likely to have contributed to local mammal extinctions in the area and may currently be affecting populations of extant species in the survey area. Feral cats, foxes and rabbits are likely to be placing considerable pressure on the native fauna in the region - cats and foxes via predation, and rabbits via competition for resources and degrading vegetation. Grazing and trampling of vegetation by stray domestic livestock can also have a considerable negative impact on native fauna due to habitat degradation. Several native species are likely to be overabundant on cleared farmland and due to access to abundant food around the grain handling facilities; these include the Galah, Little Corella, Australian Raven, Australian Magpie and Pied Butcherbird. The two cockatoos may adversely affect other native parrots, and could even be preventing Carnaby's Black-Cockatoo from breeding in the region. The remaining species are predators that could suppress the abundance particularly of small birds (e.g. Read *et al.*, 2015).

#### Local hydrology

There is no surface water present in the survey area, but the remnant vegetation to the south includes areas that may be seasonally inundated. Native vegetation and planted trees may be reliant on groundwater, but it is not known if groundwater levels are subject to change and increasing salinity as occurs in some parts of the Wheatbelt. Increasing salinity could lead to vegetation degradation.

#### Fire

Native vegetation in the survey area may be subject to infrequent fires, likely to result from vehicle movements along roads and in nearby paddocks. While appropriate fire regimes can benefit biodiversity, inappropriate regimes can lead to a loss of biodiversity. Although fire may be infrequent in the survey area, the small areas of remnant vegetation mean that the total area might be burnt in one fire event. Such events may have contributed to local declines and extinctions.

### **3.7 Summary of fauna values**

Vegetation and Substrate Associations (VSAs). The survey area encompasses four VSAs which are typical of rural areas in the wheatbelt of Western Australia. The majority of the survey area consists of Cleared paddocks (VSA 1) which provides little habitat for fauna but tends to support farmland species. Other VSAs include Eucalypt open woodland (VSA 3) consisting of Salmon gum and Gimlet over some *Acacia* and weeds, Planted trees (VSA 4) consisting of planted *E. camaldulensis* over a sparse understorey made up of grassy weeds from agricultural practices, and Complex shrubland (VSA 2) consisting of a diverse mix of small trees and shrubs over mixed herbs and grasses.

Fauna assemblage. The desktop assessment identified 212 vertebrate fauna species as potentially occurring in the survey area: eight frogs, 44 reptiles, 142 birds, 12 native mammals and six introduced mammals. Several domesticated animals, particularly sheep and goats, may be present in the survey area but are not included in the expected species counts. The presence of 18 species of birds was confirmed during the November 2022 site inspection. Overall, the assemblage of vertebrate fauna expected in the survey area is typical of fragmented and degraded vegetation in the Wheatbelt region,

with a high level of species decline and loss. The list of species expected to be present is almost certainly generous.

Species of conservation significance. Six vertebrate species that are listed under state or federal Acts or publications are expected to occur in the survey area: four CS1 and two CS2 species. The CS1 and CS2 species occur as vagrants (2 species) and regular visitors (3 species), with only one expected to be an irregular visitor (Inland Western Rosella), and none expected to be residents. An additional 100 vertebrate species are considered to be locally significant (CS3). The majority of species that are still present are considered to be of local conservation significance (CS3) because of the extensive clearing and degraded nature of remnant vegetation. An additional 49 species (4 reptiles, 16 birds, and 29 mammals) of conservation significance are locally extinct. There were four conservation significant trapdoor spiders returned from database searches (between 20 and 60 km from survey area); two of these were recorded in the survey area: Shield-backed Trapdoor Spider (CS1) and Tree-stem Trapdoor Spider (CS2).

Black-cockatoo assessment. Carnaby's Black-Cockatoo was not recorded during the site inspection and there was no evidence of foraging by this species. The survey area is out of range for the Forest Red-tailed and Baudin's Black-Cockatoos.

For Carnaby's Black-Cockatoo:

- Foraging value – overall the foraging value of the survey area is low to moderate. VSA 2 provides the highest foraging value at 4/10.
- Breeding value – twenty-three trees were identified that met the potential nest-tree criteria of DAWE and DEE (2017). The closest known record of breeding for Carnaby's Black-Cockatoo is 24 km from the survey area.
- Roosting value – one tree was identified as a potential roosting tree and likely to be more in the surrounding areas. There are no known black-cockatoo roost sites within 40 km of the survey area.

Trapdoor Spider assessment. Suitable habitat for trapdoor spiders was present within the survey area in the Complex Shrubland of VSA 2; two Shield-backed Trapdoor Spiders and one Tree-stem Trapdoor Spider burrow were found in this habitat during the first targeted survey in November 2023. Two Shield-backed Trapdoor Spider burrows were recorded within surrounding bushland in the February 2024 survey. Despite extensive survey effort in the survey area and in the surrounding bushland, spider burrows were only recorded in two areas within and adjacent to the survey area, with these areas being 1 km apart. It is likely that additional trapdoor spider burrows exist in the general area given the camouflaged nature of the lids which make them hard to detect. However, the results suggest that the spiders are not in high abundance and therefore any locations where they occur are likely to be important for the local populations. This includes locations where empty burrows were found.

Patterns of biodiversity. The complex shrubland of VSA 2 is likely to support the highest levels of biodiversity in the survey area; trapdoor spiders are likely to be restricted to this VSA. The planted trees of VSA 3 and VSA 4s may provide some shelter and resources for fauna, as well as function as connectivity to facilitate movement of fauna between patches of remnant vegetation. VSA 1 has low



value for fauna and tends to support species that are favoured in the cleared agricultural landscape, and that therefore are widespread and abundant in the Wheatbelt.

Key ecological processes. The ecological processes that currently have major effects upon the fauna assemblage include existing habitat loss, landscape connectivity, the presence of feral species and the presence of over-abundant native species. Hydrology may be a significant factor as in at least some parts of the Wheatbelt, changing levels and salinity in groundwater has led to vegetation degradation. Fire could also be a factor that has affected the fauna assemblage. The extent of habitat loss means that the small remnant in the survey area supports almost relictual populations of some species that would not be present otherwise, while the connectivity provided by native vegetation in the survey area may be essential for some local populations.

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## 5 Appendices

### Appendix 1. Explanation of fauna values.

Fauna values are the features of a site and its fauna that contribute to biodiversity, and it is these values that are potentially at threat from a development proposal. Fauna values can be examined under the five headings outlined below. It must be stressed that these values are interdependent and should not be considered equal, but contribute to an understanding of the biodiversity of a site. Understanding fauna values provides opportunities to predict and therefore mitigate impacts.

#### **Assemblage characteristics**

Uniqueness. This refers to the combination of species present at a site. For example, a site may support an unusual assemblage that has elements from adjacent biogeographic zones, it may have species present or absent that might be otherwise expected, or it may have an assemblage that is typical of a very large region. For the purposes of impact assessment, an unusual assemblage has greater value for biodiversity than a typical assemblage.

Completeness. An assemblage may be complete (i.e. has all the species that would have been present at the time of European settlement), or it may have lost species due to a variety of factors. Note that a complete assemblage, such as on an island, may have fewer species than an incomplete assemblage (such as in a species-rich but degraded site on the mainland).

Richness. This is a measure of the number of species at a site. At a simple level, a species rich site is more valuable than a species poor site, but value is also determined, for example, by the sorts of species present.

#### **Vegetation and substrate associations (VSAs)**

VSAs combine broad vegetation types, the soils or other substrate with which they are associated, and the landform. In the context of fauna assessment, VSAs are the environments that provide habitats for fauna. The term habitat is widely used in this context, but by definition an animal's habitat is the environment that it utilises (Calver et al., 2009), not the environment as a whole. Habitat is a function of the animal and its ecology, rather than being a function of the environment. For example, a species may occur in eucalypt canopy or in leaf-litter on sand, and that habitat may be found in only one or in several VSAs. VSAs are not the same as vegetation types since these may not incorporate soil and landform, and recognise floristics to a degree that VSAs do not. Vegetation types may also not recognise minor but often significant (for fauna) structural differences in the environment. VSAs also do not necessarily correspond with soil types, but may reflect some of these elements.

Because VSAs provide the habitat for fauna, they are important in determining assemblage characteristics. For the purposes of impact assessment, VSAs can also provide a surrogate for detailed information on the fauna assemblage. For example, rare, relictual or restricted VSAs should automatically be considered a significant fauna value. Impacts may be significant if the VSA is rare, a large proportion of the VSA is affected and/or the VSA supports significant fauna. The disturbance of even small amounts of habitat in a localised area can have significant impacts to fauna if rare or unusual habitats are disturbed.

VSA assessment was made with reference to the key attributes provided by (EPA, 2020):

- soil type and characteristics
- extent and type of ground surfaces and landforms
- height, cover and dominant flora within each vegetation stratum
- presence of specific flora or vegetation of known importance to fauna
- evidence of fire history including, where possible, estimates of time since fire
- evidence and degree of other disturbance or threats, e.g. feral species
- presence of microhabitats and significant habitat features, such as coarse woody debris, rocky
- outcrops, tree hollows, water sources and caves
- evidence of potential to support significant fauna
- function of the habitat as a fauna refuge or part of an ecological linkage.

### **Patterns of biodiversity across the landscape**

This fauna value relates to how the assemblage is organised across the landscape. Generally, the fauna assemblage is not distributed evenly across the landscape or even within one VSA. There may be zones of high biodiversity such as particular environments or ecotones (transitions between VSAs). There may also be zones of low biodiversity. Impacts may be significant if a wide range of species is affected even if most of those species are not significant per se.

### **Species of conservation significance**

Species of conservation significance are of special importance in impact assessment. The conservation status of fauna species in Australia is assessed under Commonwealth and State Acts such as the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the *Western Australian Biodiversity Conservation Act 2016* (BC Act). In addition, the Western Australian Department of Biodiversity, Conservation and Attractions (DBCA) recognises priority levels, while local populations of some species may be significant even if the species as a whole has no formal recognition. Therefore, three broad levels of conservation significance can be recognised and are used for the purposes of this report, and are outlined below. A full description of the conservation significance categories, schedules and priority levels mentioned below is provided in Appendix 2.

#### Conservation Significance (CS) 1: Species listed under State or Commonwealth Acts.

Species listed under the EPBC Act are assigned to categories recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN, 2012), or are listed as migratory. Migratory species are recognised under international treaties such as the China Australia Migratory Bird Agreement (CAMBA), the Japan Australia Migratory Bird Agreement (JAMBA), the Republic of South Korea Australia Migratory Bird Agreement (ROKAMBA), and/or the Convention on the Conservation of Migratory Species of Wild Animals (CMS; also referred to as the Bonn Convention). The *Wildlife Conservation Act 1950* uses a series of seven Schedules to classify conservation status that largely reflect the IUCN categories (IUCN, 2012).



### Conservation Significance (CS) 2: Species listed as Priority by DBCA but not listed under State or Commonwealth Acts.

In Western Australia, DBCA has produced a supplementary list of Priority Fauna, being species that are not considered threatened under the *Wildlife Conservation Act 1950* but for which DBCA feels there is cause for concern.

### Conservation Significance (CS) 3: Species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution.

This level of significance has no legislative or published recognition and is based on interpretation of distribution information, but is used here as it may have links to preserving biodiversity at the genetic level (EPA, 2002). If a population is isolated but a subset of a widespread (common) species, then it may not be recognised as threatened, but may have unique genetic characteristics. Conservation significance is applied to allow for the preservation of genetic richness at a population level, and not just at a species level. Species on the edge of their range, or that are sensitive to impacts such as habitat fragmentation, may also be classed as CS3, as may colonies of waterbirds. The Western Australian Department of Environmental Protection, now DBCA, used this sort of interpretation to identify significant bird species in the Perth metropolitan area as part of the Perth Bushplan (Dell & Banyard, 2000).

### Marine-listed species

Some conservation significant species may also be listed as 'Marine' under the EPBC Act. This listing protects these species in 'Commonwealth areas' which include "marine areas beyond the coastal waters of each State and the Northern Territory, and includes all of Australia's Exclusive Economic Zone (EEZ)" (DEH, 2006). The EEZ extends to 200 nautical miles (approximately 350 kilometres) from the coast (DEH, 2006). This may mean that the 'Marine' listing does not apply to a site (depending on its location). Therefore, when a species is otherwise protected (under the EPBC Act or BC Act) or priority-listed (by the DBCA) then the Marine listing is also noted but it does not have site-specific relevance. In cases where a species is solely Marine-listed (for a list see DEH, 2000) and a site is not within a Commonwealth area then it is treated like all other fauna.

### Invertebrates

Invertebrate species considered to be short range endemics (SREs) also fall within the CS3 category, as they have no legislative or published recognition, and their significance is based on interpretation of distribution information. Harvey (2002) notes that the majority of species that have been classified as short-range endemics have common life history characteristics such as poor powers of dispersal or confinement to discontinuous habitats. Several groups, therefore, have particularly high instances of short-range endemic species: Gastropoda (snails and slugs), Oligochaeta (earthworms), Onychophora (velvet worms), Araneae (mygalomorph spiders), Pseudoscorpionida (pseudoscorpions), Schizomida (schizomids), Diplopoda (millipedes), Phreatoicidea (phreatoicidean crustaceans), and Decapoda (freshwater crayfish). The poor understanding of the taxonomy of many of the short-range endemic species hinders their conservation (Harvey, 2002).

### Introduced species

In addition to these conservation levels, species that have been introduced (INT) are indicated throughout the report. Introduced species may be important to the native fauna assemblage through effects by predation and/or competition.

### **Ecological processes upon which the fauna depend**

These are the processes and conditions that apply to the existing environment and that affect and maintain fauna populations in an area. As such they are very complex; for example, populations are maintained through the dynamic of mortality, survival and recruitment being more or less in balance, and these are affected by a myriad of factors. The dynamics of fauna populations in an area may be affected and effectively determined by processes such as:

- fire regime.
- landscape patterns (such as extent of existing habitat, fragmentation and/or linkage).
- the presence of feral species.
- hydrology.



## Appendix 2. Categories used in the assessment of conservation status.

IUCN (International Union for the Conservation of Nature) categories, as outlined by IUCN (2012), and as used for the *Environment Protection and Biodiversity Conservation Act 1999* and the *Western Australian Biodiversity Conservation Act 2016*.

Extinct	Taxa not definitely located in the wild during the past 50 years.
Extinct in the Wild (Ex)	Taxa known to survive only in captivity.
Critically Endangered (CR)	Taxa facing an extremely high risk of extinction in the wild in the immediate future.
Endangered (E)	Taxa facing a very high risk of extinction in the wild in the near future.
Vulnerable (V)	Taxa facing a high risk of extinction in the wild in the medium-term future.
Near Threatened	Taxa that risk becoming Vulnerable in the wild.
Conservation Dependent	Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classed as Vulnerable or more severely threatened.
Data Deficient (Insufficiently Known)	Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
Least Concern.	Taxa that are not Threatened.

### Schedules used in the *WA Biodiversity Conservation Act 2016, updated 2023*

Schedule 1	Specially protected fauna Division 1 – Species of special conservation interest (S1D1) Division 2 – Migratory species (S1D2) Division 3 – Species otherwise in need of special protection (S1D3)
Schedule 2	Threatened species Division 1 – Critically endangered species (S2D1) Division 2 – Endangered species (S2D2) Division 3 – Vulnerable species (S2D3)
Schedule 3	Extinct species (S3)

WA DBCA Priority species (species not listed under the *WA Biodiversity Conservation Act 2016*, but for which there is some concern).

Priority 1 (P1)	Taxa with few, poorly known populations on threatened lands.
Priority 2 (P2)	Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands.
Priority 3 (P3)	Taxa with several, poorly known populations, some on conservation lands.
Priority 4. (P4)	Taxa in need of monitoring. Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change.
Priority 5 (P5)	Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years (IUCN Conservation Dependent).

## Appendix 3. Scoring system for black-cockatoo foraging value

### Scoring system for the assessment of foraging value of vegetation for black-cockatoos.

Revised 6<sup>th</sup> February 2023

Bamford Consulting Ecologists

#### Introduction

Application of the Offset Assessment Guide (offsets guide) developed by the federal environment department for assessing Black-Cockatoo foraging habitat requires the calculation of a score out of 10. The following system has been developed by Bamford Consulting Ecologists (BCE) with assistance from Quessentia Consulting to provide an objective scoring system that is practical and can be used by trained field zoologists with experience in the environments frequented by the species.

The foraging value score provides a numerical value that reflects the significance of vegetation as foraging habitat for Black-Cockatoos, and this numerical value is designed to provide the information needed by the DCCEE (formerly DAWE) to assess impact significance and offset requirements. The foraging value of the vegetation depends upon the type, density and condition of trees and shrubs in an area and can be influenced by the context such as the availability of foraging habitat nearby. The BCE scoring system for value of foraging habitat has three components as detailed above. These three components are drawn from the DAWE offsets guide<sup>2</sup> but the scoring approach was developed by BCE and includes a fourth (moderation) component. Note that the scoring system can only be applied within the range of the species or at least where the species could reasonably be expected to occur based upon existing information.

Calculating the total score (out of 10) requires the following steps:

- A. Site condition. Determining a score out of six for the vegetation composition, condition and structure; plus
- B. Site context. Determining a score out of three for the context of the site; plus
- C. Species stocking rate. Determining a score out of one for species density.
- D. Determining the total score out of 10, which may require moderation for context and species density with respect to the site condition (vegetation) score. Moderation also includes consideration of pine plantations as a special case for foraging value.

The BCE scoring system places the greatest weight on site condition (scale of 0 to 6) because this has the highest influence on the foraging values of a site, which in turn is the fundamental driver in meeting ecological requirements for continued survival.

Site context has a lower weight (scale of 0 to 3) in recognition of the mobility of the species, which means they can access good foraging habitat even in fragmented landscapes, but allowing for recognition of the extent of available habitat in a region and context in relation to activity (such as breeding and roosting). The application of scoring site context is further discussed below.

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<sup>2</sup> <https://www.agriculture.gov.au/sites/default/files/documents/offsets-how-use.pdf>



Species stocking rate is given a low weight (0 to 1) as it is a means only of recognising that a species may or may not be abundant at a site, but that abundance is dependent upon site condition and context and is thus not an independent variable. The abundance of a species is also sensitive to sampling effort, and to seasonal and annual variation, and is therefore an unreliable indicator of actual importance of a site to a species.

Calculation of scores and the moderation process are described in detail below.

