



Manuwarra Red Dog Highway Stage 4: Borrow Pits and Realignment Areas (SLK: 136 - 245)



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Environmental
Sciences



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Manuwarra Red Dog Borrow Pits Biological Survey

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1.0 Executive Summary

Main Roads Western Australia (Main Roads) is planning to commence work on Manuwarra Red Dog Highway Stage 4, located in the Pilbara region of Western Australia. As part of this, potential new materials sourcing pits or 'borrow pits' spanning the length of Manuwarra Red Dog Highway Stage 4, and two areas being considered for alternative alignment of the road, are proposed (the project).

To support the environmental impact assessment of the project, Biota Environmental Sciences (Biota) was commissioned to undertake a biological survey to identify key environmental values. The scope of the study was to:

- conduct a desktop study of a 40 km area around the survey area, to identify species or communities of significance previously recorded from the study area and to assess their likelihood of occurrence in the survey area; and
- conduct a reconnaissance and targeted flora and vegetation survey and a basic fauna survey to verify the findings of the desktop study; these surveys were conducted over three mobilisations in April, June and July 2022.

Five significant vegetation types were identified in the survey area, largely associated with the clay plains of the Tom Price realignment area:

- Two vegetation types, C4 and C5, were considered to correspond to the "Themeda grasslands on cracking clays (Hamersley Station, Pilbara)" Threatened Ecological Community (TEC). This TEC is State-listed as Vulnerable, and occurs in the southern section of the survey area in the Tom Price realignment area.
- Vegetation type C3 was considered to correspond to the "Brockman Iron cracking clay communities of the Hamersley Range" Priority Ecological Community (PEC). This Priority 1 listed PEC was similarly recorded in the Tom Price realignment area.
- Vegetation type D1, in the PMPSB01 and PMPBC02 borrow pits, contained *Eucalyptus camaldulensis* and was considered to be a Groundwater Dependent Ecosystem (GDE).
- Vegetation type D3, in the Tom Price realignment area, contained *Eucalyptus victrix* and was considered to be a potential GDE.

No Threatened flora species listed under State or Commonwealth legislation were recorded from the survey area. Seven State-listed Priority flora species were recorded from the survey area, with one other Priority flora species occurring just outside the boundary:

- *Euphorbia inappendiculata* var. *queenslandica* (P2);
- *Astrebla lappacea* (P3);
- *Dolichocarpa* sp. Hamersley Station (A. A. Mitchell PRP 1479) (P3);
- *Glycine falcata* (P3; outside the survey area boundary);
- *Streptoglossa* sp. Cracking clays (S. van Leeuwen et al. PBS 7353) (P3);
- *Swainsona thompsoniana* (P3);
- *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) (P3); and
- *Triodia basitricha* (P3).

Four significant fauna species were recorded from the survey area: the Northern Quoll (*Dasyurus hallucatus*), Western Pebble-mound Mouse (*Pseudomys chapmani*), Ghost Bat (*Macroderma gigas*), and Pilbara Leaf-nosed Bat (*Rhinonictes aurantia*).

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2.0 Introduction

2.1 Project Background

Main Roads is planning to commence work on the construction of Manuwarra Red Dog Highway Stage 4 (hereafter 'the main project corridor'), located in the Pilbara region of Western Australia (WA). The proposed works include 110 km of new highway construction from the southern end of Stage 3 of the highway (at Wallyinya Pool) to its intersection with the existing Nanutarra - Munjina Road. Biological surveys for the main corridor of the project have been completed and are reported elsewhere (Biota 2021).

Main Roads commissioned Biota to carry out biological surveys to identify key flora and fauna values for the 11 proposed borrow pit areas and two potential road realignment areas (hereafter 'the project') associated with the construction of the main project corridor (Figure 2.1).

Along with the survey completed for the main project corridor (Biota 2021), the current survey will support the environmental impact assessment (EIA) process for the project and inform referral of the project to the WA Environmental Protection Authority (EPA) and the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW).

2.2 Spatial Scope and Report Terminology

The primary spatial scope of the survey comprised proposed borrow pit areas, located along the length of the main project corridor (Figure 2.1). Terminology for the spatial extents referenced in this document is defined in Table 2.1 and shown in Figure 2.1.

Table 2.1: Spatial extents and terminology used in this document.

Report Terminology	Definition	Size (ha)	Flora Survey	Fauna Survey
Survey area	The development envelope for the 11 proposed borrow pits and two road realignment areas, which will accommodate the physical components of the project for the purposes of EIA.	2,709.7	Reconnaissance and targeted flora and vegetation survey.	Basic fauna survey
Study area	A 40 km buffer from a central point along the Manuwarra Red Dog Highway, as surveyed by Biota (Biota 2021), within which a desktop study was carried out to determine a potential species list and identify significant species that may occur in the survey area.	1,371,261	Desktop - background information gathered from databases and literature sources.	
Main corridor survey area	The road corridor encompassing the Manuwarra Red Dog Highway which was previously surveyed by Biota (Biota 2021).	8,746.4	Detailed and targeted flora and vegetation survey.	Basic and targeted fauna survey

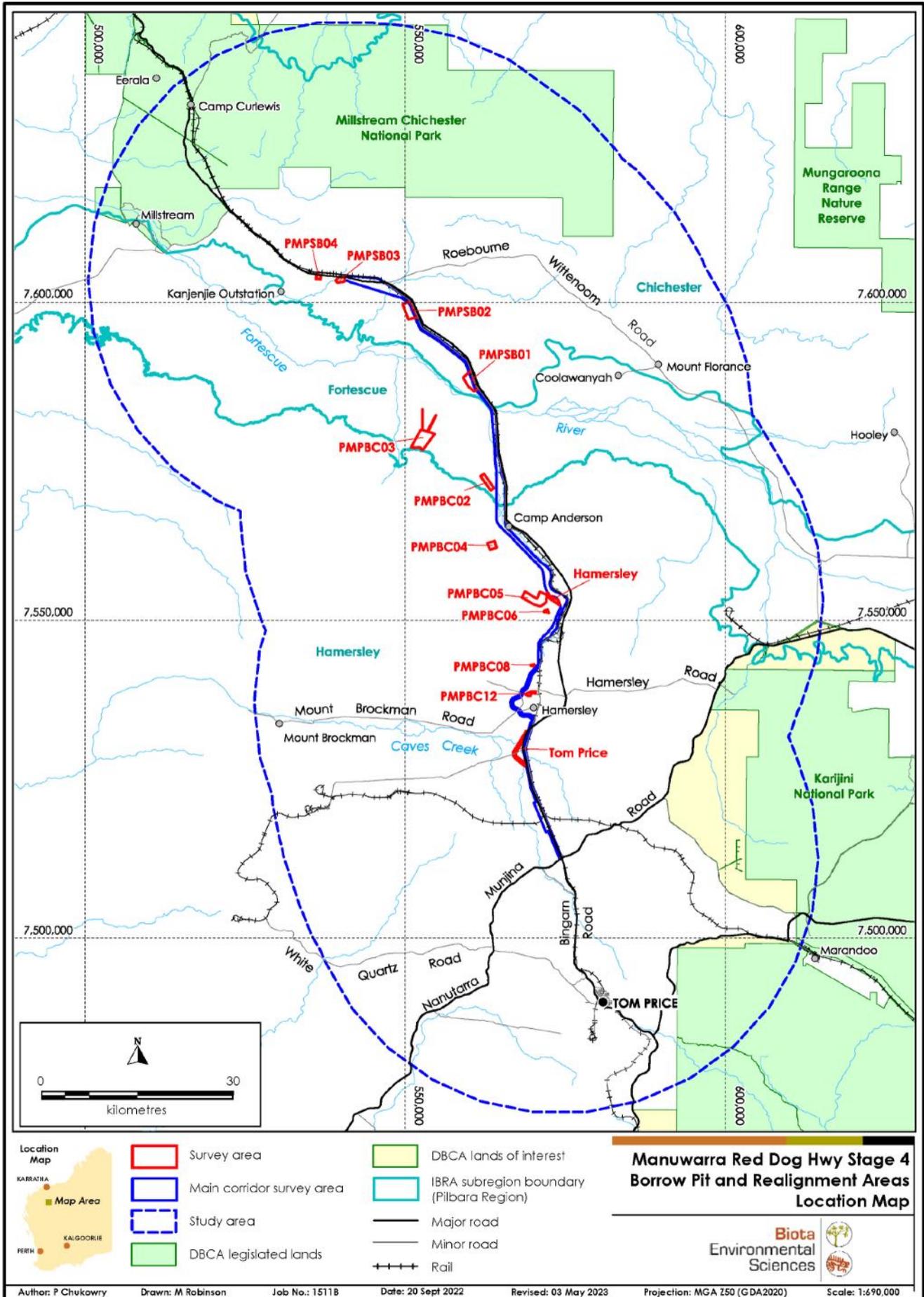


Figure 2.1: Location of survey area and study area for the project.

