

30 January 2025

Silver Kenny

Principal Approvals

South32 Worsley Alumina Pty Ltd

Level 37, 108 St Georges Terrace, Perth 6000

Dear Silver,

Please find below a memo summarising the targeted numbat (*Myrmecobius fasciatus*) survey for the South32 Worsley Alumina Pty Ltd (Worsley) Mine Expansion - Revised Proposal.

To assist in determining numbat presence and habitat use within the Marradong Timber Reserve and surrounding areas (the Study Area), ten baited cameras were deployed within a grid formation at six locations. Cameras were deployed for between 48–49 consecutive nights from 16 September to 7 November 2024, equating to a total of 2,920 sampling nights. Additional survey effort within the Study Area included 96.41 person hours of targeted numbat searches, as well as a further 6.66 person hours undertaking six termite abundance assessments over two field trips, 16–20 September and 4–7 November 2024.

No numbats were observed or recorded during the survey. A small number of potential diggings and a scat recorded during the survey had characteristics of numbat; however, due to their old condition, it was not possible to confirm the records as numbat. Six broad fauna habitats have previously been defined and delineated within the Study Area, comprising Rehabilitation (983.23 ha, 51.00%), Cleared (455.82 ha, 23.64%), Jarrah/ Marri/ Allocasuarina (207.71 ha, 10.77%); Wandoo Woodland (129.93 ha, 6.74%); Jarrah/ Marri on Slopes (131.18 ha, 6.80%) and Marri/ Jarrah on Lower Slopes (20.02 ha, 1.04%). The occurrences of Jarrah/ Marri/ Allocasuarina, Jarrah/ Marri on Slopes and Wandoo Woodland habitats provide high value breeding, foraging and dispersal habitat for numbat and are considered highly suitable, except for some small areas along the edges of patches that were degraded and considered low suitability. Marri/ Jarrah on Lower Slopes provided moderate suitability for numbats and was considered potential supporting habitat. Rehabilitation habitat ranged from low to high suitability depending on the age, vegetation growth, structure and cover, with generally older rehabilitation (>5 years planted) providing more suitable habitat. Cleared areas were not considered suitable habitat for numbat.

There is potential for the larger remnants of high suitability to support numbat individuals or pairs and breeding, particularly where there is connectivity with areas beyond the Study Area. Based on the assessed 448.88 ha (23.28%) of high suitability habitat within the Study Area and on currently known density estimates and home ranges (DPaW, 2017; Thorn, 2023), the Study Area may support between one and 12 individuals (up to six pairs). The species is known to occur at low abundance and have large home ranges, and these larger remnants are likely to form part of a home range with individuals moving in and out of the Study Area, rather than a closed population within the Study Area. It is important to note that this is an approximate estimate of what may be able to be supported, given the variability in density and home range

estimates and a number of factors (other than just habitat suitability) that may affect this estimate and is not an indication of actual population size.

There are also large areas of the Study Area that would not be considered suitable to support numbats (1,029.51 ha, 53.40%), including large cleared or younger rehabilitated areas that fragment smaller patches of remnant vegetation. However, areas of rehabilitation that connect areas of remnant vegetation may provide suitable cover and dispersal habitat between areas of high habitat suitability in the future, as rehabilitated areas are more likely to become suitable for numbat as age since planting increases.

Overall, there is potential for parts of the Study Area to support numbats within the broader landscape given high suitability habitat occurs and also considering that, whilst no numbats were confirmed as occurring during the survey, potential diggings and scats were recorded. However, other contributing factors such as fragmentation of habitat, introduced predators and fire regimes may reduce this capacity. Introduced species such as feral pigs (*Sus scrofa*) and predators including red fox (*Vulpes vulpes*) and feral cat (*Felis catus*) were recorded on many occasions throughout the Study Area and are likely to pose a threat to numbats via predation and habitat degradation and may reduce the potential of the Study Area to support individuals.

Whilst numbats were not recorded during the survey, and they may be capable of occurring within high-quality patches of habitat in the Study Area, it is more difficult to determine if it supports a viable population of numbats, defined in South32's Environmental Management Plan as a self-sustaining population with a high probability of survival because it has sufficient numbers and reproductive potential. Available published literature suggests that a population of at least 20 and a minimum area of ~2,000 ha is required (DPaW, 2017; National Environmental Science Program Threatened Species Research Hub, 2019). This would suggest that the Study Area (Marradong Timber Reserve) is unlikely to be capable of supporting a viable numbat population, given it is 1,927.90 ha (of which only 448.88 ha is considered highly suitable for numbats) and may only support a maximum of 12 individuals. However, the Study Area would not be a closed population and connecting habitat has not been considered in this assessment.

Additional targeted surveys, using additional cameras spaced over a greater area for longer duration during optimal survey timing, as well as possibly investigating connected suitable habitat outside the Study Area, may be considered to further support this conclusion on the presence of numbats (and a viable population) within the Marradong Timber Reserve.

Thank you for giving Biologic the opportunity to undertake this work. If you have any queries, please do not hesitate to get in contact.

Yours sincerely

VERITY STEPTOE

Senior Zoologist

verity@biologicenv.com.au

0456 818 504 | 08 6365 5066

Reviewed by R. Ellis, 29 January 2025

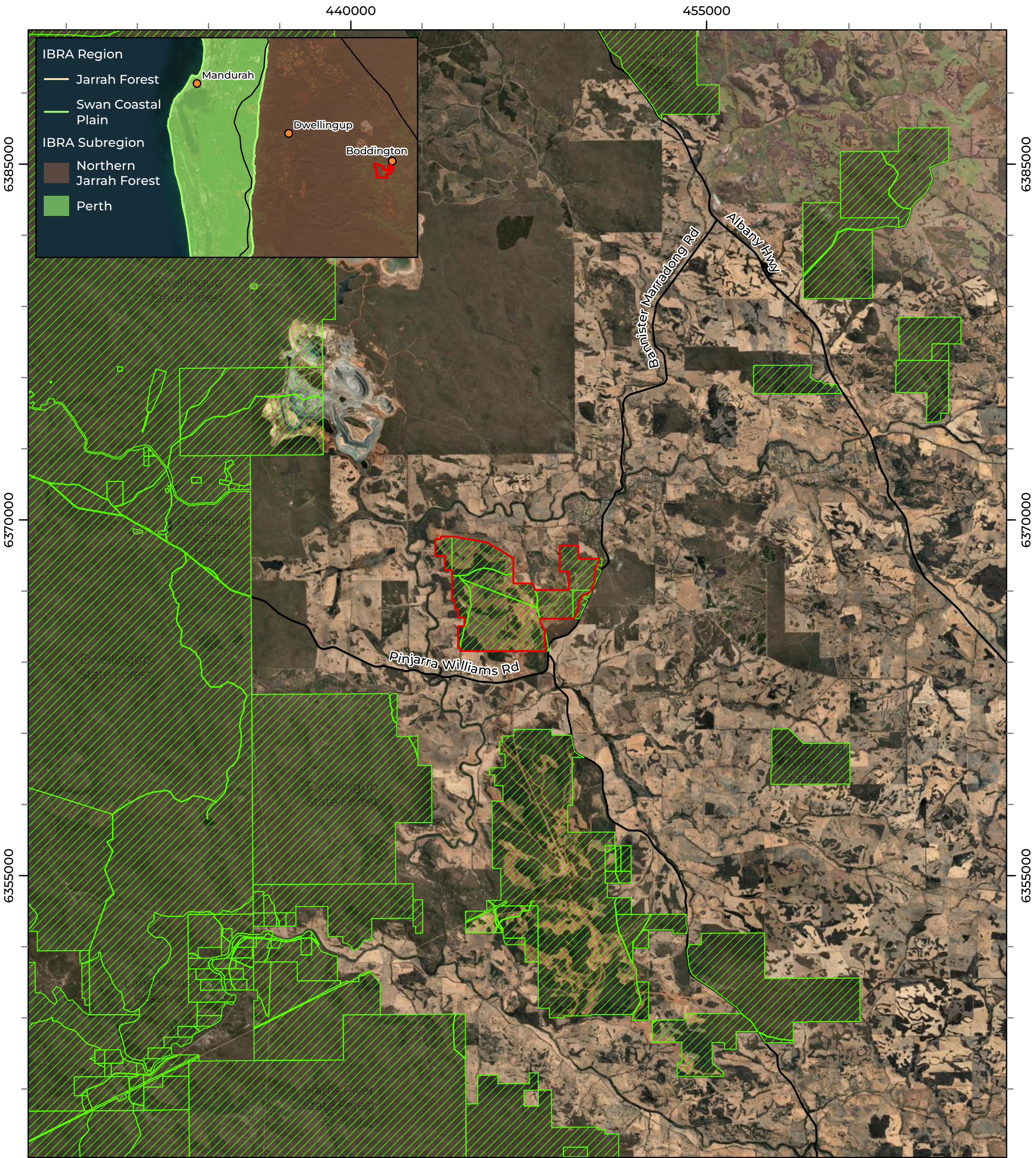
1 Introduction

1.1 Background

South32 (managing company for the South32 Worsley Alumina Pty Ltd Joint Venture [Worsley Alumina]) is currently seeking to expand its mining operations within the areas in the Northern Jarrah Forest near Boddington in south-west Western Australia. As part of a report provided by the EPA (1768), it includes Recommended Conditions (Condition B13-3) which requires the assessment of populations of threatened fauna within operational areas. This involves a targeted survey for the numbat (*Myrmecobius fasciatus* – Endangered Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) and Biodiversity Conservation Act 2016 (BC Act)) within the Marradong Timber Reserve (herein the Study Area). The Study Area is located approximately 1.5 kilometres (km) south-west of Boddington and is comprised of native and rehabilitated vegetation and cleared land, which covers an area of 1,927.90 hectares (ha) (Figure 1.1).

Since 1960, there have been 17 records of numbat within 25 km of the Study Area, with six of these records occurring within the previous 10 years (0.2–20.3 km from the Study Area) (Biostat, 2015; DBCA, 2024; Ninox, 2003a, 2003b). Prior to 2021, vertebrate fauna surveys completed within and immediately adjacent to the Study Area did not identify the presence of numbat (Biostat, 2015; Ninox, 2003a, 2003b). In 2021, following a community sighting of a numbat in an adjacent private property (only 150 metres (m) north of the Study Area), a survey was undertaken immediately north of the Study Area, identifying an additional three recordings in the area (Biostat, 2021a). It was subsequently determined that there was a high likelihood the records were associated with a single individual that has moved from Dryandra Woodland (Biostat, 2021a).

In 2024, Biologic Environmental Survey Pty Ltd (Biologic) was commissioned by South32 to undertake a targeted numbat survey within the Marradong Timber Reserve. The overarching objective of the assessment was to determine whether a viable population of numbat occurs within the Marradong Timber Reserve. A viable population has been defined within South32's Environmental Management Plan as “a self-sustaining population with a high probability of survival because it has sufficient numbers and reproductive potential”. The specific objectives were to further investigate the likelihood of the species presence within the Study Area, identify areas of suitable habitat for the numbat, and if present, determine the baseline population within the Study Area. The results and outcomes of this survey are presented herein.

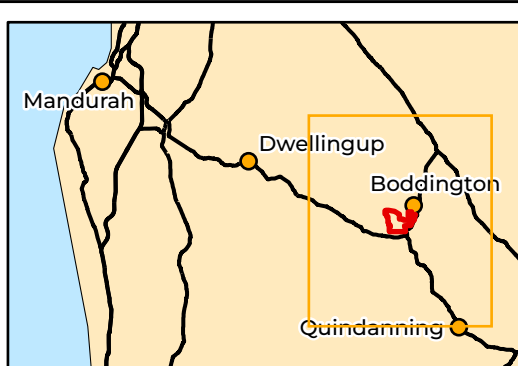


LEGEND

- Study Area
- DBCA Legislated Lands
- State Road

Scale 1:150,000

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 06/01/2025



SOUTH32/WORSLEY ALUMINA
Marradong Timber Reserve Targeted Numbat Survey

Figure 1.1: Study Area and regional context

1.2 Biogeographical Context

The Study Area occurs in the Northern Jarrah Forest bioregion, which is characterised by jarrah – marri (*Corymbia calophylla*) forest on laterite gravels in the west, grading to wandoo – marri woodlands on clayey soils in the east (Thackway & Cresswell, 1995). Vegetation within the Study Area is characterised by open woodland or forest with a mixture of eucalypt species (*E. rudis*, *E. wandoo* and *E. marginata*), *C. calophylla* whilst *Banksia grandis* and *Allocasuarina fraseriana* also occur in some site-vegetation types (Worsley Alumina, 2022).

The climate of the Study Area is characterised by cool wet winters, and warm, relatively dry summers. Mean long-term annual rainfall at the Bureau of Meteorology's (BOM's) Dwellingup station is 1,218 mm, whilst mean temperatures range between 9.6–22°C (BoM, 2024).

A number of DBCA managed conservation areas (including state forests and nature reserves) occur within or adjacent to the Study Area, including the Dwellingup State Forest, Lane Poole Reserve and Harris River State Forest (Figure 1.1). There are also a number of smaller reserves with various levels of connectivity to larger patches of native vegetation.

1.3 Numbat (*Myrmecobius fasciatus*) – Endangered (EPBC Act, BC Act)

The numbat is a small marsupial endemic to Australia and recognisable by its unique reddish fur along with a covering of white transverse bands on its rump (TSSC, 2018). Unlike almost all small Australian marsupials, it is strictly diurnal in nature, feeding almost exclusively on termites of various species (*Isoptera* spp.). Its daily activity pattern changes throughout the year, with activity largely corresponding to the availability of termites in the upper soil layers, which themselves respond to changes in temperature (Connell & Friend, 1985). Numbats spend most of the day feeding, and an animal can consume up to 20,000 termites each day (Connell & Friend, 1985; Cooper & Withers, 2005; Friend & Thomas, 1994). They intercept termites in their feeding galleries that occur underneath mounds, tree trunks or underground, by digging the upper soil surface layer, turning over wood, or by removing bark from decaying tree stumps and branches (Christensen *et al.*, 1984). They are solitary and territorial, with documented home ranges between 25 ha and 279 ha (Bester & Rusten, 2009; Christensen *et al.*, 1984; DPaW, 2017; Hayward *et al.*, 2015; Thorn, 2023). Home range size is known to vary with sex, with males having larger home ranges. A recent study in the Upper Warren subpopulation recorded female home ranges between 11.2–53.4 ha (median 29.5 ha) and male home ranges between 80.2–278.7 ha (Thorn, 2023). Home ranges have been found to vary with season in some studies, e.g., a summer range contraction for females and winter range contraction for males was recorded for the Dryandra Woodland National Park and Boyagin Nature Reserve subpopulations (DPaW, 2017). Home ranges for same sex animals generally do not overlap; however, individuals can overlap with multiple individuals of

opposite sex (Christensen *et al.*, 1984). Home range is also influenced by habitat quality, for example, a portion of the male's home range of 279 ha was burned shortly before capture, which may have increased space use due to reduced undergrowth cover from predators and/ or food resources (Thorn, 2023). Approximately one pair of established adults per 50 ha (Christensen *et al.*, 1984; DPaW, 2017), as well as a density of 0.0017 individuals per hectare (Thorn, 2023) in high quality habitat has been suggested.

Numbats use hollows and burrows for nesting at night, resting during the day and as refuges when under threat from predation and was the most important habitat element at a microhabitat level (Thorn, 2023). They may also use shrubs and fallen foliage during the summer when logs aren't available (DPaW, 2017). Nests are made in tree hollows that have only one entrance, an internal diameter of 60–80 mm, and up to 5 m above ground level (DPaW, 2017). Burrows are constructed by both males and females to a depth of 1–2 m with a terminal chamber of approximately 25 cm diameter. Nests are lined with readily available plant material and are particularly used in the cooler winter months (Christensen, 1975; Christensen *et al.*, 1984). Numbats give birth in January/ February, and deposit young in the nest (usually a burrow) in late July (DPaW, 2017; Friend, 2008). Juveniles emerge around September and start foraging in October. They largely stay close to the maternal nest until they disperse in November/ December and establish a new home range, where it will spend the rest of its life (DPaW, 2017).

Historically, the numbat had a broader distribution which is now restricted to south-west Western Australia, with population strongholds at Dryandra Woodland National Park (29 km east of the Study Area) and the Upper Warren area (including Tone-Perup Nature Reserve, Greater Kingston National Park and adjoining State Forest) (280 km south-south-east of Perth) (DPaW, 2017). Numbats have been reintroduced at a number of sites, including a self-sustaining population at Batalling Forest Block (DPaW, 2017), which is located approximately 40 km to the south of the Study Area.

Its decline is strongly linked to the introduction of the red fox (*Vulpes vulpes*) and cat (*Felis catus*) and increased land clearing and fragmentation (DPaW, 2017; TSSC, 2018). Climate change, changes in fire regimes and disease are also linked to its decline. Its presence relies on sufficient termites, cover from predators, an open understorey for feeding, and the presence of eucalypt species that provide logs and hollows (DPaW, 2017).