## A. Site condition. Vegetation composition, condition and structure scoring

Site Score	Description of Vegetation Values		
	Carnaby's Black-Cockatoo	Baudin's Black-Cockatoo	Forest Red-tailed Black-Cockatoo
0	<p>No foraging value. No Proteaceae, eucalypts or other potential sources of food. Examples:</p> <ul style="list-style-type: none"> <li>Water bodies (e.g. salt lakes, dams, rivers);</li> <li>Bare ground;</li> <li>Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits) or with vegetation of no food value, such as some suburban landscapes.</li> <li>Mown grass</li> </ul>	<p>No foraging value. No eucalypts or other potential sources of food. Examples:</p> <ul style="list-style-type: none"> <li>Water bodies (e.g. dams, rivers);</li> <li>Bare ground;</li> <li>Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits).</li> </ul>	<p>No foraging value. No eucalypts or other potential sources of food. Examples:</p> <ul style="list-style-type: none"> <li>Water bodies (e.g. dams, rivers);</li> <li>Bare ground;</li> <li>Developed sites devoid of vegetation (e.g. infrastructure, roads, gravel pits).</li> </ul>
1	<p>Negligible to low foraging value. Examples:</p> <ul style="list-style-type: none"> <li>Scattered specimens of known food plants but projected foliage cover of these is &lt; 2%. This could include urban areas with scattered foraging trees;</li> <li>Paddocks that are lightly vegetated with melons or other known food-source weeds (e.g. <i>Erodium</i> spp.) that represent a short-term and/or seasonal food source;</li> <li>Blue Gum plantations (foraging by Carnaby's Black-Cockatoos has been reported but appears to be unusual).</li> </ul>	<p>Negligible to low foraging value. Scattered specimens of known food plants but projected foliage cover of these &lt; 1%. This could include urban areas with scattered foraging trees.</p>	<p>Negligible to low foraging value. Scattered specimens of known food plants but projected foliage cover of these &lt; 1%. Could include urban areas with scattered foraging trees.</p>



Site Score	Description of Vegetation Values		
	Carnaby's Black-Cockatoo	Baudin's Black-Cockatoo	Forest Red-tailed Black-Cockatoo
2	<p>Low foraging value. Examples:</p> <ul style="list-style-type: none"> <li>Shrubland in which species of foraging value, such as shrubby banksias, have &lt; 10% projected foliage cover;</li> <li>Woodland with tree banksias 2-5% projected foliage cover;</li> <li>Eucalypt woodland/mallee of small-fruited species;</li> <li>Paddocks that are densely vegetated with melons or other known food-source weeds (e.g. <i>Erodium</i> spp.) that represent a short-term and/or seasonal food source.</li> </ul>	<p>Low foraging value. Examples:</p> <ul style="list-style-type: none"> <li>Woodland with scattered specimens of known food plants (e.g. Marri and Jarrah) 1-5% projected foliage cover;</li> <li>Urban areas with scattered foraging trees.</li> <li>Paddocks with <i>Erodium</i> spp. and other weeds.</li> </ul>	<p>Low foraging value. Examples:</p> <ul style="list-style-type: none"> <li>Woodland with scattered specimens of known food plants (e.g. Marri, Jarrah or Sheoak) 1-5% projected foliage cover;</li> <li>Urban areas with scattered food plants such as Cape Lilac, <i>Eucalyptus caesia</i> and <i>E. erythrocorys</i>.</li> <li>Paddocks with <i>Erodium</i> spp. and other weeds.</li> </ul>
3	<p>Low to Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> <li>Shrubland in which species of foraging value, such as shrubby banksias, have 10-20% projected foliage cover;</li> <li>Woodland with tree banksias 5-20% projected foliage cover;</li> <li>Eucalypt Woodland with Marri 5- 10% projected foliage cover.</li> <li>Eucalypt Woodland/Forest with known food plants such as Marri 10-40% projected foliage cover but badly degraded understorey (poor long-term viability without management);</li> </ul>	<p>Low to Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> <li>Eucalypt Woodland with known food plants (especially Marri) 5-10% projected foliage cover;</li> <li>Eucalypt Woodland/Forest with known food plants such as Marri 10-40% projected foliage cover but badly degraded understorey (poor long-term viability without management);</li> <li>Managed revegetation with known food plants 10-40% projected foliage cover (establishing food sources with good long-term viability).</li> </ul>	<p>Low to Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> <li>Eucalypt Woodland with known food plants (especially Marri and Jarrah) 5-20% projected foliage cover;</li> <li>Parkland-cleared Eucalypt Woodland/Forest with known food plants such as Marri 10-40% projected foliage cover but badly-degraded understorey (poor long-term viability without management);</li> <li>Managed revegetation with known food plants 10-40% projected foliage cover (establishing food sources with good long-term viability).</li> </ul>

Site Score	Description of Vegetation Values		
	Carnaby's Black-Cockatoo	Baudin's Black-Cockatoo	Forest Red-tailed Black-Cockatoo
4	<p>Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> <li>Woodland/low forest with tree banksias (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) 20-40% projected foliage cover;</li> <li>Kwongan/ Shrubland in which species of foraging value, such as shrubby banksias, have 20-40% projected foliage cover;</li> <li>Eucalypt Woodland/Forest with Marri 20-60% projected foliage cover. Depending on understorey condition (and thus long-term viability) and Marri density, may downgrade to 3 or upgrade to 5.</li> </ul>	<p>Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> <li>Marri-Jarrah Woodland/Forest with 20-40% projected foliage cover;</li> <li>Marri-Jarrah Forest with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths.</li> <li>Eucalypt Woodland/Forest with diverse, healthy understorey and known food trees (especially Marri) 10-20% projected foliage cover.</li> <li>Orchards with highly desirable food sources (e.g. apples, pears, some stone fruits).</li> </ul>	<p>Moderate foraging value. Examples:</p> <ul style="list-style-type: none"> <li>Marri-Jarrah Woodland/Forest with 20-40% projected foliage cover;</li> <li>Marri-Jarrah Forest with 40-60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>Sheoak Forest with 40-60% projected foliage cover.</li> </ul>
5	<p>Moderate to High foraging value. Examples:</p> <ul style="list-style-type: none"> <li>Banksia Low Forest (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with 40-60% projected foliage cover;</li> <li>Banksia Low Forest (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with &gt; 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths;</li> <li>Pine plantations with trees more than 10 years old (but see pine note below in moderation section).</li> </ul>	<p>Moderate to High foraging value. Examples:</p> <ul style="list-style-type: none"> <li>Marri-Jarrah Forest with 40-60% projected foliage cover;</li> <li>Marri-Jarrah Forest with &gt; 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths.</li> </ul>	<p>Moderate to High foraging value. Examples:</p> <ul style="list-style-type: none"> <li>Marri-Jarrah Forest with 40-60% projected foliage cover;</li> <li>Marri-Jarrah Forest with &gt; 60% projected foliage cover but vegetation condition reduced due to weed invasion and/or some tree deaths.</li> <li>Sheoak Forest with &gt; 60% projected foliage cover.</li> </ul>



Site Score	Description of Vegetation Values		
	Carnaby's Black-Cockatoo	Baudin's Black-Cockatoo	Forest Red-tailed Black-Cockatoo
6	<p>High foraging value. Example:</p> <ul style="list-style-type: none"> <li>Banksia Low Forest (of key species <i>B. attenuata</i> and <i>B. menziesii</i>) with &gt; 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term).</li> </ul>	<p>High foraging value. Example:</p> <ul style="list-style-type: none"> <li>Marri-Jarrah Forest with &gt; 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term).</li> </ul>	<p>High foraging value. Example:</p> <ul style="list-style-type: none"> <li>Marri-Jarrah Forest with &gt; 60% projected foliage cover and vegetation condition good with low weed invasion and/or low tree deaths (indicating it is robust and unlikely to decline in the medium term).</li> </ul>

Vegetation structural class terminology follows Keighery (1994).

## B. Site context

Site Context is a function of site size, availability of nearby habitat and the availability of nearby breeding areas. Site context includes consideration of connectivity, although Black-Cockatoos are very mobile and will fly across paddocks to access foraging sites. Based on BCE observations, Black-Cockatoos are unlikely to regularly go over open ground for a distance of more than a few kilometres and prefer to follow tree-lines.

The maximum score for site context is 3, and because it is effectively a function of presence/absence of nearby breeding and the distribution of foraging habitat across the landscape, the following table, developed by Bamford Consulting in conjunction with DEE, provides a *guide* to the assignation of site context scores. Note that 'local area' is defined as within a 15 km radius of the centre point of the study site. This is greater than the maximum distance of 12 km known to be flown by Carnaby's Black-Cockatoo when feeding chicks in the nest.

Site Context Score	Percentage of the existing native vegetation within the 'local' area that the study site represents.	
	'Local' breeding known/likely	'Local' breeding unlikely
3	> 5%	> 10%
2	1 - 5%	5 - 10%
1	0.1 - 1%	1 - 5%
0	< 0.1%	< 1%

The table above provides weighting for where nearby breeding is known (or suspected) and for the proportion of foraging habitat within 15 km represented by the site being assessed. Some adjustments may be needed based on the judgement of the assessor and in relation to the likely function of the site. For example, a small area of foraging habitat (eg 0.5% of such habitat within 15 km) could be upgraded to a context of 2 if it formed part of a critical movement corridor. In contrast, the same sized area of habitat, of the same local proportion, could be downgraded if it were so isolated that birds could never access it. Adjustments to context score are further discussed below (moderation of scores).

## C. Species density (stocking rate).

Species stocking rate is described as "the usage and/or density of a species at a particular site" in the offsets guide. The description also implies that a site supports a discrete population, which is unlikely in the case of very mobile black-cockatoos. Assignment of the species density score (0 or 1) is based upon the black-cockatoo species being either abundant or not abundant. A score of 1 is used where the species is seen or reported regularly and/or there is abundant foraging evidence. Regularly is when the species is seen at intervals of every few days or weeks for at least several months of the year. A score of 0 is used when the species is recorded or reported very infrequently and there is little or no foraging evidence. Where information on actual presence of birds is lacking, a species density score can be assigned by interpreting the landscape and the site context. For example, a site with a moderate condition score that is part of a network of such habitat where a black-cockatoo species is



known would get a species density score of 1 even without clear presence data, while a species density score of 0 can be assigned to a site where the level of usage can confidently be predicted to be low.

#### D. Moderation of scores for the calculation of a value out of 10.

The calculation out of 10 requires the vegetation characteristics (out of 6) to be combined with the scores given for context and species density. It is considered that the context and density scores are not independent of vegetation characteristics; otherwise habitat of absolutely no value for black-cockatoo foraging (such as concrete or a wetland) could get a foraging score out of 10 as high as 4 if it occurred in an area where the species breed (context score of 3) and are abundant (species density score of 1). Similarly, vegetation of negligible or low characteristics which could not support black-cockatoos could be assigned a score as high as 6 out of 10. In that case, the score of 6 would be more a reflection of nearby vegetation of high characteristics than of the foraging value of the negligible to low scoring vegetation. The Black-Cockatoos would only be present because of vegetation of high characteristics, so applying the context and species density scores to vegetation of low characteristics would not give a true reflection of their foraging value.

For this reason, the context and species density scores need to be moderated for the vegetation characteristic score to prevent vegetation of little or no foraging value receiving an excessive score out of 10. A simple approach is to assign a context and species density score of zero to sites with a Condition score of low (2), negligible (1) or none (0), on the basis that birds will not use such areas unless they are adjacent to at least low-moderate quality foraging habitat ( $\geq 3$ ). The approach to calculating a score out of 10 can be summarised as follows:

vegetation composition, condition and structure score (out of 6)	context score	Species density score
3-6 (low/moderate to high value)	Assessed as per B above	Assessed as per C above
0-2 (no to low value)	0	0

Note that this moderation approach may require interpretation depending on the context. For example, vegetation with a condition score of 2 could be given a context score of 1 under special circumstances; such as when very close to a major breeding area or if strategically located along a movement corridor. It could also get an elevated context score if it is the only foraging habitat in an area and birds are present, and also if it is immediately alongside at least moderately good foraging habitat, on the basis that birds are more likely to utilise it if they are nearby. Species density score might also be raised if there is a high likelihood of the birds actually being present. Context score can also be used to give a fine adjustment to the total score, such as if there are two vegetation types with the same vegetation composition score, but one may be slightly better foraging habitat and covers a larger area. Moderation is a means by which fairly subtle differences in overarching foraging value can be recognised.

### Pine plantations

Pine plantations are an important foraging resource for Carnaby's Black-Cockatoo (only) but are not directly comparable with native vegetation. In comparing native vegetation with pine plantations for the purpose of calculating offsets, the following should be noted:

- Pine plantations are a commercial crop established with the intention of being harvested and thus have short-term availability (30-50 years), whereas native vegetation is available indefinitely if protected. Due to the temporary nature of pines as a food source, site condition and context differs between pines and native vegetation.
- Although pines provide a high abundance of food in the form of seeds, they are a limited food resource compared with native vegetation which provides seeds, insect larvae, flowers and nectar. The value of insect larvae in the diet of Carnaby's Black-Cockatoo has not been quantified, but in the vicinity of Perth, the birds forage very heavily on insect larvae in young cones of *Banksia attenuata* in winter, ignoring the seeds in these cones and seeds in older cones on the same trees (Scott & Black, 1981; M. Bamford pers. obs.). This suggests that insect larvae are of high nutritional importance immediately prior to the breeding season.
- Pine plantations have very little biodiversity value other than their importance as a food source for Carnaby's Black-Cockatoos. They inhibit growth of other flora. While this is not a factor for direct consideration with respect to Carnaby's Black-Cockatoo, it is a factor in regional conservation planning of which offsets for the cockatoos are a part.

Taking the above points into consideration, it is possible to assign pine plantations a foraging value as follows:

- Site condition. The actual foraging value of pines is high. Stock *et al.* (2013) report that it takes nearly twice as many seeds of *Pinus pinaster* to meet the daily energy requirements for Carnaby's Black-Cockatoo compared with Marri, and three times as many *P. pinaster* seeds compared with Slender Banksia. However, pines are planted at a high density so the food supply per hectare can be high. Taking account of the lack of variety of food from pines, this suggests a site condition score of 4 or 5 out of 6 (5 is used in Section A above). As a source of food, pines are thus comparable to the best banksia woodland. This site condition score then needs to be adjusted to take account of the short-term nature of the food supply (for pine plantations to be harvested. Where pines are 'ornamental, such as in some urban contexts, they can be treated as with other trees in urban landscapes). The foraging value of a site after pines are harvested will effectively be 0, or possibly 1 if there is some retention. It is proposed that this should approximately halve the site condition score; young pine plantations could be redacted slightly less than old plantations on the basis that a young plantation provides a slightly longer term food supply. If a maximum site condition score of 5 is given, then a young plantation (>10 but <30 years old) could be assigned a score of 3, and an old plantation (>30 years old) could be assigned a score of 2. Plantations <10 years old and thus not producing large quantities of cones could also get a score of 2, but recognising they may increase in value.
- Site context. Although a temporary food source, pines can be very important for Carnaby's Black-Cockatoo in some contexts; they could be said to carry populations in areas where there is little native vegetation. The system for assigning a context score as outlined above (Section B) also applies to pines. Thus, a context score of 3 can be given where pines are a significant proportion of foraging habitat (>5% if breeding occurs; >10% if no breeding), but where pines are a small part of the foraging landscape they will receive a context score of less than this.



- Species density. As outlined above (Section C), pines will receive a species density score of 1 where Carnaby's Black-Cockatoo are regular visitors. This is irrespective of an old plantation having a moderated condition score of 2.

Based on the above, pine plantations that represent a substantial part of the foraging landscape, such as in the region immediately north of Perth, would receive a total score (out of 10) of 6; young plantations in this area would receive a score of 7. In contrast, isolated and small plantations in rural landscapes could receive a score of just 2 if they are only a small proportion of foraging habitat and Carnaby's Black-Cockatoos are not regularly present.

## Appendix 4. Vertebrate fauna expected to occur in the survey area.

### Status codes:

CS1, CS2, CS3 = (summary) levels of conservation significance. See Appendix 1 for full explanation.

EPBC Act listings: CR = Critically Endangered, E = Endangered, V = Vulnerable, M = Migratory, Mar = Marine (see Appendix 2).

Biodiversity Conservation Act 2016 listings: S1 to S3 = Schedules 1 to 3, D1 to D3 = Divisions 1 to 3 (see Appendix 2).

DBCA Priority species: P1 to P4 = Priority 1 to 4 (see Appendix 2).

Int = introduced species.

### Expected Occurrence categories:

See Section 2.3.4 for explanation of expected occurrence categories.

Source: 1 = Atlas of Living Australia, 2 = Birddata, 3 = previous fauna surveys/reports, 4 = Naturemap, 5 = Protected Matters Search Tool, 6 = DBCA threatened and priority fauna search, 7 = general literature

Latin name	Common name	Status	Expected Occurrence	Source
<b>Hylidae (Tree frogs)</b>				
<i>Litoria moorei</i>	Motorbike Frog		Irregular visitor	1 4
<b>Limnodynastidae (Burrowing frogs)</b>				
<i>Heleioporus albopunctatus</i>	Western Spotted Frog		Regular visitor	1 4
<i>Heleioporus eyrei</i>	Moaning Frog		Regular visitor	1 4
<i>Limnodynastes dorsalis</i>	Western Banjo Frog		Regular visitor	1 4
<i>Neobatrachus pelobatoides</i>	Humming Frog		Regular visitor	1 4
<b>Myobatrachidae (Ground frogs)</b>				
<i>Crinia pseudinsignifera</i>	Bleating Froglet		Irregular visitor	1 4
<i>Myobatrachus gouldii</i>	Turtle Frog	CS3	Probably absent	1 4
<i>Pseudophryne guentheri</i>	Gunther's Toadlet		Irregular visitor	1 4
<b>Carphodactylidae (Carphodactylid geckoes)</b>				
<i>Underwoodisaurus milii</i>	Barking Gecko	CS3	Irregular visitor	1 4
<b>Diplodactylidae (Diplodactylid geckoes)</b>				
<i>Crenadactylus ocellatus</i>	South-western Clawless Gecko	CS3	Probably absent	1 4
<i>Diplodactylus granariensis</i>	Wheat-belt Stone Gecko	CS3	Probably absent	1 4
<i>Diplodactylus pulcher</i>	Fine-faced Gecko	CS3	Probably absent	1 4
<i>Hesperoedura reticulata</i>	Reticulated Velvet Gecko	CS3	Resident	1 4



<i>Strophurus spinigerus</i>	South-western Spiny-tailed Gecko	CS3	Resident	1 4
<b>Gekkonidae (Gekkonid geckos)</b>				
<i>Christinus marmoratus</i>	Marbled Gecko		Resident	1 4
<i>Gehyra variegata</i>	Tree Dtella		Resident	1 3 4
<i>Heteronotia binoei</i>	Bynoe's Gecko		Resident	1 4
<b>Pygopodidae (Legless lizards)</b>				
<i>Aprasia pulchella</i>	Western Granite Worm-lizard		Resident	1 4
<i>Delma fraseri</i>	Fraser's Delma	CS3	Resident	1 4
<i>Delma grayii</i>	Side-barred Delma	CS3	Probably absent	1 4
<i>Lialis burtonis</i>	Burton's Snake-lizard		Resident	1 4
<i>Pygopus lepidopodus</i>	Common Scaly-foot	CS3	Probably absent	1 4
<b>Agamidae (Dragons)</b>				
<i>Ctenophorus reticulatus</i>	Western Netted Dragon		Resident	1 4
<i>Moloch horridus</i>	Thorny Devil	CS3	Probably absent	1 4
<i>Pogona minor</i>	Dwarf Bearded Dragon	CS3	Resident	1 4
<b>Scincidae (Skinks)</b>				
<i>Cryptoblepharus buchanani</i>	Buchanan's Snake-eyed Skink		Resident	1 4
<i>Ctenotus pantherinus</i>	Leopard Ctenotus	CS3	Probably absent	1 4
<i>Ctenotus schomburgkii</i>	Schomburgk's Ctenotus	CS3	Probably absent	1 4
<i>Eremiascincus richardsonii</i>	Broad-banded Sand-swimmer		Resident	1 4
<i>Lerista distinguenda</i>	Dwarf Four-toed Slider		Resident	1 4
<i>Lerista gerrardii</i>	Bold-striped Robust Slider	CS3	Resident	1 4
<i>Lerista macropisthopus macropisthopus</i>	Southern Unpatterned Robust Slider	CS3	Resident	1 4
<i>Liopholis multiscutata</i>	Southern Sand-Skink	CS3	Probably absent	1 4
<i>Menetia greyii</i>	Common Dwarf Skink		Resident	1 3 4
<i>Morethia butleri</i>	Woodland Morethia Skink		Resident	1 4
<i>Morethia obscura</i>	Shrubland Morethia Skink		Resident	1 3 4
<i>Tiliqua occipitalis</i>	Western Blue-tongue	CS3	Resident	1 4
<i>Tiliqua rugosa</i>	Bobtail		Resident	1 3 4