2.3 Study Objectives and Scope

This report documents the methods, results and key findings of the biological survey of the survey area. The survey consisted of sampling of both flora and vegetation, and fauna, with the specific scopes described in Sections 2.3.1 and 2.3.2 respectively.

2.3.1 Reconnaissance and Targeted Flora and Vegetation Survey

The objectives of the flora and vegetation survey were to:

- undertake a desktop study of relevant databases and previous surveys to consolidate existing records of significant flora from the study area, in order to predict those that were likely to occur, or may occur, within the survey area;
- conduct a single-phase "reconnaissance" survey as per EPA (2016a) and a targeted survey for flora of significance (Threatened and Priority flora) within the survey area, including:
 - completing low intensity sampling of flora and vegetation within the survey area to describe and characterise the vegetation, including quadrat and relevé sampling;
 - compiling a list of vascular flora species recorded from the survey area;
 - conducting targeted searches and traverses of habitat likely to support flora of significance;
 - recording and photographing introduced flora species (weeds) as well as any other disturbances; and
 - identifying and mapping key constraints relevant to flora and vegetation in the survey area.

The approach and scope of the flora and vegetation survey was consistent with the following policies:

- Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016a); and,
- Environmental Factor Guideline – Flora and Vegetation (EPA 2016b).

2.3.2 Basic and Targeted Fauna Survey

The objectives of the fauna survey component of this study were to:

- undertake a desktop study to identify records of significant fauna from the study area;
- conduct a "basic" fauna survey of the survey area as per current EPA guidelines (EPA 2020) to determine the fauna habitats present, assess their suitability to support fauna of significance, and to search for any evidence of significant vertebrate species;
- undertake targeted sampling for significant bat species and the Northern Quoll in the parts of the survey area where these species might occur and searches for secondary signs of other target species (e.g. Pebble-mound Mouse mounds);
- map fauna habitat types in the survey area;
- create a list of the vertebrate fauna recorded from or potentially occurring in the survey area;
- identify and assess the likelihood of occurrence of the significant species that have the potential to occur in the survey area; and
- identify and map key constraints relevant to fauna in the survey area.

The methodology used for the fauna survey was consistent with the following guidelines:

- Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2020);
- Environmental Factor Guideline – Terrestrial Fauna (EPA 2016c).

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3.0 Methodology

3.1 Significance Framework

3.1.1 Communities

TECs are described by the Department of Biodiversity Conservation and Attractions (DBCA) as biological assemblages occurring in a particular habitat, which are under threat of modification or destruction from various processes. TECs are significant at State level, being protected under the State *Biodiversity Conservation Act 2016* (BC Act), as well as having protection as Environmentally Sensitive Areas (ESAs) under the State *Environmental Protection Act 1986*. Some TECs are also protected at Commonwealth level under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Further information regarding the classification of TECs is provided in Appendix 1.

PECs are biological communities that are recognised to be of significance, but do not meet the criteria for listing as a TEC. There are five categories of PECs, none of which are currently protected under legislation (see Appendix 1).

3.1.2 Species

Native flora and fauna species that are rare, threatened with extinction, or have high conservation value, are specially protected by law as Threatened species under the BC Act and/or the EPBC Act. Migratory and Marine fauna species are also protected under the EPBC Act as Matters of National Environmental Significance (MNES). In addition, the DBCA maintains a list of species that are deemed a priority for conservation, which have not been assigned statutory protection under the BC Act but are still considered to be of conservation priority, or are considered to be rare but not threatened and are in need of monitoring. Appendix 1 details categories of significance recognised under the above frameworks.

3.2 Desktop Study

A desktop study, including a literature review, was undertaken to identify features of significance known from the study area. This involved collation of the outputs of various database searches along with information from previous biological surveys overlapping the study area.

The results of the desktop study were used as the basis for compiling lists of flora species, fauna species, and ecological communities of significance potentially occurring in the survey area. In reviewing previous surveys carried out nearby, the potential presence of habitat types associated with significant species was identified and used to tailor the design and timing of the current field survey.

3.2.1 Database Searches

The following databases were searched as part of the main study in 2020 to assist in the determination of the potential flora and fauna assemblages of the study area:

- NatureMap database (<http://NatureMap.dec.wa.gov.au>): a joint project of the DBCA and the Western Australian Museum (WAM). This database represented the most comprehensive source of information on the distribution of Western Australia's flora and fauna, before it was taken offline in December 2021. It comprised records from the Fauna Survey Returns database, the WA Threatened Flora and Fauna Databases, the WA Herbarium and WA Museum Specimen databases, and the BirdLife Australia Atlas. In order to account for the spatial spread of the corridor, the database was searched in 2020 using the line method at six points along the length of the main project corridor (Table 3.1). Due to buffer size limitations, it was only possible to apply an 18 km buffer on the search area (Appendix 2).

- The DBCA databases of TECs and PECs, Declared Rare and Priority Flora, and Threatened Fauna. These searches returned records from a 40 km buffer around the main project corridor as provided by Main Roads in 2020. For the purpose of this report, only records that intersect the study area are discussed.
- The Commonwealth EPBC Act Protected Matters search tool. The database search conducted in 2020 requested the return of records from the study area using six points positioned along the length of the study area (Table 3.1; see Appendix 2).

Table 3.1: Coordinates used for database searches.

Location	Latitude	Longitude
North End	-21.674296	117.446276
North	-21.863438	117.617909
Middle North	-22.017518	117.634518
Middle South	-22.122148	117.731687
South	-22.337121	117.668409
South End	-22.493854	117.723366

3.2.2 Literature Review

Publicly available literature (including previous surveys commissioned by Main Roads) was reviewed for relevant flora and vegetation surveys and fauna surveys conducted in the study area (Section 4.8). Information from the Manuwarra Red Dog Highway Stage 4 Biological Survey was also considered (Biota 2021). The species of significance recorded during these previous surveys were used to inform the assessment of species and communities likely to occur in the survey area (Sections 4.9 and 4.10).

3.2.3 Assessment of Likelihood of Occurrence

The likelihood of occurrence of significant species identified in the desktop study was assessed prior to and after the survey. This assessment was based on the proximity of previous records to the survey area, knowledge of the habitat preferences of each taxon, an assessment of the habitats present within the survey area, and any records obtained during the field survey. The criteria used to assess likelihood of occurrence are outlined in Table 3.2. For the purposes of this report, the term “close proximity” is defined as within 10 km of the survey area, while “locality” comprises the study area.

Table 3.2: Criteria used to assess likelihood of species occurrence within the survey area.

Likelihood	Criteria
Recorded	1. The species has been recorded in the survey area.
Likely to occur	1. There are existing records of the species in close proximity to the survey area (within 10 km); and <ul style="list-style-type: none"> • the species is strongly linked to a specific habitat, which is present in the survey area; or • the species has more general habitat preferences, and suitable habitat is present.
May occur	1. There are existing records of the species from the study area, however <ul style="list-style-type: none"> • the species is strongly linked to a specific habitat, of which only a small amount is present in the survey area; or • the species has more general habitat preferences, but only some suitable habitat is present in the survey area. 2. There is suitable habitat in the survey area, but the species is recorded infrequently in the locality.
Unlikely to occur	1. The species is linked to a specific habitat, which is absent from the survey area; or 2. Suitable habitat is present in the survey area, however there are no existing records of the species from the study area despite reasonable previous sampling effort in suitable habitat; or 3. There is some suitable habitat in the survey area, however the species is very infrequently recorded in the study area or the only records are historical (>40 years ago).

Likelihood	Criteria
Would not occur	<ol style="list-style-type: none"> 1. The species is strongly linked to a specific habitat, which is absent from the survey area; or 2. The species' range is very restricted and does not include the survey area; or 3. The species is not considered extant in the study area.

3.3 Field Survey

3.3.1 Timing and Personnel

A summary of field sampling mobilisations and survey team personnel are included in Table 3.3, while a summary of the field personnel and their respective roles in the survey is provided in Table 3.4.

The survey mobilisations for this assessment were undertaken in April, June and July 2022 (Table 3.3). In addition, any biological data that was collected during the surveys undertaken for the main project corridor that intersects the current survey area will also be presented in this report (Table 3.3). Details of the field personnel and timing for these previous surveys are outlined in Biota (2021).

Table 3.3: Summary of field sampling events undertaken during the survey.

Survey Dates	Survey	Sites Sampled in Survey Area
Borrow Pits and Realignment Areas Survey		
25 th – 27 th April 2022 4 th – 9 th June 2022 27 th – 30 th July 2022	Flora and fauna – Borrow pits and realignment areas survey	13 quadrats, 6 relevés
Intersecting Site Data from Previous Surveys		
2020	Fauna	2 sites
2020	Main corridor - Flora	3 quadrats (KTF27, KTF43, KTF46)

Table 3.4: Survey team qualifications and experience.