Currently occupied habitat usually comprises of eucalypt woodlands, particularly jarrah (*Eucalyptus marginata*), wandoo (*Eucalyptus wandoo*), York gum (*Eucalyptus loxophleba*), and mallee (*Eucalyptus* spp.), which provide hollow logs for shelter, food (i.e. exclusively termites), and protection against predators. Because numbats only exist in a small proportion of the range of habitat types previously occupied by the species, it is not possible to provide an exhaustive description of habitat critical to their survival. However, some key characteristics consistently occurring in occupied areas include:

- presence of termites in sufficient abundance
- presence of eucalypt species, thus providing logs and hollows and possibly higher termite densities
- sufficient adequate cover near ground level to provide refuge from predators
- sufficient open understorey is also required for feeding.

A combination of an open understorey interspersed with thickets and/ or hollow logs is considered ideal (TSSC, 2018). Numbats need large areas of natural woodland vegetation because of their relatively large home ranges and limited resources; therefore, habitat that allows for natural expansion of the species and habitat linking existing subpopulations are also considered critical (DPaW, 2017).

2 Methods

2.1 Licensing and Ethics

The current survey was conducted under the *Animal Welfare Act 2002* Licence to use animals for scientific purposes (License No. U244/2022-2024), administered through the Department of Primary Industries and Regional Development (DPIRD). This is enabled through Biologic's chosen Animal Ethics Committee (AEC), Murdoch University, under permit RW3354-21. The fauna sampling for this survey was conducted under a DBCA Regulation 27 "Fauna Taking (Biological Assessment) License" (BA27001087-b) and Section 40 Authorisation to Take or Disturb Threatened Species (TFA 2324-0244b) issued to Chris Knuckey.

2.2 Survey Personnel

The field surveys were completed by zoologists with extensive experience undertaking vertebrate fauna surveys in the region (Table 2.1).

Table 2.1 Survey personnel and experience

Name	Qualification	Experience
Verity Steptoe (Senior Zoologist) Trip 1 and 2	BSc Marine Biology/ Zoology Hons (Antarctic Studies)	15 years zoology 14 years field survey 12 years Environmental Impact Assessment (EIA) consulting
John Radford (Zoologist) Trip 1	BSc Sustainable Resource Management	3 years zoology 3 years field survey 3 years EIA consulting
Jessica Johnston (Principal Zoologist) Trip 2	PhD Zoology BSc (Hons) Zoology	25 years zoology 25 years field survey 20 years EIA consulting
Misty Cannings (Senior Zoologist) Trip 1	BSc (Hons) Science/ Marine Biology	18 years zoology 14 years field survey 6 years EIA consulting
Sammy Alatas (Zoologist) Trip 2	BSc Conservation and Wildlife Biology (in progress)	1 year Zoology 3 years Field Survey 2 years EIA consulting

2.3 Survey Timing and Weather

The field surveys were undertaken over two trips from 16–20 September (trip 1) and 4–7 November (trip 2) 2024. The timing of trip 1 of the field survey fell just outside the recommended timing for numbats (between November to early December) (DPaW, 2017), coinciding with juvenile numbat dispersal, and therefore the time of maximum numbat abundance when detection is most likely. However, numbats will still be undertaking regular foraging and dispersal activities outside this period and secondary evidence of occurrence via scats, diggings and denning can be assessed throughout the year.

Observed weather conditions prior to and during the field surveys are shown in Figure 2.1, alongside long-term climatic data from Wandering (temperature - station #01097), located approximately 20 km south-east of the Study Area, and Marradong (rainfall – station #009575), within the Study Area (BoM, 2024). In the 12 months prior to the survey, temperatures recorded at Wandering were similar to long-term averages (LTA), with slightly higher average temperatures experienced overall (BoM, 2024). During the survey, mean temperatures ranged from a minimum of 4.1°C to a maximum of 27.1°C (BoM, 2024). Rainfall in the 12 months leading up to the survey (492.8 millimetres (mm)) was 225.4 mm (69%) lower than the LTA of 718.2 mm at Marradong (BoM, 2024). While the conditions experienced during and prior to the field survey were drier and warmer than expected, they were not considered a significant limitation to the detection of the target species.

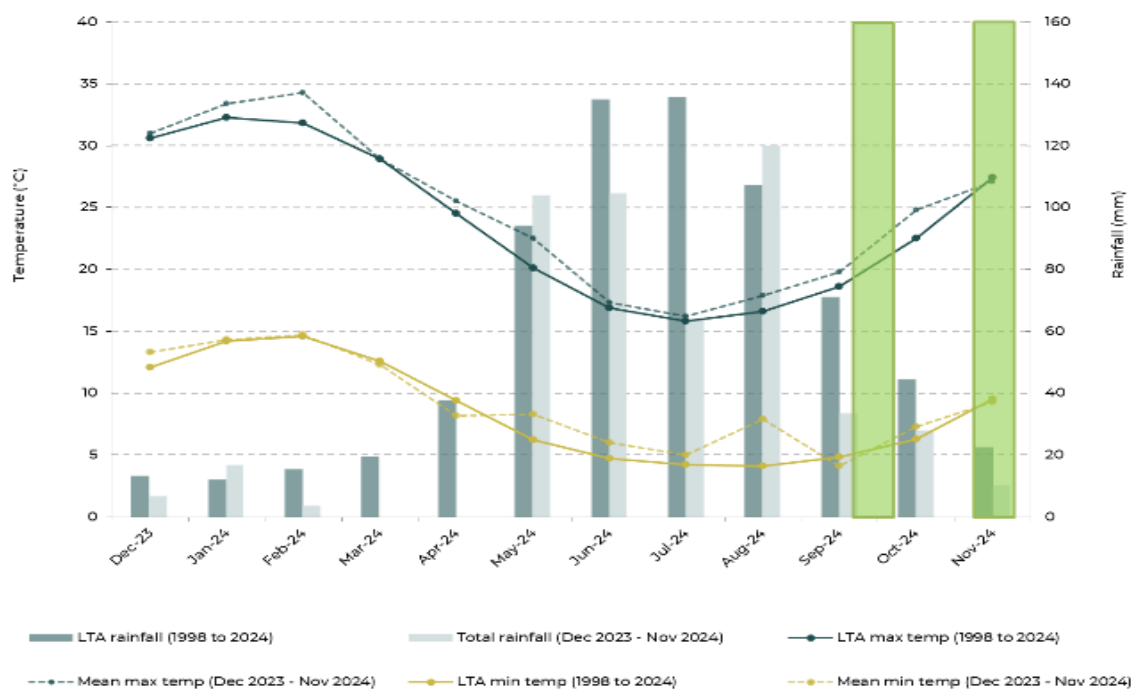


Figure 2.1 Long-term average and observed climate data recorded near the Study Area (BoM, 2024) Approximate survey trip timing shown in shaded boxes.

2.4 Sampling and Survey Methods

2.4.1 Habitat Assessments and Mapping

The mapping and nomenclature of broad fauna habitats described in the previous fauna surveys (Biologic, 2023b, 2024; Biostat, 2020, 2021b) and vegetation mapping by Mattiske (2021) were used for the current assessment. Additional fauna habitat assessments were undertaken throughout the Study Area during the current field survey to assess the suitability to support numbats.

Fauna habitat assessments were undertaken at 27 sites during the current survey to characterise and define habitats and their significance to numbats (Appendix B). Assessments were conducted using methodology and terminology modified from the Australian Soil and Land Survey Field Handbook (National Committee on Soil and Terrain, 2009).

The characteristics recorded during the habitat assessments were:

- site information: photo and location;
- landform: slope, relative inclination of slope, morphological type and landform type;
- vegetation: leaf litter %, wood litter, hollow bearing trees, broad floristic formation;
- land surface: abundance and size of coarse fragments, rock outcropping, water bodies
- soil: type and availability;
- substrate: bare ground, rock size, rock type, rock outcropping; and
- disturbance: time since last fire, evidence of weeds, grazing, or human disturbances.

Additionally, the habitat features below were assessed for suitability for numbat:

- abundance of termites (Section 2.4.4);
- occurrence of open understorey suitable for feeding. A combination of an open understorey interspersed with thickets and suitable hollow logs (diameter of approximately 60–80 mm and within five metres of the ground) is considered ideal for numbats;
- foraging resources (e.g. visual observation of termite mounds, fallen, decomposing wood, debris, and leaf litter, visual observation of termite damage (tunnels) on fallen wood or exposed galleries and presence of other digging mammals (e.g. echidna (*Tachyglossus aculeatus*), woylie (*Bettongia penicillata ogilbyi*) and quenda (*Isodon fusciventer*));
- protection and refuge resources (e.g. proportion of cover from both canopy and understorey, type and degree of disturbance, evidence of predator presence);
- breeding resources (e.g. qualitative estimation of fallen logs, dimensions of entrance, evidence of use, presence of low (<5 m) tree hollows, presence of earth burrows), and
- provision of dispersal habitat and vegetation corridors.

Suitable habitat within the Study Area was categorised as providing breeding and/or foraging and/or dispersal. Unsuitable habitat was defined as habitat that is unlikely to support the species and impact upon its presence (note individuals may be recorded in these habitats intermittently, though are not expected to be reliant on them).

The presence and quality of each of the above resources were used to determine a high, moderate, low, and nil suitability rating for each habitat type (Table 2.2). It should be noted that assessment of habitat significance applies only to habitat occurring within the Study Area, and therefore may not be representative of significance applied to the same habitat outside the Study Area. For example, a habitat within the Study Area may be deemed unsuitable due to the absence of certain habitat features that are required for the species persistence (e.g. hollow logs), despite the same habitat occurring outside the Study Area being considered of greater significance.

Additionally, a total of 530 habitat mapping notes were recorded throughout the Study Area to provide ground truthing of the overarching habitat mapping. Details such as dominant vegetation and understory species were noted during the survey at locations where a change in the vegetation structure or components were observed, or at regular intervals during targeted searches within new areas.

Table 2.2 Targeted habitat assessment criteria used to determine suitability of habitat for numbat

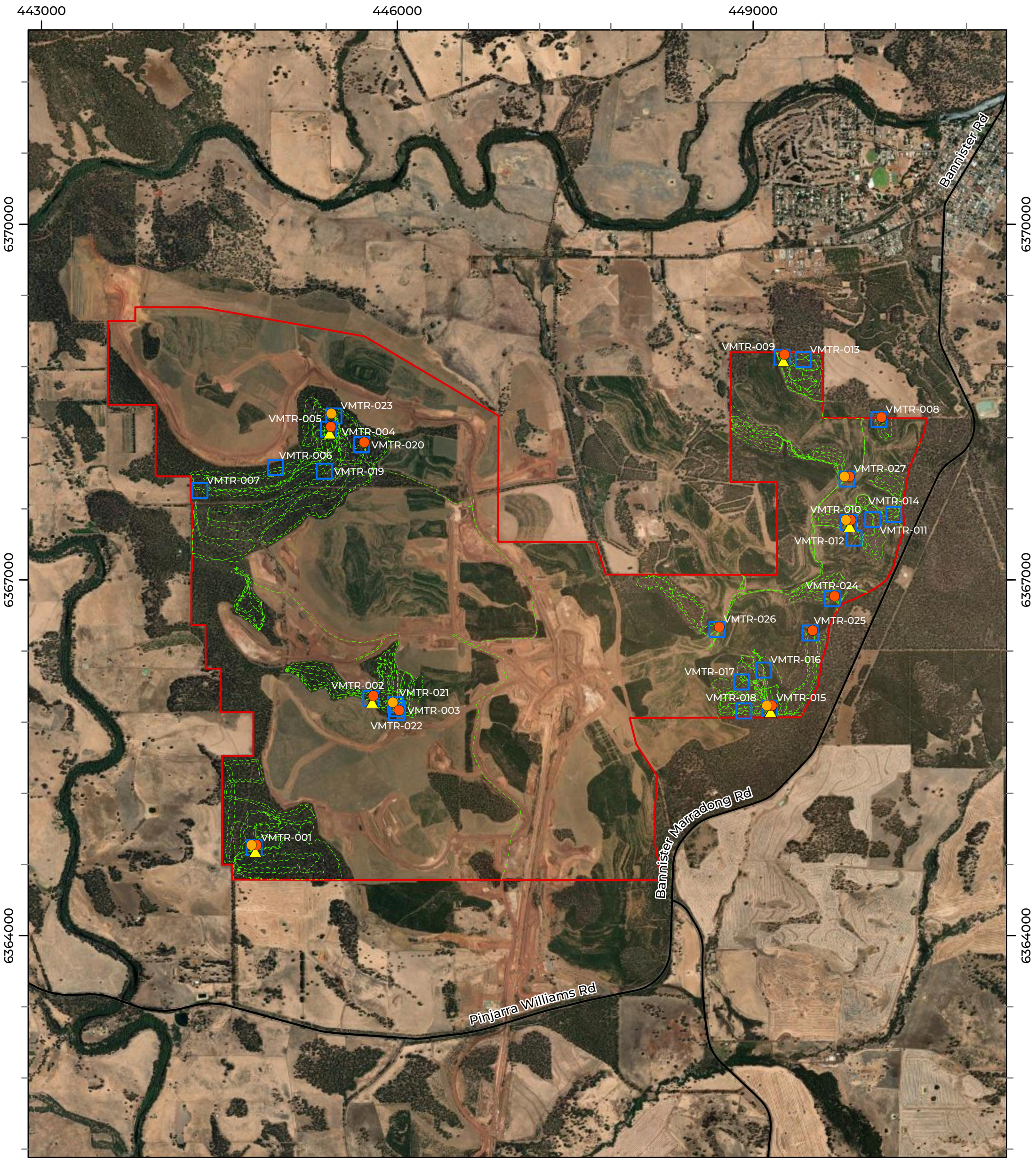
Habitat Scoring		
Habitat quality: High	Habitat quality: Moderate	Habitat quality: Low
Mature jarrah, marri or wandoo forest or woodlands, with dense understorey and high density of hollows (60–80 mm diameter) in trees (<5 m above ground) and hollow logs on ground. Substrate with high burrowing potential and evidence of presence of other digging mammals. High density of termite mounds, fallen, decomposing wood, debris and leaf litter. Very limited to no habitat damage by herbivores or previous land management activities. Low density of introduced predator species present.	Mature jarrah, marri or wandoo forest or woodlands, with moderately dense understorey and density of hollows (60–80 mm diameter) in trees (<5 m above ground) and hollow logs on ground. Substrate with moderate burrowing potential and moderate evidence of presence of other digging mammals. Moderate density of termite mounds, fallen, decomposing wood, debris and leaf litter. Limited habitat damage by herbivores. Low density of introduced predator species.	Little to no vegetation, tree hollows, hollow logs or evidence of termites. High density of introduced predator species. Substrate with low burrowing potential and limited evidence of presence of other digging mammals. Low density of termite mounds, fallen, decomposing wood, debris and leaf litter. Habitat damage by herbivores is evident.

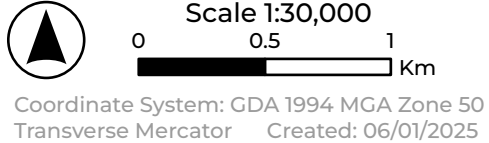
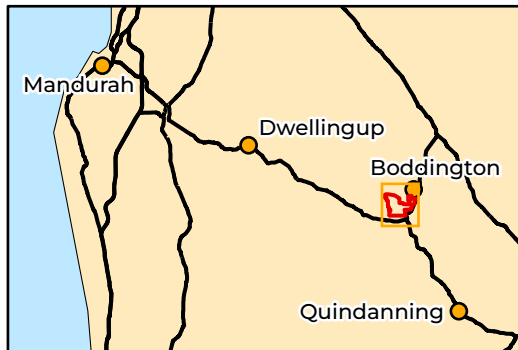
2.4.2 Targeted Searches

Numbats naturally occur at low densities and are not easily trapped. As such, they are primarily surveyed by sighting surveys from vehicles along transects, track counts, or targeted searches for secondary evidence (diggings and scats) during daylight hours (Connell & Friend, 1985; Seidlitz *et al.*, 2021b; Thorn *et al.*, 2022). Targeted diurnal searches (on foot) for the presence of numbats (direct observation and/or secondary evidence such as diggings and scats) were undertaken at 22 sites within the Study Area. During each targeted search, two to four people searched along meandering transects for between one and seven person hours, resulting in a total of 96.41 person hours over the two trips.

2.4.3 Camera Trap Grids

Camera trap grids were deployed at six sites during trip 1 and retrieved during trip 2. Cameras were placed within a grid formation (three by three cameras with one additional camera), spaced approximately 100 m apart (Figure 2.2). Cameras were positioned approximately 25–50 cm above the ground (considered optimal height for numbat detection, Seidlitz *et al.*, 2021a) and baited with universal bait (a mixture of oats, sardines, and peanut butter) in a non-reward bait tube. There are no known baits or lures for numbats, so universal bait was placed in front of the camera to assist with identifying the presence of other significant species that may occur within the Study Area. Cameras were deployed for between 48–49 consecutive nights, between 16 September and 7 November 2024, equating to a total of 2,920 trap nights (Appendix C).