<b>Varanidae (Monitors and goannas)</b>				
<i>Varanus gouldii</i>	Gould's Goanna	CS3	Resident	1 4
<i>Varanus tristis</i>	Black-headed Monitor		Resident	1 4
<b>Typhlopidae (Blind snakes)</b>				
<i>Anilius australis</i>	Southern Blind Snake	CS3	Resident	1 4
<i>Anilius waitii</i>	Beaked Blind Snake	CS3	Resident	1 4
<b>Elapidae (Venomous land snakes)</b>				
<i>Brachyuropsis fasciolatus</i>			Probably absent	1 4
<i>Brachyuropsis semifasciatus</i>	Southern Shovel-nosed Snake	CS3	Probably absent	1 4
<i>Demansia reticulata</i>	Yellow-faced Whip Snake	CS3	Resident	1 4
<i>Neelaps bimaculatus</i>	Black-naped Snake	CS3	Resident	1 4
<i>Pseudechis australis</i>	Mulga Snake, King Brown Snake		Resident	1 4
<i>Pseudonaja mengdeni</i>	Gwardar		Resident	1 4
<i>Pseudonaja modesta</i>	Ringed Brown Snake	CS3	Resident	1 4
<i>Simoselaps bertholdi</i>	Jan's Banded Snake		Resident	1 4
<i>Suta fasciata</i>	Rosen's Snake	CS3	Resident	1 4
<i>Suta gouldii</i>	Gould's Hooded Snake	CS3	Probably absent	1 4
<b>Casuariidae (Emus and Cassowaries)</b>				
<i>Dromaius novaehollandiae</i>	Emu	CS3	Irregular visitor	1 2 3 4
<b>Phasianidae (Pheasants and Quail)</b>				
<i>Coturnix pectoralis</i>	Stubble Quail		Regular visitor	1 2 3 4
<b>Anatidae (Ducks, Geese and Swans)</b>				
<i>Anas gracilis</i>	Grey Teal		Regular visitor	1 2 4
<i>Anas superciliosa</i>	Pacific Black Duck		Regular visitor	1 2 4
<i>Chenonetta jubata</i>	Australian Wood Duck		Regular visitor	1 2 4
<i>Spatula rhynchotis</i>	Australasian Shoveler		Regular visitor	1 2 4
<b>Podicipedidae (Grebes)</b>				
<i>Poliocephalus poliocephalus</i>	Hoary-headed Grebe		Regular visitor	1 2 4
<b>Columbidae (Pigeons and Doves)</b>				

<i>Columba livia</i>	Rock Dove/Feral Pigeon	Int	Regular visitor	1 2 4
<i>Geopelia cuneata</i>	Diamond Dove		Regular visitor	1 2 4
<i>Ocyphaps lophotes</i>	Crested Pigeon		Regular visitor	1 2 4
<i>Phaps chalcoptera</i>	Common Bronzewing	CS3	Regular visitor	1 2 3 4
<i>Phaps elegans</i>	Brush Bronzewing	CS3	Vagrant	1 2 4
<i>Spilopelia senegalensis</i>	Laughing Dove	Int	Irregular visitor	1 2 4
<i>Streptopelia chinensis</i>	Spotted Dove	Int	Irregular visitor	1 2 4
<b>Podargidae (Frogmouths)</b>				
<i>Podargus strigoides</i>	Tawny Frogmouth	CS3	Irregular visitor	1 2 4
<b>Eurostopodidae (Eared Nightjars)</b>				
<i>Eurostopodus argus</i>	Spotted Nightjar		Regular visitor	1 2 4
<b>Apodidae (Swifts and Swiftlets)</b>				
<i>Apus pacificus</i>	Fork-tailed Swift	CS1 (M, S1D2)	Regular visitor	1 2 4 5 6
<b>Cuculidae (Cuckoos)</b>				
<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	CS3	Irregular visitor	1 2 3 4
<i>Chalcites basal</i>	Horsfield's Bronze-Cuckoo	CS3	Regular visitor	1 2 4
<i>Chalcites lucidus</i>	Shining Bronze-Cuckoo	CS3	Irregular visitor	1 2 4
<i>Chalcites osculans</i>	Black-eared Cuckoo	CS3	Irregular visitor	1 2 4
<i>Heteroscenes pallidus</i>	Pallid Cuckoo	CS3	Regular visitor	1 2 4
<b>Otididae (Bustards)</b>				
<i>Ardeotis australis</i>	Australian Bustard		Irregular visitor	1 2 4
<b>Ardeidae (Herons, Egrets and Bitterns)</b>				
<i>Egretta novaehollandiae</i>	White-faced Heron		Regular visitor	1 2 3 4
<b>Charadriidae (Plovers, Dotterel and Lapwings)</b>				
<i>Vanellus tricolor</i>	Banded Lapwing		Irregular visitor	1 2 4
<b>Turnicidae (Button-quail)</b>				
<i>Turnix varius</i>	Painted Button-quail	CS3	Irregular visitor	1 2 4
<i>Turnix velox</i>	Little Button-quail		Irregular visitor	1 2 4
<b>Tytonidae (Masked Owls)</b>				



<i>Tyto alba</i>	Barn Owl		Irregular visitor	1 2 4
<b>Strigidae (Hawk-Owls)</b>				
<i>Ninox novaeseelandiae</i>	Southern Boobook	CS3	Irregular visitor	1 2 4
<b>Accipitridae (Eagles, Kites, Goshawks)</b>				
<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk	CS3	Regular visitor	1 2 4
<i>Accipiter fasciatus</i>	Brown Goshawk	CS3	Regular visitor	1 2 4
<i>Aquila audax</i>	Wedge-tailed Eagle	CS3	Regular visitor	1 2 3 4
<i>Circus approximans</i>	Swamp Harrier	CS3	Irregular visitor	1 2 4
<i>Circus assimilis</i>	Spotted Harrier	CS3	Regular visitor	1 2 4
<i>Elanus axillaris</i>	Black-shouldered Kite		Regular visitor	1 2 3 4
<i>Elanus scriptus</i>	Letter-winged Kite	CS2 (P4)	Vagrant	1 4
<i>Haliastur sphenurus</i>	Whistling Kite	CS3	Regular visitor	1 2 4
<i>Hamirostra melanosternon</i>	Black-breasted Buzzard	CS3	Irregular visitor	1 2 4
<i>Hieraaetus morphnoides</i>	Little Eagle	CS3	Irregular visitor	1 2 4
<i>Lophoictinia isura</i>	Square-tailed Kite	CS3	Irregular visitor	1 2 3 4
<i>Milvus migrans</i>	Black Kite		Vagrant	1 2 4
<b>Meropidae (Bee-eaters)</b>				
<i>Merops ornatus</i>	Rainbow Bee-eater	CS3	Regular visitor	1 2 3 4
<b>Alcedinidae (Kingfishers)</b>				
<i>Dacelo novaeguineae</i>	Laughing Kookaburra	Int	Irregular visitor	1 2 3 4
<i>Todiramphus pyrrhopygius</i>	Red-backed Kingfisher		Irregular visitor	1 2 4
<i>Todiramphus sanctus</i>	Sacred Kingfisher	CS3	Regular visitor	1 2 4
<b>Falconidae (Falcons)</b>				
<i>Falco berigora</i>	Brown Falcon		Regular visitor	1 2 4
<i>Falco cenchroides</i>	Nankeen Kestrel		Regular visitor	1 2 3 4
<i>Falco longipennis</i>	Australian Hobby		Regular visitor	1 2 3 4
<i>Falco peregrinus</i>	Peregrine Falcon	CS1 (S1D3)	Regular visitor	1 2 3 4 6
<b>Cacatuidae (Cockatoos and Corellas)</b>				
<i>Cacatua pastinator</i>	Western Corella		Regular visitor	1 2 3 4 6

<i>Cacatua sanguinea</i>	Little Corella		Regular visitor	1 2 4
<i>Cacatua tenuirostris</i>	Long-billed Corella	Int	Irregular visitor	1 2 4
<i>Calyptorhynchus banksii exconditus</i>	Inland Red-tailed Black-Cockatoo		Regular visitor	1 2 4 5
<i>Calyptorhynchus latirostris</i>	Carnaby's Black-Cockatoo	CS1 (E, S2D2)	Regular visitor	1 2 3 4 5 6
<i>Eolophus roseicapilla</i>	Galah		Resident	1 2 3 4
<i>Nymphicus hollandicus</i>	Cockatiel		Irregular visitor	1 2 4
<b>Psittaculidae (Parrots, Lorikeets and Rosellas)</b>				
<i>Barnardius zonarius</i>	Australian Ringneck		Resident	1 2 3 4
<i>Glossopsitta porphyrocephala</i>	Purple-crowned Lorikeet	CS3	Regular visitor	1 2 4
<i>Melopsittacus undulatus</i>	Budgerigar		Irregular visitor	1 2 4
<i>Neophema elegans</i>	Elegant Parrot		Irregular visitor	1 2 4
<i>Neophema splendida</i>	Scarlet-chested Parrot		Vagrant	1
<i>Neopsephotus bourkii</i>	Bourke's Parrot		Irregular visitor	1 2 4
<i>Platycercus icterotis xanthogenys</i>	Inland Western Rosella	CS2 (P4)	Irregular visitor	1 2 4 6
<i>Polytelis anthopeplus</i>	Regent Parrot		Irregular visitor	1 2 4
<i>Psephotellus varius</i>	Mulga Parrot		Irregular visitor	1 2 4
<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	Int	Irregular visitor	1 2 4
<b>Maluridae (Fairy-wrens, Emu-wrens and Grasswrens)</b>				
<i>Malurus assimilis</i>	Purple-backed Fairy-wren	CS3	Resident	1 2 3 4
<i>Malurus leucopterus</i>	White-winged Fairy-wren	CS3	Resident	1 2 4
<i>Malurus pulcherrimus</i>	Blue-breasted Fairy-wren	CS3	Resident	1 2 4
<i>Malurus splendens</i>	Splendid Fairy-wren	CS3	Resident	1 2 3 4
<b>Meliphagidae (Honeyeaters and Chats)</b>				
<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater	CS3	Regular visitor	1 2 4
<i>Acanthorhynchus superciliosus</i>	Western Spinebill	CS3	Irregular visitor	1 2 3 4
<i>Anthochaera carunculata</i>	Red Wattlebird	CS3	Irregular visitor	1 2 3 4
<i>Anthochaera lunulata</i>	Western Wattlebird	CS3	Irregular visitor	1 2 3 4
<i>Certhionyx variegatus</i>	Pied Honeyeater		Irregular visitor	1 2 4
<i>Epthianura albifrons</i>	White-fronted Chat		Regular visitor	1 2 4

<i>Epthianura aurifrons</i>	Orange Chat		Irregular visitor	1
<i>Epthianura tricolor</i>	Crimson Chat		Irregular visitor	1 2 4
<i>Gavicalis virescens</i>	Singing Honeyeater		Resident	1 2 3 4
<i>Glyciphila melanops</i>	Tawny-crowned Honeyeater	CS3	Irregular visitor	1 2 4
<i>Lichmera indistincta</i>	Brown Honeyeater		Regular visitor	1 2 3 4
<i>Manorina flavigula</i>	Yellow-throated Miner	CS3	Resident	1 2 3 4
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater	CS3	Irregular visitor	1 2 4
<i>Nesoptilotis leucotis</i>	White-eared Honeyeater	CS3	Vagrant	1 2 4
<i>Phylidonyris niger</i>	White-cheeked Honeyeater	CS3	Irregular visitor	1 2 3 4
<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater	CS3	Irregular visitor	1 2 3 4
<i>Ptilotula ornata</i>	Yellow-plumed Honeyeater	CS3	Regular visitor	1 2 4
<i>Purnella albifrons</i>	White-fronted Honeyeater	CS3	Irregular visitor	1 2 4
<i>Sugomel niger</i>	Black Honeyeater		Irregular visitor	1 2 4
<b>Pardalotidae (Pardalotes)</b>				
<i>Pardalotus punctatus</i>	Spotted Pardalote	CS3	Irregular visitor	1 2 4
<i>Pardalotus striatus</i>	Striated Pardalote	CS3	Regular visitor	1 2 3 4
<b>Acanthizidae (Thornbills and Gerygones)</b>				
<i>Acanthiza apicalis</i>	Inland Thornbill	CS3	Resident	1 2 3 4
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	CS3	Resident	1 2 3 4
<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill	CS3	Resident	1 2 4
<i>Aphelocephala leucopsis</i>	Southern Whiteface	CS3	Irregular visitor	1 2 4
<i>Calamanthus montanellus</i>	Western Fieldwren		Irregular visitor	1
<i>Gerygone fusca</i>	Western Gerygone	CS3	Regular visitor	1 2 3 4
<i>Sericornis frontalis</i>	White-browed Scrubwren	CS3	Irregular visitor	1 2 3 4
<i>Smicrornis brevirostris</i>	Weebill	CS3	Resident	1 2 3 4
<b>Pomatostomidae (Babblers)</b>				
<i>Pomatostomus superciliosus</i>	White-browed Babbler	CS3	Regular visitor	1 2 4
<b>Neosittidae (Sittellas)</b>				
<i>Daphoenositta chrysoptera</i>	Varied Sittella	CS3	Irregular visitor	1 2 4



<b>Oreoicidae (Australo-Papuan Bellbirds)</b>					
<i>Oreoica gutturalis</i>	Crested Bellbird	CS3	Regular visitor	1 2 4	
<b>Cinclosomatidae (Quail-thrushes)</b>					
<i>Cinclosoma clarum</i>	Copperback Quail-thrush	CS3	Irregular visitor	1	
<b>Pachycephalidae (Whistlers, Shrike-thrushes and allies)</b>					
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	CS3	Irregular visitor	1 2 3 4	
<i>Pachycephala fuliginosa</i>	Western Whistler	CS3	Irregular visitor	1 2 3 4	
<i>Pachycephala rufiventris</i>	Rufous Whistler	CS3	Resident	1 2 3 4	
<b>Psophodidae (Wedgebills)</b>					
<i>Psophodes occidentalis</i>	Chiming Wedgebill	CS3	Irregular visitor	2	
<b>Campephagidae (Cuckoo-shrikes and Trillers)</b>					
<i>Coracina maxima</i>	Ground Cuckoo-shrike		Vagrant	1 2 4	
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike		Regular visitor	1 2 3 4	
<i>Lalage tricolor</i>	White-winged Triller		Regular visitor	1 2 4	
<b>Artamidae (Woodswallows, Currawongs, Butcherbirds and Magpie)</b>					
<i>Artamus cinereus</i>	Black-faced Woodswallow		Resident	1 2 3 4	
<i>Artamus cyanopterus</i>	Dusky Woodswallow		Irregular visitor	1 2 4	
<i>Artamus minor</i>	Little Woodswallow		Irregular visitor	1 2 4	
<i>Artamus personatus</i>	Masked Woodswallow		Vagrant	1 2 4	
<i>Cracticus nigrogularis</i>	Pied Butcherbird		Resident	1 2 3 4	
<i>Cracticus torquatus</i>	Grey Butcherbird	CS3	Resident	1 2 3 4	
<i>Gymnorhina tibicen</i>	Australian Magpie		Resident	1 2 3 4	
<i>Strepera versicolor</i>	Grey Currawong	CS3	Irregular visitor	1 2 4	
<b>Rhipiduridae (Fantails)</b>					
<i>Rhipidura albiscapa</i>	Grey Fantail	CS3	Regular visitor	1 2 3 4	
<i>Rhipidura leucophrys</i>	Willie Wagtail		Resident	1 2 3 4	
<b>Monarchidae (Monarch and Flycatchers)</b>					
<i>Grallina cyanoleuca</i>	Magpie-lark		Regular visitor	1 2 3 4	
<i>Myiagra inquieta</i>	Restless Flycatcher	CS3	Vagrant	1 2 4	

**Corvidae (Crows and Ravens)**

<i>Corvus bennetti</i>	Little Crow		Irregular visitor	1 2 4
<i>Corvus coronoides</i>	Australian Raven		Resident	1 2 3 4
<i>Corvus orru</i>	Torresian Crow		Irregular visitor	2

**Petroicidae (Australian Robins)**

<i>Eopsaltria griseogularis</i>	Western Yellow Robin	CS3	Irregular visitor	1 2 4
<i>Melanodryas cucullata</i>	Hooded Robin	CS3	Irregular visitor	1 2 4
<i>Microeca fascians</i>	Jacky Winter	CS3	Irregular visitor	1 2 3 4
<i>Petroica boodang</i>	Scarlet Robin	CS3	Vagrant	1 2 3 4
<i>Petroica goodenovii</i>	Red-capped Robin	CS3	Resident	1 2 4

**Aegothelidae (Owlet-nightjars)**

<i>Aegotheles cristatus</i>	Australian Owlet-nightjar	CS3	Irregular visitor	1 2 4
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**Locustellidae (Grassbirds)**

<i>Cincloramphus cruralis</i>	Brown Songlark		Regular visitor	1 2 3 4
<i>Cincloramphus mathewsi</i>	Rufous Songlark		Regular visitor	1 2 4

**Hirundinidae (Swallows and Martins)**

<i>Cheramoeca leucosterna</i>	White-backed Swallow		Regular visitor	1 2 4
<i>Petrochelidon ariel</i>	Fairy Martin		Irregular visitor	1 2 4
<i>Petrochelidon nigricans</i>	Tree Martin		Regular visitor	1 2 3 4
<i>Hirundo neoxena</i>	Welcome Swallow		Regular visitor	1 2 3 4

**Zosteropidae (White-eyes)**

<i>Zosterops lateralis</i>	Silvereye		Regular visitor	1 2 3 4
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**Dicaeidae (Flowerpeckers)**

<i>Dicaeum hirundinaceum</i>	Mistletoebird	CS3	Regular visitor	1 2 3 4
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**Estrildidae (Munias)**

<i>Taeniopygia guttata</i>	Zebra Finch		Regular visitor	1 2 4
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**Motacillidae (Pipits and Wagtails)**

<i>Anthus novaeseelandiae</i>	Australasian Pipit		Resident	1 2 3 4
<i>Motacilla cinerea</i>	Grey Wagtail	CS1 (M, S1D2)	Vagrant	2 5

<b>Tachyglossidae (Echidnas)</b>					
<i>Tachyglossus aculeatus acanthion</i>	Short-beaked Echidna	CS3	Probably absent	1 3 4	
<b>Dasyuridae (Dasyurids)</b>					
<i>Sminthopsis crassicaudata</i>	Fat-tailed Dunnart	CS3	Regular visitor	1 4	
<b>Burramyidae (Pygmy-possums)</b>					
<i>Cercartetus concinnus</i>	Western Pygmy-possum	CS3	Irregular visitor	1 4	
<b>Phalangeridae (Brushtail possums)</b>					
<i>Trichosurus vulpecula</i>	Brushtail Possum	CS3	Irregular visitor	1 3 4	
<b>Macropodidae (Kangaroos)</b>					
<i>Macropus fuliginosus melanops</i>	Western Grey Kangaroo		Resident	1 3 4	
<i>Osphranter robustus</i>	Euro		Irregular visitor	1 4	
<b>Muridae (Rats and mice)</b>					
<i>Mus musculus</i>	House Mouse	Int	Resident	1 4	
<i>Rattus norvegicus</i>	Brown Rat	Int	Vagrant	4	
<i>Rattus rattus</i>	Black Rat	Int	Regular visitor	1 4	
<b>Leporidae (Rabbits and hares)</b>					
<i>Oryctolagus cuniculus</i>	Rabbit	Int	Resident	1 3 4	
<b>Molossidae (Freetail bats)</b>					
<i>Austronomus australis</i>	White-striped Free-tailed Bat		Regular visitor	1 4	
<i>Ozimops kitcheneri</i>	South-western Free-tailed Bat		Irregular visitor	1 4	
<b>Vespertilionidae (Vespertilionid bats)</b>					
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat		Regular visitor	1 4	
<i>Chalinolobus morio</i>	Chocolate Wattled Bat		Regular visitor	1 4	
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	CS3	Regular visitor	1 4	
<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat	CS3	Irregular visitor	1 4	
<b>Canidae (Dogs)</b>					
<i>Vulpes vulpes</i>	Red Fox	Int	Resident	1 3 4	
<b>Felidae (Cats)</b>					
<i>Felis catus</i>	Cat	Int	Resident	1 3 4	



## Appendix 5. Species recorded in the field investigations.

Species Name	Common Name
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike
<i>Colluricincla harmonica</i>	Grey Shrike-thrush
<i>Lichenostomus virescens</i>	Singing Honeyeater
<i>Purnella albifrons</i>	White-faced Honeyeater
<i>Anthus novaeseelandiae</i>	Australasian Pipit
<i>Artamus cinereus</i>	Black-faced Woodswallow
<i>Columba livia</i>	Rock Dove
<i>Ocyphaps lophotes</i>	Crested Pigeon
<i>Anthochaera carunculata</i>	Red Wattlebird
<i>Eolophus roseicapilla</i>	Galah
<i>Barnardius zonarius</i>	Australian Ringneck
<i>Falco peregrinus</i>	Peregrine Falcon
<i>Falco cenchroides</i>	Nankeen Kestrel
<i>Rhipidura leucophrys</i>	Willie Wagtail
<i>Cacatua sanguinea</i>	Little Corella
<i>Petrochelidon nigricans</i>	Tree Martin
<i>Pachycephala rufiventris</i>	Rufous Whistler
<i>Melopsittacus undulatus</i>	Budgerigar

## Appendix 6. Species returned from the literature review and database search that have been omitted from the expected species list because they are extinct or considered locally extinct.