Name	Position	Survey Role	Qualification	Years of Experience	DBCA Flora Licence No.
Michi Maier	Director / Principal Botanist	Flora (team member)	BSc. Hons	30	FB62000033
Ayesha Lapinski	Botanist	Flora (2022 project manager)	GradDipSc.	4	FB62000106
Michael Greenham	Senior Biologist	Fauna (field team lead)	BSc.	20	N/A

3.3.2 Climate

Long-term climate data (rainfall from 1972 – 2011, temperature data from 1997 – 2011) were obtained from the Bureau of Meteorology weather station in Tom Price (station number 5072), approximately 20 km south-southwest of the southern-most survey area polygon. Temperature and rainfall data were obtained from the Bureau's weather station at Karijini North (station number 5098). Figure 3.1 illustrates the average monthly minimum and maximum temperatures and rainfall from the 12 months preceding the beginning of the survey period (April 2022) to the end of the survey period (July 2022) compared to the long-term averages.

Maximum temperatures were higher than the long-term averages in all months except for June 2021 and May 2022, and minimum temperatures were higher than long-term averages for all months in the survey period (Figure 3.1).

In the six months preceding the final winter survey (July 2022), 353.8 mm of rainfall was received in the area, more than double the long-term average (174.3; 1997-2011), providing optimal conditions for collecting flora.

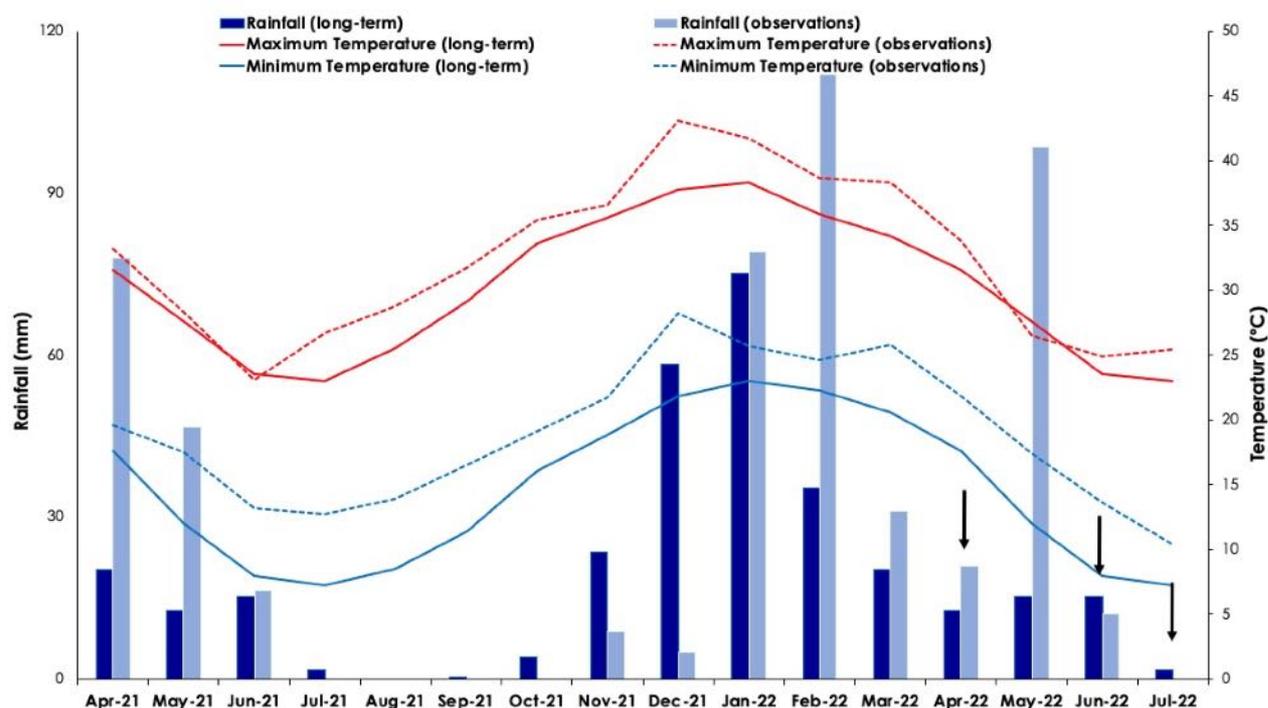


Figure 3.1: Climate and weather graph depicting long-term and monthly averages 12 months preceding and during the survey period (arrows indicate field mobilisations).

3.4 Reconnaissance and Targeted Flora and Vegetation Survey

3.4.1 Floristic Data Collection: Assessment of Quadrats and Relevés

Indicative sites were selected prior to the field survey, based on the broad habitats and vegetation types apparent. Once in the field, the actual locations of the sites were adjusted as necessary (e.g. to be placed in an area more representative of the broader vegetation type, to avoid recently burnt areas, etc.).

Sampling sites were established as either:

1. **Quadrats:** bounded floristic sampling sites. The standard for the Pilbara bioregion comprises a 50 m x 50 m square (or a modified shape with an equivalent area). Quadrats were measured out using optical squares and measuring tapes, and permanently marked with a steel fence dropper at each corner; or
2. **Relevés:** unbounded floristic sampling sites with a similar search area to a quadrat. Relevés were typically used where the target vegetation was too small or too narrow to effectively establish a quadrat. The relevés during the current survey were thoroughly surveyed for flora but were not permanently marked.

The following parameters were recorded for all quadrats and relevés:

1. Location coordinates¹ (± 2 m) were recorded using a hand-held Global Positioning System (GPS) unit; coordinates were recorded for all four corners of a quadrat. A central point was recorded as a minimum for the relevés, with a start and end point recorded for relevés that were undertaken in linear habitats such as long narrow creek lines;

¹ All coordinates presented in this report are in GDA94 datum and MGA51 projection.

2. Habitat: A description of the landform and habitat;
3. Soil: A broad description of the soil and any stony surface mantle or rocky outcropping;
4. Fire History: An estimate of time since last fire;
5. Disturbance Details: Vegetation condition was ranked according to the scale from EPA (2016a), which was based on that developed by Trudgen (1988); this considered evidence of grazing, physical disturbance, weed invasion etc. (see Appendix 3);
6. Vegetation Description: A broad description based on the height and estimated cover of dominant species after Aplin's (1979) modification of the vegetation classification system of Specht (1970) (see Appendix 3);
7. Flora Species: The estimated percentage foliar cover of each flora species present within the quadrat, or in the vicinity of the relevé (within a ~30 m radius of the centre point); and
8. Photograph: A representative digital photograph of the vegetation was taken, typically from the north or northwest corner of the quadrat or the central point of a relevé.

The survey area was sampled with 13 quadrats and 6 relevés (Figure 3.2).

3.4.2 Vegetation Description and Mapping

The scale of vegetation mapping is influenced by a range of factors including spatial characteristics of the survey area (e.g. the size and variety of habitats present), and other factors such as the scope of the survey and the availability of current, high-resolution aerial photography. The vegetation types for this study were described at the association level (level V as per the National Vegetation Information System; NVIS)². This level of detail would be considered fine-scale (intra-locality) delineation of vegetation types as per EPA (2016a). In general, minor variations in the vegetation that were not clearly defined on aerial photography or were not practical to accurately map in the field were incorporated into the surrounding 'parent' vegetation type.

Vegetation sampling included information from the quadrat and relevé sampling, as well as mapping notes which were utilised to mark the boundaries of vegetation types in the field to allow for more accurate delineation following the survey. Vegetation types mapped for the survey area were kept consistent with those used in the adjacent project corridor completed by Biota (2021). Vegetation types and boundaries were subsequently verified using both the data collected in the field and digital imagery. Each vegetation type mapped for this assessment was given a unique alphanumeric code, comprising a character representing the broad landform group (e.g. 'P' for plains, 'H' for hills, and 'M' for mulga), followed by a number sequence.

Vegetation maps were created and consolidated using Geographical Information System (GIS) software (QGIS and MapInfo Professional). All maps in this report were produced by Melissa Robinson (Senior GIS Cartographer at Biota).