LEGEND			
 Study Area	 Camera Trap		
 State Road	 Habitat Assessment	 Numbat and Woylie	SOUTH32/WORSLEY ALUMINA Marradong Timber Reserve Targeted Numbat Survey
	 Targeted Search	 Termite	
			Figure 2.2: Fauna sample sites and traverses

2.4.4 Termite Abundance Assessments

Numbats are obligate termite feeders and hence will not persist in areas where termites are not in a high enough abundance to support them (Friend, 2004). Targeted termite abundance assessments were conducted at six locations within the Study Area (Plate 2.1; Figure 2.2) (for a total of 6.66 person hours). Termite abundance assessments were completed within areas of Jarrah, Marri and Wandoo Woodland habitat judged suitable for numbat foraging with features present such as a mix of open areas and cover from aerial predators, consisting of some open patches with exposed soil, where leaf litter was sparse or absent and with woody debris (preferably trees) available (Figure 2.2). Assessments were not conducted in cleared or rehabilitation areas due to the lack of suitable conditions considered appropriate for termite activity; however, may be considered for future survey effort as a matter of recording the difference between disturbed and undisturbed sites.

The assessments followed (in part) methodology described by Friend (2004). This included scraping leaf litter away along two 10 m lines intersecting at the 5 m mark and digging furrows to a depth of 40 mm along each line and investigating the furrow and soil spoil for termites. The presence of termites and determining distances between occupied galleries within the furrows give an indication of the presence of termite colonies and numbers within each transect area (Plate 2.2). The termite assessments undertaken during the current survey provide preliminary information on the relative availability of termites within the numbat feeding zone, in order to assist in assessing the overall suitability of the Study Area to support numbats.

Comprehensive termite abundance assessments were not within the scope of work for the current survey and would include more survey points within each vegetation type and additional useful measures including measurement of soil and air temperatures and collection of termites for identification at the species level in accordance with the Friend (2004) methodology. These detailed termite abundance assessments may be a consideration for future targeted numbat surveys within the Study Area.



Plate 2.1: Termite abundance assessment in Jarrah habitat (site VMTR-021)



Plate 2.2 Termite exiting gallery during targeted termite abundance assessment (VMTR-023)

2.4.5 Limitations

The EPA (2020) outlines several potential limitations and constraints which have the potential to affect results of terrestrial vertebrate fauna surveys (Table 2.3).

Table 2.3: Survey limitations and constraints

Potential limitation or constraint	Limitation	Applicability to this survey
Availability of data and information	No	There has been numerous basic and targeted previous vertebrate fauna surveys undertaken in the region (Bamford Consulting Ecologists, 2021; Biologic, 2023b; Biostat, 2017, 2019, 2020, 2021a, 2021b; Ninox, 2003b). Numerous research programs and studies on numbat have been conducted within the local region such as at the Dryandra Woodland National Park, Boyagin Nature Reserve, and Batalling Forest Block (Christensen, 1975; Christensen <i>et al.</i>, 1984; Connell & Friend, 1985; Friend & Thomas, 1994; Hayward <i>et al.</i>, 2015; Maisey & Bradbury, 1982; Moseby <i>et al.</i>, 2011) as well as on interstate translocated populations (Hayward <i>et al.</i>, 2015; Moseby <i>et al.</i>, 2011; Vieira <i>et al.</i>, 2007). Recent work on sign surveys has also been published (Seidlitz, 2021; Seidlitz <i>et al.</i>, 2021a, 2021b; Thorn <i>et al.</i>, 2022), as well as a recent thesis on the population in the Upper Warren (Thorn, 2023). Overall, numbat ecology, populations, and habitat are well studied and understood, and as such adequate data and information was available to complete the assessment.
Competency/ experience of the survey team, including experience in the bioregion surveyed	No	The zoologists who undertook the survey have extensive survey experience within the region and are familiar with and competent in the fauna sampling methods outlined.
Scope (groups sampled and whether any constraints affect this)	No	The survey was completed in line with the scope of a terrestrial vertebrate fauna survey (EPA, 2020). All components of the survey were completed over the field survey period.
Timing, weather and season	Minor	Trip 1 of the current survey fell just outside of the period of juvenile numbat dispersal (November to early December) (DPaW, 2017), while trip 2 was planned to coincide with the time of maximum numbat abundance when detection is most likely. The conditions experienced were considered suitable to assess the suitability of habitat for numbat, as foraging and breeding resources would not have been detrimentally affected by climatic conditions leading up to the field survey.
Disturbance that may have affected results	No	The primary disturbances to the Study Area are mining-related activities, previous agricultural land use, and road network, which fragment the habitat present and limit the fauna that can be reside or disperse through the Study Area and broader region. However, these disturbances were not considered to constrain the survey methodology and are a feature of the Study Area, having been present for decades.

Potential limitation or constraint	Limitation	Applicability to this survey
Proportion of fauna identified, recorded, or collected	No	All observed fauna were either identified at the point of observation or identified during analysis of camera data when downloaded.
Adequacy of the survey intensity and proportion of survey achieved	Minor	A targeted numbat survey was undertaken across the Study Area. It is considered that the work is of a sufficient level to meet EPA requirements and the objectives of the survey. Most of the remnant vegetation within the Study Area was traversed on foot with all tasks achieved within the allotted field time. Termite abundance assessments were undertaken in part (less survey points than suggested in Friend (2004) methodology) as an additional measure of habitat suitability for numbats.
Access problems	No	Most of the remnant vegetation within the Study Area was traversed either by vehicle or foot. The main disturbance to the Study Area is the presence of mining activity that limited access to some areas, however, habitat assessments and targeted searches were undertaken in all suitable habitats within the Study Area.
Problems with data and analysis	No	No issues with data or analysis were experienced.

3 Results and Discussion

3.1 Previous Records

Prior to the current assessment, there were 17 records of numbat within 25 km of the Study Area, ten of which were greater than 40 years old (DBCA, 2024) (Figure 3.1). These records include multiple observations north of the Study Area within the Youralling State Forest from 1960–1981. One record from 1997 occurs along a mine access road within the Marradong area of the Boddington Bauxite Mine; however, this record did not coincide with any known fauna survey results, and Biostat (2021b) (following consultation with Ninox Wildlife Consulting who recorded the sighting), concluded that the sighting was likely a misidentification of a chuditch (*Dasyurus geoffroii*) or quenda. In 2015, a photograph of a numbat was taken in the Bell Conservation Park on the corner of Bell Brook Road and Boundary Road, approximately 20 km south of the Study Area (DBCA, 2024). Dryandra Woodland National Park, located approximately 29 km east of the Study Area, is estimated to support greater than 100 adult numbats with populations remaining stable and even increasing in the last few years to more than 500 individuals (DPaW, 2017).

In 2021, following a community sighting of a numbat in an adjacent private property (only 150 m north of the Study Area), a survey was undertaken immediately north of the Study Area, which identified an additional three numbat records (Biostat, 2021a). It was later determined that these records were likely to be representative of a single dispersing individual that had originated from Dryandra Woodland (Biostat, 2021a), although it may also have dispersed from the Batalling Forest Block (Biologic, 2023a).

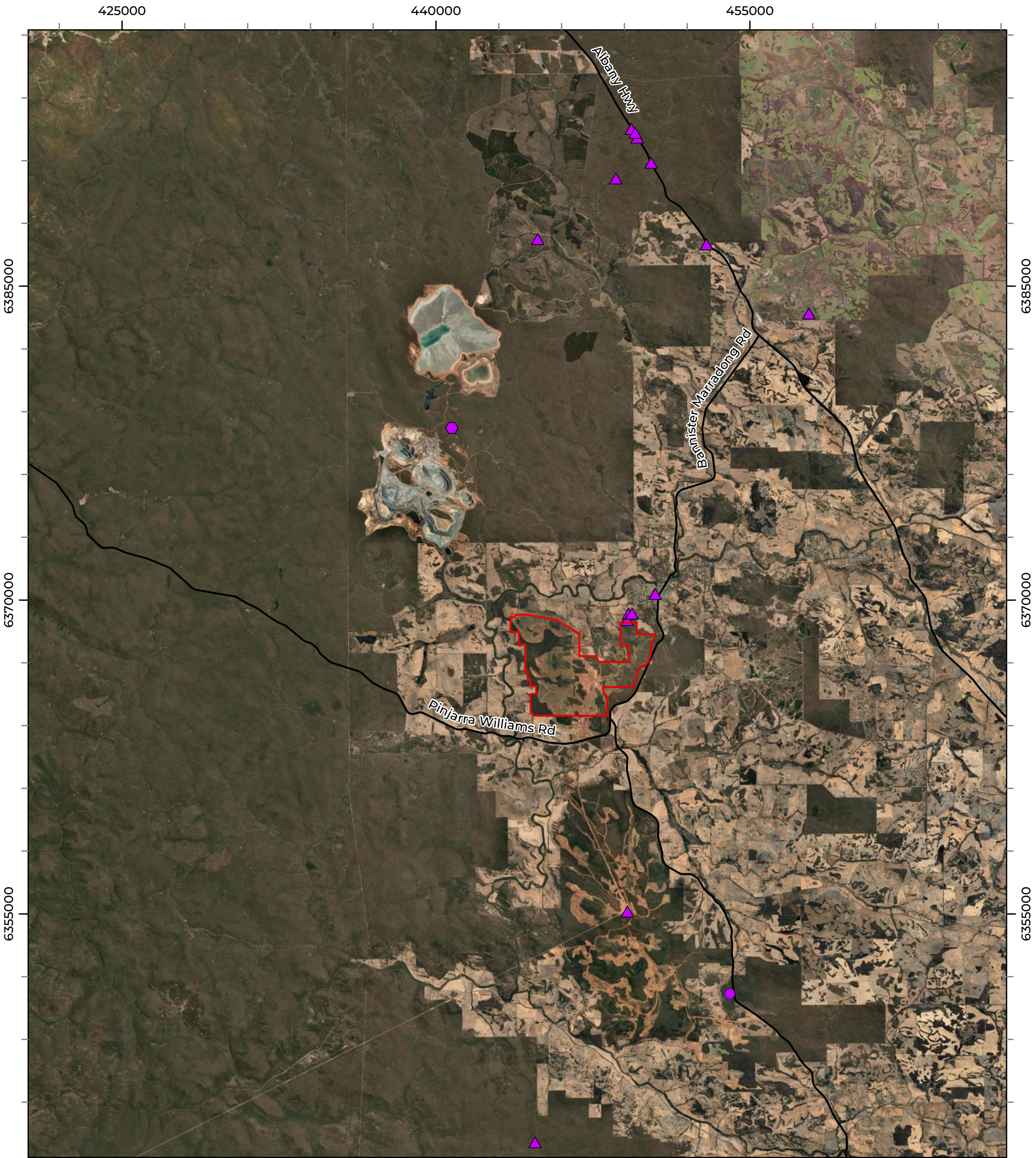
The same individual was sighted on multiple occasions, including crossing major roads between the remnant vegetation and Boddington townsite (P. Bullock, Worsley Alumina, pers. comms, October 2021). Given that it was recorded over a six month period outside the primary dispersal period of November or early December (DPaW, 2017), and numbats remain in the same home range after dispersal, it is considered likely that this is a resident in the area. This individual had not been recorded again despite further camera trapping attempts in 2022 by South32 and is assumed to have either moved on or been taken by a predator (S. Kenny, Worsley Alumina, pers. comms, December 2024).

In 2022, Biologic (2023b) recorded numbat from secondary evidence (diggings and scat) within rehabilitation in proximity to the Newmont Boddington Gold Mine, approximately 9.4 km north-west of the Study Area (Figure 3.1). Ten diggings that opened into termite galleries were recorded. Additionally, a scat recorded during the survey was collected and sent for morphological identification and determined to be from numbat. Most recently in 2023 (Biologic, 2024) recorded three scat and three diggings confirmed to be numbat in the

Lupton Nature Reserve, approximately 40 km to the north-east of the Study Area. While this is a reasonably large distance, the habitats in which they were detected (in patches of Wandoo within Jarrah/ Marri Woodland Habitat) are analogous with those in the current Study Area and are also connected to parts of adjoining State Forest that includes other recent and historical numbat records.

3.2 Current Survey Records

No confirmed evidence of numbats occurrence was recorded within the Study Area during the current surveys. While potential secondary evidence of numbat was observed in the field, including five records of potential diggings and one scat record, these could not be confirmed with certainty due to their age and poor condition. The five records of potential numbat diggings observed appeared to be of the correct diameter, depth, shape, lacked a unidirectional soil scatter, and were recorded in small clusters (between 2–6 diggings) across multiple exposed soil piles. However, the diggings were not fresh and lacked evidence of entry points into termite galleries; these diggings cannot be confirmed as numbat. The single scat was recorded during trip 1 (19 September 2024) and appeared to be of appropriate size, shape and colour to be numbat scat. The contents were examined in the field and appeared to consist of materials inclusive of termite exoskeletons.

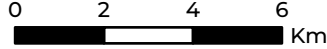


LEGEND

- | | |
|---|---|
|  Study Area | Numbat - EN |
|  State Road |  DBCA |
| |  Biologic (2022) |
| |  Biologic (2023) |
| |  Biologic (2024) |



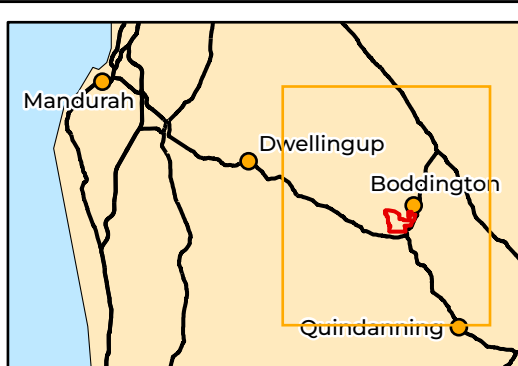
Scale 1:170,000



Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 06/01/2025



Biologic



**SOUTH32/WORSLEY ALUMINA
Marradong Timber
Reserve Targeted
Numbat Survey**

Figure 3.1: Previous records
of Numbat in the vicinity
of the Study Area

3.3 Habitat Suitability

3.3.1 Fauna Habitats

Six broad habitat types were mapped across the Study Area, comprising, in decreasing extent (Table 3.1; Figure 3.2):

- Rehabilitation (983.23 ha, 51.00%)
- Jarrah/ Marri/ Allocasuarina (207.71 ha, 10.77%)
- Wandoo Woodland (129.93 ha, 6.74%)
- Jarrah/ Marri on Slopes (131.18 ha, 6.80%)
- Marri/ Jarrah on Lower Slopes (20.02 ha, 1.04%)

The remaining areas within the Study Area are Cleared areas (those cleared for agriculture, infrastructure, and mining), comprising 455.82 ha (23.64%) (Figure 3.2).

Within the Rehabilitation habitat, there are a variety of revegetation age classes, each containing varying degrees of vegetation growth, cover, structure, and soil qualities.

Four habitat types have *Eucalyptus* species as their dominant upper storey: Jarrah/ Marri/ Allocasuarina (207.71 ha, 10.77%); Jarrah/ Marri on Slopes (131.18 ha, 6.80%); Wandoo Woodland (129.93 ha, 6.74%) and Marri/ Jarrah on Lower Slopes (20.02 ha, 1.04%) (Figure 3.2). As the survey targeted numbat and the presence of suitable habitat for this species, survey effort was highest within these four habitat types.

Table 3.1: Fauna habitats present in Study Area

Fauna habitat	Description	Photo	Area within Study Area (ha) %	Numbat habitat suitability			
				Foraging	Breeding	Dispersal	Overall
Rehabilitation	Areas of land cleared for the purposes of mining, at various stages of rehabilitation. Includes areas recently ripped and seeded with little germination present, to areas of rehabilitation completed >5 years ago with close to 100% vegetation cover including various species of tree and shrub, scattered stands of large woody debris for fauna habitat/cover. Rehabilitated areas had scarce vegetation litter, no hollows, minimal hollow logs, and minimal outcropping.		983.23 ha 51.00%	Nil-Moderate	Nil	Nil-High	Low-High ¹
							
Cleared	Habitat includes areas cleared of native vegetation including agricultural land, roads, infrastructure, and mining areas. The dominant landform of the habitat was recorded as Undulating Low Hills and Plain on Loamy Sand.		455.82 ha 23.64%	Low-Moderate	Low	Low	Low

¹ Rehabilitated areas varied in their suitability for numbats depending on the age of rehabilitation which may range from just seeded to > 5 years old.

Fauna habitat	Description	Photo	Area within Study Area (ha) %	Numbat habitat suitability			
				Foraging	Breeding	Dispersal	Overall
Jarrah/ Marri/ Allocasuarina	Habitat including a mixture of jarrah, marri, with understory including <i>Acacia</i> spp., <i>Banksia</i> spp., peppermint (<i>Agonis flexuosa</i>), cypress pine (<i>Callitris</i> spp.), sheoak (<i>Allocasuarina</i> spp.), and York gum. The dominant landform of the habitat was recorded as Undulating Low Hills on Clay/ Loam.		207.71 ha 10.77%	High	Moderate	Moderate-High	High
Wandoo Woodland	Woodland habitat dominated by wandoo. The dominant landform of the habitat was recorded as Undulating Low Hills on Clay/ Loam.		129.93 ha 6.74%	Moderate-High	Moderate-High	Moderate-High	High
Jarrah/ Marri on Slopes	Forest habitat dominated by one or a mixture of jarrah and marri, over an understorey and midstorey of native shrubs, grasses, and herbs. The dominant landform of the habitat was recorded as Undulating Low Hills on Clay/ Loam.		131.18 ha 6.80%	High	Moderate-High	High	High
Marri/ Jarrah on Lower Slopes	Forest habitat dominated by one or a mixture of jarrah and marri, over an understorey and midstorey of native shrubs, grasses, and herbs. The dominant landform of the habitat was recorded as Undulating Low Hills on Clay/ Loam. Small drainage line runs through part of this habitat and soil was wetter on these lower slopes. Ground truthing recorded predominantly jarrah woodland in this Mattiske (2021) vegetation type.		20.02 ha 1.04%	Moderate	Moderate	High	Moderate
Total			1,927.90 100%				

3.3.2 Numbat Habitat Suitability Assessment

Four types of eucalypt woodland occur in the Study Area, of which three types have jarrah and marri as their dominant overstorey. It was previously thought that numbats prefer wandoo woodland over other habitats, based on studies within the Dryandra Woodland National Park (Calaby, 1960); however, recent studies have found no preference between jarrah and wandoo-dominated habitat types (Seidlitz, 2021). This is consistent with their presence in the jarrah forest of the Upper Warren region where numbats persist in high numbers due to the presence of available hollows over tree species (Seidlitz, 2021).