Status codes: CS1, CS2, CS3 = (summary) levels of conservation significance. See Appendix 1 for full explanation.

EPBC Act listings: CR = Critically Endangered, E = Endangered, V = Vulnerable, M = Migratory, Mar = Marine (see Appendix 2).

Biodiversity Conservation Act 2016 listings: S1 to S3 = Schedules 1 to 3, D1 to D3 = Divisions 1 to 3 (see Appendix 2).

DBCA Priority species: P1 to P4 = Priority 1 to 4 (see Appendix 2).

Int = introduced species.

See Section 2.3.4 for explanation of expected occurrence categories.

Sources: 1 = Atlas of Living Australia, 2 = Birddata, 3 = previous fauna surveys/reports, 4 = Naturemap, 5 = Protected Matters Search Tool, 6 = DBCA threatened and priority fauna search, 7 = general literature

Species Name	Common name	Status	Expected Occurrence	Source
<b>Scincidae (Skinks)</b>				
<i>Egernia stokesii badia</i>	Western Spiny-tailed Skink	CS1 (E, S2D3)	Locally extinct	1 4 5 6
<b>Pythonidae (Pythons)</b>				
<i>Antaresia childreni</i>	Children's Python		Locally extinct	1
<i>Aspidites ramsayi</i>	Woma	CS2 (P1)	Locally extinct	1 4 6
<i>Morelia spilota imbricata</i>	SW Carpet Python		Locally extinct	1 4
<b>Megapodiidae (Mallefowl)</b>				
<i>Leipoa ocellata</i>	Malleefowl	CS1(V, S2D3)	Locally extinct	1 2 4 5 6
<b>Burhinidae (Stone-curlews)</b>				
<i>Burhinus grallarius</i>	Bush Stone-curlew		Locally extinct	1 2 4
<b>Tytonidae (Masked Owls)</b>				
<i>Tyto novaehollandiae</i>	Masked Owl	CS2 (P3)	Locally extinct	1 4 6
<b>Strigidae (Hawk-Owls)</b>				
<i>Ninox connivens</i>	Barking Owl	CS2 (P3)	Locally extinct	1 4 6
<b>Cacatuidae (Cockatoos and Corellas)</b>				
<i>Cacatua leadbeateri</i>	Major Mitchell's Cockatoo		Locally extinct	1 2 4
<b>Climacteridae (Treecreepers)</b>				
<i>Climacteris rufus</i>	Rufous Treecreeper		Locally extinct	1 2 3 4
<b>Maluridae (Fairy-wrens, Emu-wrens and Grasswrens)</b>				

Species Name	Common name	Status	Expected Occurrence	Source
<i>Amytornis textilis</i>	Western Grasswren		Locally extinct	7
<i>Stipiturus malachurus</i>	Southern Emu-wren		Locally extinct	1
<b>Acanthizidae (Thornbills and Gerygones)</b>				
<i>Acanthiza inornata</i>	Western Thornbill		Locally extinct	1 2 3 4
<i>Calamanthus cautus</i>	Shy Heathwren		Locally extinct	1 2 4
<i>Pyrholaemus brunneus</i>	Redthroat		Locally extinct	1 2 4
<b>Falcunculidae (Shrike-tits)</b>				
<i>Falcunculus frontatus</i>	Crested Shrike-tit		Locally extinct	1 2 4
<b>Pachycephalidae (Whistlers, Shrike-thrushes and allies)</b>				
<i>Pachycephala inornata</i>	Gilbert's Whistler		Locally extinct	1 2 4
<b>Psophodidae (Whipbirds)</b>				
<i>Psophodes nigrogularis nigrogularis</i>	Western Whipbird	CS1 (E, S2D2)	locally extinct	1 4 6
<i>Psophodes nigrogularis oberon</i>	Western Whipbird	CS2 (P4)	locally extinct	1 4
<b>Petroicidae (Australian Robins)</b>				
<i>Drymodes brunneopygia</i>	Southern Scrub-robin		Locally extinct	1 2 4
<b>Dasyuridae (Dasyurids)</b>				
<i>Antechinomys laniger</i>	Kultarr		Locally extinct	1 4
<i>Parantechinus apicalis</i>	Dibbler	CS1 (E, S2D2)	Locally extinct	
<i>Dasyurus geoffroii</i>	Chuditch	CS1 (V, S2D3)	Locally extinct	1 4 5 6
<i>Phascogale calura</i>	Red-tailed Phascogale	CS1 (V, S1D1)	Locally extinct	4 5 6
<i>Phascogale tapoatafa wambenger</i>	South-western Brush-tailed Phascogale	CS1 (S1D1)	Locally extinct	1 4 6
<i>Sminthopsis dolichura</i>	Little Long-tailed Dunnart		Locally extinct	1 4
<i>Sminthopsis fuliginosus</i>	Dusky Dunnart		Locally extinct	1
<i>Sminthopsis gilberti</i>	Gilbert's Dunnart		Locally extinct	1 4
<i>Sminthopsis granulipes</i>	White-tailed Dunnart		Locally extinct	1 4
<b>Myrmecobiidae (Numbats)</b>				
<i>Myrmecobius fasciatus</i>	Numbat	CS1 (E, S2D2)	Locally extinct	1 4 5 6
<b>Chaeropodidae (Pig-footed Bandicoots)</b>				



Species Name	Common name	Status	Expected Occurrence	Source
<i>Chaeropus ecaudatus</i>	Southern Pig-footed Bandicoot	CS1 (Ex, S3)	Extinct	4 6
<b>Peramelidae (Bandicoots)</b>				
<i>Isodon fusciventer</i>	Quenda	CS2 (P4)	Locally extinct	1 4 6
<i>Perameles bougainville</i>	Western Barred Bandicoot	CS1 (Ex, S3)	Extinct	4
<i>Perameles eremiana</i>	Desert Bandicoot	CS1 (Ex, S3)	Extinct	4
<b>Thylacomyidae (Bilbies)</b>				
<i>Macrotis lagotis</i>	Greater Bilby	CS1 (V, S2D3)	Locally extinct	1 4 6
<i>Macrotis leucura</i>	Lesser Bilby	CS1 (Ex, S3)	Extinct	4
<b>Pseudocheiridae (Ringtail possums)</b>				
<i>Pseudocheirus occidentalis</i>	Western Ringtail Possum	CS1 (CR, S2D1)	Locally extinct	4
<b>Tarsipedidae (Honey Possum)</b>				
<i>Tarsipes rostratus</i>	Honey Possum, Noolbenger		Locally extinct	1 4
<b>Potoroidae (Potoroos and Bettongs)</b>				
<i>Bettongia penicillata ogilbyi</i>	Woylie	CS1 (E, S2D1)	Locally extinct	1 4 5 6
<i>Bettongia lesueur graii</i>	Burrowing Bettong, Boodie	CS1 (Ex, S3)	Extinct	4 6
<i>Potorous platyops</i>	Broad-faced Potoroo	CS1 (Ex, S3)	Extinct	4
<b>Macropodidae (Kangaroos)</b>				
<i>Notamacropus irma</i>	Brush Wallaby	CS2 (P4)	Locally extinct	1 4
<i>Petrogale lateralis</i>	Black-footed Rock-Wallaby	CS1 (E, S2D2)	Locally extinct	1 4 5 6
<i>Lagostrophus fasciatus</i>	Banded Hare-Wallaby	CS1 (V, S2D3)	Locally extinct	4 6
<i>Notamacropus eugenii</i>	Tammar Wallaby	CS2 (P4)	Locally extinct	4 6
<i>Onychogalea lunata</i>	Crescent Nail-tail Wallaby	CS1 (Ex, S3)	Extinct	4 6
<i>Setonix brachyurus</i>	Quokka	CS1 (V, S2D3)	Locally extinct	1 4 5
<b>Muridae (Rats and mice)</b>				
<i>Notomys mitchellii</i>	Mitchell's Hopping-Mouse		Locally extinct	1 4
<i>Pseudomys albocinereus</i>	Ash-grey Mouse		Locally extinct	1 4
<i>Pseudomys bolami</i>	Bolam's Mouse		Locally extinct	4
<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse		Locally extinct	1 4
<i>Pseudomys occidentalis</i>	Western Mouse	CS2 (P4)	Locally extinct	4 6

Species Name	Common name	Status	Expected Occurrence	Source
<i>Rattus fuscipes fuscipes</i>	Western Bush Rat, Moodit		Locally extinct	1 4
<i>Leporillus apicalis</i>	Lesser Stick-nest Rat	CS1 (Ex, S3)	Extinct	4
<i>Notomys amplus</i>	Short-Tailed Hopping-Mouse	CS1 (Ex, S3)	Extinct	4
<i>Notomys longicaudatus</i>	Long-tailed Hopping-Mouse	CS1 (Ex, S3)	Extinct	4 6
<i>Notomys macrotis</i>	Big-eared Hopping-Mouse	CS1 (Ex, S3)	Extinct	4 6
<i>Rattus tunneyi</i>	Pale Field-Rat		Locally extinct	4
<b>Vespertilionidae (Vespertilionid bats)</b>				
<i>Nyctophilus major tor</i>	Central Long-eared Bat	CS2 (P3)	Locally extinct	1 4
<b>Canidae (Dogs)</b>				
<i>Canis lupus dingo</i>	Dingo		Locally extinct	4

## Appendix 7. Species returned from the literature review that have been omitted from the expected species list because of habitat or range limitations, or because they are domesticated species.

Note that some birds could still occur as extremely rare vagrants.

Sources: 1 = Atlas of Living Australia, 2 = Birddata, 3 = previous fauna surveys/reports, 4 = Naturemap, 5 = Protected Matters Search Tool, 6 = DBCA threatened and priority fauna search, 7 = general literature

Latin name	Common name	Reason for omitting	Source
<i>Leptatherina wallacei</i>	Western Hardyhead	No suitable habitat	1 4
<i>Cetorhinus maximus</i>	Basking Shark	Out of range	4
<i>Carassius auratus</i>	Goldfish	No suitable habitat	1 4
<i>Galaxias occidentalis</i>	Western Galaxias	No suitable habitat	1 4
<i>Galaxiella munda</i>	Western Mud Minnow	Out of range	4 6
<i>Pseudogobius olorum</i>	Bluespot Goby	Out of range	1 4
<i>Bostockia porosa</i>	Nightfish	Out of range	1 4
<i>Nannatherina balstoni</i>	Balston's Pygmy perch	Out of range	5
<i>Gambusia holbrooki</i>	Mosquitofish	No suitable habitat	1
<i>Leiopotherapon unicolor</i>	Spangled Perch	Out of range	1 4
<i>Litoria adelaidensis</i>	Slender Tree Frog	No suitable habitat	1 4
<i>Heleioporus barycragus</i>	Western Marsh Frog	Out of range	1 4
<i>Heleioporus inornatus</i>	Plains Frog	Out of range	1 4
<i>Heleioporus psammophilus</i>	Sand Frog	Out of range	1 4
<i>Neobatrachus albipes</i>	White-footed Frog	Out of range	1 4
<i>Neobatrachus kunapalari</i>	Kunapalari Frog	Out of range	1 4
<i>Neobatrachus sutor</i>	Shoemaker Frog	Out of range	1 4
<i>Crinia georgiana</i>	Tschudi's Froglet	Out of range	1 4
<i>Crinia glauerti</i>	Glauert's Froglet	Out of range	1 4
<i>Geocrinia lea</i>	Lea's Frog	Out of range	1
<i>Pseudophryne occidentalis</i>	Orange-crowned Toadlet	Out of range	1 4
<i>Chelodina oblonga</i>	South-Western Long-necked Tortoise	No suitable habitat	1 4



Latin name	Common name	Reason for omitting	Source
<i>Pseudemydura umbrina</i>	Western Swamp Tortoise	Out of range	6
<i>Nephurus vertebralis</i>	Midline Knob-tail Gecko	Out of range	1 4
<i>Diplodactylus alboguttatus</i>	White-spotted Ground Gecko	Out of range	4
<i>Diplodactylus calcicolus</i>	South Coast Gecko	Out of range	1 4
<i>Diplodactylus lateroides</i>	Speckled Stone Gecko	Out of range	1 4
<i>Diplodactylus polyophthalmus</i>	Spotted Sandplain Gecko	Out of range	4
<i>Lucasium maini</i>	Main's Ground Gecko	Out of range	1 4
<i>Hemidactylus frenatus</i>	House Gecko	Out of range	1
<i>Aprasia repens</i>	Southwestern Sandplain Worm Lizard	Out of range	1 4
<i>Delma australis</i>	Marble-faced Delma	Out of range	1 4
<i>Pygopus nigriceps</i>	Western Hooded Scaly-foot	Out of range	1 4
<i>Ctenophorus cristatus</i>	Crested Dragon	Out of range	1 4
<i>Ctenophorus isolepis</i>	Military Dragon	Out of range	1 4
<i>Ctenophorus maculatus</i>	Spotted Military Dragon	Out of range	1 4
<i>Ctenophorus ornatus</i>	Ornate Dragon	No suitable habitat	1 4
<i>Ctenophorus salinarum</i>	Claypan Dragon	No suitable habitat	1 4
<i>Ctenophorus scutulatus</i>	Lozenge-marked Dragon	Out of range	1 4
<i>Acritoscincus trilineatus</i>	Western Three-lined Skink	No suitable habitat	1 4
<i>Cryptoblepharus plagiocephalus</i>	Peron's Snake-eyed Skink	Out of range	1 4
<i>Ctenotus atlas</i>	Southern Mallee Ctenotus	Out of range	1 4
<i>Ctenotus australis</i>	Western Limestone Ctenotus	Out of range	1
<i>Ctenotus delli</i>	Darling Range South-west Ctenotus	Out of range	1 4 6
<i>Ctenotus fallens</i>	West-coast Ctenotus	Out of range	4
<i>Ctenotus impar</i>	Odd-striped Ctenotus	Out of range	1 4
<i>Ctenotus inornatus</i>	Bar-shouldered Ctenotus	Out of range	1
<i>Ctenotus leonhardii</i>	Leonhardi's Ctenotus	Out of range	1 4
<i>Ctenotus mimetes</i>	Checker-sided Ctenotus	Out of range	1 4
<i>Ctenotus uber</i>	Rich Ctenotus	Out of range	1 4
<i>Cyclodomorphus melanops</i>	Mallee Slender Blue-tongue Lizard	Out of range	1 4

Latin name	Common name	Reason for omitting	Source
<i>Egernia depressa</i>	Pygmy Spiny-tailed Skink	Out of range	1 4
<i>Egernia kingii</i>	King's Skink	Out of range	1 4
<i>Egernia napoleonis</i>	South-western Crevice-skink	Out of range	1 4
<i>Hemiergis initialis</i>	Southwestern Earless Skink	Out of range	1 4
<i>Lampropholis delicata</i>	Dark-flecked Garden Sunskink	Out of range	1
<i>Lampropholis guichenoti</i>	Pale-flecked Garden Sunskink	Out of range	1
<i>Lerista elegans</i>	Elegant Slider	Out of range	1 4
<i>Lerista kingi</i>	King's Slider	Out of range	1 4
<i>Lerista lineopunctulata</i>	Dotted-line Robust Slider	Out of range	4
<i>Lerista muelleri</i>	Wood Mulch-slider	Out of range	1 4
<i>Liopholis inornata</i>	Desert Skink	Out of range	1 4
<i>Liopholis pulchra</i>	South-western Rock-Skink	Out of range	1 4
<i>Morethia lineoocellata</i>	West Coast Morethia Skink	Out of range	1 3 4
<i>Anilius bicolor</i>	Dark-spined Blind Snake	Out of range	1 4
<i>Anilius bituberculatus</i>	Prong-snouted Blind Snake	Out of range	1 4
<i>Anilius hamatus</i>	Pale-headed Blind Snake	Out of range	1 4
<i>Anilius pinguis</i>	Fat Blind Snake	Out of range	1 4
<i>Echiopsis curta</i>	Bardick	Out of range	1 4
<i>Furina ornata</i>	Orange-naped Snake	Out of range	1 4
<i>Neelaps calonotus</i>	Black-striped Burrowing Snake	Out of range	1 4 6
<i>Notechis scutatus</i>	Tiger Snake	Out of range	1 4
<i>Pseudonaja affinis</i>	Dugite	Out of range	1 4
<i>Pseudonaja nuchalis</i>	Northern Brown Snake	Out of range	1 4
<i>Suta monachus</i>	Monk Snake	Out of range	1 4
<i>Suta nigriceps</i>	Mitchell's Short-tailed Snake	Out of range	1 4
<i>Numida meleagris</i>	Helmeted Guineafowl	Domestic	1 2
<i>Gallus gallus</i>	Feral Chicken	Domestic	1 4
<i>Pavo cristatus</i>	Indian Peafowl	Domestic	1 2 4
<i>Synoicus ypsilophorus</i>	Brown Quail	Out of range	1 2 4

Latin name	Common name	Reason for omitting	Source
<i>Anas castanea</i>	Chestnut Teal	No suitable habitat	1 2 4
<i>Anas platyrhynchos</i>	Northern Mallard	Out of range	1 2 4
<i>Anser anser</i>	Greylag Goose	Out of range	2
<i>Aythya australis</i>	Hardhead	No suitable habitat	1 2 4
<i>Biziura lobata</i>	Musk Duck	No suitable habitat	1 2 4
<i>Cairina moschata</i>	Muscovy Duck	No suitable habitat	2
<i>Cygnus atratus</i>	Black Swan	No suitable habitat	1 2 4
<i>Cygnus olor</i>	Mute Swan	Out of range	1 4
<i>Dendrocygna arcuata</i>	Wandering Whistling-Duck	Out of range	1 2 4
<i>Malacorhynchus membranaceus</i>	Pink-eared Duck	No suitable habitat	1 2 4
<i>Nettapus pulchellus</i>	Green Pygmy-Goose	Out of range	1
<i>Oxyura australis</i>	Blue-billed Duck	No suitable habitat	1 2 4 6
<i>Radjah radjah</i>	Radjah Shelduck	Out of range	2
<i>Stictonetta naevosa</i>	Freckled Duck	No suitable habitat	1 2 4
<i>Tadorna tadornoides</i>	Australian Shelduck	No suitable habitat	1 2 4
<i>Anseranas semipalmata</i>	Magpie Goose	Out of range	4
<i>Podiceps cristatus</i>	Great Crested Grebe	No suitable habitat	1 2 4
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe	No suitable habitat	1 2 4
<i>Fulica atra</i>	Eurasian Coot	No suitable habitat	1 2 4
<i>Gallinula tenebrosa</i>	Dusky Moorhen	No suitable habitat	1 2 4
<i>Hypotaenidia philippensis</i>	Buff-banded Rail	No suitable habitat	1 2 4
<i>Porphyrio porphyrio</i>	Purple Swamphen	No suitable habitat	1 2 4
<i>Porzana fluminea</i>	Australian Spotted Crake	No suitable habitat	1 2 4
<i>Tribonyx ventralis</i>	Black-tailed Native-hen	No suitable habitat	1 2 4
<i>Zapornia pusilla</i>	Baillon's Crake	No suitable habitat	1 2 4
<i>Zapornia tabuensis</i>	Spotless Crake	No suitable habitat	1 2 4