² <http://www.environment.gov.au/land/publications/australian-vegetation-attribute-manual-v6/>

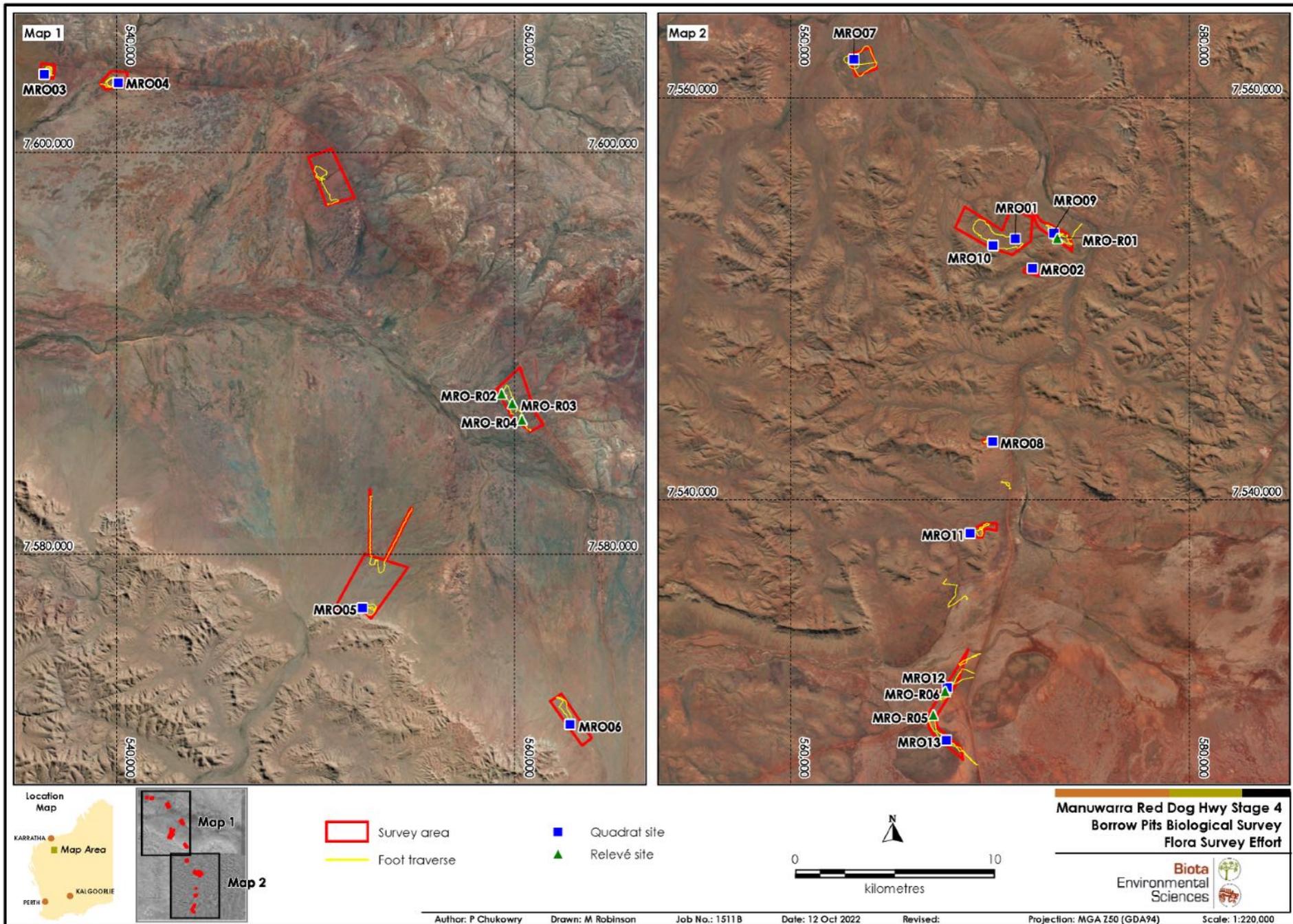


Figure 3.2: Overview of quadrats and relevés sampled within the survey area, and tracklogs.

3.4.3 Searches for Significant Flora and Weeds

Targeted, non-systematic searches were conducted in areas considered to be potential habitat for significant flora (i.e. Threatened and Priority listed species) (see Figure 3.2).

Locations of species of significance or unknown taxa were recorded using a hand-held GPS unit. The number of individuals and extent of the population were also recorded for each location, together with the habitat and associated species. Locations of introduced flora species (weeds) were also recorded during the foot traverses, along with an estimate of their population size. These latter searches focussed on weeds of particular management concern; i.e. Declared Pests under the *WA Biosecurity and Agriculture Management Act 2007* (the BAM Act) and Weeds of National Significance (WoNS).

3.4.4 Specimen Identification, Nomenclature and Data Entry

Common taxa that were well known to the survey botanists were confirmed in the field. A voucher specimen was collected if the taxon was either difficult to determine without closer examination, belonged to a recognised species complex, was poorly collected or otherwise unusual. Each voucher specimen was assigned a unique internal code to facilitate tracking of data. Specimens were pressed in the field and then returned to Perth for further examination and confirmation.

Voucher specimens were identified using all available flora keys, comparison with reference collections of specimens at the WA Herbarium, and in-house at Biota. Specimens were identified by Biota botanists and were generally confirmed by either Michi Maier or consultant taxonomist Pierre-Louis de Kock (dk Botanical). Some specimens (particularly of significant species) were submitted to the WA Herbarium for confirmation.

Nomenclature and significance rankings used in this report are consistent with the current listing of WA flora recognised by the WA Herbarium on Florabase³ at the time of preparation of this report. All data were entered into a Microsoft Access database maintained at Biota, which was developed by Ted Griffin at the request of Malcolm Trudgen (M.E. Trudgen & Associates).

3.5 Basic Fauna Sampling Methods

A basic fauna survey was undertaken in the survey area to verify the accuracy of the desktop study. This involved describing and mapping fauna habitats (Section 3.5.1), and undertaking selective low-intensity sampling.

Various methods were used to target significant fauna species identified as potentially occurring in the survey area, including the deployment of passive recording equipment such as ultrasonic automated recording units (ARUs) and motion cameras. Traverses were also conducted on foot through each survey area to search for evidence of significant species, particularly:

- pebble-mounds of the Western Pebble-mound Mouse;
- any suitable caves or other rocky areas that may represent roosting or denning opportunities for significant bat species or the Northern Quoll; and
- signs of any other significant species (e.g. sloughed skins, tracks etc).

Each search method employed targeted multiple species simultaneously, as outlined in Table 3.5, and effort was expended in the habitats mostly likely to support significant species. All other fauna species encountered opportunistically within the survey area were also recorded. An overview of the distribution of fauna sampling effort within the survey area is shown in Figure 3.3.

The field survey was completed under licence BA27000237 issued by DBCA (Appendix 4). More detailed methodology for sampling techniques is provided in Sections 3.5.1 and 3.5.3.

³ <http://florabase.dpaw.wa.gov.au>

Table 3.5: Methods targeting significant fauna species that were employed during the survey.

Species	Conservation Status		Passive Recording		Ultrasonic ARUs	Opportunistic
	State	Federal	Diurnal Searches	Motion Cameras		
Mammals						
Northern Quoll, <i>Dasyurus hallucatus</i>	EN	EN	•	•		
Bilby, <i>Macrotis lagotis</i>	VU	VU	•			
Ghost Bat, <i>Macroderma gigas</i>	VU	VU	•		•	
Pilbara Leaf-nosed Bat, <i>Rhinonictis aurantia</i>	VU	VU			•	
Long-tailed Dunnart, <i>Sminthopsis longicaudata</i>	P4	-		•		
Spectacled Hare-wallaby, <i>Lagorchestes conspicillatus leichardti</i>	P4	-		•		
Short-tailed Mouse, <i>Leggadina lakedownensis</i>	P4	-		•		
Western Pebble-mound Mouse, <i>Pseudomys chapmani</i>	P4		•	•		•
Birds						
Night Parrot, <i>Pezoporus occidentalis</i>	CR	CR	• ¹			
Grey Falcon, <i>Falco hypoleucos</i>	VU	-				•
Pacific Swift, <i>Apus pacificus</i>	MI	MI				•
Peregrine Falcon, <i>Falco peregrinus</i>	OS	-				•
Reptiles						
Pilbara Olive Python, <i>Liasis olivaceus barroni</i>	VU	VU	•	•		•
Pilbara Barking Gecko, <i>Underwoodisaurus seorsus</i>	P2		•			•
<i>Ctenotus uber</i>	P2		•			•
<i>Notoscincus butleri</i>	P4		•			•
<i>Anilius ganeii</i>	P1		•			•

¹ No suitable habitat found for deployment of audible ARU.

3.5.1 Fauna Habitat Mapping

Fauna habitat mapping was undertaken using a functional, ecological perspective on fauna use of the landscape (Biota 2013). Habitat elements recorded included landscape type, soil type, surface material, landform, any notable microhabitats present, any disturbance (e.g. fire, weeds, grazing, evidence of introduced fauna), broad vegetation types, and representative photographs. Site descriptions were then considered in the context of the detailed vegetation mapping descriptions provided in Section 5.2.

Broad fauna habitat areas were mapped in the field using a combination of foot traverses, vehicle traverses of the existing road, and examination of aerial photography. Habitats were described and mapped based on portions within the survey area that would be likely to offer a range of ecological niches for a suite of different species, with consideration of landform, substrate and vegetation. It is important to note that each broad habitat area defined here cannot be used to map the distribution of any one species or group of taxa, as many species use a range of ecological niches for specific activities such as foraging, commuting, breeding and nesting. The resultant habitat mapping should therefore be viewed as a guide to delineate areas that may be of differing ecological importance to the fauna species utilising the survey area.