Three of the eucalypt woodland habitats within the Study Area (Jarrah/ Marri on Slopes, Jarrah/ Marri/ Allocasuarina and Wandoo Woodland) have suitable quality and quantities of critical habitat elements (hollow logs or woody debris, understorey cover, food resources) to support numbats for foraging, breeding, and predator protection, and are classified as having high suitability (Table 3.1). These areas with high suitability comprise 141.37 ha (22.00%) of the Study Area (Figure 3.3). These areas also had the highest breeding suitability of habitats present, characterised by the presence of suitable hollow logs for nesting and dense understorey for cover from predators. There were small areas within these three habitats considered low suitability (usually on the edge of Rehabilitation and Cleared areas) (40.85 ha, 2.12%) due to the degraded nature of the habitat and edge effects, providing low cover and less hollow logs available for protection and refuge from predators.

The Marri/Jarrah on Lower Slopes habitat (20.02 ha, 1.04%) was considered moderate suitability (supporting habitat) for numbats due to its location in the landscape at the bottom of a valley, with a drainage line and natural seep in parts of this habitat, indicating it may be too wet for numbat foraging. It would be considered supporting habitat.

Large parts of the Study Area were cleared or Rehabilitation habitat, consisting of relatively young rehabilitation (<5 years old). These areas lack surface leaf litter, sticks and fallen logs, which consequently reduces termite abundance and were therefore rated as low suitability (988.67 ha, 51.28%). Areas of older rehabilitation (>5 years old) are likely to have small amounts of leaf litter and fallen debris, and organic materials present in the soil that contribute to termite abundance in those areas and, as such, present higher availability of foraging resources for numbats but there was a lack of open areas and were therefore rated as moderate suitability (425.62 ha, 22.08%) and considered to provide potential supporting habitat. Two areas of older Rehabilitation habitat within the Study Area are considered to provide suitable foraging, breeding and/or dispersal habitat for numbats, and provide some elements considered critical for the numbat, and were therefore considered high suitability (24.77 ha, 1.28%). In these areas, succession has led to thinning of vegetation and more open ground, allowing for suitable foraging whilst also providing protection from predators.

Termites use a number of different micro-habitats within the eucalypt forests (including leaf litter, and woody debris) and the presence of these indicates high quality foraging resources for the numbat. Almost 93% of the habitat assessment sites (n = 25), had large areas of leaf litter and woody debris (noting that assessments were not undertaken in Cleared areas) (Appendix B). Only two sites (in Rehabilitation and Jarrah/ Marri habitat) had no discernible leaf litter due to recent fire. Termite abundance assessments were undertaken at six sites and most detected active galleries in the surface soils. Abundance assessments uncovered the greatest number of termite galleries at sites VMTR-015 (ten galleries) and VMTR-021 (nine galleries) which were both located in jarrah-dominated habitats (Table 3.2). Whilst the detection of termite galleries confirms numbat food resources within the Study Area, termite availability (with the exception of VMTR-015 and VMTR-021) was lower compared to that recorded within Dryandra Woodland National Park (11.4 and 22 occupied galleries per 20 m furrows) (Friend, 2004). Termite abundance varied greatly within the Study Area, including within the same habitat type. Further widespread assessments could be undertaken to better understand the distribution of the food resources available to numbats across various habitats.

Table 3.2 Termite abundance assessments

Location	Habitat	Occupied galleries within 2 m x 10 m transects (T1 and T2) with distance at which galleries were recorded along each transect and number of individual termites in brackets	Occupied galleries/ 20 m
VMTR-001	Jarrah/ Marri on Slopes	T1: 2.70 m (1) T2: 7.30 m (1)	2
VMTR-010	Jarrah/ Marri on Slopes	T1: 0 T2: 8.40 m (2)	1
VMTR-015	Jarrah/ Marri on Slopes	T1: 5.85 m (1), 5.95 m (10) T2: 7.40 m (2), 8.10 m (2), 7.20 m (3), 6.10-7.50 m (50), 5.80 m (2), 5.40 m (1), 5.0 m (1), 4.40 m (1)	10
VMTR-021	Jarrah/ Marri/ Allocasuarina	T1: 8.40 m (2), 7.60 m (2), 6.40-6.70 m (>30), 5.45-5.90 m (>50), 2.70 m (1), 2.50 m (30), 2.12 m (5), 1.90 m (2) T2: 3.91 m (2)	9
VMTR-023	Wandoo Woodland	T1: 0.30 m (10) T2: 5.50 m (2), 7.40 m (3)	3
VMTR-027	Rehabilitation	T1: 0 T2: 3.60 m (3), 7.00 m (3), 7.40 m (20), 8.0-8.30 m (5)	4
Mean			4.83

Refugia from predators, daytime rest areas and nesting hollows occur in all the eucalypt habitat sites. Hollow logs were observed at over 52% of sites in these habitats (Appendix B). As the Study Area was largely located within jarrah dominated woodlands, the availability of fallen trees with hollows would be expected to be moderate, given the woody growth nature of jarrah and the general lack of hollow-forming structure in this species. Most hollows present included burnt out logs of jarrah and other species or fallen trunks and limbs of marri and other species with naturally formed hollows.

The patch size and connectivity of remnant vegetation is also important in determining the likely usage of habitats by numbats within the Study Area. Numbats require large areas of natural woodland vegetation because of their relatively large home ranges (~25 - 280 ha, median of 30-50 ha), which are exclusive from individuals of other sexes and differ between sexes (DPaW, 2017; Thorn, 2023). Habitat rated as high suitability within the Study Area comprises 448.88 ha (23.28%) and based on the density estimate from the Upper Warren subpopulation and the general ranges used for numbats (i.e. 50 ha per pair), the Study Area may support one up to 12 individuals (six pairs), when taking into account connected patches of vegetation of greater than 50 ha rather than just a total combined area of individual patches. It should be noted that this is a very rough approximation of the potential number of numbats that the Study Area may support, given the variability in home ranges and also noting that this is likely to vary seasonally as well as with habitat type and quality.

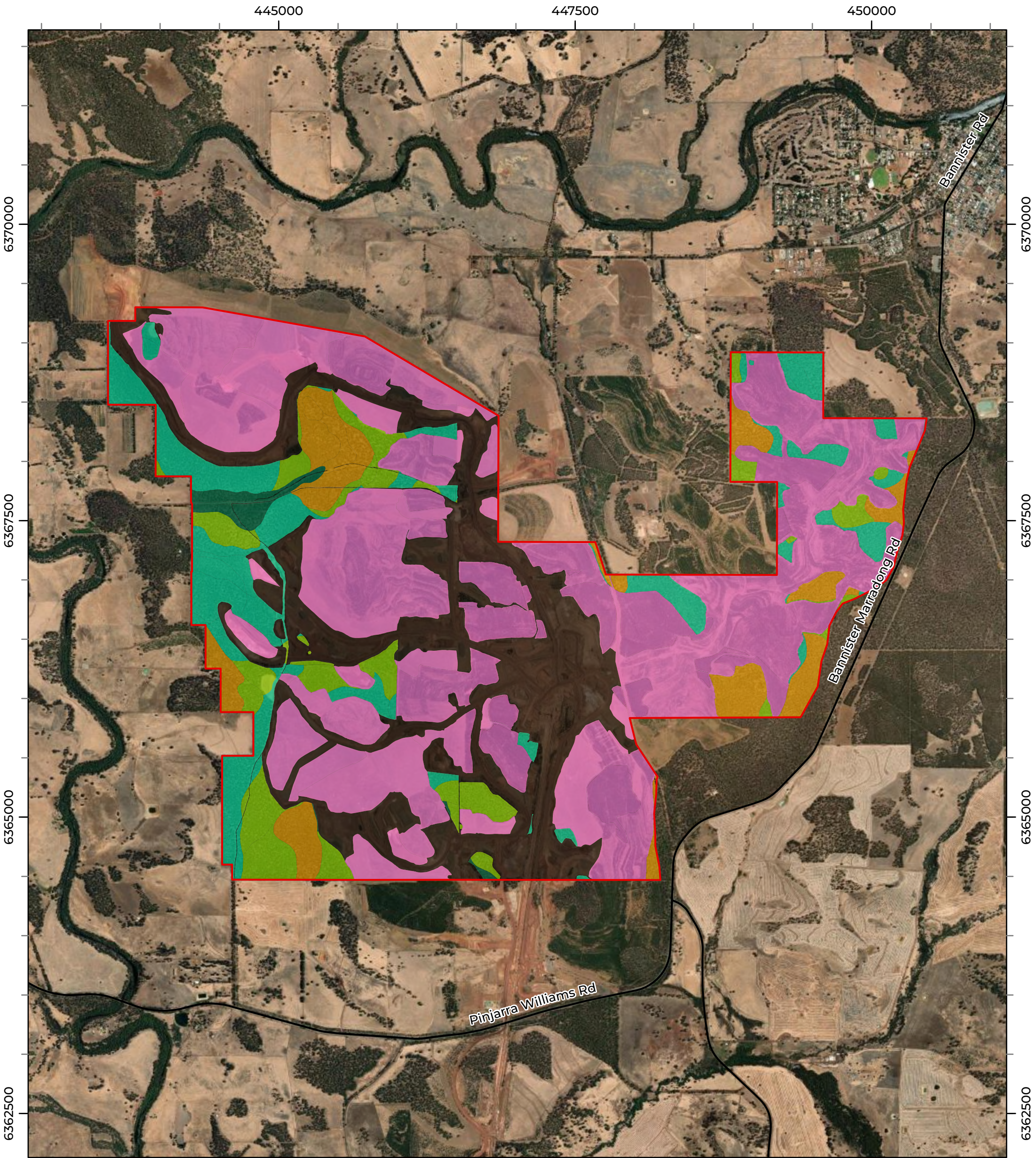
While the Study Area is predominantly surrounded by farmlands (Figure 1.1), some of the intact remnant vegetation considered high suitability are connected via corridors and/ or pockets of vegetation to larger more extensive areas of forest and reserve where previous records of numbat are known to previously occur or still exist. The Dwellingup State Forest is located approximately 4 km from the Study Area, with minor habitat corridors connecting this forest to similar vegetation within the Study Area (Figure 1.1). While considered relatively minor, these corridors do offer potential avenues of protection for ingress/ egress to and from the Study Area. Dwellingup State Forest forms a large continuous corridor that integrates the Batalling Forest Block numbat population to the south and allows connectivity to the Study Area for dispersing individuals.

Further abroad, Dryandra Woodland National Park located east of the Study Area is separated by approximately 29 km of cleared and otherwise unnatural habitat. Whilst it is generally considered unlikely that numbats would disperse this distance, given their large home range, and tracking studies recording dispersal distances from Dryandra of up to 22–25 km in 1991–1995 (Tony Friend pers. comm. in Biostat (2021c)), larger dispersal movements may be possible. The individual numbat records from 2021 and thought to have come from Dryandra are located just outside the north-eastern boundary of the Study Area near sites VMTR-009 and VMTR-013 (Figure 3.1). This area of remnant vegetation extends outside of the Study Area to the north and east and connects with the larger Marradong Timber Reserve.

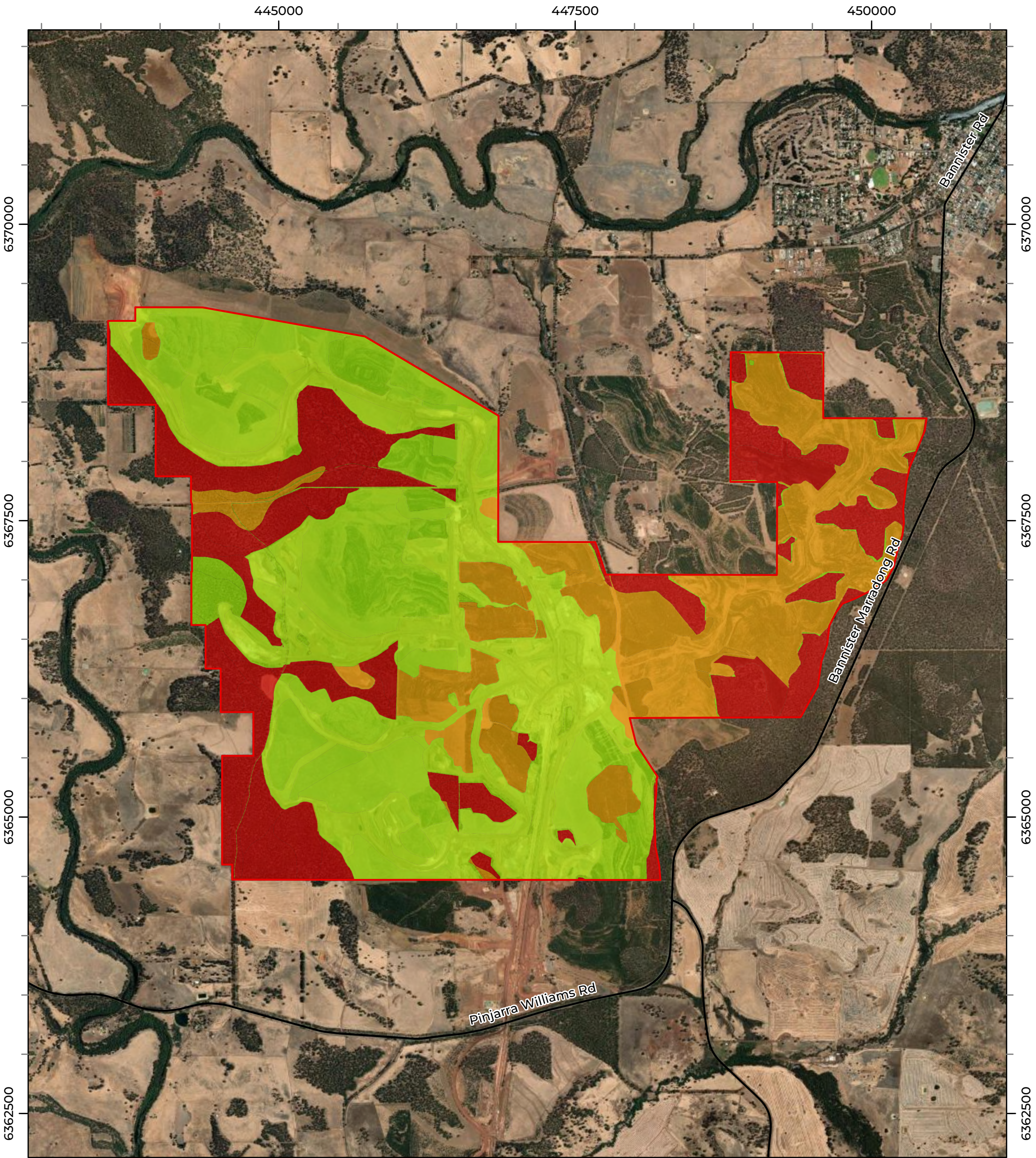
The largest area of high suitability habitat is located within the north-western portion of the Study Area (Figure 1.1). This pocket of vegetated habitat (~100 ha) provides one of the only vegetated sites that extends into suitable habitat outside of the Study Area boundary and which is large enough that it could support up to two pairs (based on DPaW (2017) density estimates). Thin vegetated corridors extend to the north from the north-west corner of the Study Area and connect to the broader Dwellingup State Forest (Figure 1.1). Studies have shown that dispersing numbats rarely cross farmland and instead use corridors of native vegetation, following the edge of the bushland (Friend, 2008). The vegetated area of high suitability habitat located in the south-west of the Study Area (~100 ha), which could support up to two pairs (based on DPaW (2017) density estimates) is connected to this large patch to the north, but only by vegetated areas of low suitability and is dissected by a road.

Small patches of high suitability habitat occur along the eastern portion of the Study Area (including sites such as VMTR-008, VMTR-014, VMTR-015, VMTR-018, VMTR-025 and VMTR-027) that are connected to each other through similar habitat within the greater Marradong Timber Reserve outside the Study Area. The combined area of these patches is approximately ~75 ha within the Study Area, and considering additional habitat exists outside, these patches may support up to two pairs (based on DPaW (2017)).