Latin name	Common name	Reason for omitting	Source
<i>Tribonyx mortierii</i>	Tasmanian Native-hen	Out of range	1
<i>Grus rubicunda</i>	Brolga	Out of range	1
<i>Pterodroma mollis</i>	Soft-plumaged Petrel	No suitable habitat	1 4
<i>Pterodroma macroptera</i>	Great-winged Petrel	No suitable habitat	1 4
<i>Puffinus huttoni</i>	Hutton's Shearwater	No suitable habitat	1 2 4
<i>Platalea flavipes</i>	Yellow-billed Spoonbill	No suitable habitat	1 2 4
<i>Platalea regia</i>	Royal Spoonbill	No suitable habitat	1 2 4
<i>Plegadis falcinellus</i>	Glossy Ibis	No suitable habitat	1 2 4 6
<i>Threskiornis moluccus</i>	Australian White Ibis	No suitable habitat	1 2 4
<i>Threskiornis spinicollis</i>	Straw-necked Ibis	No suitable habitat	1 2 3 4
<i>Ardea alba</i>	Great Egret	No suitable habitat	1 2 4
<i>Ardea intermedia</i>	Intermediate Egret	Out of range	1 2 4
<i>Ardea pacifica</i>	White-necked Heron	No suitable habitat	1 2 4
<i>Botaurus poiciloptilus</i>	Australasian Bittern	Out of range	1
<i>Bubulcus ibis</i>	Cattle Egret	No suitable habitat	1
<i>Egretta garzetta</i>	Little Egret	No suitable habitat	1 2 4
<i>Egretta sacra</i>	Eastern Reef Egret	No suitable habitat	
<i>Ixobrychus dubius</i>	Australian Little Bittern	No suitable habitat	1 4 6
<i>Ixobrychus flavicollis australis</i>	Black Bittern (southwest subpop.)	No suitable habitat	6
<i>Nycticorax caledonicus</i>	Nankeen Night-Heron	No suitable habitat	1 2 4
<i>Pelecanus conspicillatus</i>	Australian Pelican	No suitable habitat	1 2 4
<i>Microcarbo melanoleucos</i>	Little Pied Cormorant	No suitable habitat	1 2 4
<i>Phalacrocorax carbo</i>	Great Cormorant	No suitable habitat	1 2 4
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant	No suitable habitat	1 2 4
<i>Phalacrocorax varius</i>	Pied Cormorant	No suitable habitat	1 2 4
<i>Anhinga novaehollandiae</i>	Australasian Darter	No suitable habitat	1 2 4

Latin name	Common name	Reason for omitting	Source
<i>Cladorhynchus leucocephalus</i>	Banded Stilt	No suitable habitat	1 2 4
<i>Himantopus leucocephalus</i>	Pied Stilt	No suitable habitat	1 2 4
<i>Recurvirostra novaehollandiae</i>	Red-necked Avocet	No suitable habitat	1 2 4
<i>Charadrius australis</i>	Inland Dotterel	No suitable habitat	1 2 4
<i>Charadrius leschenaultii</i>	Greater Sand Plover	No suitable habitat	1
<i>Charadrius ruficapillus</i>	Red-capped Plover	No suitable habitat	1 2 4
<i>Elseyornis melanops</i>	Black-fronted Dotterel	No suitable habitat	1 2 4
<i>Erythronyx cinctus</i>	Red-kneed Dotterel	No suitable habitat	1 2 4
<i>Pluvialis fulva</i>	Pacific Golden Plover	No suitable habitat	1
<i>Thinornis cucullatus</i>	Hooded Plover	No suitable habitat	1 2 4 6
<i>Vanellus miles</i>	Masked Plover	Out of range	1
<i>Rostratula australis</i>	Australian Painted Snipe	No suitable habitat	1 2 4 5 6
<i>Actitis hypoleucos</i>	Common Sandpiper	No suitable habitat	1 2 4 5 6
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	No suitable habitat	1 2 4 5 6
<i>Calidris ferruginea</i>	Curlew Sandpiper	No suitable habitat	1 2 4 5 6
<i>Calidris melanotos</i>	Pectoral Sandpiper	No suitable habitat	5 6
<i>Calidris ruficollis</i>	Red-necked Stint	No suitable habitat	1 2 4 5 6
<i>Calidris subminuta</i>	Long-toed Stint	No suitable habitat	6
<i>Numenius madagascariensis</i>	Eastern Curlew	No suitable habitat	1 5
<i>Tringa glareola</i>	Wood Sandpiper	No suitable habitat	1 2 4 6
<i>Tringa nebularia</i>	Common Greenshank	No suitable habitat	1 2 4 5 6
<i>Limosa limosa</i>	Black-tailed Godwit	No suitable habitat	6
<i>Chlidonias hybrida</i>	Whiskered Tern	No suitable habitat	1 2 4
<i>Chlidonias leucopterus</i>	White-winged Tern	No suitable habitat	1
<i>Chroicocephalus novaehollandiae</i>	Silver Gull	No suitable habitat	1 2 4
<i>Gelochelidon nilotica</i>	Gull-billed Tern	No suitable habitat	1 4 6
<i>Hydroprogne caspia</i>	Caspian Tern	No suitable habitat	1 6
<i>Onychoprion anaethetus</i>	Bridled Tern	No suitable habitat	1

Latin name	Common name	Reason for omitting	Source
<i>Sternula nereis</i>	Fairy Tern	No suitable habitat	1
<i>Thalasseus bergii</i>	Crested Tern	No suitable habitat	1
<i>Pandion cristatus</i>	Eastern Osprey	No suitable habitat	5
<i>Haliaeetus leucogaster</i>	White-bellied Sea-Eagle	No suitable habitat	1
<i>Accipiter novaehollandiae</i>	Grey Goshawk	Out of range	4
<i>Aviceda subcristata</i>	Pacific Baza	Out of range	4
<i>Dacelo leachii</i>	Blue-winged Kookaburra	Out of range	1 4
<i>Alcedo azurea</i>	Azure Kingfisher	Out of range	4
<i>Todiramphus chloris</i>	Collared Kingfisher	Out of range	5
<i>Falco hypoleucos</i>	Grey Falcon	Out of range	1 5
<i>Falco subniger</i>	Black Falcon	Out of range	1
<i>Cacatua galerita</i>	Sulphur-crested Cockatoo	Out of range	1 2
<i>Calyptorhynchus banksii naso</i>	Forest Red-tailed Black-Cockatoo	Out of range	1 2 4 5 6
<i>Calyptorhynchus baudinii</i>	Baudin's Black-Cockatoo	Out of range	1 2 4 5 6
<i>Neophema chrysostoma</i>	Blue-winged Parrot	Out of range	1
<i>Neophema petrophila</i>	Rock Parrot	Out of range	1
<i>Pezoporus flaviventris</i>	Western Ground Parrot	Out of range	4 5 6
<i>Psephotus haematonotus</i>	Red-rumped Parrot	Out of range	1
<i>Purpureicephalus spurius</i>	Red-capped Parrot	Out of range	1 2 4
<i>Platycercus eximius</i>	Eastern Rosella	Out of range	1
<i>Ptilonorhynchus guttatus</i>	Western Bowerbird	Out of range	1 2
<i>Malurus elegans</i>	Red-winged Fairy-wren	Out of range	1 2
<i>Lichenostomus cratitius</i>	Purple-gaped Honeyeater	Out of range	1
<i>Melithreptus affinis</i>	Black-headed Honeyeater	Out of range	1
<i>Melithreptus chloropsis</i>	Gilbert's Honeyeater	Out of range	1 2 4
<i>Melithreptus gularis</i>	Black-chinned Honeyeater	Out of range	1
<i>Ptilotula penicillata</i>	White-plumed Honeyeater	Out of range	1
<i>Ptilotula plumula</i>	Grey-fronted Honeyeater	Out of range	1



Latin name	Common name	Reason for omitting	Source
<i>Acanthiza iredalei</i>	Slender-billed Thornbill	Out of range	1
<i>Acanthiza pusilla</i>	Brown Thornbill	Out of range	1
<i>Acanthiza robustirostris</i>	Slaty-backed Thornbill	Out of range	1 2
<i>Aphelocephala nigricincta</i>	Banded Whiteface	Out of range	4
<i>Gerygone levigaster</i>	Mangrove Gerygone	Out of range	4
<i>Gerygone magnirostris</i>	Large-billed Gerygone	Out of range	4
<i>Gerygone olivacea</i>	White-throated Gerygone	Out of range	4
<i>Gerygone tenebrosa</i>	Dusky Gerygone	Out of range	4
<i>Cinclosoma castanotus</i>	Chestnut Quail-thrush	Out of range	1 2 4
<i>Artamus superciliosus</i>	White-browed Woodswallow	Out of range	1
<i>Paradisaea raggiana</i>	Kumul	Out of range	4
<i>Quoyornis georgianus</i>	White-breasted Robin	Out of range	1 2 4
<i>Petroica multicolor</i>	Norfolk Island Robin	Out of range	1 4
<i>Acrocephalus australis</i>	Australian Reed-Warbler	No suitable habitat	1 2 4
<i>Poodytes gramineus</i>	Little Grassbird	No suitable habitat	1 2 4
<i>Turdus merula</i>	Common Blackbird	Out of range	1
<i>Chloebia gouldiae</i>	Gouldian Finch	Out of range	1
<i>Neochmia temporalis</i>	Red-browed Finch	Out of range	1
<i>Stagonopleura oculata</i>	Red-eared Firetail	Out of range	1
<i>Serinus serinus</i>	Serin	Out of range	4
<i>Sminthopsis murina</i>	Common Dunnart	Out of range	1 4
<i>Isodon auratus</i>	Golden Bandicoot	Out of range	4
<i>Isodon macrourus</i>	Northern Brown Bandicoot	Out of range	4
<i>Notoryctes caurinus</i>	Northern Marsupial-mole	Out of range	4
<i>Notoryctes typhlops</i>	Southern Marsupial-mole	Out of range	4
<i>Lasiorhinus latifrons</i>	Southern Hairy-nosed Wombat	Out of range	4
<i>Petaurus breviceps</i>	Sugar Glider	Out of range	4
<i>Petropseudes dahli</i>	Rock Ringtail	Out of range	4

Latin name	Common name	Reason for omitting	Source
<i>Potorous gilbertii</i>	Gilbert's Potoroo	Out of range	4
<i>Osphranter rufus</i>	Red Kangaroo	Out of range	1 4
<i>Petrogale penicillata</i>	Brush-tailed Rock-Wallaby	Out of range	1
<i>Petrogale rothschildi</i>	Rothschild's Rock-Wallaby	Out of range	4
<i>Hydromys chrysogaster</i>	Water-rat, Rakali	No suitable habitat	1 4 6
<i>Notomys alexis</i>	Spinifex Hopping-Mouse	Out of range	4
<i>Pseudomys desertor</i>	Desert Mouse	Out of range	4
<i>Rattus villosissimus</i>	Long-haired Rat	Out of range	4
<i>Conilurus penicillatus</i>	Brush-tailed Rabbit-Rat	Out of range	4
<i>Leggadina forresti</i>	Forrest's Mouse	Out of range	4
<i>Leggadina lakedownensis</i>	Lakeland Downs Mouse	Out of range	4
<i>Melomys burtoni</i>	Grasslands Melomys	Out of range	4
<i>Mesembriomys macrurus</i>	Golden-Backed Tree-Rat	Out of range	4
<i>Notomys fuscus</i>	Dusky Hopping-Mouse	Out of range	4
<i>Pseudomys australis</i>	Plains Mouse	Out of range	4
<i>Pseudomys chapmani</i>	Western Pebble-mound Mouse	Out of range	4
<i>Pseudomys delicatulus</i>	Delicate Mouse	Out of range	4
<i>Pseudomys fieldi</i>	Shark Bay Mouse	Out of range	4
<i>Pseudomys laborifex</i>	Kimberley Mouse	Out of range	4
<i>Pseudomys nanus</i>	Western Chestnut Mouse	Out of range	4
<i>Pseudomys shortridgei</i>	Heath Mouse	Out of range	4
<i>Rattus exulans</i>	Polynesian Rat	Out of range	4
<i>Zyzomys pedunculatus</i>	Central Rock-Rat	Out of range	4
<i>Zyzomys woodwardi</i>	Kimberley Rock-Rat	Out of range	4
<i>Pteropus alecto</i>	Black Flying-fox	Out of range	4
<i>Pteropus scapulatus</i>	Little Red Flying-fox	Out of range	1 4
<i>Macroglossus minimus</i>	Northern Blossom Bat	Out of range	4
<i>Hipposideros ater</i>	Dusky Leaf-nosed Bat	Out of range	4

Latin name	Common name	Reason for omitting	Source
<i>Hipposideros stenotis</i>	Northern Leaf-nosed Bat	Out of range	4
<i>Rhinonictes aurantia</i>	Orange Leaf-nosed Bat	Out of range	4
<i>Macroderma gigas</i>	Ghost Bat	Out of range	4
<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tailed Bat	Out of range	4
<i>Taphozous georgianus</i>	Common Sheath-tailed Bat	Out of range	4
<i>Taphozous hilli</i>	Hill's Sheath-Tailed Bat	Out of range	4
<i>Chaerephon jobensis</i>	Greater Northern Free-tailed Bat	Out of range	4
<i>Ozimops beccarii</i>	Beccari's Free-tailed Bat	Out of range	4
<i>Ozimops lorae</i>	Little Northern Free-tailed Bat	Out of range	4
<i>Ozimops planiceps</i>	South-eastern Freetail Bat	Out of range	4
<i>Miniopterus schreibersii</i>	Southern Bent-wing Bat	Out of range	4
<i>Chalinolobus nigrogriseus</i>	Hoary Wattled Bat	Out of range	4
<i>Falsistrellus mackenziei</i>	Western False-Pipistrelle	Out of range	4 6
<i>Nyctophilus holtorum</i>	Holt's Long-eared Bat	Out of range	4
<i>Vespadelus baverstocki</i>	Inland Forest Bat	Out of range	4
<i>Vespadelus finlaysoni</i>	Finlayson's Cave Bat	Out of range	4
<i>Vespadelus regulus</i>	Southern Forest Bat	Out of range	1 4
<i>Myotis moluccarum</i>	Arafura Large-footed Bat	Out of range	4
<i>Nyctophilus bifax</i>	Eastern Long-eared Bat	Out of range	4
<i>Nyctophilus timoriensis</i>	South-eastern Long-eared Bat	Out of range	4
<i>Nyctophilus walkeri</i>	Pygmy Long-eared Bat	Out of range	4
<i>Vespadelus douglasorum</i>	Yellow-lipped Cave Bat	Out of range	4
<i>Neophoca cinerea</i>	Australian Sea Lion	Out of range	4
<i>Arctocephalus forsteri</i>	New Zealand Fur-seal	Out of range	4
<i>Arctocephalus tropicalis</i>	Subantarctic Fur Seal	Out of range	4
<i>Lobodon carcinophaga</i>	Crabeater Seal	Out of range	4
<i>Canis lupus familiaris</i>	Common Dog	Domestic	1
<i>Equus asinus</i>	Donkey	Out of range	4



Latin name	Common name	Reason for omitting	Source
<i>Equus caballus</i>	Horse	Domestic	4
<i>Sus scrofa</i>	Pig	Domestic	1 4
<i>Camelus dromedarius</i>	Dromedary, Camel	Out of range	4
<i>Bos taurus</i>	European Cattle	Domestic	4
<i>Capra hircus</i>	Goat	Domestic	1 4
<i>Ovis aries</i>	Sheep	Domestic	1 4
<i>Cervus elaphus</i>	Red Deer	Out of range	4
<i>Dama dama</i>	Fallow Deer	Out of range	5

## Appendix 8. Excluded conservation significant invertebrate fauna species.

Status codes:

CS1, CS2, CS3 = (summary) levels of conservation significance. See Appendix 1 for full explanation.

EPBC Act listings: CR = Critically Endangered, E = Endangered, VU = Vulnerable, M = Migratory, Mar = Marine (see Appendix 2).

Biodiversity Conservation Act 2016 listings: S1 to S3 = Schedules 1 to 3, D1 to D3 = Divisions 1 to 3 (see Appendix 2).

DBCA Priority species: P1 to P4 = Priority 1 to 4 (see Appendix 2).

Sources: 1 = Atlas of Living Australia, 2 = Birddata, 3 = previous fauna surveys/reports, 4 = Naturemap, 5 = Protected Matters Search Tool, 6 = DBCA threatened and priority fauna search, 7 = general literature, WB = DBCA threatened and priority fauna list for Wheatbelt region.

Species Name	Common Name	Status	Reason for excluding	Source
<b>Insecta (Insects)</b>				
<i>Ixalodectes flectocercus</i>	cricket	CS2 (P3)	Out of range	4 6 WB
<i>Throscodectes xederoides</i>	Mogumber bush cricket, Northern Throsco	CS2 (P3)	Out of range	6 WB
<i>Ogyris subterrestris</i>	Arid Bronze Azure Butterfly	CS1 (CR, S2D1)	Out of range	4 5 6 WB
<i>Hylaeus globuliferus</i>	woolybush bee	CS2 (P3)	Out of range	WB
<b>Arachnida (Spiders and Scorpions)</b>				
<i>Idiosoma dandaragan</i>	Dandaragan Plateau shield-backed trapdoor spider	CS2 (P2)	Out of range	4 6 WB
<i>Idiosoma formosum</i>	Ornate Shield-backed Trapdoor Spider	CS1 (S2)	Out of range	1 4 6
<i>Idiosoma intermedium</i>	Coolgardie Shield-backed Trapdoor Spider	CS2 (P3)	Out of range	1 4 6
<i>Idiosoma kopejtkorum</i>	Lake Goorly Shield-backed Trapdoor Spider	CS1 (S2)	Out of range	1 4 6 WB
<i>Idiosoma kwongan</i>	Kwongan heath shield-backed trapdoor spider	CS2 (P1)	Out of range	WB
<i>Idiosoma mcclementsorum</i>	Julimar Shield-backed Trapdoor Spider	CS2 (P2)	Out of range	1 4 6 WB
<i>Idiosoma mcnamarai</i>	Central-eastern Wheatbelt Shield-backed Trapdoor Spider	CS2 (P1)	Out of range	1 4 6 WB
<i>Idiosoma schoknechtorum</i>	Mortlock River Shield-backed Trapdoor Spider	CS2 (P3)	Out of range	1 4 6
<i>Idiosoma sigillatum</i>	Swan Coastal Plain Shield-backed Trapdoor Spider	CS2 (P3)	Out of range	4
<i>Kwonkan eboracum</i>	Yorkrakine Trapdoor Spider	CS1 (S2D1)	Out of range	4 6 WB
<i>Teyl</i> sp. (MYG693)	Minnivale trapdoor spider	CS1 (S2D1)	Out of range	4 6 WB
<i>Bertmainius monachus</i>	Talyuberlup pygmy trapdoor spider	CS1 (S2D2)	Out of range	WB
<b>Mollusca (Snails and bivalves)</b>				
<i>Bothriembryon praecelsus</i>	land snail	CS1 (S3)	Listed as extinct	4 6 WB
<i>Bothriembryon bradshawi</i>	Bradshaw's bothriembryontid land snail (Tambellup)	CS2 (P3)	Out of range	WB

Species Name	Common Name	Status	Reason for excluding	Source
<i>Glacidorbis occidentalis</i>	freshwater snail	CS2 (P3)	Out of range	4 6
<i>Westralunio carteri</i>	Carter's Freshwater Mussel	CS1 (VU, S2D3)	Out of range	4 5 6 WB
<b>Branchiopoda (Freshwater shrimp)</b>				
<i>Daphnia jollyi</i>	water flea	CS2 (P1)	No habitat	1 4 6 WB
<i>Parartemia contracta</i>	brine shrimp	CS2 (P1)	No habitat	4 6 WB
<i>Branchinella basispina</i>	a fairy shrimp (Balladonia-Norseman)	CS2 (P3)	Out of range	WB
<i>Branchinella simplex</i>	a fairy shrimp (inland WA)	CS2 (P1)	Out of range	WB



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## **APPENDIX 5**

### **REVEGETATION MANAGEMENT PLAN (CBH 2025)**

# Revegetation Management Plan

Ballidu Revegetation Site

Authorities					
STORE ID	STORE-310043234-202380	Parent Doc.			Version 1.0
Division	Operations	Department	Environment	Function	Approvals
Owner	Maya Dillon	Approver	Andrew Black	Custodian	Andrew Black
Reviewed	28/07/2025	Approved	28/07/2025	Published	N/A
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Version	Date	Reviewer	Position	Change
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## **1. INTRODUCTION**

### **1.1. Background**

Established in 1933, CBH is Australia's largest co-operative and a leader in the Australian grains industry. It is a Western Australian (WA) based grain storage and handling organisation, with operations extending along the value chain from fertilizer to grain storage, handling, transport, marketing and processing. Owned and controlled by approximately 3,500 WA grain growing businesses, the core purpose of CBH is to sustainably create and return value to both current and future growers. The CBH storage and handling system is world class and currently receives and exports around 90% of the WA grain harvest through a network of more than 130 grain receival sites and 4 export terminals.