Quality of fauna habitat was also considered according to the criteria defined in Table 3.6.

Table 3.6: Criteria used to assess fauna habitat quality.

Habitat Quality	Criteria
Excellent	Minimal to no modification of habitat from intense/frequent fires, trampling/grazing by introduced herbivores or weed invasion.
Good	Some habitat modification from intense/frequent fires, trampling/grazing by introduced herbivore and/or weed invasion.
Poor	Habitat mostly or completely modified by intense/frequent fires, trampling by introduced herbivores, invasion of weeds and/or clearing.

3.5.2 Remote Cameras

Reconyx infrared motion cameras were deployed at three locations where suitable habitat for significant species was identified. The locations of these camera and total trap nights are presented in Table 3.7.

Table 3.7: Location of motion cameras deployed.

Site	Latitude	Longitude	Fauna Habitat	Deployed	Effort (nights)
MRD01MC	-22.131536	117.694765	RHS	2022-04-26	9
MRD02MC	-22.126554	117.712402	RHS	2022-04-26	9
MRD03MC	-22.142312	117.699983	RHS	2022-04-26	9
Total Effort:					27

3.5.3 Ultrasonic Sound Recorders

SongMeter2BAT (SM2BAT) ultrasonic ARUs were used to detect bat species within the proposed pit areas, including the significant Ghost Bat (*Macroderma gigas*) and Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*). The units were programmed following the manufacturer's recommendations for selectable filters and triggers, jumper and audio settings for bat detection (Wildlife Acoustics 2010). Bat sampling was undertaken at three sites for a period of nine nights at each site (Table 3.8).

Bat echolocation call analysis was conducted by Dan Kamien of Biota using Kaleidoscope Pro software (version 4.3.2), and following methods recommended by the Australasian Bat Society (2006) in conjunction with available reference data (Churchill 2008, McKenzie and Bullen 2009). Only sequences containing good quality search phase calls were considered for identification.

Table 3.8: Location of ultrasonic sound recorders deployed.

Site	Latitude	Longitude	Fauna Habitat	Deployed	Effort (nights)
MRD01Bat	-22.133240	117.694452	RHS	2022-04-26	9
MRD02Bat	-22.124450	117.710220	RHS	2022-04-26	9
MRD03Bat	-22.144115	117.702438	MDE	2022-04-26	9
Total Effort:					27

3.5.4 Fauna Nomenclature

As per the relevant Technical Guidance (EPA 2016d), species nomenclature for mammals, reptiles and amphibians follows that of the WAM fauna taxonomic checklist, which was last revised in April 2020. Species nomenclature for avifauna follows that of the International Ornithological Congress (IOC) World Bird List⁴.

⁴ <https://www.worldbirdnames.org/>

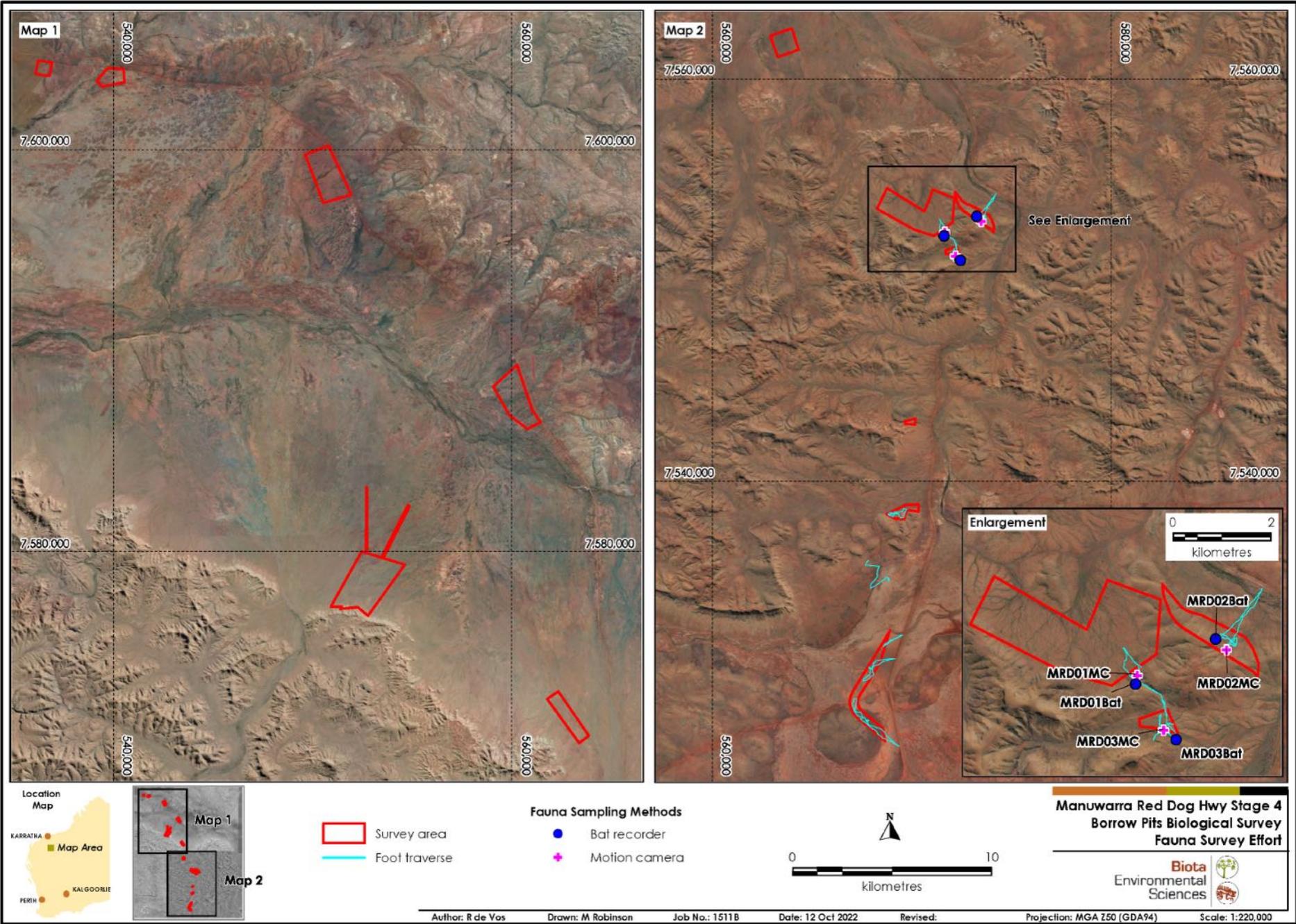


Figure 3.3: Overview of fauna sampling effort within the survey area.

3.6 Survey Limitations

In accordance with the EPA Technical Guidance for 'Flora and Vegetation Surveys for Environmental Impact Assessment' (EPA 2016a) and 'Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment' (EPA 2020), potential constraints and limitations of this biological survey are addressed in Table 3.9

Table 3.9: Potential constraints and limitations of the biological survey.

Potential Constraint	Statement of Limitations
1. Availability of contextual information at a regional and local scale	<ul style="list-style-type: none"> • Extensive previous survey work has been undertaken in the region and contextual information was readily available. • Contextual information was not a limitation.
2. Competency/ experience of the team carrying out the survey, including experience in the bioregion surveyed	<ul style="list-style-type: none"> • All field personnel were suitably qualified and have extensive experience in the Pilbara region. • Competency was not considered to be a limitation.
3. Proportion of species recorded and/or collected, any identification issues	<ul style="list-style-type: none"> • All vascular flora encountered in the survey area were recorded, with collections made of any taxa that were unusual, or difficult to identify without microscopic examination. The great majority of flora taxa were able to be identified to the lowest level possible within the current taxonomic framework. • The basic fauna survey recorded species via targeted and opportunistic methods, and verified habitats with the potential to support significant species; the targeted surveys focused on recording evidence of significant species. An inventory survey of all fauna species was not completed, as this would require systematic trapping as part of a larger detailed survey, which was not required to meet the objectives of the current survey. • Overall, identification and proportion of fauna and flora recorded were not considered to be a limitation given the objectives of this survey.
4. Appropriate area fully surveyed (effort and extent)	<ul style="list-style-type: none"> • The survey area was surveyed appropriately from both a fauna and flora perspective. • Foot traverses were completed through the majority of the survey area to search for significant flora. • Low intensity sampling of the vegetation with quadrats and relevés was undertaken, which matched the requirements of a reconnaissance level flora survey as per the EPA guidance (EPA 2016a). Three sampling sites were assessed for most vegetation types, and with the exception of: <ul style="list-style-type: none"> ○ C5 – this vegetation type was very restricted, with only 0.02 ha mapped. ○ F5 – this vegetation type was thought to represent P8 in the field but was assessed post-survey as being distinct from the surrounding vegetation. It was described with a mapping note. • This study targeted specific fauna species of significance. The study comprehensively assessed the occurrence of habitat for these species within the survey area. • Survey effort and extent was not considered to be a limitation.
5. Access restrictions within the survey and contextual areas	<ul style="list-style-type: none"> • Most borrow pit and road realignment polygons of the survey area were readily accessible, being located adjacent to the existing rail access road. Borrow pits located distant from vehicle access points were either accessed on foot from other existing tracks, or by using a helicopter. • Access was not considered to be a limitation.