Isolated patches of remnant vegetation of high suitability smaller than 50 ha occur throughout the Study Area separated by large expanses of cleared or rehabilitated areas (200 m up to 1 km). These patches are considered too small and isolated to support individual numbats. Although not considered suitable to maintain a population of numbats, they may be important if they connect areas of larger habitat and have adequate vegetation cover that can be used by dispersing numbats. Areas of older rehabilitation that connect areas of remnant vegetation can also provide suitable cover and dispersal habitat between areas of high habitat suitability.



LEGEND		 Scale 1:30,000 0 0.5 1 Km Coordinate System: GDA 1994 MGA Zone 50 Transverse Mercator Created: 08/01/2025	 Biologic
 Study Area	Fauna Habitat (adapted from Mattiske, 2021)  Cleared  Jarrah/ Marri on slopes  Jarrah/ Marri/ Allocasuarina  Marri/ Jarrah on lower slopes  Rehabilitation  Wandoo woodlands		



LEGEND

 Study Area

Numbat Habitat Suitability

 High

 Moderate

 Low



Scale 1:30,000

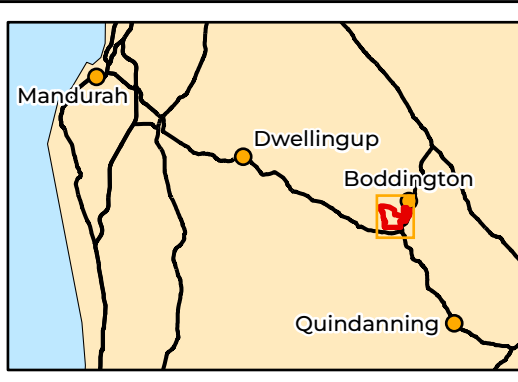
0

0.5

1

Km

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 08/01/2025



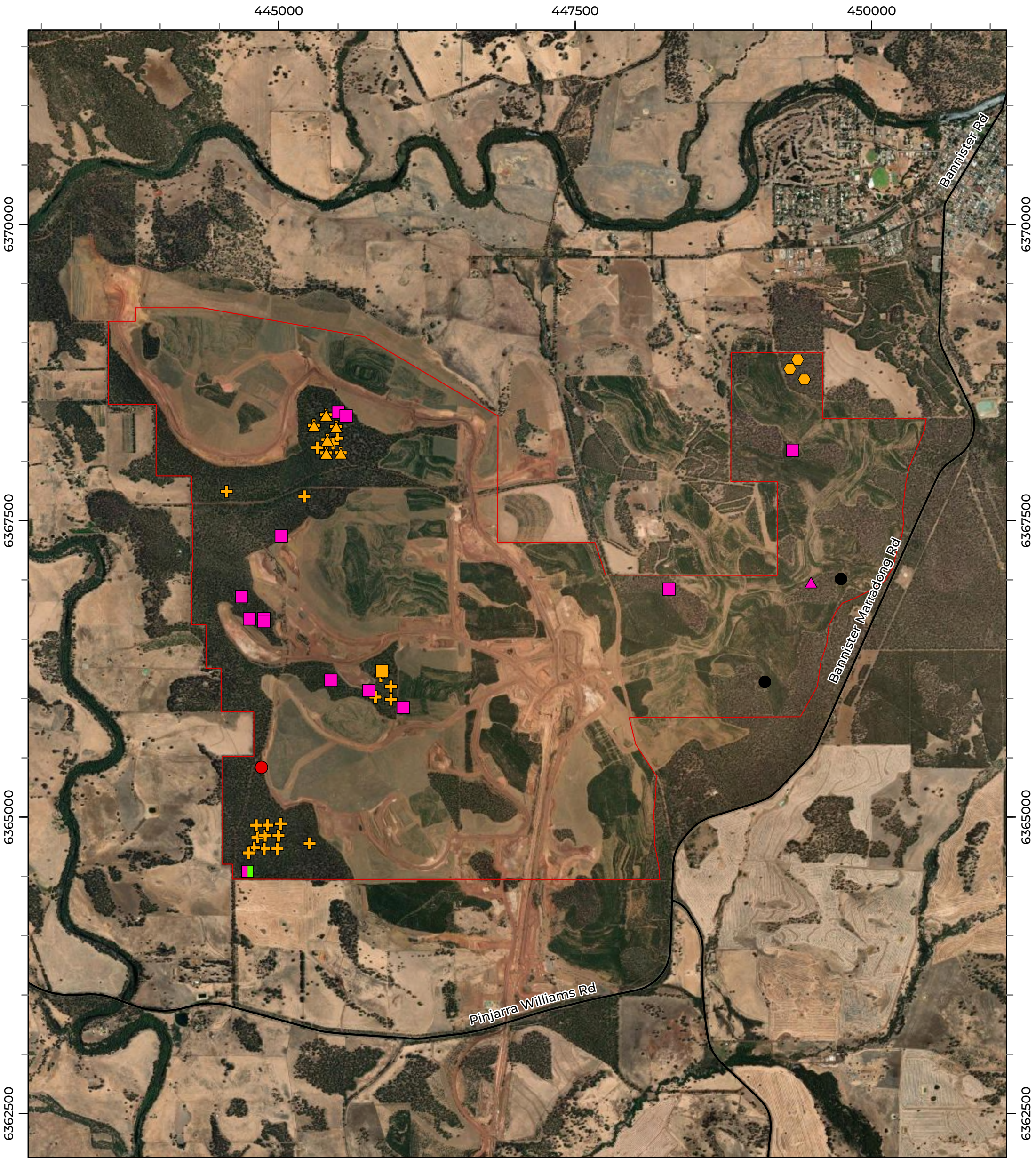
SOUTH32/WORSLEY ALUMINA
Marradong Timber
Reserve Targeted
Numbat Survey

Figure 3.3: Numbat habitat suitability in the Study Area

3.4 Other Significant Species

Six non-target significant species were recorded in the Study Area during the current survey (Figure 3.4; Appendix D):

- Woylie were recorded on 14 occasions, including one record of primary evidence (a live individual) and a further 13 records of secondary evidence (scat and diggings). A single individual was observed within Jarrah/ Marri on Slopes (site VMTR-002) (Plate 3.2) whilst undertaking targeted searches on 5 November 2024. A further 13 observations of secondary evidence including diggings (n = 11) and digging with associated scat (n = 2) (Plate 3.1) were recorded within Jarrah/ Marri on Slopes and Jarrah/ Marri/ Allocasuarina habitats.
- Baudin's cockatoo (*Zanda baudinii* - Endangered (EPBC Act and BC Act) - were recorded on two occasions (three individuals and two individuals) in Wandoo Woodland habitat.
- Forest red-tailed black cockatoo (*Calyptorhynchus banksii naso* - Vulnerable (EPBC Act and BC Act) was recorded on one occasion (two individuals) flying opportunistically over the Study Area.
- Red-tailed phascogale (*Phascogale calura* - Vulnerable (EPBC Act) and Conservation Dependant (BC Act)) were identified 22 times via camera trap at site VMTR-009 in Jarrah/ Marri/ Allocasuarina habitat (Plate 3.3).
- Quenda (Priority 4 (DBCA) was identified 20 times via camera trap at site VMTR-005 and once opportunistically via a digging (no site) (Plate 3.4). Biologic (2023a) also recorded quenda within the Study Area from a digging located in Jarrah Woodland.
- Western brush wallaby (*Notamacropus irma* - Priority 4 (DBCA) were recorded on 93 occasions across the Study Area, of which 87 were identified via camera trap at sites VMTR-001, VMTR-002, and VMTR-005 in Jarrah/ Marri on Slopes, Jarrah/ Marri/ Allocasuarina Woodland and Wandoo Woodland habitats (Plate 3.5). One active individual was recorded during a targeted search at VMTR-001, and a further five individuals were recorded opportunistically, four at unspecified sites and one at VMTR-002.



LEGEND

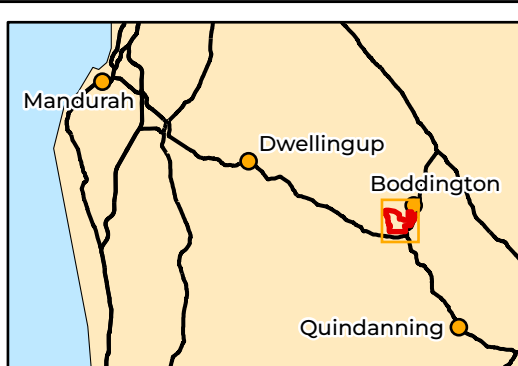
- | | |
|------------------------------|---------------------------------------|
| Study Area | Forest red-tailed black cockatoo - VU |
| State Road | Individual (alive) |
| Significant Species Recorded | Quenda - P4 |
| Woylie - CR | Digging |
| Individual (alive) | Individual (alive) |
| Digging | Western brush wallaby - P4 |
| Digging and Scat | Individual (alive) |
| Baudin's cockatoo - EN | Red-tailed Phascogale - CD |
| Individual (alive) | Individual (alive) |



Scale 1:30,000

0 0.5 1 Km

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 08/01/2025



Biologic

**SOUTH32/WORSLEY ALUMINA
Marradong Timber
Reserve Targeted
Numbat Survey**

Figure 3.4: Other significant fauna recorded during the current survey



Plate 3.1 Woylie digging and associated scat recorded in Jarrah/Marri on Slopes at targeted search site VMTR-001



Plate 3.2 Jarrah/ Marri on Slopes at site VMTR-002 where a live woylie was observed



Plate 3.3: Red-tailed phascogale recorded on camera trap at VMTR-009 in Jarrah/ Marri/ Allocasuarina habitat



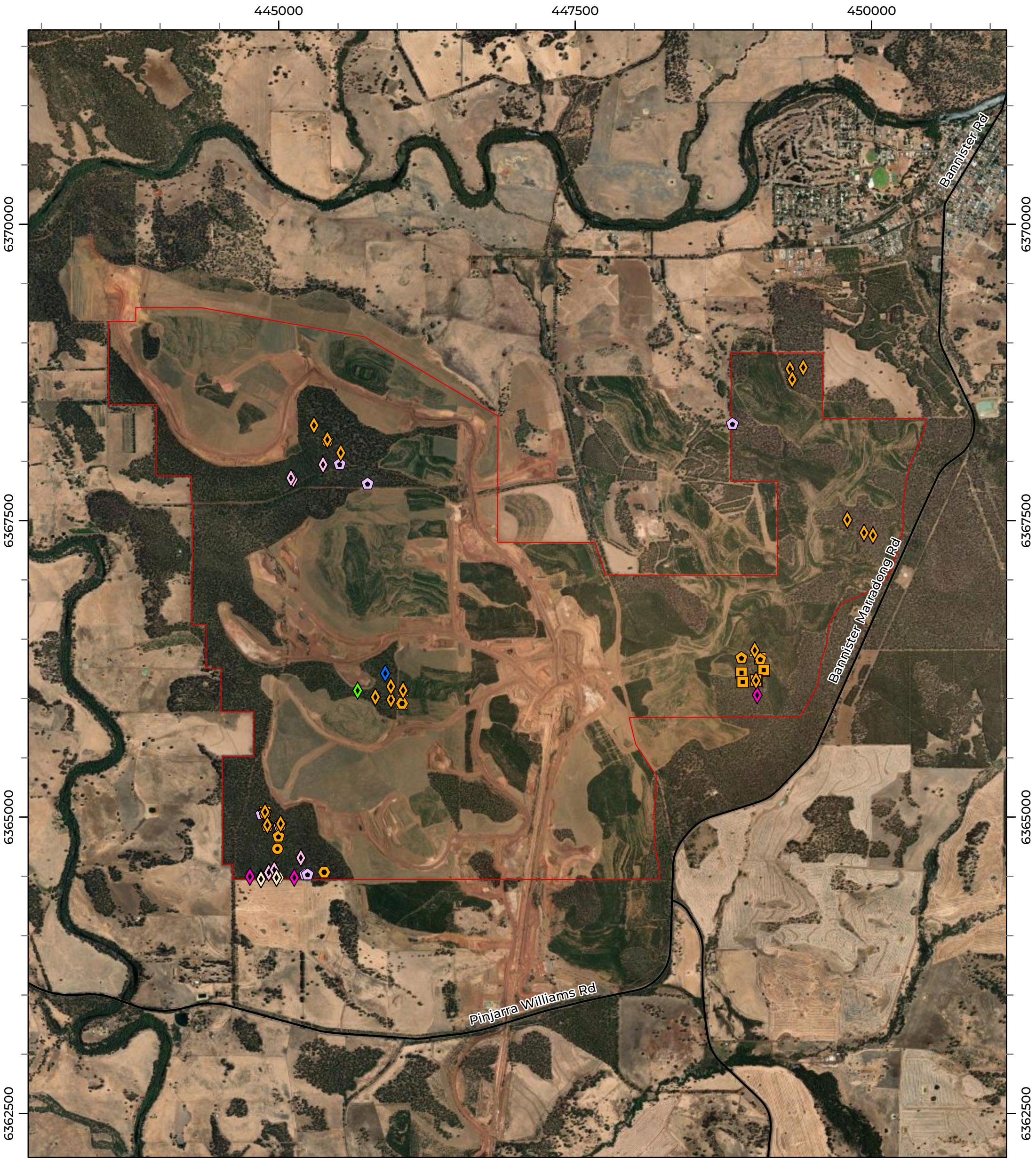
Plate 3.4: Quenda recorded on camera trap at VMTR-005 in Wandoo Woodland



Plate 3.5: Western brush wallaby recorded on camera trap at VMTR-001 in Jarrah/ Marri on Slopes

3.5 Introduced Species

Six introduced species were recorded within the Study Area during the current surveys, including two predator species; red fox and feral cat (Figure 3.5). Red foxes were identified on 31 occasions via camera traps at six locations (VMTR-001, VMTR-002, VMTR-005, VMTR-009, VMTR-010, and VMTR-015) (Plate 3.6), with a further 14 records of secondary evidence (dens, scats) (Plate 3.6; Figure 3.5). Feral cats were recorded on 23 occasions via camera traps at two locations (VMTR-001 and VMTR-015) (Plate 3.7). Additionally, pig ($n = 46$), black rat (*Rattus rattus*) ($n = 20$), rabbit (*Oryctolagus cuniculus*) ($n = 13$) and house mouse (*Mus musculus*) ($n = 10$) were recorded via camera traps and opportunistically across the Study Area (Figure 3.5). The introduced predator species (cat and red fox) were recorded within both remnant vegetation and Rehabilitation habitat, mostly on the edges of large vegetation patches, in small vegetation patches, or areas recently burned.



LEGEND

- Study Area
- State Road

Introduced Species

- Black Rat
 - Individual (alive)
- Cat
 - Individual (alive)
- House mouse
 - Individual (alive)
- Pig
 - Digging
 - Individual (alive)

Rabbit

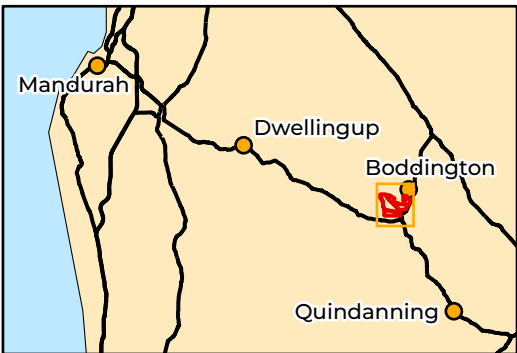
- Individual (alive)
 - Individual (dead)
- Red fox
- Den (active)
 - Den (inactive)
 - Individual (alive)
 - Individual (dead)
 - Scat
 - Secondary Evidence



Scale 1:30,000

0 0.5 1 Km

Coordinate System: GDA 1994 MGA Zone 50
Transverse Mercator Created: 09/01/2025



Biologic

SOUTH32/WORSLEY ALUMINA
Marradong Timber
Reserve Targeted
Numbat Survey

Figure 3.5: Introduced
species recorded during
the Survey



Plate 3.6: Red fox captured on camera trap at site VMTR-002 in jarrah dominated woodland



Plate 3.7 Feral cat detected via camera trap at site VMTR-015 in jarrah dominated woodland

4 Conclusion and Recommendations

At a broad scale, 448.88 ha (23.28% of the Study Area) is considered of high suitability for numbats, as the dominant vegetation types are mature eucalypt woodlands, with hollows for numbats to use for nesting, and suitable levels of ground cover for protection from predatory species. While survey effort during the current survey was considered appropriate for the detection of numbats, no numbats were confirmed in the Study Area during the survey (potential diggings and scat could not be confirmed due to degradation and age). Due to the species' cryptic behaviour and its occurrence often in low abundance, the likelihood of detecting very few individuals is challenging, therefore assessment of habitat suitability and proximity to recent records of the species is also considered important in determining the value of these areas and the likelihood of use by numbats.

Three of the eucalypt woodland habitats of the Study Area; Jarrah/ Marri/ Allocasuarina, Jarrah/ Marri on Slopes and Wandoo woodlands, are considered highly suitable for numbats (424.11 ha, 22.00%) and provide critical elements suitable for foraging, vegetation cover for refuge and, in most areas, hollows suitable for breeding. In addition, some older areas of Rehabilitation habitat within the Study Area were considered high suitability (24.77 ha, 1.28% rated as high).