CBH has total assets with a replacement value of approximately \$6.5 billion and employs approximately 1,100 permanent employees and up to 1,800 casual employees during the harvest period from October through to January. To meet its strategic objectives, CBH's storage capacity must be expanded at strategically chosen sites that meets the pace and innovation of growers and investment to increase out-bound supply chain capacity via out-loading infrastructure, rail siding upgrades and rail lines.

The Ballidu Grain Receival Site (Ballidu site; Figure 1) has been identified in the CBH Network Strategy as a primary (important) site of the future, and for expansion within the CBH Operations Network Plan.

The proposed expansion of the Ballidu site is required to cater for the growing quantities of grain receivals around the Ballidu region and surrounding catchments, which is driven by improved cropping and farming techniques, and higher yielding seed varieties being planted by WA growers. In addition to operational, financial, grower and logistical considerations when identifying expansion options under its Operations Network Plan, CBH seeks to build or expand sites in proximity to regional towns and communities built around the original grain receival site. This contributes to the longevity of rural communities by employing local and regional residents and attracting customers for local businesses during the out-loading of grain and peak harvest receival periods, whilst also reducing the need for employees to travel significant distances following long shifts. As such, the options explored for Ballidu were focused on locations proximate to the local community and the existing CBH receival site.

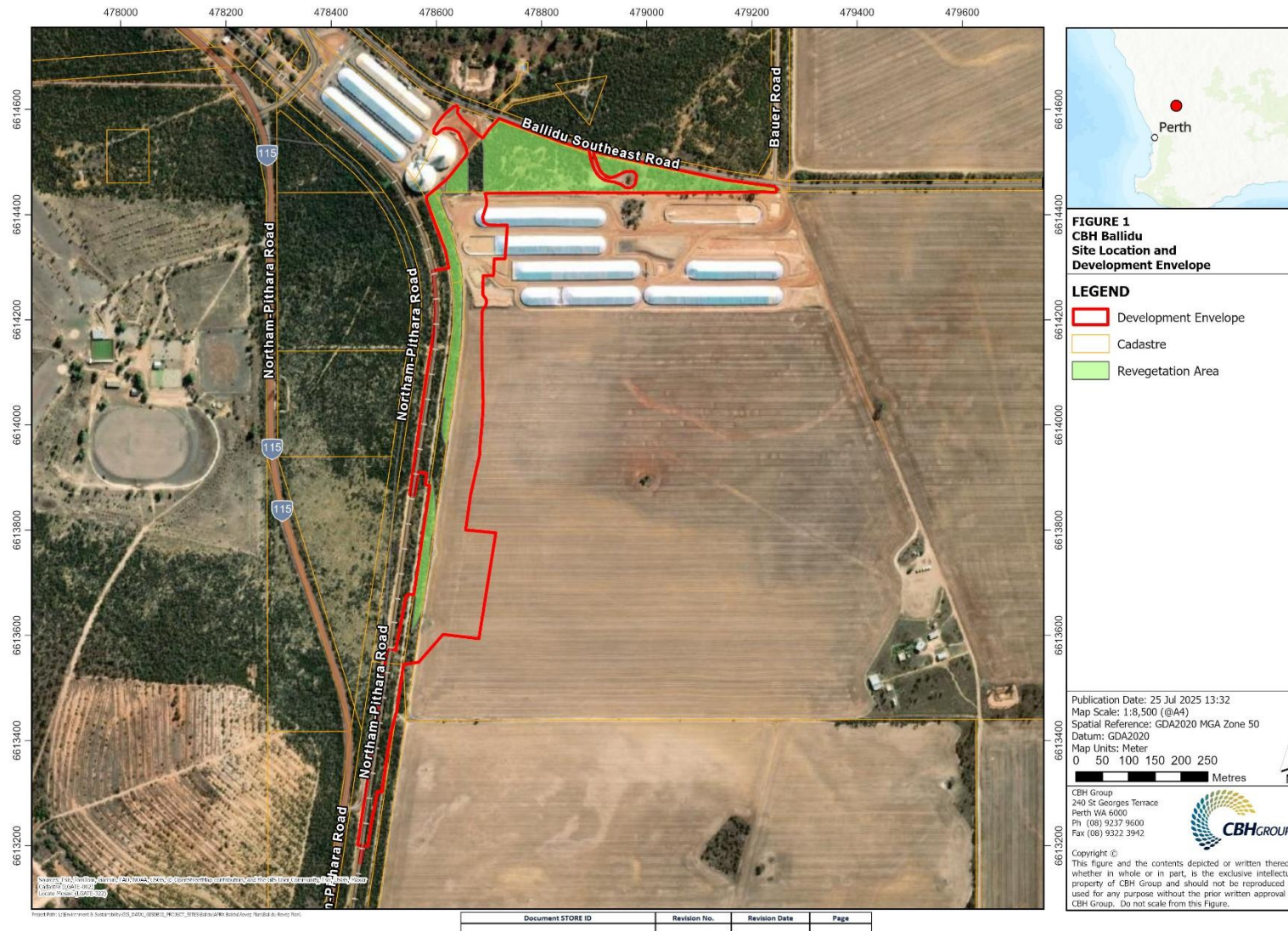
### **1.2. Purpose and Scope**

The purpose of this Revegetation Management Plan (the Plan) is to describe the processes CBH will implement for revegetating (re-establishing) and rehabilitating (improving) native vegetation communities at the Ballidu site.

This document has been prepared to meet the requirements of the Department of Water and Environmental Regulation's (DWER) 'A Guide to Preparing Revegetation Plans for Clearing Permits' (DWER 2018) (the Guidelines) and is supported by information from ecological studies and investigations of the Ballidu site. As such, the Plan includes:

- An outline of the revegetation and rehabilitation commitments for the site
- Relevant background information about the area proposed to be cleared
- Relevant information collected from reference survey sites
- Completion criteria and progress targets
- Approaches and procedures for the revegetation and rehabilitation activities
- A follow-up monitoring and management program.





**Figure 1: Location and layout of the Ballidu site**

### 1.3. Revegetation and Rehabilitation Commitments

To support its application to clear 2.20 ha of remnant native vegetation to support the expansion of its Ballidu site, CBH will implement the following revegetation and rehabilitation activities to ensure that the clearing does not result in a significant residual impact to the environment and its values:

1. Revegetating 1.43 ha of cleared land and 0.03 ha of Completely Degraded with endemic vegetation of similar floristic composition and structure to the existing native vegetation of the site that is in Good condition or better.
2. Rehabilitating 0.57 ha of Degraded and 3.18 ha of Good condition vegetation to an improved level of Good and Very Good condition, respectively.
3. Managing, monitoring and maintaining the Revegetation Area over a minimum period of 10 years, including restricting access and controlling invasive weeds.

CBH will ensure the activities are planned and/or conducted by appropriately qualified and experienced personnel.

### 1.4. Clearing Overview

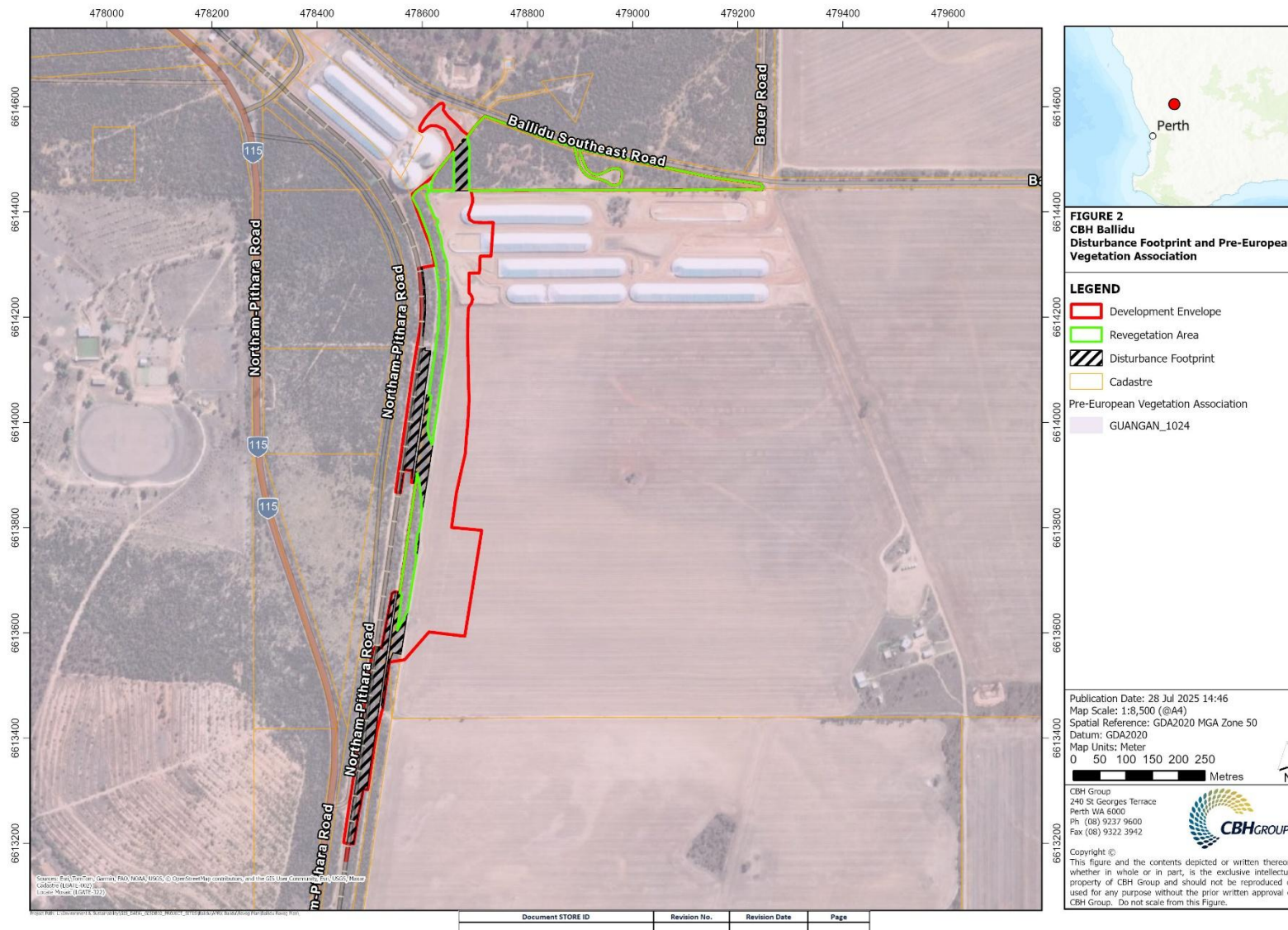
The Ballidu site is located within the townsite of Ballidu in the Shire of Wongan-Ballidu and occupies part of Lot 27<sup>1</sup> on Deposited Plan 425196, which is owned by CBH. The proposed site upgrades will largely consist of a new/extended rail siding, loadout facility and additional wheat bins. These upgrades will require the clearing of up to 2.20 ha of remnant vegetation, which is described in Table 1 and shown in Figure 2.

**Table 1: Key environmental values of vegetation to be cleared**

Aspect	Details
Total Area	2.20 ha
IBRA Region	Avon Wheatbelt
Vegetation Association	Guangan 1024 (Shrublands; mallee & casuarina thicket), with 11.45% remaining in IBRA Region
Vegetation Condition	0.62 ha Very Good; 1.55 ha Good; and 0.03 Degraded condition
Vegetation Type/s (AECOM 2023)	<b>McGdWa Tall Shrubland</b> <i>Melaleuca conothamnoides</i> , <i>Allocasuarina campestris</i> and <i>Grevillea paradoxa</i> tall shrubland over <i>Gahnia drummondii</i> low to tall open sedgeland over <i>Waitzia acuminata</i> var <i>acuminata</i> , <i>Trachymene pilosa</i> and <i>Platysace trachymenioides</i> low sparse forbland.
Vegetation values	Not representative of any Threatened or priority ecological community. Vegetation along rail corridor provides continuous habitat for flora. Vegetation is part of a remnant in an area that has been extensively cleared.
Flora values	Vegetation type is habitat for <i>Acacia lirellata</i> subsp. <i>Compressa</i> (Priority 2) and <i>Grevillea rosieri</i> (Priority 2), but none found within clearing area.
Fauna values	Vegetation includes approximately 1.78 ha of potential foraging habitat for Carnaby's black cockatoo (no birds or evidence of their presence was observed, and site is on extreme edge of their range). Vegetation along rail corridor provides continuous habitat for fauna.
Other values	The vegetation is not associated with surface or groundwater resources, nor with any conservation areas.

<sup>1</sup> Lot 27 now includes part of the (former) railway reserve Land ID Number 3124108.





**Figure 2: Ballidu clearing application area (Disturbance Footprint)**

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Version 1.0



## 2. DETAILS OF THE REVEGETATION AREA

### 2.1. Land Details

The area in which the proposed revegetation and rehabilitation activities (the Revegetation Area) will be undertaken is shown in **Figure 3** and its land details are described in Table 2.

**Table 2: Land details of the Revegetation Area**

Aspect	Details
Property details	Lot 27 on Deposited Plan 425196 Lot P Road- Land ID 3768559
Shire	Wongan-Ballidu
Size of Revegetation Area	5.21 ha (including 3.87 ha of remnant vegetation)
Ownership and vesting	Lot 27 owned by CBH. Affected part of local road (Land ID 3768559) will be accessed under agreement with Shire of Wongan-Ballidu.
Zoning and tenure	Lot 27 is freehold land, zoned Rural.
Access and works agreement details	Lot 27 and some part of local road is owned by CBH with further section of the local road will be acquired by CBH and negotiation is under way.

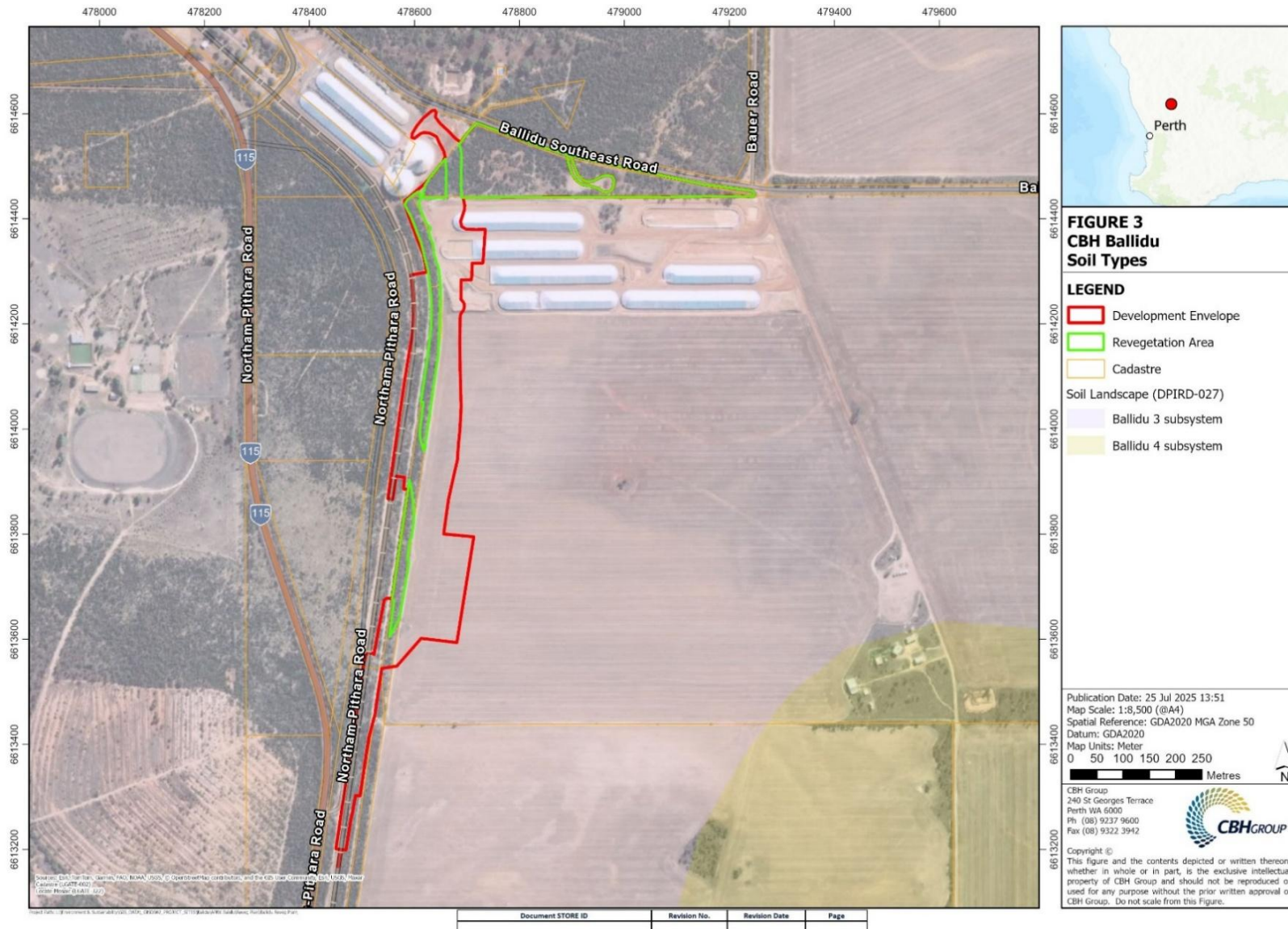
### 2.2. Relevant Studies and Plans

CBH has commissioned a number of baseline assessments of the flora, vegetation and fauna conservation values of the Ballidu site, which have been instrumental in the development of this plan:

- Bamford Consulting Ecologists 2024: *CBH Ballidu Level 1 Fauna Assessment, Black Cockatoo and Targeted Trapdoor Spider Assessment*.
- AECOM Australia Pty Ltd 2023: *Ballidu – Flora and Vegetation Assessment*.

CBH has also reviewed publicly available revegetation plans and guidelines applicable to the central and northern wheatbelt regions, such as:

- *Wheatbelt Restoration Standards*, The Western Australian Biodiversity Science Institute, 2025
- *Waddington-Wongan Hills Rd Offset Site Revegetation Plan* (CPS 8506/1), Shire of Wongan-Ballidu, 2020
- *Native Revegetation Guide for the Moore River Catchment*, Moore River Catchment Council, 2018
- *Revegetation Guide by Soil Type for the Central and Eastern Wheatbelt*, S. Fry and T. Hobbs, 2014
- *Revegetation Guide to the Central Wheatbelt*, Department of Agriculture and Food, and CSIRO, 1991



**Figure 3: CBH Ballidu soil types**

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### 2.3. Bioregional Setting

The Revegetation Area is located within the Avon Wheatbelt (AVW) Interim Biogeographical Regionalisation for Australia (IBRA) Bioregion and the Merredin (AVW01) subregion (Department of Climate Change, Energy, the Environment and Water 2024a).

### 2.4. Topography, Landform and Soils

The Revegetation Area lies at elevation 300 mAHD within the Ballidu 3 Subsystem, which is characterised by undulating plain, crests and upper slopes from weathered granite (DPIRD 2022). Soils of this subsystem are mainly loamy gravel, yellow deep sand, sandy and loamy earth, red shallow loamy duplex, or sandy loamy duplex. Soils of the Revegetation Area are described by AECOM (2023) as flat, hard yellow orange clay loams, with some sandy clay areas in the eastern side.

### 2.5. Drainage

The Revegetation Area does not lie within any Public Drinking Water Source areas (Department of Water and Environmental Regulation [DWER] 2023). There are no wetlands or waterways located within the Revegetation Area.

### 2.6. Vegetation and Flora

#### 2.6.1. Vegetation Cover and Condition

The AECOM (2023) survey of the 5.21 ha Revegetation Area recorded that 1.46 ha was totally cleared or in Completely Degraded condition. The remaining vegetation is either in Degraded (0.57 ha) or Good (3.18 ha) condition (Figure 4).