Potential Constraint	Statement of Limitations
6. Survey timing, rainfall, season of survey	<ul style="list-style-type: none"> • The fauna surveys were undertaken from April to July, which is optimal timing for detecting most terrestrial fauna groups in the Pilbara. • The survey area had received adequate rainfall for flora collecting in the months prior to each of the flora surveys, and rainfall received was generally above the long-term averages. High rainfall provided excellent conditions for flora collection. • Survey timing was not considered to be a limitation.
7. Disturbance that may have affected the results of the survey (such as fire, flood or clearing)	<ul style="list-style-type: none"> • Only minor portions of the survey area had been recently burnt. • Existing clearing associated with mining exploration activities, tracks and the railway network comprised the majority of cleared areas within the survey area. However, the majority of the survey area remained uncleared, allowing all habitat types to be sampled within undisturbed areas. • Disturbance is not considered to have been a limitation for the study.

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4.0 Desktop Study

4.1 IBRA Bioregion and Subregions

The Interim Biogeographic Regionalisation for Australia (IBRA) recognises 89 bioregions and 419 subregions within Australia (DSEWPac 2012). The survey area lies within the Pilbara bioregion, which is divided into four subregions. The survey area intersects the Fortescue, Chichester and Hamersley IBRA subregions (see Figure 2.1). A description of each of these subregions and their extent in the survey area is provided in Table 4.1.

The Pilbara bioregion is a major centre for biodiversity within Western Australia. In recognition of this high species diversity and the high levels of endemism in the region, the Hamersley subregion is considered one of the 15 national biodiversity hotspots in Australia. This appears to be related to the diversity of geological, altitudinal and climatic elements in the region, as well as being a function of its location in a transitional zone between the floras of the Eyrean (central desert) and southern Torresian (tropical) bioclimatic regions (see for example van Leeuwen and Bromilow (2002) for a detailed discussion of the significance of the Hamersley Range).

Table 4.1: Description of the IBRA subregions within the survey area.

IBRA Subregion	Description (Reference)	Extent in Pilbara Bioregion (ha)	Extent in Survey Area	
			Area (ha)	Proportion of Extent in Pilbara
Chichester (PIL 1)	Undulating Archaean granite and basalt plains include significant areas of basaltic ranges. Plains support a shrub steppe characterised by <i>Acacia inaequilatera</i> over <i>Triodia wiseana</i> (formerly <i>Triodia pungens</i>) hummock grasslands, while <i>Eucalyptus leucophloia</i> tree steppes occur on ranges (Kendrick and McKenzie 2003).	8,383,933.4	836.0	0.01%
Fortescue (PIL 2)	Extensive salt marsh, mulga-bunch grass, and short grass communities on alluvial plains in the east. Deeply incised gorge systems in the western (lower) part of the drainage. River gum woodlands fringe the drainage lines. Northern limit of Mulga (<i>Acacia aneura</i>). An extensive calcrete aquifer (originating within a paleo-drainage valley) feeds numerous permanent springs in the central Fortescue, supporting large permanent wetlands with extensive stands of river gum and cadjeput <i>Melaleuca</i> woodlands (Kendrick 2003a).	1,953,621.1	820.8	0.04%
Hamersley (PIL 3)	Mountainous area of Proterozoic sedimentary ranges and plateaus, dissected by gorges (basalt, shale and dolerite). Mulga low woodland over bunch grasses on fine textured soils in valley floors, and <i>Eucalyptus leucophloia</i> over <i>Triodia brizoides</i> on skeletal soils of the ranges (Kendrick 2003b).	5,632,612.7	1,052.9	0.02%

4.2 Land Systems

Land systems are composed of repeating patterns of topography, soils and vegetation, which are described as a series of land units (Christian and Stewart 1953). A total of 105 land systems have been identified and mapped in the Pilbara bioregion by the then Department of Agriculture. Land systems mapping covering the survey area was prepared by van Vreeswyk et al. (2004).

Eight land systems are mapped within the survey area. A further 25 land systems mapped within the surrounding study area do not occur within the survey area (Figure 4.1). The Boolgeeda land system was best represented, accounting for 54% of the survey area, followed by the Urandy land system at 23% (Table 4.2 and Figure 4.1). Only a small proportion of the total extent of each of the land systems in the Pilbara bioregion is intersected by the survey area (Table 4.2).

Table 4.2: Land systems within the survey area.

Data from Department of Agriculture WA (van Vreeswyk et al. 2004).

Land System	Description	Extent in Survey Area		Extent in Pilbara Bioregion (ha)	Extent in Survey Area as a Proportion of the Pilbara Bioregion
		Area (ha)	Proportion		
Boolgeeda (RGEBGD)	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands.	1,461.0	53.9%	961,637	0.2%
Brockman (RGEBRO)	Gilgai alluvial plains with cracking clay soils supporting tussock grasslands.	145.8	5.4%	74,108	0.2%
Hooley (RGEHOY)	Alluvial clay plains supporting a mosaic of snakewood shrublands and tussock grasslands.	90.1	3.3%	59,081	0.2%
Jurrawarrina (RGEJUR)	Hardpan plains and alluvial tracts supporting mulga shrublands with tussock and spinifex grasses.	25.6	0.9%	66,475	<0.1%
Newman (RGENEW)	Rugged jaspilite plateaus, ridges and mountains supporting hard spinifex grasslands.	286.5	10.6%	1,993,745	<0.1%
Platform (RGEPLA)	Dissected slopes and raised plains supporting hard spinifex grasslands.	61.7	2.3%	236,336	<0.1%
River (RGERIV)	Active flood plains, major rivers and banks supporting grassy eucalypt woodlands, tussock grasslands and soft spinifex grasslands.	10.3	0.4%	497,421	<0.1%
Urandy (RGEURY)	Stony plains, alluvial plains and drainage lines supporting shrubby soft spinifex grasslands.	628.7	23.2%	131,976	0.5%
Total		2,709.7	100%		