The patch size and connectivity of high suitability habitat is also important in determining the likely usage of these habitats by numbats. While the Study Area is mostly surrounded by cleared land, corridors of remnant vegetation remain in the landscape that provide linkages between the Study Area and state forest. This includes high suitability habitat along the western boundary being connected to Dwellingup State Forest by narrow vegetated corridors in the north, and patches of high suitability habitat along the eastern boundary connected to the greater Marradong Timber Reserve outside the Study Area, increasing the potential for these areas to potentially support numbats.

Based on the occurrence of 448.88 ha (23.28%) of large remnants of high suitability habitat within the Study Area and on known density estimates and home ranges (DPaW, 2017; Thorn, 2023), the Study Area could support from one up to 12 individuals (six pairs) and reproductive potential amongst a locally occurring population. This is taking into account patch size and connectivity of patches within and outside the Study Area. The species is known to occur at low abundance and have large home ranges, and these larger remnants are likely to form part of a home range with individuals moving in and out of the Study Area, rather than a closed population within the Study Area.

There are large areas of the Study Area that would not be considered suitable for supporting numbats (1,029.51 ha, 53.40%), including large Cleared or more recently rehabilitated areas that fragment smaller patches of remnant vegetation. However, areas of rehabilitation that connect areas of remnant vegetation may provide suitable cover and dispersal habitat between areas of high habitat suitability in the future, as rehabilitated areas more likely to become suitable for numbat as age since planting increases.

Overall, there is potential for parts of the Study Area to support individuals or pairs of numbats within the broader landscape given high suitability habitat occurs and also considering that, whilst no numbats were confirmed as occurring during the survey, potential diggings and scats were recorded. However, other contributing factors such as fragmentation of habitat, introduced predators and fire regimes may reduce this capacity. Introduced predators were recorded frequently during the current survey, mostly on the edges of large vegetation patches, in small vegetation patches, or areas recently burned. The presence of these feral predators is likely to have a detrimental effect on the occurrence of numbats within the Study Area.

Whilst numbats may be capable of occurring within habitats of the Study Area (although not confirmed), whether it supports a viable population of numbats, defined as a self-sustaining population with a high probability of survival because it has sufficient numbers and reproductive potential, is more difficult to establish. There is no published literature on the numbers of numbats required for a self-sustaining population, although there appears to be no self-sustaining populations (as defined in DPaW (2017) of less than 20 individuals (DPaW, 2017; National Environmental Science Program Threatened Species Research Hub, 2019). In addition, the minimum area considered to be required to support a self-sustaining numbat (sub)population has been estimated at ~2,000 ha (DPaW, 2017). Therefore, it is unlikely that the Study Area (Marradong Timber Reserve) does support a viable numbat population, given that no numbats were recorded, it is 1,927.90 ha, of which only 448.88 ha is considered highly suitable for numbats, and could only potentially support up to 12 individuals.

Further targeted surveys for another year, using additional cameras spaced over a greater area for longer duration during optimal survey timing, as well as possibly investigating connected suitable habitat outside the Study Area, may be considered to further support this conclusion on the presence of numbats (and a viable population) within the Marradong Timber Reserve.

5 References

- Bamford Consulting Ecologists. (2021). *South 32 (Worsley). Summary progress report fauna investigations of proposed offset areas spring 2021*. Unpublished report prepared for South32 (Worsley). Bamford Consulting Ecologists, Kingsley, WA.
- Bester, A., & Rusten, K. (2009). Trial translocation of the numbat (*Myrmecobius fasciatus*) into arid Australia. *Australian Mammalogy*, 31(1), 9-16.
 doi:<https://doi.org/10.1071/AM08104>
- Biologic. (2023a). *South32 Worsley Alumina Boddington Mine and Offset Properties - Numbat Habitat Assessment*. Unpublished report for South32 / Worsley Alumina. Biologic Environmental Survey, East Perth, WA.
- Biologic. (2023b). *South32 Worsley Alumina Boddington Mine and Offset Properties - Numbat Habitat Assessment*. Unpublished report for South32 (Worsley).
- Biologic. (2024). *Worsley Alumina Extended Mine Areas - Numbat Habitat Assessment*. Unpublished report prepared for South32 Worsley Alumina. Biologic Environmental Survey, East Perth, WA.
- Biostat. (2015). *Vertebrate Fauna Monitoring Boddington Bauxite Mine 2014-2015*. Unpublished report prepared for South32 Worsley Alumina. Biostat, North Perth, WA.
- Biostat. (2017). *Mining extension areas associated with the Worsley Alumina production increase to 5.1Mtpa - Level 1 fauna assessment (1009025-002)*. Unpublished report for South32 Worsley Alumina. Biostat, North Perth, WA.
- Biostat. (2019). *Vertebrate Fauna Monitoring 2017-2018 Saddleback Operations*. Unpublished report prepared for South32. Biostat, North Perth, WA.
- Biostat. (2020). *PAA Offset Fauna Habitat Assessment Desktop Study/Ecological Values Field Surveys 2020*. Unpublished report prepared for South32. Biostat, North Perth, WA.
- Biostat. (2021a). *Targeted Surveys: Newmont Boddington Gold Mine and Worsley Refinery Lease Area*. Unpublished report prepared for South32 Worsley Alumina. Biostat, North Perth, WA.
- Biostat. (2021b). *Worsley Alumina Mine Expansion (PAA) Desktop Fauna Assessment*. Unpublished report prepared for South32 Worsley Alumina. Biostat, North Perth, WA.
- Biostat. (2021c). *Worsley Mine Expansion Offsets Fauna Habitat Assessment Ecological Values*. Unpublished report prepared for South32. Biostat, North Perth, WA.
- BoM, Bureau of Meteorology. (2024). Climate Data Online. Retrieved 2024
<http://www.bom.gov.au/climate/data/index.shtml>
- Calaby, J. (1960). Observations on the Banded ant-eater *Myrmecobius fasciatus* Waterhouse (Marsupialia). *Journal of Zoology*, 135(2), 183-207.
- Christensen, P. (1975). The breeding burrow of the Banded Anteater or Numbat (*Myrmecobius fasciatus*). *Western Australian Naturalist*, 13, 32-34.
- Christensen, P., Maisey, K., & Perry, D. (1984). Radiotracking the Numbat, *Myrmecobius fasciatus*, in the Perup Forest of Western Australia. *Wildlife Research*, 11(2), 275-288.
 doi:<https://doi.org/10.1071/WR9840275>
- Connell, G., & Friend, T. (1985). *Searching for numbats*. Landscape. Department of Conservation and Land Management,
- Cooper, C., & Withers, P. (2005). Physiological significance of the microclimate in night refuges of the numbat *Myrmecobius fasciatus*. *Australian Mammalogy*, 27(2), 169-174.
 doi:<https://doi.org/10.1071/AM05169>

- DBCA, Department of Biodiversity, Conservation and Attractions. (2024). Threatened and Priority Fauna database (custom search). from Department of Biodiversity Conservation and Attractions <https://www.dbca.wa.gov.au/management/threatened-species-and-communities/resources/threatened-species-and-communities-database-searches>
- DPaW, Department of Parks and Wildlife (2017). *Numbat (Myrmecobius fasciatus) Recovery Plan*. Wildlife Management Program No. 60. Department of Parks and Wildlife, Perth, WA.
- EPA, Environmental Protection Authority. (2020). *Technical guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment*. Western Australia: Environmental Protection Authority.
- Friend, J. (2008). Numbat, *Myrmecobius fasciatus*. In C. Van Dyck & R. Strahan (Eds.), *The Mammals of Australia* (pp. 162-165). Chatswood, NSW: Reed New Holland.
- Friend, J., & Thomas, N. (1994). Reintroduction and the numbat recovery program. In *Reintroduction biology of Australian and New Zealand Fauna* (pp. 189-198). Chipping Norton, NSW: Surrey Beatty & Sons.
- Friend, T. (2004). *Termite abundance assessment at potential numbat translocation sites*. Department of Conservation and Land Management, WA, Albany, WA.
- Hayward, M., Poh, A., Cathcart, J., Churcher, C., Bentley, J., Herman, K., . . . Friend, J. (2015). Numbat nirvana: conservation ecology of the endangered numbat (*Myrmecobius fasciatus*) (Marsupialia: Myrmecobiidae) reintroduced to Scotia and Yookamurra Sanctuaries, Australia. *Australian Journal of Zoology*, 63(4), 258-269. doi:<https://doi.org/10.1071/ZO15028>
- Maisey, K., & Bradbury, H. (1982). New Light on the Numbat. *Forest Focus*, 27, 14-24.
- Mattiske. (2021). *Assessment of Flora and Vegetation at Worsley Mine Expansion Primary Assessment Area*. Unpublished report prepared for South32 Worsley Alumina. Mattiske Consulting. Kalamunda, WA.
- Moseby, K., Read, J., Paton, D., Copley, P., Hill, B., & Crisp, H. (2011). Predation determines the outcome of 10 reintroduction attempts in arid South Australia. *Biological Conservation*, 144(12), 2863-2872. doi:<https://doi.org/10.1016/j.biocon.2011.08.003>
- National Committee on Soil and Terrain. (2009). *Australian soil and land survey field handbook* (Third ed.). Collingwood, VIC: CSIRO Publishing.
- National Environmental Science Program Threatened Species Research Hub. (2019). *Threatened Species Strategy Year 3 Scorecard - Numbat*. Canberra, ACT Retrieved from <http://www.environment.gov.au/biodiversity/threatened/species/20-mammals-by2020/numbat>.
- Ninox. (2003a). *Monitoring of Vertebrate Fauna within Forest & Rehabilitation at the Boddington Bauxite Mine*. Unpublished report prepared for Worsley Alumina. Ninox Wildlife Consulting, Lower King, WA.
- Ninox. (2003b). *The vertebrate fauna of the Boddington Gold Mine*. Unpublished report prepared for BGM Management Company. Ninox Wildlife Consulting, Lower King, WA.
- Seidlitz, A. (2021). *Development and application of survey methods to determine habitat use in relation to forest management and habitat characteristics of the endangered numbat (Myrmecobius fasciatus) in the Upper Warren region, Western Australia*. (Doctor of Philosophy), Murdoch University, Perth, WA.
- Seidlitz, A., Bryant, K., Armstrong, N., Calver, M., & Wayne, A. (2021a). Optimising camera trap height and model increases detection and individual identification rates for a small mammal, the numbat (*Myrmecobius fasciatus*). *Australian Mammalogy*, 43(2), 226-234. doi:<https://doi.org/10.1071/AM20020>

- Seidlitz, A., Bryant, K., Armstrong, N., Calver, M., & Wayne, A. (2021b). Sign surveys can be more efficient and cost effective than driven transects and camera trapping: a comparison of detection methods for a small elusive mammal, the numbat (*Myrmecobius fasciatus*). *Wildlife Research*. doi:<https://doi.org/10.1071/WR20020>
- Thackway, R., & Cresswell, I. (1995). *An interim biogeographical regionalisation for Australia: A framework for setting priorities in the National Reserves System Cooperation Plan*. Canberra, ACT: Australian Nature Conservation Agency.
- Thorn, M. (2023). *The population and spatial ecology of the numbat (Myrmecobius fasciatus) in the Upper Warren, southwest Australia*. (Doctor of Philosophy PhD Thesis), University of Western Australia, Perth, WA.
- Thorn, S., Maxwell, M., Ward, C., & Wayne, A. (2022). Remote sensor camera traps provide the first density estimate for the largest natural population of the numbat (*Myrmecobius fasciatus*). *Wildlife Research*, 49(6), 529-539. doi:<https://doi.org/10.1071/WR21115>
- TSSC, T. S. S. C. (2018). *Conservation Advice: Myrmecobius fasciatus (Numbat)*. Canberra, ACT.
- Vieira, E., Finlayson, G., & Dickman, C. (2007). Habitat use and density of numbats (*Myrmecobius fasciatus*) reintroduced in an area of mallee vegetation, New South Wales. *Australian Mammalogy*, 29, 17-24. doi:<https://doi.org/10.1071/AM07002>
- Worsley Alumina. (2022). *Biodiversity Offsets Plan*. Unpublished report prepared for the Worsley Mine Expansion, Revised EPA Assessment No. 2216.

Appendix A: Important Note

Biologic Environmental Survey Pty Ltd ("Biologic") has prepared this report for South32 Worsley Alumina Pty Ltd

("Client"), in accordance with the Client's specific instructions and solely for the purposes for which it is required by the Client ("Purpose"). This report and its content are only pertinent to the Purpose and any matters, facts or results contained in this report are not to be used for any purpose other than the Purpose.

The information contained in this report is not financial advice and Biologic is not licenced to provide financial advice. The report does not take into account the investment objectives, financial situation or specific investment needs of the Client and should not form the basis of an investment decision by the Client

In preparing this report Biologic has assumed the accuracy and completeness of all the information and documents received or obtained from the Client and all information and documents received or obtained as a result of any request or enquiry made to a government department, authority, government register or database. Biologic has not independently verified any such assumptions.

Apart from fair dealing for the purposes of private study, research, criticism, or review as permitted under the Copyright Act, no part of this report, its attachments or appendices may be reproduced by any process, released, or distributed without the written consent of Biologic. All enquiries should be directed to Biologic.

This report is presented without the assumption of a duty of care to any other person (other than the Client) ("Third Party"). The report may not contain sufficient information for the purposes of a Third Party or for other uses and may not be relied on by a Third Party without Biologic's prior written consent.

Biologic will not be liable to a Third Party for any loss, damage, liability, or claim arising out of or incidental to a Third-Party publishing, using or relying on the facts, content, opinions or subject matter contained in this report.

If a Third Party uses or relies on the facts, content, opinions, or subject matter contained in this report with or without the consent of Biologic, Biologic disclaims all risk, and the Third Party assumes all risk and releases and indemnifies and agrees to keep Biologic indemnified from any Loss, Damage, claim or liability arising directly or indirectly from the use of or reliance on this report.

For the purpose of this document, a reference to "Loss" and "Damage" includes past and prospective economic loss, loss of profits, damage to property, injury to any person (including death) costs and expenses incurred in taking measures to prevent, mitigate or rectify any harm, loss of opportunity, legal costs, compensation, interest and any other direct, indirect, consequential, or financial or other loss.

Appendix B: Habitat Assessments

Site ID	Co-ordinates	Date	Habitat Type	Landform	Aspect/ Slope	Soil		Outcropping / Rock Type	Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Tree Hollows		Hollow Logs	Water Present	Last Fire	Disturbances	Numbat Suitability	Photo
						Type	Availability		Rock Size	Veg. Litter	Woody Debris			Hollows (<10cm)	Hollows (>10cm)						
VMTR-001	-32.8540, 116.4099	16/09/2024	Jarrah/ Marri on Slopes	Undulating Low Hills	South/ Low	Clay	Scarce	Negligible	Gravel (1- 4cm)	Many small patches	Few large patches	Nil	Nil	Scarce (1 - 2)	None	Scarce (1 - 2)	None	Long unburnt or no fire (6+ years)	Logging / firewood collection, road / access track, rubbish / litter, weed invasion	Foraging - protective understorey or canopy, evidence of termites Breeding - hollow logs present	
VMTR-002	-32.8427, 116.4206	17/09/2024	Jarrah/ Marri/ Allocasuarina	Undulating Low Hills	West/ Low	Clay	Scarce	Negligible	Gravel (1- 4cm)	Many large patches	Few large patches	Nil	Low	Scarce (1 - 2)	None	Scarce (1 - 2)	None	Long unburnt or no fire (6+ years)	Mining exploration, road / access track	Breeding - hollow logs present Foraging - protective understorey or canopy	
VMTR-003	-32.8435, 116.4230	17/09/2024	Rehabilitation	Undulating Low Hills	Flat/ Flat	Clay	Scarce	Negligible	Gravel (1- 4cm)	Scarce	Scarce	Nil	Nil	None	None	None	None	Long unburnt or no fire (6+ years)	Road / access track, mining exploration	None	
VMTR-004	-32.8234, 116.4199	17/09/2024	Wandoo Woodland	Undulating Low Hills	West/ Low	Clay loam	Few small patches	Negligible	Gravel (1- 4cm)	Evenly spread	Many large patches	Nil	Low	Scarce (1 - 2)	None	Scarce (1 - 2)	Scarce	Long unburnt or no fire (6+ years)	Mining exploration, road / access track	Foraging - protective understorey or canopy, evidence of termites Breeding - hollow logs present	
VTMR-005	-32.8222, 116.4169	17/09/2024	Wandoo Woodland	Undulating Low Hills	Flat/ Flat	Loam	Few small patches	Negligible	Gravel (1- 4cm)	Non- discernible	Non- discerni ble	Nil	Nil	None	None	None	Scarce	Recent high intensity burns (0 to 2 years)	Agriculture / farming	Foraging - protective understorey or canopy, evidence of termites Breeding - hollow logs present	