#### 2.6.2. Disturbance History

The Revegetation Area has been partially cleared for vehicle tracks including laydown areas for historical roadworks. A groundwater bore maintained by the Wongan-Ballidu Shire Council sits within the Revegetation Area but has been excised from it so as to allow ongoing use. Two small concrete pads (likely old shed floors) are also present, indicating the site may have been used more intensively in the past.

#### 2.6.3. Vegetation Associations

The entire Revegetation Area has been mapped as Guangan 1024 (AECOM 2023), which is the same Vegetation Association as the clearing area.

#### 2.6.4. Site Vegetation Types

The three native vegetation types that were described and mapped within the Revegetation Area by AECOM (2023) are described in Table 3 and shown in Representative photos of the three vegetation types provided as Plates 1 – 3.

**Table 3: Site vegetation types remaining within the Revegetation Area**

Veg Type	Description	Diversity	Extent
McGdWa Tall Shrubland	<i>Melaleuca conothamnoides</i> , <i>Allocasuarina campestris</i> and <i>Grevillea paradoxa</i> tall shrubland over <i>Gahnia drummondii</i> low to tall open sedgeland over <i>Waitzia acuminata</i> var. <i>acuminata</i> , <i>Trachymene pilosa</i> and <i>Platysace trachymenioides</i> low sparse forbland recorded on hard yellow orange clay loam soils	48 native species.	2.77 ha
EwMhAs Open Mallee Woodland	<i>Eucalyptus wubinensis</i> , <i>Eucalyptus moderata</i> and <i>Acacia yorkkrakensis</i> subsp. <i>acrita</i> mid open woodland over <i>Melaleuca hamata</i> , <i>Acacia mackeyana</i> and <i>Acacia acutaria</i> tall to low open shrubland over <i>Austrostipa scabra</i> , <i>*Pentamerisairoides</i> and <i>Waitzia acuminata</i> var. <i>acuminata</i> tall to low mixed sparse grass and forbland recorded on flats with sandy clay soils.	20 native and 1 weed species	0.93 ha
AcDr Shrubland	<i>Allocasuarina campestris</i> , <i>Hakea meisneriana</i> and <i>Melaleuca conothamnoides</i> tall shrubland over <i>Dianella revoluta</i> , <i>Pimelea imbricata</i> var. <i>piligera</i> and <i>Ricinocarpos undulatus</i> low sparse forbland representing dense overstorey over sparse understorey on flats with gravel brown soils	28 native and 1 weed species	0.10 ha



Veg Type	Description	Diversity	Extent
Trees	<i>Eucalyptus moderata</i> saplings, with no understorey.	1 native species	0.07 ha

### 2.6.5. Conservation Significant Flora

#### *Acacia scalena* (DBCA Priority 3)

Two individuals were recorded in two locations within the Revegetation Area, both within the McGdWa Tall Shrubland.

#### *Acacia lirellata* subsp. *compressa* (DBCA Priority 2)

One individual was recorded within the Revegetation Area. The individual in the Revegetation Area was recorded in the vegetation type McGdWa, however, majority of the individuals recorded in the wider site survey occur on yellow sandplains associated with AcBs Open Heathland.



**Plate 1: Vegetation community McGdWa (AECOM survey site 10)**



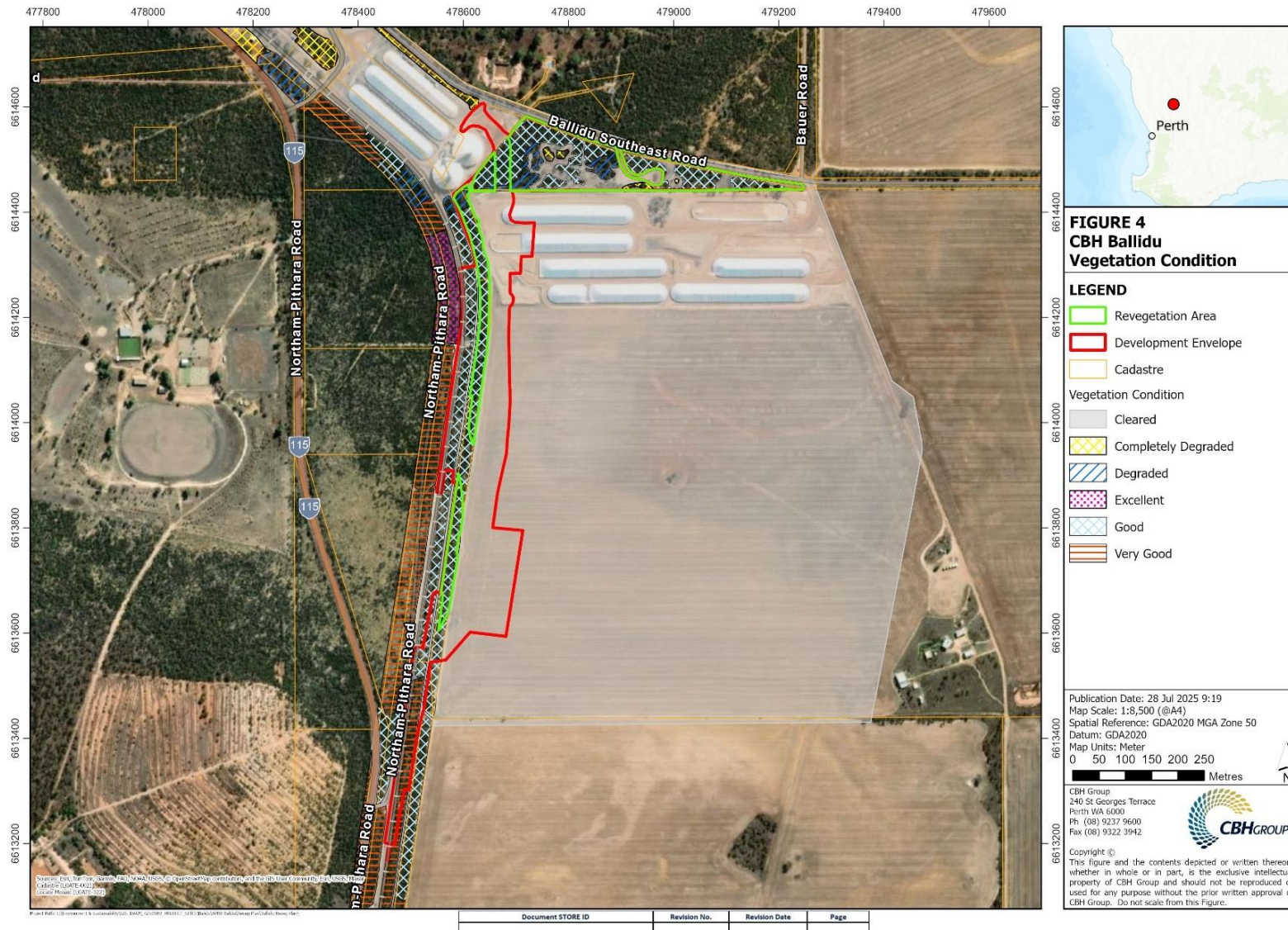


**Plate 2: Vegetation community EwMhAs (AECOM survey site 11)**



**Plate 3: Vegetation community AcDr (AECOM survey site 12)**





**Figure 4: CBH Ballidu vegetation condition**



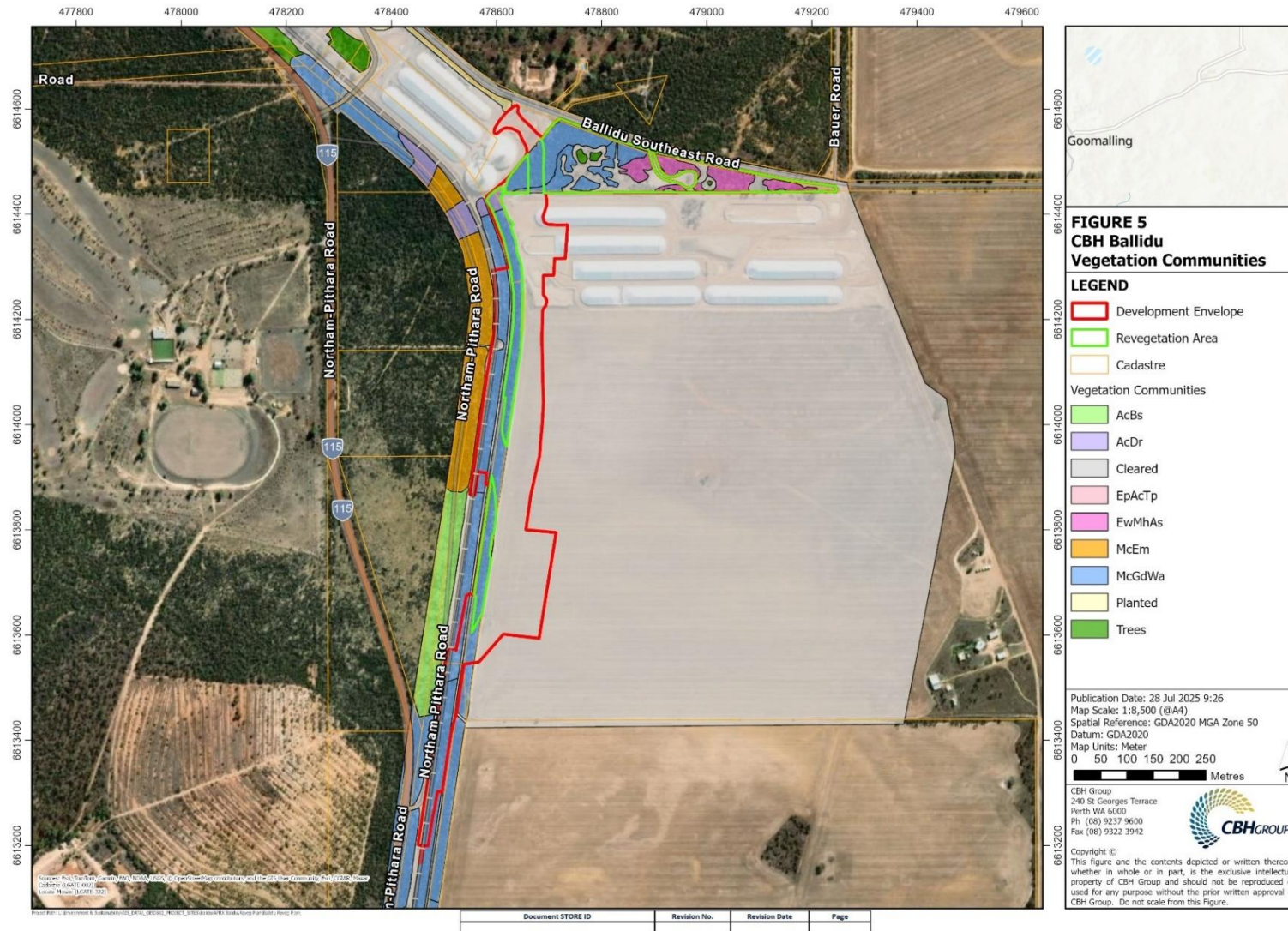


Figure 5: CBH Ballidu vegetation communities

## 2.7. Fauna Values

### 2.7.1. Fauna Habitats

The fauna assessment (Bamford Consulting Ecologists 2024) described and mapped two types of fauna habitat (as vegetation/substrate associations or VSAs) within the Revegetation Area. These are shown in Figure 6 and summarised in Table 4.

**Table 4: Vegetation-Substrate Associations within the Revegetation Area**

VSA	Broad Description	Key Habitat Values	Extent
VSA2	Complex shrubland.	Numerous Proteaceae species that provide foraging resources for Black Cockatoo and many other native vertebrate fauna and insects. Dense mid-storey favoured by birds.	4.21 ha
VSA3	Eucalypt open woodland.	May contain potential breeding trees for Black Cockatoo and other conservation significant fauna. Low foraging resources compared to VSA2.	0.81 ha

### 2.7.2. Conservation Significant Fauna

#### Carnaby's Black Cockatoo

The fauna assessment (BCE 2024) identified that the Revegetation Area may provide suitable foraging and roosting/breeding habitat for Carnaby's black cockatoo (Table 5), but noted that no black cockatoo or secondary evidence of utilization of the site were observed during the survey.

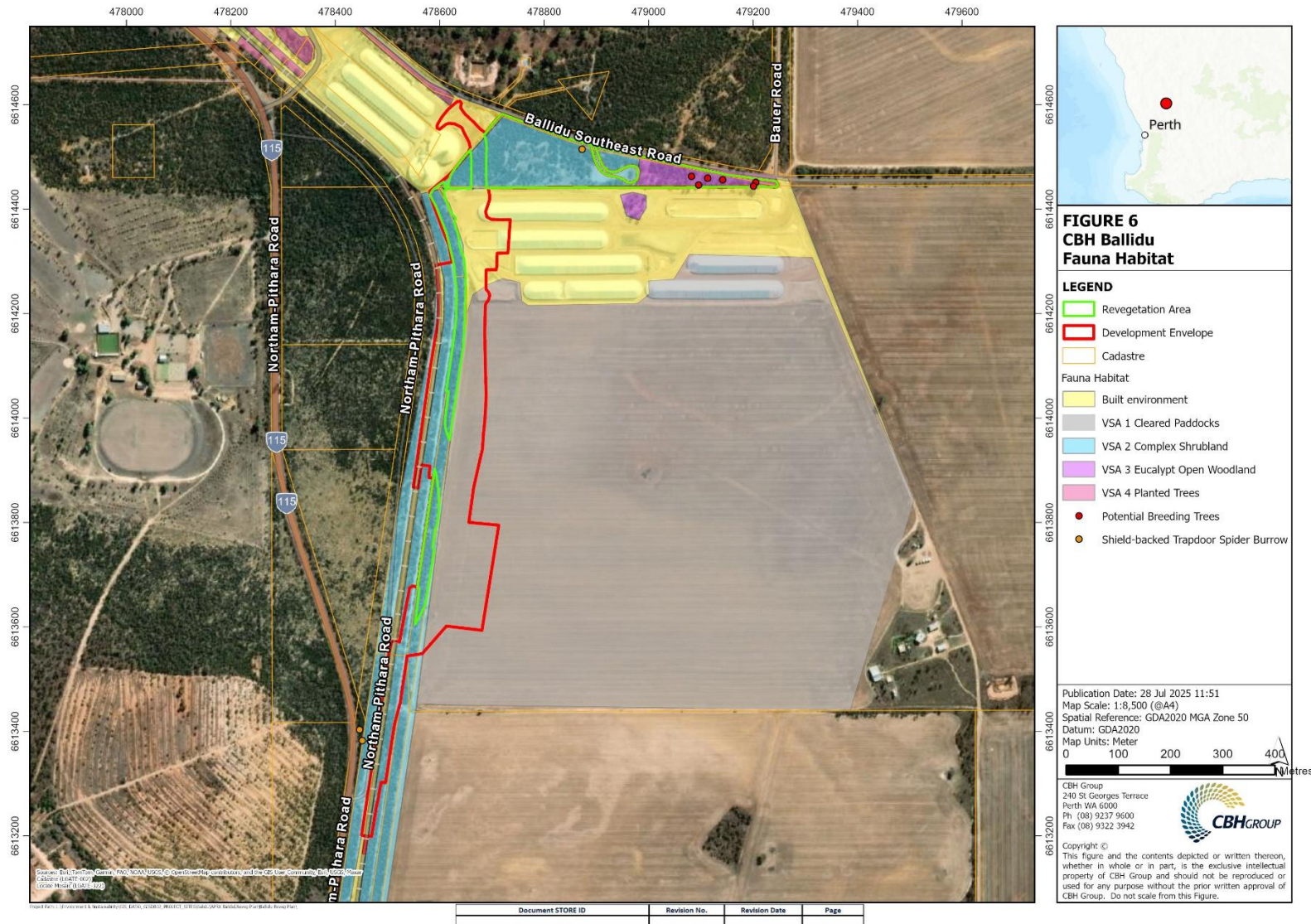
**Table 5: Black Cockatoo habitat values within the Revegetation Area**

VSA	Foraging Habitat	Breeding Habitat	Extent
VSA2 Shrubland	Foraging habitat score: 4	No potential breeding trees recorded.	4.21 ha
VSA3 Woodland	Foraging habitat score: 3	Six potential breeding trees recorded (Figure 6).	0.81 ha

#### Trapdoor Spider

A single Shield-Backed Trapdoor spider (*Idiosoma nigrum*) burrow was recorded within the Revegetation Area (Figure 6). *I. nigrum* is classed as Endangered under the *Biodiversity Conservation Act 2016* (BC Act). If still present at the time of revegetation works, the burrow will be appropriately demarcated to prevent disturbance.





**Figure 6: CBH Ballidu Fauna Habitat**

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### 3. MANAGEMENT PLAN

#### 3.1. Revegetation and Rehabilitation Areas

#### 3.2. Objectives

The revegetation and rehabilitation activities will aim to ensure that the clearing of 2.20 ha of shrubland vegetation in mostly Good condition or better does not result in a significant residual impact to the environment and its values.

This aim will be achieved by:

1. Revegetating 1.43 ha of cleared land and 0.03 ha of Completely Degraded with endemic vegetation of similar floristic composition and structure to the existing native vegetation of the site that is in Good condition or better.
2. Rehabilitating 0.57 ha of Degraded and 3.18 ha of Good condition vegetation to an improved level of Good and Very Good condition, respectively.
3. Managing, monitoring and maintaining the Revegetation Area for a minimum period of 10 years, including restricting access and controlling invasive weeds.

#### 3.3. Management Zones

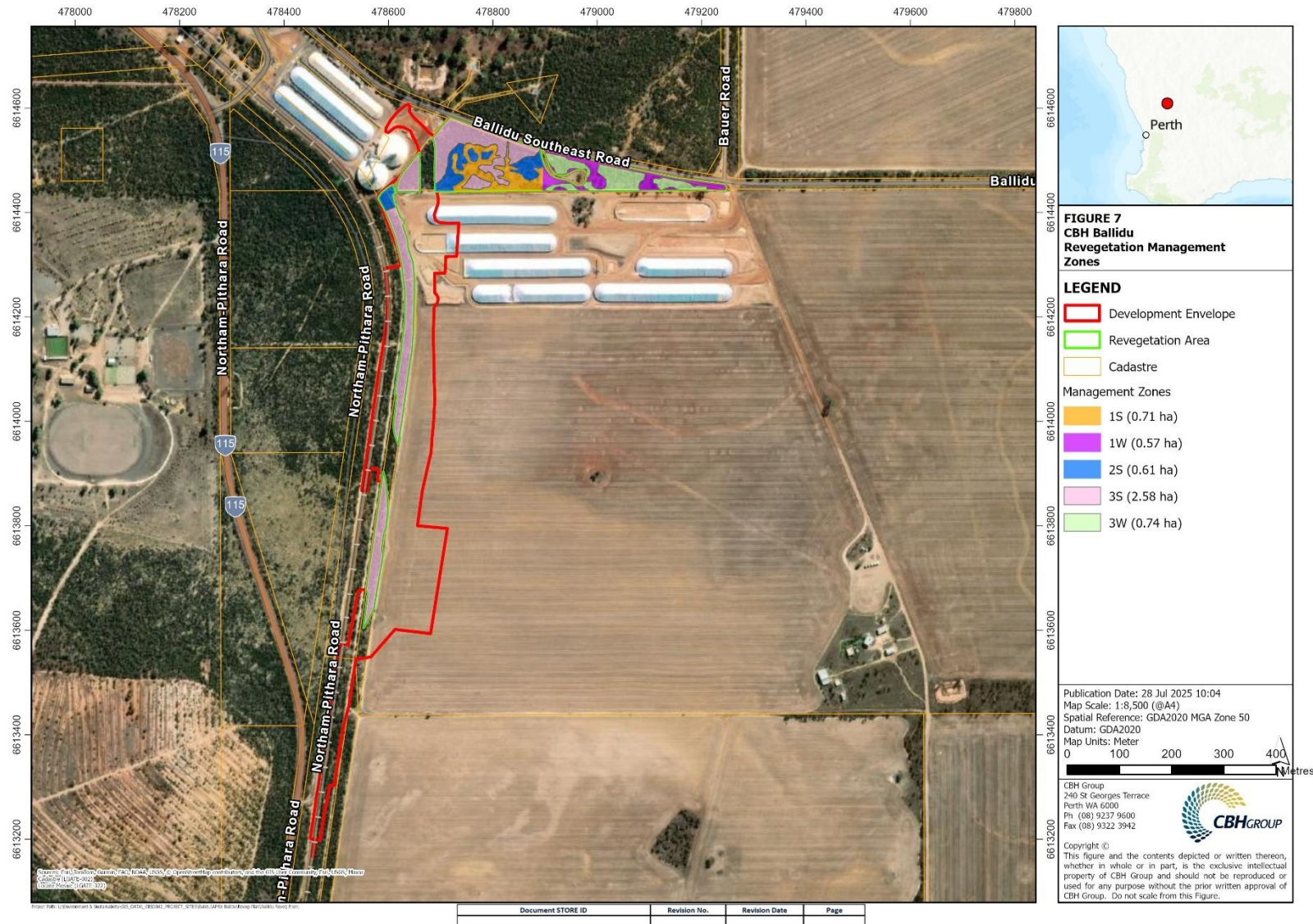
To support the effective implementation of the proposed revegetation and rehabilitation activities, the Revegetation Area has been divided into five management areas within 2 larger domains, defined by their respective management requirements and outcomes. These zones are described in Table 6Figure 7 and shown in Figure 7Figure 7.