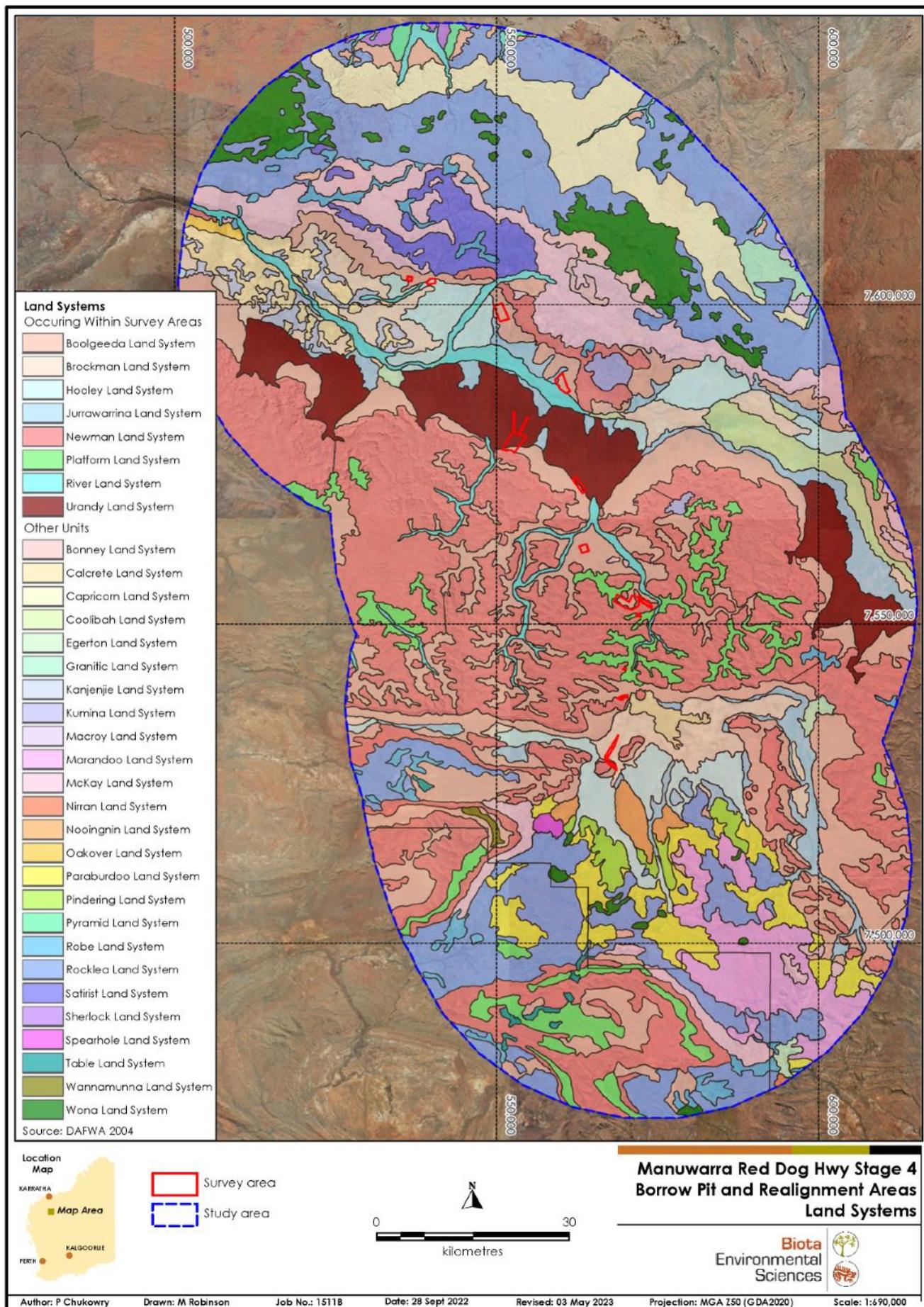


Figure 4.1: Land systems mapping of the survey area and the study area.

4.3 Geology

Mapping of the surface geological units in the locality was prepared based on data from Stewart et al. (2008). Six geological units occur within the survey area (see Table 4.3 and Figure 4.2), with an additional 21 geological units mapped within the wider study area (Figure 4.2). The dominant surface geology type in the survey area is Qrc (colluvium), comprising around 78% of the survey area.

Table 4.3: Description and extent of geological units within the survey area.
Data from Geoscience Australia (Stewart et al. 2008).

Geological Unit	Description	Extent in Survey Area	
		Area (ha)	Proportion
Achm – Marra Mamba Iron Formation	Chert, ferruginous chert, jaspilite, banded iron-formation, minor shale, siltstone, mudstone.	1.4	<0.1%
Ashm – Mt. McRae Shale and Mt. Sylvia Formation	Interbedded shale, chert, banded iron-formation.	2.4	<0.1%
Czlr – Robe Pisolite	Pisolitic, oolitic, and massive limonite, goethite, and hematite deposits containing fossil wood fragments; iron ore.	67.6	2.5%
Lchk – Brockman Iron Formation	Banded iron-formation, chert, mudstone and siltstone.	330.3	12.2%
Qa – Alluvium	Channel and flood plain alluvium; gravel, sand, silt, clay, locally calcreted.	208.4	7.7%
Qrc – Colluvium	Colluvium, sheetwash, talus; gravel piedmonts and aprons over and around bedrock; clay-silt-sand with sheet and nodular kankar; alluvial and aeolian sand-silt-gravel in depressions and broad valleys in Canning Basin; local calcrete, reworked laterite.	2,099.7	77.5%
Total		2,709.7	100%

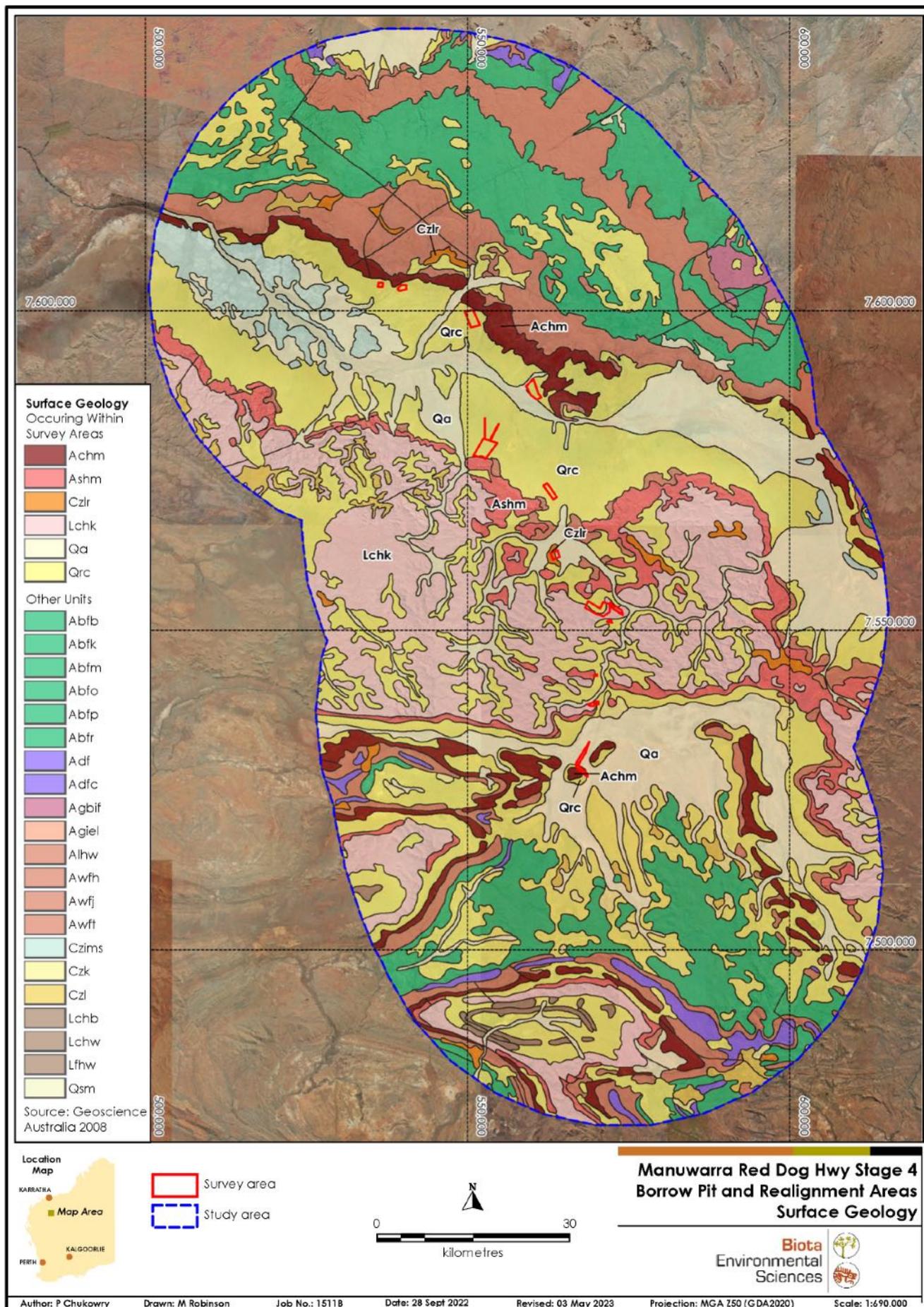


Figure 4.2: Geological units of the survey area and the study area.

4.4 Soils

Soil units have been mapped by Northcote et al. (1960). Seven broad soil types have been mapped within the survey area (see Table 4.4 and Figure 4.3), while a further 10 units occur only in the broader study area (Figure 4.3). The dominant units in the survey area comprise the valley plain unit associated with Fortescue River, Ja1, which makes up 54% of the survey area; and Fa13, which represents shallow, stony soils associated with the Hamersley Range and accounts for 26% of the survey area.

Table 4.4: Description and extent of soil units within the survey area.

Data from Northcote et al. (1960).