Site ID	Co-ordinates	Date	Habitat Type	Landform	Aspect/ Slope	Soil		Outcropping / Rock Type	Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Tree Hollows		Hollow Logs	Water Present	Last Fire	Disturbances	Numbat Suitability	Photo
						Type	Availability		Rock Size	Veg. Litter	Woody Debris			Hollows (<10cm)	Hollows (>10cm)						
VMTR-006	-32.8251, 116.4121	17/09/2024	Jarrah/ Marri/ Allocasuarina	Undulating Low Hills	South/ Moderate	Clay	Many small patches	Negligible	Gravel (1- 4cm)	Evenly spread	Evenly spread	Nil	Low	Scarce (1 - 2)	None	Only non- hollow logs present	None	Long unburnt or no fire (6+ years)	Mining exploration	Foraging - evidence of termites	
VMTR-007	-32.8268, 116.4053	17/09/2024	Jarrah/ Marri/ Allocasuarina	Undulating Low Hills	South/ Moderate	Clay loam	Few small patches	Negligible	Gravel (1- 4cm)	Evenly spread	Evenly spread	Nil	Low	Scarce (1 - 2)	None	Scarce (1 - 2)	None	Long unburnt or no fire (6+ years)	Mining exploration, road / access track	Foraging - protective understorey or canopy, evidence of termites Breeding - hollow logs present Threats - no obvious evidence of introduced predators or competitors	
VMTR-008	-32.8217, 116.4665	18/09/2024	Jarrah/ Marri/ Allocasuarina	Undulating Low Hills	East/ Low	Clay loam	Few small patches	Limited outcropping, conglomerate	Large rocks (21-60cm)	Evenly spread	Evenly spread	Nil	Low	Scarce (1 - 2)	None	Only non- hollow logs present	None	Long unburnt or no fire (6+ years)	Road / access track	Foraging - protective understorey or canopy, evidence of termites Threats - no obvious evidence of introduced predators or competitors	
VMTR-009	-32.8169, 116.4577	18/09/2024	Jarrah/ Marri/ Allocasuarina	Undulating Low Hills	East/ Low	Clay loam	Few small patches	Limited outcropping, conglomerate	Gravel (1- 4cm)	Evenly spread	Evenly spread	Nil	Low	Scarce (1 - 2)	None	Scarce (1 - 2)	None	Long unburnt or no fire (6+ years)	Mining exploration, road / access track	Foraging - protective understorey or canopy, evidence of termites Breeding - hollow logs present	

Site ID	Co-ordinates	Date	Habitat Type	Landform	Aspect/ Slope	Soil		Outcropping / Rock Type	Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Tree Hollows		Hollow Logs	Water Present	Last Fire	Disturbances	Numbat Suitability	Photo
						Type	Availability		Rock Size	Veg. Litter	Woody Debris			Hollows (<10cm)	Hollows (>10cm)						
VMTR-010	-32.8295, 116.4637	18/09/2024	Jarrah/ Marri on Slopes	Undulating Low Hills	South/ Low	Loam	Evenly spread	Negligible	Gravel (1-4cm)	Evenly spread	Evenly spread	Nil	Low	Scarce (1 - 2)	None	Scarce (1 - 2)	None	Long unburnt or no fire (6+ years)	Road / access track	Foraging - protective understorey or canopy, evidence of termites Breeding - hollow logs present Threats - no obvious evidence of introduced predators or competitors	
VMTR-011	-32.8293, 116.4659	18/09/2024	Wandoo Woodland	Undulating Low Hills	East/ Low	Clay loam	Few small patches	Negligible	Gravel (1-4cm)	Evenly spread	Evenly spread	Nil	Low	Scarce (1 - 2)	None	Only non-hollow logs present	None	Long unburnt or no fire (6+ years)	Road / access track	Breeding - hollow logs present Foraging - evidence of termites Threats - no obvious evidence of introduced predators or competitors	
VMTR-012	-32.8307, 116.4642	18/09/2024	Rehabilitation	Undulating Low Hills	North/ Low	Clay	Many large patches	Limited outcropping, conglomerate	Large rocks (21-60cm)	Few small patches	Few small patches	Low	Low	None	None	Only non-hollow logs present	None	Long unburnt or no fire (6+ years)	Plantation, road / access track	Foraging - protective understorey or canopy Threats - no obvious evidence of introduced predators or competitors	
VMTR-013	-32.8171, 116.4597	18/09/2024	Jarrah/ Marri/ Allocasuarina	Undulating Low Hills	East/ Low	Loam	Evenly spread	Limited outcropping, conglomerate	Small rocks (11-20cm)	Evenly spread	Evenly spread	Nil	Moderate	Scarce (1 - 2)	None	Scarce (1 - 2)	None	Long unburnt or no fire (6+ years)	Mining exploration, road / access track	Breeding - hollow logs present	

Site ID	Co-ordinates	Date	Habitat Type	Landform	Aspect/ Slope	Soil		Outcropping / Rock Type	Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Tree Hollows		Hollow Logs	Water Present	Last Fire	Disturbances	Numbat Suitability	Photo
						Type	Availability		Rock Size	Veg. Litter	Woody Debris			Hollows (<10cm)	Hollows (>10cm)						
VMTR-014	-32.8289, 116.4678	18/09/2024	Wandoo Woodland	Undulating Low Hills	South/ Low	Clay loam	Many small patches	Negligible	Gravel (1-4cm)	Many large patches	Many small patches	Nil	Low	Scarce (1 - 2)	None	No logs present	None	Long unburnt or no fire (6+ years)	Road / access track	Foraging - protective understorey or canopy, evidence of termites Threats - no obvious evidence of introduced predators or competitors	
VMTR-015	-32.8436, 116.4565	19/09/2024	Jarrah/ Marri on Slopes	Undulating Low Hills	South/ Low	Clay loam	Evenly spread	Negligible	Large rocks (21-60cm)	Evenly spread	Evenly spread	Nil	Moderate	Scarce (1 - 2)	None	Scarce (1 - 2)	None	Long unburnt or no fire (6+ years)	Road / access track	Foraging - protective understorey or canopy, evidence of termites Breeding - hollow logs present	
VMTR-016	-32.8407, 116.4559	19/09/2024	Rehabilitation	Undulating Low Hills	East/ Moderate	Clay	Evenly spread	Negligible	Gravel (1-4cm)	Few small patches	Few large patches	Low	Very High	None	None	Only non-hollow logs present	None	Long unburnt or no fire (6+ years)	Plantation, road / access track	Foraging - protective understorey or canopy, evidence of termites Threats - no obvious evidence of introduced predators or competitors	
VMTR-017	-32.8416, 116.4540	19/09/2024	Wandoo Woodland	Undulating Low Hills	East/ Low	Clay loam	Evenly spread	Negligible	Small rocks (11-20cm)	Evenly spread	Evenly spread	Nil	High	Scarce (1 - 2)	None	Only non-hollow logs present	None	Long unburnt or no fire (6+ years)	Non-discernible	Foraging - protective understorey or canopy, evidence of termites Threats - no obvious evidence of introduced predators or competitors	
VMTR-018	-32.8438, 116.4542	19/09/2024	Wandoo Woodland	Undulating Low Hills	South-west/ Low	Clay loam	Evenly spread	Negligible	Negligible	Evenly spread	Evenly spread	Nil	High	None	None	Only non-hollow logs present	None	Long unburnt or no fire (6+ years)	Road / access track	Foraging - protective understorey or canopy, evidence of termites	

Site ID	Co-ordinates	Date	Habitat Type	Landform	Aspect/ Slope	Soil		Outcropping / Rock Type	Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Tree Hollows		Hollow Logs	Water Present	Last Fire	Disturbances	Numbat Suitability	Photo
						Type	Availability		Rock Size	Veg. Litter	Woody Debris			Hollows (<10cm)	Hollows (>10cm)						
VMTR-019	-32.8254, 116.4165	19/09/2024	Marri/Jarrah on Lower Slopes	Undulating Low Hills	Flat/ Flat	Clay loam	Evenly spread	Negligible	Negligible	Evenly spread	Evenly spread	Nil	High	Scarce (1 - 2)	None	Scarce (1 - 2)	Prone To Pooling	Long unburnt or no fire (6+ years)	Road / access track, weed invasion	Foraging - protective understorey or canopy, evidence of termites Breeding - hollow logs present	
VMTR-020	-32.8234, 116.4199	17/09/2024	Wandoo Woodland	Undulating Low Hills	West/ Low	Clay loam	Few small patches	Negligible	Gravel (1-4cm)	Evenly spread	Many large patches	Nil	Low	Scarce (1 - 2)	None	Scarce (1 - 2)	Scarce	Long unburnt or no fire (6+ years)	Mining exploration, road / access track	Foraging - protective understorey or canopy, evidence of termites Breeding - hollow logs present	
VMTR-021	-32.8432, 116.4228	5/11/2024	Jarrah/ Marri/ Allocasuarina	Undulating Low Hills	West/ Low	Clay loam	Many large patches	Negligible	Gravel (1-4cm)	Evenly spread	Evenly spread	Low	Moderate	None	None	Only non-hollow logs present	None	Long unburnt or no fire (6+ years)	Mining exploration, road / access track	Foraging - protective understorey or canopy, evidence of termites	
VMTR-022	-32.8437, 116.4229	5/11/2024	Rehabilitation	Undulating Low Hills	West/ Low	Clay loam	Evenly spread	Limited Outcropping	Gravel (1-4cm)	Few small patches	Few large patches	Low	Moderate	None	None	Only non-hollow logs present	None	Long unburnt or no fire (6+ years)	Revegetation	Foraging - protective understorey or canopy	
VMTR-023	-32.8212, 116.4174	5/11/2024	Wandoo Woodland	Undulating Low Hills	South/ Low	Sandy clay loam	Few small patches	Negligible	Gravel (1-4cm)	Many large patches	Few large patches	Nil	Low	Moderate (3 - 5)	Scarce (1 - 2)	Scarce (1 - 2)	None	Regrowth present (3 to 5 years)	Logging / Firewood collection, mining exploration	Foraging - evidence of termites	

Site ID	Co-ordinates	Date	Habitat Type	Landform	Aspect/ Slope	Soil		Outcropping / Rock Type	Ground Cover			Rocky Cracks / Crevices	Burrowing Suitability	Tree Hollows		Hollow Logs	Water Present	Last Fire	Disturbances	Numbat Suitability	Photo
						Type	Availability		Rock Size	Veg. Litter	Woody Debris			Hollows (<10cm)	Hollows (>10cm)						
VMTR-024	-32.8353, 116.4622	6/11/2024	Jarrah/Marri on Slopes	Undulating Low Hills	South-east/ Low	Silty clay loam	Scarce	Minor outcropping	Gravel (1- 4cm)	Many large patches	Many large patches	Nil	Nil	Scarce (1 - 2)	None	Scarce (1 - 2)	None	Long unburnt or no fire (6+ years)	Logging / firewood collection	Foraging - evidence of termites	
VMTR-025	-32.8379, 116.4602	6/11/2024	Jarrah/Marri on Slopes	Undulating Low Hills	East/ Moderate	Clay loam	Many small patches	Limited outcropping	Gravel (1- 4cm)	Evenly spread	Many small patches	Low	Moderate	None	None	Only non- hollow logs present	None	Long unburnt or no fire (6+ years)	Mining exploration, road / access track, rubbish / litter	Foraging - protective understorey or canopy, evidence of termites	
VMTR-026	-32.8376, 116.4518	6/11/2024	Jarrah/ Marri/ Allocasuarina	Undulating Low Hills	North-west/ Moderate	Clay loam	Few small patches	Limited outcropping	Pebbles (5- 10cm)	Evenly spread	Evenly spread	Low	Low	None	None	Scarce (1 - 2)	None	Long unburnt or no fire (6+ years)	Mining exploration, road / access track, plantation	Foraging - protective understorey or canopy Breeding - hollow logs present	
VMTR-027	-32.8262, 116.4636	7/11/2024	Jarrah/ Marri/ Allocasuarina	Undulating Low Hills	South-east/ Low	Clay loam	Many small patches	Negligible	Gravel (1- 4cm)	Evenly spread	Evenly spread	Nil	Low	Scarce (1 - 2)	None	Scarce (1 - 2)	None	Long unburnt or no fire (6+ years)	Mining exploration, road / access track	Foraging - protective understorey or canopy, evidence of termites	

Appendix C: Survey Effort during Current Field Survey

Site Name	Latitude	Longitude	Total Sample Effort	Start Date	End Date	Habitat type
Camera Traps						
VMTR-001	-32.8540	116.4100	490 (10 traps x 49 nights)	16/09/2024	4/11/2024	Jarrah/ Marri on Slopes
VMTR-002	-32.8427	116.4206	480 (10 traps x 48 nights)	17/09/2024	4/11/2024	Jarrah/ Marri/ Allocasuarina
VMTR-005	-32.8222	116.4169	490 (10 traps x 49 nights)	17/09/2024	5/11/2024	Wandoo Woodland
VMTR-009	-32.8169	116.4578	490 (10 traps x 49 nights)	18/09/2024	6/11/2024	Jarrah/ Marri/ Allocasuarina
VMTR-010	-32.8295	116.4637	490 (10 traps x 49 nights)	18/09/2024	6/11/2024	Jarrah/ Marri on Slopes
VMTR-015	-32.8436	116.4565	480 (10 traps x 48 nights)	19/09/2024	6/11/2024	Jarrah/ Marri on Slopes
Total			2,920 trap nights			
Termite Abundance Assessments						
VMTR-001	-32.8540	116.4100	1 person hour	4/11/2024	4/11/2024	Jarrah/ Marri on Slopes
VMTR-010	-32.8295	116.4637	1 person hour	7/11/2024	7/11/2024	Jarrah/ Marri on Slopes
VMTR-015	-32.8436	116.4565	1 person hour	6/11/2024	6/11/2024	Jarrah/ Marri on Slopes
VMTR-021	-32.8432	116.4228	1 person hour	5/11/2024	5/11/2024	Jarrah/ Marri/ Allocasuarina
VMTR-023	-32.8212	116.4174	1 person hour	5/11/2024	5/11/2024	Wandoo Woodland
VMTR-027	-32.8262	116.4636	1.66 person hours	7/11/2024	7/11/2024	Jarrah Woodland
Total			6.66 person hours			
Numbat Targeted Searches						
VMTR-001	-32.8540	116.4100	6.3 person hours	16/09/2024	16/09/2024	Jarrah/ Marri on Slopes
VMTR-001	-32.8540	116.4100	9.33 person hours	4/11/2024	4/11/2024	Jarrah/ Marri on Slopes
VMTR-002	-32.8427	116.4206	5 person hours	17/09/2024	17/09/2024	Jarrah/ Marri/ Allocasuarina
VMTR-002	-32.8427	116.4206	3.66 person hours	5/11/2024	5/11/2024	Jarrah/ Marri/ Allocasuarina
VMTR-005	-32.8222	116.4169	7 person hours	17/09/2024	17/09/2024	Wandoo Woodland
VMTR-005	-32.8222	116.4169	4.83 person hours	19/09/2024	19/09/2024	Wandoo Woodland
VMTR-005	-32.8222	116.4169	1.17 person hours	19/09/2024	19/09/2024	Wandoo Woodland
VMTR-005	-32.8222	116.4169	3 person hours	5/11/2024	5/11/2024	Wandoo Woodland
VMTR-005	-32.8222	116.4169	6.66 person hours	5/11/2024	5/11/2024	Wandoo Woodland
VMTR-008	-32.8217	116.4665	0.83 person hours	18/09/2024	18/09/2024	Jarrah/ Marri/ Allocasuarina
VMTR-009	-32.8169	116.4578	3.66 person hours	18/09/2024	18/09/2024	Jarrah/ Marri/ Allocasuarina
VMTR-010	-32.8295	116.4637	5.5 person hours	18/09/2024	18/09/2024	Jarrah/ Marri on Slopes
VMTR-015	-32.8436	116.4565	6.83 person hours	19/09/2024	19/09/2024	Jarrah/ Marri on Slopes
VMTR-015	-32.8436	116.4565	3.66 person hours	6/11/2024	6/11/2024	Jarrah/ Marri on Slopes
VMTR-020	-32.8234	116.4199	7 person hours	17/09/2024	17/09/2024	Wandoo Woodland
VMTR-020	-32.8234	116.4199	4.83 person hours	19/09/2024	19/09/2024	Wandoo Woodland
VMTR-020	-32.8234	116.4199	1.17 person hours	19/09/2024	19/09/2024	Wandoo Woodland
VMTR-022	-32.8438	116.4229	2.66 person hours	5/11/2024	5/11/2024	Rehabilitation
VMTR-024	-32.8353	116.4622	2 person hours	6/11/2024	6/11/2024	Jarrah/Marri on Slopes
VMTR-025	-32.8379	116.4602	1.66 person hours	6/11/2024	6/11/2024	Jarrah/ Marri on Slopes
VMTR-026	-32.8376	116.4518	3 person hours	6/11/2024	6/11/2024	Jarrah/ Marri/ Allocasuarina
VMTR-027	-32.8262	116.4636	6.66 person hours	7/11/2024	7/11/2024	Jarrah/ Marri/ Allocasuarina
Total			96.41 person hours			