#### 3.4. Reference Sites and Seed Mixes

To inform the desired seed mixes for the revegetation and rehabilitation zones, CBH has used the species/cover lists from the AECOM (2023) survey sites Quadrat 3 and Relevé 10 for the shrubland areas, and Relevé 11 for the woodland areas. The preliminary seed lists are provided in Table 6, and will be refined in consultation with the revegetation coordinators and seed collection contractors prior to commencing collection.

**Table 6: Revegetation and Rehabilitation Management Zones (as shown in Figure 7) with associated mitigation actions**

Domain	Management Zone	Mitigation Approach	Extent	Ref. Site/s	Preliminary Seed Lists
Shrubland areas	1S – Shrubland areas that have been cleared.	Revegetation with endemic shrubland species using a combination of ripping, seeding, topsoil translocation and mulching (using topsoil and mulch from clearing areas), after prior removal of any foreign materials, including old concrete slabs.	0.71 ha	AECOM Quadrat 3; Relevé 10	<i>Melaleuca conothamnoides</i> , <i>Allocasuarina campestris</i> , <i>Grevillea paradoxa</i> , <i>Gahnia drummondii</i> , <i>Waitzia acuminata</i> var <i>acuminata</i> , <i>Trachymene pilosa</i> , <i>Platysace trachymenioides</i> , <i>Amphipogon amphipogonoides</i> , <i>Austrostipa Eremophila</i> , <i>Petrophile incurvate</i> , <i>Grevillea petrophiloides</i> subsp. <i>Petrophiloides</i> , <i>Hakea meisneriana</i>
	2S – Shrubland areas in Degraded condition.	Rehabilitation with endemic shrubland species using seeding and mulching (where available). Weed control will be on an as-needs basis, due to low weed pressure.	0.61 ha		
	3S – Shrubland areas in Good condition.	Management to control weeds and protection by restricting uncontrolled access.	2.58 ha	N/A.	N/A.
Woodland areas	1W – Woodland areas that have been cleared.	Revegetation with endemic woodland species using a combination of ripping and seeding, after prior removal of any foreign materials, including old concrete slabs.	0.57 ha	AECOM Relevé 11	<i>Eucalyptus wubinensis</i> , <i>E. moderata</i> , <i>Acacia yorkrakinensis</i> , <i>Melaleuca hamata</i> , <i>A. mackeyana</i> , <i>A. acuarina</i> , <i>Grevillea huegii</i> , <i>Austrostipa scabra</i> , <i>Waitzia acuminata</i> var. <i>acuminata</i>
	3W – Woodland areas in Good condition.	Management to control weeds and protection by restricting uncontrolled access.	0.74 ha	N/A.	



**Figure 7: Map of revegetation management zones**



### 3.5. Performance Monitoring

Monitoring sites (quadrats) will be established in both domains to ensure that the revegetation objectives are progressing towards achievement, with the ultimate success measured against the completion criteria. Quadrats will be established in areas that provide a representative sample of the vegetation structure, floristics and condition.

The quantity, location and size of monitoring quadrats will be established in accordance with the *Standard Operating Procedure Establishing Vegetation Quadrats* (Department of Environment and Conservation 2009), and the Environmental Protection Authority's (EPA) *Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment* (2016). Monitoring will be undertaken within the revegetation areas annually for a minimum of five years, or until completion criteria have been met and maintained for a period of two years.

Monitoring data obtained from the quadrats will be used to assess the success of revegetation against completion criteria. Formal monitoring for the revegetation zones will be performed by experienced consultants in growth periods for the duration of the 5-year management period.

The monitoring activities will collect the following data:

- Site number
- At least two photos of the vegetation, preferentially at the opposing corners of quadrats, or along transects
- Native flora species density (plants per m<sup>2</sup>) – noting species in current vegetation communities
- Native species flora richness (per quadrat) - noting species in current vegetation communities
- Native species and foliage cover (%)
- Dead or visibly stressed native plants
- Weed species and foliage cover (%)
- DBH of all of trees > 8m tall
- Indicators of the presence of fauna (e.g., scats, burrows, tracks)
- General observations (e.g., pest insects, feral animal disturbance, fire occurrence)

Seedling survival will be monitored by counting alive and dead/missing plants. Weed cover will be estimated by visual site assessment, and the presence of any particularly significant weed species noted.

During the rehabilitation phase, a brief one to two-page report will be developed by the rehabilitation specialist, giving a snapshot of the status of the revegetation program. This report will provide a results summary, establish trends with respect to previous assessments (including photographs) and give recommendations for action. The results of the monitoring and general observations will determine whether remedial action such as weed control and infill planting are required to meet the success targets.

### 3.6. Completion Criteria

Table 3 sets the completion criteria to be applied to relevant management zones. CBH will develop interim progress targets based on a review of the first two years of monitoring and inform future monitoring and maintenance activities (see section 4).

Table 4 outlines the contingency measures to be implemented if aspects of the completion criteria are not achieved.

**Table 7: Completion criteria**

Criterion	Criteria	Objective/Target	Completion criteria for each zone and target area		Monitoring
			Zone	Criterion	
1a	Vegetation structure and plant density	The vegetation in revegetated areas will have similar structure, plant density/cover and species richness to relevant baseline data.	Applicable to all zones	Average plant densities (stems/m <sup>2</sup> ) for dominant trees, shrubs, and understorey species, are at least 40% with target being 60% of plant densities recorded from reference sites.	Baseline data (pre-disturbance survey) to establish species' density criteria.  Monitoring will occur in spring by an environmental specialist until completion criteria has been met and maintained. Monitoring event proposed at 1, 2, 3, 5, 7 and 10 years after the planting.
1b	Species richness/diversity			At least 60% with target being 80% of the species in the respective species list for the domain.	
3a	High Impact Weeds	No high impact weeds  No Weeds of National Significance	Applicable to all zones	No weeds present that are listed as Priority Alert, High Impact or Rapid invasiveness on the DBCA Wheatbelt Region Impact and Invasiveness Ratings list as updated from time to time	Monitor the revegetation site for weeds by quadrats twice annually in spring and autumn for a minimum of three years after the last year plants were established  Monitoring will occur in spring by an environmental specialist until completion criteria has been met and maintained. Monitoring event proposed at 1, 2, 3, 5, 7 and 10 years after the planting.
3b	Weed density/cover	Weed cover is no greater than baseline data.	Applicable to all zones	For each zone, weed cover shall be no greater than the baseline data.	Annually in spring by an environmental specialist until completion criterion has been met and maintained for two years (i.e. three successive monitoring events).  Monitoring will occur in spring by an environmental specialist until completion criteria has been met and maintained. Monitoring event proposed at 1, 2, 3, 5, 7 and 10 years after the planting.

4	Bare ground	No more than 5 percent greater than the baseline data for each management zone	Applicable to all zones	No more than 70% bare ground	Annually in summer by an environmental specialist until completion criteria has been met and maintained for two years (i.e. three successive monitoring events)
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### 3.7. Revegetation methodology

#### 3.7.1. Timing

Revegetation will take place during or immediately after the wetter months upon completion of the construction phase. Due to the size of the area compared to available resources, revegetation is expected take place over several years.

#### 3.7.2. Site Preparation

Where required, surface preparation activities such as ripping and/or hand auguring will be performed by experienced personnel.

#### 3.7.3. Seed sources and seedling propagation

Seeds used for seedlings and direct seeding will be of local provenance (i.e., within 100 km of the impact site) where possible, however it is expected that seed sources are expected to be extremely limited and may need to be supplemented from sources further away in the Avon-Wheatbelt bioregion.

Seedlings will be acquired from a commercial nursery, propagated from material sourced as close to the site as available at the time of order. Alternatively, if timing permits it may be possible to collect seeds from the site for future propagation.

#### 3.7.4. Fencing

Where applicable, the installation of fencing and upgrades to existing fencing will be conducted to manage risks regarding vehicle access and grazing animals.

#### 3.7.5. Drainage

Where erosion may be a risk to the revegetation objectives, local surface water drainage features will be stabilized with appropriate materials, such as jute matting or rocks.

#### 3.7.6. Weed control

The implementation of a weed control program will prevent weed species from competing with native vegetation for light, nutrients and moisture, and will also reduce the fuel load.

Weed control events will be required both prior to and following planting and will commence at least three months prior to vegetation establishment. Targeted weed spraying will be undertaken by traversing the entire area by foot and spot spraying for weeds prior to the planting of tubestock.

The annual spraying and weed management shall continue for a period of three years post revegetation works commencing. The application of herbicide will occur in still, dry conditions when no rain is predicted within 12 hours.

Spraying will be conducted in such a manner that spray drift is minimised and that any nearby native species are not affected. Following spraying, the ground will be left for a minimum of two weeks before the preparation of planting commences. Herbicide application will be undertaken by trained personnel in accordance with manufacturers' instruction, which will include the application of appropriate safety requirements.

The Ballidu locality is not recognised as a dieback risk area, nor was it referenced within any surveys performed by consultants. Preventative controls such as appropriately cleaning machinery and vehicles will still need to be implemented to mitigate the risk of contaminated soil or seeds being brought to site.

#### 3.7.7. Revegetation

Bare areas will be scoured and seeded at rates determined to be appropriate to the completion criteria. Seeding will take place in April-June. Tubestock will be utilised for revegetation. Plant layout will reflect natural conditions to the greatest extent possible by distributing plant species with adequate spacing for root development. It is necessary to ensure that planting density reflects the natural bush surroundings in order to create 'like for like' vegetation conditions.

Planting will preferably be undertaken with a motorised post hole digger by skilled personnel. The planting hole will be excavated vertically into free draining mulched soil to an approximate depth of 0.5 – 0.7 m to accommodate the root ball of the plant.

Each seedling planted will have a biodegradable tree guard placed around them if necessary to reduce predation from rabbits and kangaroos. The tree guards will be held in place with three 60 cm to 80 cm bamboo sticks. These tree guards will be removed after one year which will prevent damage to the growing seedlings caused by constriction of outward growth.

## 4. REVEGETATION MAINTENANCE

### 4.1. Monitoring

Monitoring inspections will be undertaken in Spring during years 1, 2, 3, 5, 7 and 10 after initial planting and will evaluate the success of revegetation works through analysis of data (both spatial and temporal trends against control and revegetated sites).

### 4.2. Maintenance

Maintenance will be actioned in accordance with the findings identified from monitoring events. The key elements associated with maintenance works will include soil stabilization or treatment, additional spraying for weeds and infill planting/seeding.

### 4.3. Contingency Measures

Contingency actions may be required if completion criteria are not achieved. This may be due to factors such as unseasonal or changes in weather patterns and disturbance from grazing animals, namely rabbits and/or kangaroos. Measures will be adaptive to both informal and formal monitoring and may not be limited to the actions detailed in Table 8.

**Table 8: Contingency measures**

Issue	Actions
<b>Monitoring indicates revegetation areas do not comply with the completion criteria.</b>	Identify revegetation shortfalls: <ul style="list-style-type: none"> <li>Identify likely cause of failure (e.g. weeds, lack of water, inappropriate timing of revegetation, lack of nutrients, poor soil condition, lack of water, insect/fungus attack, dieback, predation by herbivores, poor species selection)</li> <li>Address cause of failure (this may include watering strategies, mulching, soil stabilisation, pest control, tree guards)</li> <li>Plan infill planting/seeding to compensate for vegetation shortfalls</li> </ul>
<b>Inadequate tubestock/seed available in first year</b>	Commission alternative nurseries to germinate stock <ul style="list-style-type: none"> <li>Identify alternative species in consultation with botanical specialist</li> <li>Plant additional tubestock/seed in subsequent year</li> </ul>

### 4.4. Revegetation Schedule

Table 9 provides an outline of the schedule for revegetation works within the Project site. To ensure quality and consistent outcomes, revegetation and weed management works will be undertaken by a suitably qualified and experienced revegetation contractor. The revegetation performance targets for the design density seedlings will be at least 60% at the end of the maintenance period, inclusive of any weed coverage not impacting planted seedlings with an absence of declared weed species.

**Table 9: Schedule of revegetation and monitoring activities**

Phase	Action	Action Detail	Responsibility	Evidence/Output	Frequency	Corrective Action
<b>Year 1</b>	Species List and Completion Criteria	Establish a species list for revegetation and update completion criteria.	Revegetation specialist/contractor	Invoice/seed stock supplies/inspection report	Annual	Source additional supply from revegetation / accredited nurseries
	Seed collection	Suitably qualified professional to collect and manage seeds	Revegetation specialist/contractor	Invoice/seed stock supplies	Annual	Source additional supply from revegetation / accredited nurseries
	Weed Control	Initiate weed control as per Section 3.7.6	Contractor	Inspection report	Annual	Investigate cause and assign action in SHARE (CBH internal recording system)  Determine appropriate remedy (e.g. additional round of weed control, adjusted method, alternative herbicides, changed timing)  Implement remedy
	Order Plants	Order local endemic plants/seed mix on species list	Revegetation specialist/contractor	Invoice/seed stock supplies	Annual	Source additional supply from revegetation / accredited nurseries
	Planting	Consideration to plant seedlings/seed mix in accordance with species outlined in Section 3.6	Revegetation specialist/contractor	Inspection report	Annual	Investigate cause and assign action in SHARE
	Monitoring and reporting	Undertake monitoring to determine the required maintenance measures (i.e. weed control, pest control and infill planting).	Revegetation specialist/contractor	Monitoring report	Annual	Investigate cause and assign action in SHARE
<b>Year 2</b>	Weed Control	Undertake management of annual weed germinants in	Contractor	Inspection report	Annual	Investigate cause and assign action in SHARE



Phase	Action	Action Detail	Responsibility	Evidence/Output	Frequency	Corrective Action
		revegetation areas as required				Determine appropriate remedy (e.g. additional round of weed control, adjusted method, alternative herbicides, changed timing) Implement remedy
	Pest Control	Undertake control measures for pest incursion if found to be required during monitoring	Contractor	Inspection report	Annual	Investigate cause and assign action in SHARE  Determine appropriate remedy (e.g. additional round of weed control, adjusted method, alternative herbicides, changed timing) Implement remedy
	Planting	Consideration to plant seedlings/seed mix in accordance with species list for domain	Revegetation specialist/contractor	Inspection Report	Annual	Investigate cause and assign action in SHARE
	Infill Planting	Order local endemic plants/seed mix on species list based on survival rates  Plant seedlings in accordance with Plan	Revegetation specialist/contractor	Inspection report	Annual	Investigate cause and assign action in SHARE
<b>Year 3</b>	Monitoring and reporting	Undertake monitoring to determine the required maintenance measures (i.e. weed control, pest control and infill planting).	Revegetation specialist/contractor	Monitoring report	Annual	Investigate cause and assign action in SHARE

Phase	Action	Action Detail	Responsibility	Evidence/Output	Frequency	Corrective Action
	Weed Control	Undertake management of annual weed germinants in revegetation areas as required	Contractor	Inspection report	Annual	Investigate cause and assign action in SHARE  Determine appropriate remedy (e.g. additional round of weed control, adjusted method, alternative herbicides, changed timing)  Implement remedy
	Pest Control	Undertake control measures for pest incursion if found to be required during monitoring	Contractor	Inspection report	Annual	Investigate cause and assign action in SHARE  Determine appropriate remedy (e.g. additional round of weed control, adjusted method, alternative herbicides, changed timing)  Implement remedy
	Infill planting	Order local endemic plants/seed mix on species list based on survival rates  Plant seedlings in accordance with plan	Revegetation specialist/contractor	Inspection report	Annual	Investigate cause and assign action in SHARE
<b>Year 3</b>	Weed Control	Undertake management of annual weed germinants in revegetation area as required	Contractor	Inspection report	Annual	Investigate cause and assign action in SHARE  Determine appropriate remedy (e.g. additional round of weed control, adjusted method, alternative herbicides, changed timing)  Implement remedy

Phase	Action	Action Detail	Responsibility	Evidence/Output	Frequency	Corrective Action
	Infill planting	Order local endemic plants/seed mix on species list based on survival rates  Plant seedlings/seed mix in accordance with plan	Revegetation specialist/contractor	Inspection report	Annual	Investigate cause and assign action in SHARE
Year 4	Monitoring and reporting	Undertake monitoring to determine the required maintenance measures (i.e. weed control, pest control and infill planting).	Revegetation specialist/contractor	Monitoring report	Annual	Investigate cause and assign action in SHARE
	Weed Control	Undertake management of annual weed germinants in revegetation areas as required	Contractor	Inspection report	Annual	Investigate cause and assign action in SHARE  Determine appropriate remedy (e.g. additional round of weed control, adjusted method, alternative herbicides, changed timing)  Implement remedy
	Pest Control	Undertake control measures for pest incursion if found to be required during monitoring	Contractor	Inspection report	Annual	Investigate cause and assign action in SHARE  Determine appropriate remedy (e.g. additional round of weed control, adjusted method, alternative herbicides, changed timing)  Implement remedy



Phase	Action	Action Detail	Responsibility	Evidence/Output	Frequency	Corrective Action
	Infill planting	Order local endemic plants/seed mix on species list based on survival rates  Plant seedlings/seed mix in accordance with plan	Revegetation specialist/contractor	Inspection report	Annual	Investigate cause and assign action in SHARE
<b>Year 5 and beyond (continue annually until completion criteria has been met and maintained for two years) – Spring</b>	Monitoring and reporting	Undertake monitoring to determine the required maintenance measures (i.e. weed control, pest control and infill planting).	Revegetation specialist/contractor	Monitoring report	Annual	Investigate cause and assign action in SHARE
	Weed Control	Undertake management of annual weed germinants in revegetation areas as required	Contractor	Inspection report	Annual	Investigate cause and assign action in SHARE  Determine appropriate remedy (e.g. additional round of weed control, adjusted method, alternative herbicides, changed timing)  Implement remedy
	Pest Control	Undertake control measures for pest incursion if found to be required during monitoring	Contractor	Inspection report	Annual	Investigate cause and assign action in SHARE  Determine appropriate remedy (e.g. additional round of weed control, adjusted method, alternative herbicides, changed timing)  Implement remedy

Phase	Action	Action Detail	Responsibility	Evidence/Output	Frequency	Corrective Action
	Infill planting	Order local endemic plants/seed mix on species list based on survival rates  Based on the survival rates of plants from the monitoring program, additional seedlings to be acquired,	Revegetation specialist/contractor	Inspection report/Invoice seed stock supplies	Annual	Identify revegetation shortfalls (via monitoring report)  <ul style="list-style-type: none"> <li>Identify likely cause of failure (e.g. weeds, lack of water, inappropriate timing of revegetation, lack of nutrients, poor soil condition, lack of water, insect/fungus attack, dieback, predation by herbivores)</li> <li>Address cause of failure (this may include mulching, soil stabilisation, pest control, tree guards)</li> </ul> Plan infill planting/seeding to compensate for vegetation shortfalls
<b>Years 10 or two years after completion criteria being met and maintained</b>	Monitoring and reporting	Completion survey and closure	Revegetation specialist/contractor	Monitoring report	Annual	Investigate cause and assign action in SHARE

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