Appendix D: Significant Species Records during the Current Survey

Site ID	Location		Date Observed	Scientific Name	Common Name	Conservation Status			Habitat Type	Observation Method	Record Type	Abundance
	Latitude	Longitude				EPBC Act	BC Act	DBCA				
VMTR-015	-32.8416	116.4561	6/11/2024	<i>Zanda baudinii</i>	Baudin's cockatoo	EN	EN		Wandoo Woodland	Targeted search	Individual (alive)	3
VMTR-024	-32.8338	116.4630	6/11/2024	<i>Zanda baudinii</i>	Baudin's cockatoo	EN	EN		Wandoo Woodland	Targeted search	Individual (alive)	2
VMTR-001	-32.8558	116.4094	16/09/2024	<i>Bettongia penicillata</i>	Woylie	EN	CR		Jarrah/ Marri on Slopes	Targeted search	Digging	1
No Site	-32.8434	116.4235	17/09/2024	<i>Bettongia penicillata</i>	Woylie	EN	CR		Rehabilitation	Opportunistic	Digging	1
VMTR-005	-32.8366	116.4110	5/11/2024	<i>Bettongia penicillata</i>	Woylie	EN	CR		Wandoo Woodland	Targeted search	Digging	1
No Site	-32.8366	116.4097	5/11/2024	<i>Bettongia penicillata</i>	Woylie	EN	CR		Jarrah/ Marri/ Allocasuarina	Opportunistic	Digging	1
No Site	-32.8349	116.4090	5/11/2024	<i>Bettongia penicillata</i>	Woylie	EN	CR		Jarrah/ Marri/ Allocasuarina	Opportunistic	Digging	1
VMTR-002	-32.8421	116.4204	5/11/2024	<i>Bettongia penicillata</i>	Woylie	EN	CR		Jarrah/ Marri/ Allocasuarina	Targeted search	Digging	1
VMTR-002	-32.8413	116.4170	5/11/2024	<i>Bettongia penicillata</i>	Woylie	EN	CR		Jarrah/ Marri on Slopes	Targeted search	Digging	1
VMTR-005	-32.8209	116.4178	5/11/2024	<i>Bettongia penicillata</i>	Woylie	EN	CR		Wandoo Woodland	Targeted search	Digging	1
VMTR-005	-32.8212	116.4185	5/11/2024	<i>Bettongia penicillata</i>	Woylie	EN	CR		Wandoo Woodland	Targeted search	Digging	1
No Site	-32.8406	116.4216	5/11/2024	<i>Bettongia penicillata</i>	Woylie	EN	CR		Jarrah/ Marri on Slopes	Opportunistic	Individual (alive)	1
No Site	-32.8368	116.4110	5/11/2024	<i>Bettongia penicillata</i>	Woylie	EN	CR		Jarrah/ Marri/ Allocasuarina	Opportunistic	Digging	1
No Site	-32.8303	116.4126	5/11/2024	<i>Bettongia penicillata</i>	Woylie	EN	CR		Jarrah/ Marri/ Allocasuarina	Opportunistic	Digging	1
No Site	-32.8345	116.4475	6/11/2024	<i>Bettongia penicillata</i>	Woylie	EN	CR		Jarrah/ Marri/ Allocasuarina	Opportunistic	Digging	1
VMTR-026	-32.8240	116.4587	7/11/2024	<i>Bettongia penicillata</i>	Woylie	EN	CR		Jarrah/ Marri/ Allocasuarina	Targeted search	Digging	1
No Site	-32.8479	116.4107	4/11/2024	<i>Calyptorhynchus banksii naso</i>	Forest red-tailed black cockatoo	VU	VU		Jarrah/ Marri on Slopes	Opportunistic	Individual (alive)	2
VMTR-005	-32.8220	116.4176	23/09/2024	<i>Isoodon fusciventer</i>	Quenda			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8220	116.4176	24/09/2024	<i>Isoodon fusciventer</i>	Quenda			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8220	116.4176	27/09/2024	<i>Isoodon fusciventer</i>	Quenda			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8220	116.4176	29/09/2024	<i>Isoodon fusciventer</i>	Quenda			P4	Wandoo Woodland	Camera trap	Individual (alive)	1

Site ID	Location		Date Observed	Scientific Name	Common Name	Conservation Status			Habitat Type	Observation Method	Record Type	Abundance
	Latitude	Longitude				EPBC Act	BC Act	DBCA				
VMTR-005	-32.8230	116.4168	31/10/2024	<i>Isoodon fusciventer</i>	Quenda			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	21/09/2024	<i>Isoodon fusciventer</i>	Quenda			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	22/09/2024	<i>Isoodon fusciventer</i>	Quenda			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	23/09/2024	<i>Isoodon fusciventer</i>	Quenda			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	29/09/2024	<i>Isoodon fusciventer</i>	Quenda			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8219	116.4156	27/09/2024	<i>Isoodon fusciventer</i>	Quenda			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8240	116.4167	17/09/2024	<i>Isoodon fusciventer</i>	Quenda			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8240	116.4167	18/09/2024	<i>Isoodon fusciventer</i>	Quenda			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8240	116.4167	19/09/2024	<i>Isoodon fusciventer</i>	Quenda			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8240	116.4167	22/09/2024	<i>Isoodon fusciventer</i>	Quenda			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8240	116.4167	29/09/2024	<i>Isoodon fusciventer</i>	Quenda			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8240	116.4167	12/10/2024	<i>Isoodon fusciventer</i>	Quenda			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8240	116.4167	18/10/2024	<i>Isoodon fusciventer</i>	Quenda			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8240	116.4167	30/10/2024	<i>Isoodon fusciventer</i>	Quenda			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8240	116.4167	30/10/2024	<i>Isoodon fusciventer</i>	Quenda			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8240	116.4180	26/09/2024	<i>Isoodon fusciventer</i>	Quenda			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
No Site	-32.8340	116.4603	6/11/2024	<i>Isoodon fusciventer</i>	Quenda			P4	Wandoo Woodland	Opportunistic	Digging	1
VMTR-009	-32.8171	116.4592	26/09/2024	<i>Phascogale calura</i>	Red-tailed phascogale	VU	CD		Jarrah/ Marri/ Allocasuarina	Camera trap	Individual (alive)	1
VMTR-009	-32.8171	116.4592	6/10/2024	<i>Phascogale calura</i>	Red-tailed phascogale	VU	CD		Jarrah/ Marri/ Allocasuarina	Camera trap	Individual (alive)	1
VMTR-009	-32.8171	116.4592	7/10/2024	<i>Phascogale calura</i>	Red-tailed phascogale	VU	CD		Jarrah/ Marri/ Allocasuarina	Camera trap	Individual (alive)	1

Site ID	Location		Date Observed	Scientific Name	Common Name	Conservation Status			Habitat Type	Observation Method	Record Type	Abundance
	Latitude	Longitude				EPBC Act	BC Act	DBCA				
VMTR-009	-32.8178	116.4585	27/09/2024	<i>Phascogale calura</i>	Red-tailed phascogale	VU	CD		Jarrah/ Marri/ Allocasuarina	Camera trap	Individual (alive)	1
VMTR-009	-32.8186	116.4598	21/09/2024	<i>Phascogale calura</i>	Red-tailed phascogale	VU	CD		Jarrah/ Marri/ Allocasuarina	Camera trap	Individual (alive)	1
VMTR-009	-32.8186	116.4598	21/09/2024	<i>Phascogale calura</i>	Red-tailed phascogale	VU	CD		Jarrah/ Marri/ Allocasuarina	Camera trap	Individual (alive)	1
VMTR-009	-32.8186	116.4598	22/09/2024	<i>Phascogale calura</i>	Red-tailed phascogale	VU	CD		Jarrah/ Marri/ Allocasuarina	Camera trap	Individual (alive)	1
VMTR-009	-32.8186	116.4598	23/09/2024	<i>Phascogale calura</i>	Red-tailed phascogale	VU	CD		Jarrah/ Marri/ Allocasuarina	Camera trap	Individual (alive)	1
VMTR-009	-32.8186	116.4598	23/09/2024	<i>Phascogale calura</i>	Red-tailed phascogale	VU	CD		Jarrah/ Marri/ Allocasuarina	Camera trap	Individual (alive)	1
VMTR-009	-32.8186	116.4598	23/09/2024	<i>Phascogale calura</i>	Red-tailed phascogale	VU	CD		Jarrah/ Marri/ Allocasuarina	Camera trap	Individual (alive)	1
VMTR-009	-32.8186	116.4598	24/09/2024	<i>Phascogale calura</i>	Red-tailed phascogale	VU	CD		Jarrah/ Marri/ Allocasuarina	Camera trap	Individual (alive)	1
VMTR-009	-32.8186	116.4598	24/09/2024	<i>Phascogale calura</i>	Red-tailed phascogale	VU	CD		Jarrah/ Marri/ Allocasuarina	Camera trap	Individual (alive)	1
VMTR-009	-32.8186	116.4598	25/09/2024	<i>Phascogale calura</i>	Red-tailed phascogale	VU	CD		Jarrah/ Marri/ Allocasuarina	Camera trap	Individual (alive)	1
VMTR-009	-32.8186	116.4598	25/09/2024	<i>Phascogale calura</i>	Red-tailed phascogale	VU	CD		Jarrah/ Marri/ Allocasuarina	Camera trap	Individual (alive)	1
VMTR-009	-32.8186	116.4598	26/09/2024	<i>Phascogale calura</i>	Red-tailed phascogale	VU	CD		Jarrah/ Marri/ Allocasuarina	Camera trap	Individual (alive)	1
VMTR-009	-32.8186	116.4598	26/09/2024	<i>Phascogale calura</i>	Red-tailed phascogale	VU	CD		Jarrah/ Marri/ Allocasuarina	Camera trap	Individual (alive)	1
VMTR-009	-32.8186	116.4598	26/09/2024	<i>Phascogale calura</i>	Red-tailed phascogale	VU	CD		Jarrah/ Marri/ Allocasuarina	Camera trap	Individual (alive)	1
VMTR-009	-32.8186	116.4598	30/09/2024	<i>Phascogale calura</i>	Red-tailed phascogale	VU	CD		Jarrah/ Marri/ Allocasuarina	Camera trap	Individual (alive)	1
VMTR-009	-32.8186	116.4598	2/10/2024	<i>Phascogale calura</i>	Red-tailed phascogale	VU	CD		Jarrah/ Marri/ Allocasuarina	Camera trap	Individual (alive)	1
VMTR-009	-32.8186	116.4598	4/10/2024	<i>Phascogale calura</i>	Red-tailed phascogale	VU	CD		Jarrah/ Marri/ Allocasuarina	Camera trap	Individual (alive)	1
VMTR-009	-32.8186	116.4598	13/10/2024	<i>Phascogale calura</i>	Red-tailed phascogale	VU	CD		Jarrah/ Marri/ Allocasuarina	Camera trap	Individual (alive)	1
VMTR-009	-32.8186	116.4598	20/10/2024	<i>Phascogale calura</i>	Red-tailed phascogale	VU	CD		Jarrah/ Marri/ Allocasuarina	Camera trap	Individual (alive)	1
VMTR-005	-32.8229	116.4177	29/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1

Site ID	Location		Date Observed	Scientific Name	Common Name	Conservation Status			Habitat Type	Observation Method	Record Type	Abundance
	Latitude	Longitude				EPBC Act	BC Act	DBCA				
VMTR-005	-32.8220	116.4176	18/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	2
VMTR-005	-32.8220	116.4176	20/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8220	116.4176	21/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8220	116.4176	30/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8220	116.4176	2/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8220	116.4176	18/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8220	116.4176	27/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8220	116.4176	3/11/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8220	116.4176	3/11/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8220	116.4176	4/11/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8230	116.4168	18/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	19/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	2
VMTR-005	-32.8211	116.4167	20/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	21/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	21/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	24/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	25/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	25/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	27/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	2
VMTR-005	-32.8211	116.4167	28/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1

Site ID	Location		Date Observed	Scientific Name	Common Name	Conservation Status			Habitat Type	Observation Method	Record Type	Abundance
	Latitude	Longitude				EPBC Act	BC Act	DBCA				
VMTR-005	-32.8211	116.4167	30/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	2
VMTR-005	-32.8211	116.4167	2/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	3/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	2
VMTR-005	-32.8211	116.4167	5/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	5/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	13/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	14/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	15/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	2
VMTR-005	-32.8211	116.4167	16/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	16/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	17/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	18/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	2
VMTR-005	-32.8211	116.4167	21/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	2
VMTR-005	-32.8211	116.4167	22/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	25/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	26/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	28/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	31/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	31/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	1/11/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1

Site ID	Location		Date Observed	Scientific Name	Common Name	Conservation Status			Habitat Type	Observation Method	Record Type	Abundance
	Latitude	Longitude				EPBC Act	BC Act	DBCA				
VMTR-005	-32.8211	116.4167	2/11/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8211	116.4167	4/11/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	2
VMTR-005	-32.8219	116.4156	21/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	2
VMTR-005	-32.8219	116.4156	21/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	2
VMTR-005	-32.8219	116.4156	29/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	2
VMTR-005	-32.8219	116.4156	29/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8219	116.4156	30/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8219	116.4156	7/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	2
VMTR-005	-32.8219	116.4156	14/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8219	116.4156	17/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8219	116.4156	19/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8219	116.4156	19/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8219	116.4156	26/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8219	116.4156	2/11/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	2
VMTR-005	-32.8236	116.4159	9/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8236	116.4159	5/11/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	2
VMTR-005	-32.8240	116.4167	30/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8240	116.4167	3/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8240	116.4167	29/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1
VMTR-005	-32.8240	116.4180	23/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Camera trap	Individual (alive)	1

Site ID	Location		Date Observed	Scientific Name	Common Name	Conservation Status			Habitat Type	Observation Method	Record Type	Abundance
	Latitude	Longitude				EPBC Act	BC Act	DBCA				
VMTR-001	-32.8531	116.4122	18/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo woodlands	Camera trap	Individual (alive)	1
VMTR-001	-32.8531	116.4122	21/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo woodlands	Camera trap	Individual (alive)	1
VMTR-001	-32.8541	116.4109	7/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Jarrah/Marri on slopes	Camera trap	Individual (alive)	1
VMTR-001	-32.8541	116.4109	26/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Jarrah/Marri on slopes	Camera trap	Individual (alive)	1
VMTR-001	-32.8540	116.4100	20/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Jarrah/Marri on slopes	Camera trap	Individual (alive)	1
VMTR-001	-32.8540	116.4100	22/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Jarrah/Marri on slopes	Camera trap	Individual (alive)	1
VMTR-001	-32.8540	116.4100	5/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Jarrah/Marri on slopes	Camera trap	Individual (alive)	1
VMTR-001	-32.8540	116.4100	6/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Jarrah/Marri on slopes	Camera trap	Individual (alive)	1
VMTR-001	-32.8540	116.4100	18/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Jarrah/Marri on slopes	Camera trap	Individual (alive)	1
VMTR-001	-32.8540	116.4100	23/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Jarrah/Marri on slopes	Camera trap	Individual (alive)	1
VMTR-001	-32.8522	116.4124	14/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo woodlands	Camera trap	Individual (alive)	1
VMTR-001	-32.8522	116.4124	23/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo woodlands	Camera trap	Individual (alive)	1
VMTR-001	-32.8532	116.4103	7/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Jarrah/Marri on slopes	Camera trap	Individual (alive)	1
VMTR-001	-32.8531	116.4110	14/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Jarrah/Marri on slopes	Camera trap	Individual (alive)	1
VMTR-001	-32.8541	116.4121	1/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Jarrah/Marri on slopes	Camera trap	Individual (alive)	1
VMTR-001	-32.8523	116.4112	17/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Jarrah/Marri on slopes	Camera trap	Individual (alive)	2
VMTR-001	-32.8523	116.4112	4/11/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Jarrah/Marri on slopes	Camera trap	Individual (alive)	1
VMTR-001	-32.8523	116.4102	28/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Jarrah/Marri on slopes	Camera trap	Individual (alive)	1
VMTR-002	-32.8428	116.4224	20/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Jarrah/Marri/Allocasuarina	Camera trap	Individual (alive)	1
VMTR-002	-32.8428	116.4224	23/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Jarrah/Marri/Allocasuarina	Camera trap	Individual (alive)	1

Site ID	Location		Date Observed	Scientific Name	Common Name	Conservation Status			Habitat Type	Observation Method	Record Type	Abundance
	Latitude	Longitude				EPBC Act	BC Act	DBCA				
VMTR-002	-32.8418	116.4224	18/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Jarrah/Marri on slopes	Camera trap	Individual (alive)	1
VMTR-002	-32.8418	116.4224	19/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Jarrah/Marri on slopes	Camera trap	Individual (alive)	1
VMTR-002	-32.8410	116.4215	28/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Jarrah/Marri on slopes	Camera trap	Individual (alive)	1
VMTR-002	-32.8426	116.4210	19/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Jarrah/Marri/Allocasu arina	Camera trap	Individual (alive)	2
VMTR-002	-32.8426	116.4210	28/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Jarrah/Marri/Allocasu arina	Camera trap	Individual (alive)	1
VMTR-002	-32.8426	116.4210	30/10/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Jarrah/Marri/Allocasu arina	Camera trap	Individual (alive)	1
VMTR-001	-32.8544	116.4095	16/09/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Jarrah/Marri on slopes	Targeted search	Individual (alive)	1
No Site	-32.8537	116.4150	4/11/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Opportunistic	Individual (alive)	1
VMTR-002	-32.8407	116.4217	5/11/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Jarrah/Marri on slopes	Opportunistic	Individual (alive)	1
No Site	-32.8233	116.4173	5/11/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Opportunistic	Individual (alive)	1
No Site	-32.8269	116.4077	5/11/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Marri/ Jarrah on Lower Slopes	Opportunistic	Individual (alive)	1
No Site	-32.8273	116.4147	5/11/2024	<i>Notamacropus irma</i>	Western brush wallaby			P4	Wandoo Woodland	Opportunistic	Individual (alive)	1