Soil Unit	Description	Extent in Survey Area (ha)	
		Area (ha)	Proportion
Fa13	Ranges of banded jaspilite and chert along with shales, dolomites, and iron ore formations; some areas of ferruginous duricrust as well as occasional narrow winding valley plains and steeply dissected pediments. This unit is largely associated with the Hamersley and Ophthalmia Ranges. The soils are frequently stony and shallow and there are extensive areas without soil cover: chief soils are shallow stony earthy loams (Um5.51) along with some (Uc5.11) soils on the steeper slopes. Associated are (Dr2.33 and Dr2.32) soils on the limited areas of dissected pediments, while (Um5.52) and (Uf6.71) soils occur on the valley plains.	707.8	26.1%
Fa14	Steep hills and steeply dissected pediments on areas of banded jaspilite and chert along with shales, dolomite, and iron ore formations; some narrow winding valley plains: chief soils are shallow stony earthy loams (Um5.51) along with some (Uc5.11) soils on the steeper slopes. (Dr2.33 and Dr2.32) soils which occur on the pediments are more extensive than in unit Fa13. (Um5.52) and (Uf6.71) soils occur on the valley plains.	94.0	3.5%
Fb3	High-level valley plains set in extensive areas of unit Fa13. There are extensive areas of pisolitic limonite deposits: principal soils are deep earthy loams (Um5.52) along with small areas of (Gn2.12) soils.	125.9	4.7%
Ja1	Extensive valley plains largely associated with the Fortescue River: chief soils are earthy clays (Uf6.71) along with some (Ug5.38), (Um5.5), and (Dr2.33) soils. Small areas of calcrete (kunkar) with (Um5.11) soils also occur.	1,475.0	54.4%
MM16	Alluvial plains dominated by deep cracking clays (Ug5.38) along with some areas of (Uf6.71) soils, and minor areas of (Dr2.33) soils.	125.2	4.6%
My55	Gently sloping outwash plains generally flanking the northern face of the Hamersley Range; coarse surface gravels are extensive: chief soils are neutral red earths (Gn2.12) with some (Gn2.11) and (Dr2.33) soils.	44.3	1.6%
Oc74	Dissected pediments with low stony hills as in unit Oc70, and with some residuals capped by ironstone gravels and underlain by pallid zones to 30 ft; pediments have a gravel veneer of coarse rock fragments: hard alkaline and neutral red soils (Dr2.33 and Dr2.32) are dominant with some (Um5.52) on pediments and rock outcrop, and there are gravelly loams (KS-Um5.51) and sands (KS-Uc5.21) overlying duricrust at shallow depths on the residuals.	137.5	5.1%
Total		2,709.7	100%

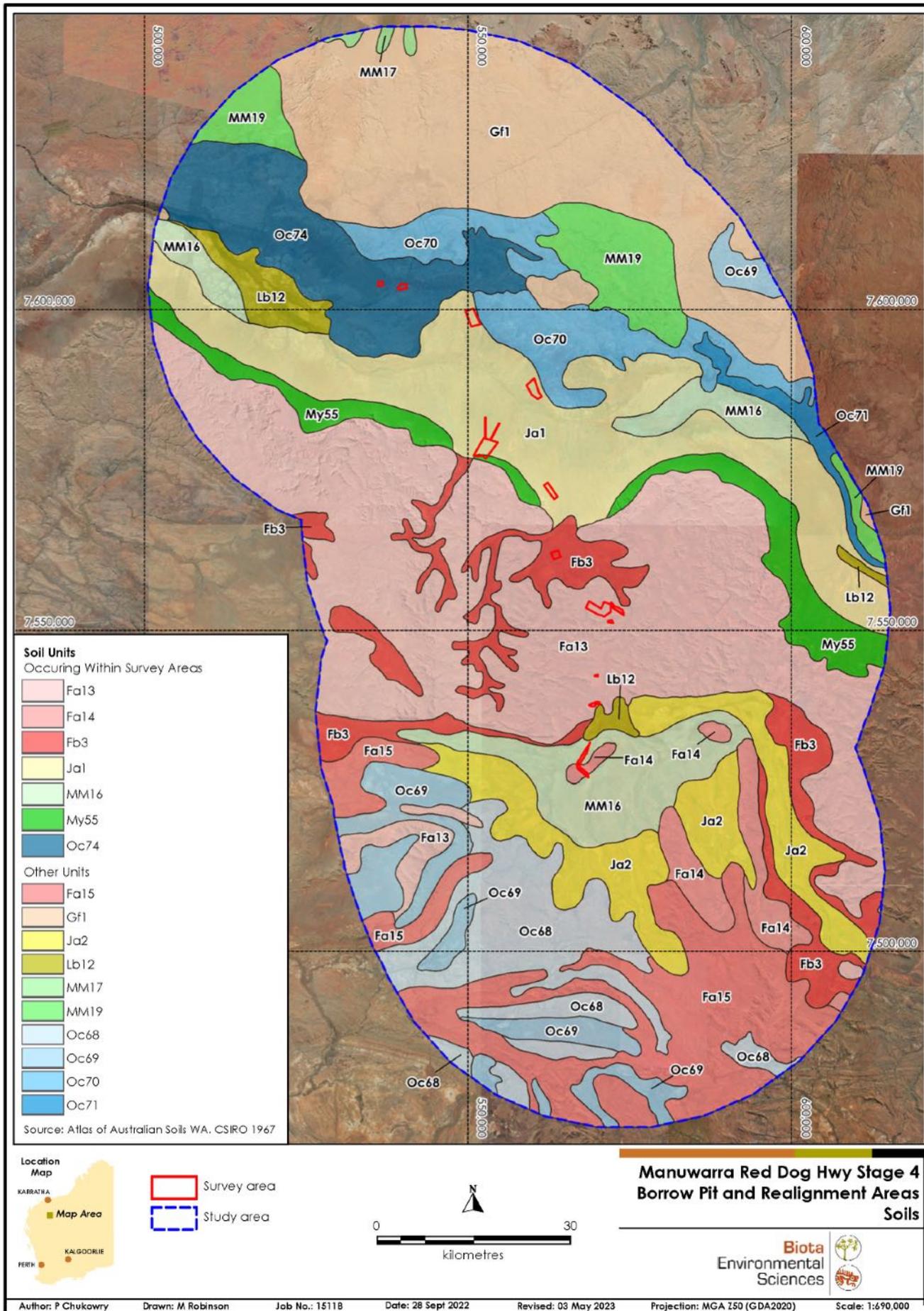


Figure 4.3: Soil units of the survey area and the study area.

4.5 Hydrology

The survey area does not intersect any major drainage systems, but includes minor un-named tributaries of the Fortescue River and other creeks through the Hamersley Range (see Figure 2.1).

4.6 Conservation Reserves

There is no formally gazetted conservation tenure within the survey area.

The nearest reserve is the Millstream-Chichester National Park, which is located approximately 16 km north of the northern-most polygon of the survey area and intersects the study area boundary (Figure 2.1). Karijini National Park is also located approximately 30 km east of several of the polygons in the south of the survey area. Figure 2.1 also shows Department of DBCA lands of interest adjacent to Karijini National Park. These areas include the former leasehold areas of Mt Florence and Hamersley Stations, that are proposed for conservation in the future.

4.7 Pre-European Vegetation

Broad-scale vegetation mapping for the locality has been prepared at the 1:1,000,000 scale based on the work of J.S. Beard for the Pilbara (Beard 1975a). The survey area intersects eight of Beard's vegetation associations (Table 4.5 and Figure 4.4), while an additional 23 associations occur in the surrounding study area (see Figure 4.4). The majority of the survey area is mapped as hummock grassland units (nearly 93%). Beard's dominant vegetation associations in the survey area are Chichester Plateau 607 and Hamersley 645, which account for nearly 50% of the survey area combined. Low mulga woodland (Hamersley 29 and Hamersley 18) and short bunch grassland (Hamersley 175) are also present in the survey area.

The pre-European and current extents of Beard's vegetation system associations have been calculated using interpretation of imagery to determine areas that have been cleared (as per Shepherd et al. 2002, and Government of Western Australia 2019; noting that the latter has not been updated since 2018). These sources indicate that over 99% of the extent of each of these units remained uncleared as of 2018.

Table 4.5: Description and extent of Beard's vegetation associations within the survey area.

Data from Beard (1975b).

Vegetation Association	Description	Extent in Survey Area		Extent in Pilbara Bioregion (ha)	Extent in Survey Area as a Proportion of the Pilbara Bioregion
		Area (ha)	Proportion		
Chichester Plateau 607	Hummock grasslands, low tree steppe; snappy gum and bloodwood over soft spinifex and <i>Triodia wiseana</i> .	758.5	28.0%	118,907	0.6%
Chichester Plateau 646	Hummock grasslands, shrub steppe; snakewood over <i>Triodia basedowii</i> .	77.5	2.9%	18,046	0.4%
Hamersley 175	Short bunch grassland - savanna/grass plain (Pilbara).	130.5	4.8%	95,091	0.1%
Hamersley 29	Sparse low woodland; mulga, discontinuous in scattered groups.	64.2	2.4%	149,833	<0.1%
Hamersley 565	Hummock grasslands, low tree steppe; bloodwood over soft spinifex.	519.0	19.2%	108,945	0.5%
Hamersley 644	Hummock grassland with scattered bloodwoods and snappy gum; <i>Triodia</i> spp., <i>Corymbia dichromophloia</i> , and <i>Eucalyptus leucophloia</i> .	174.5	6.4%	27,069	0.6%
Hamersley 645	Hummock grassland with scattered shrubs or mallee; <i>Triodia</i> , <i>Acacia</i> , <i>Grevillea</i> and <i>Eucalyptus</i> spp.	581.6	21.5%	84,658	0.7%
Hamersley 82	Hummock grasslands, low tree steppe; snappy gum over <i>Triodia wiseana</i> .	403.8	14.9%	2,157,842	<0.1%
	Total	2,709.7	100%		

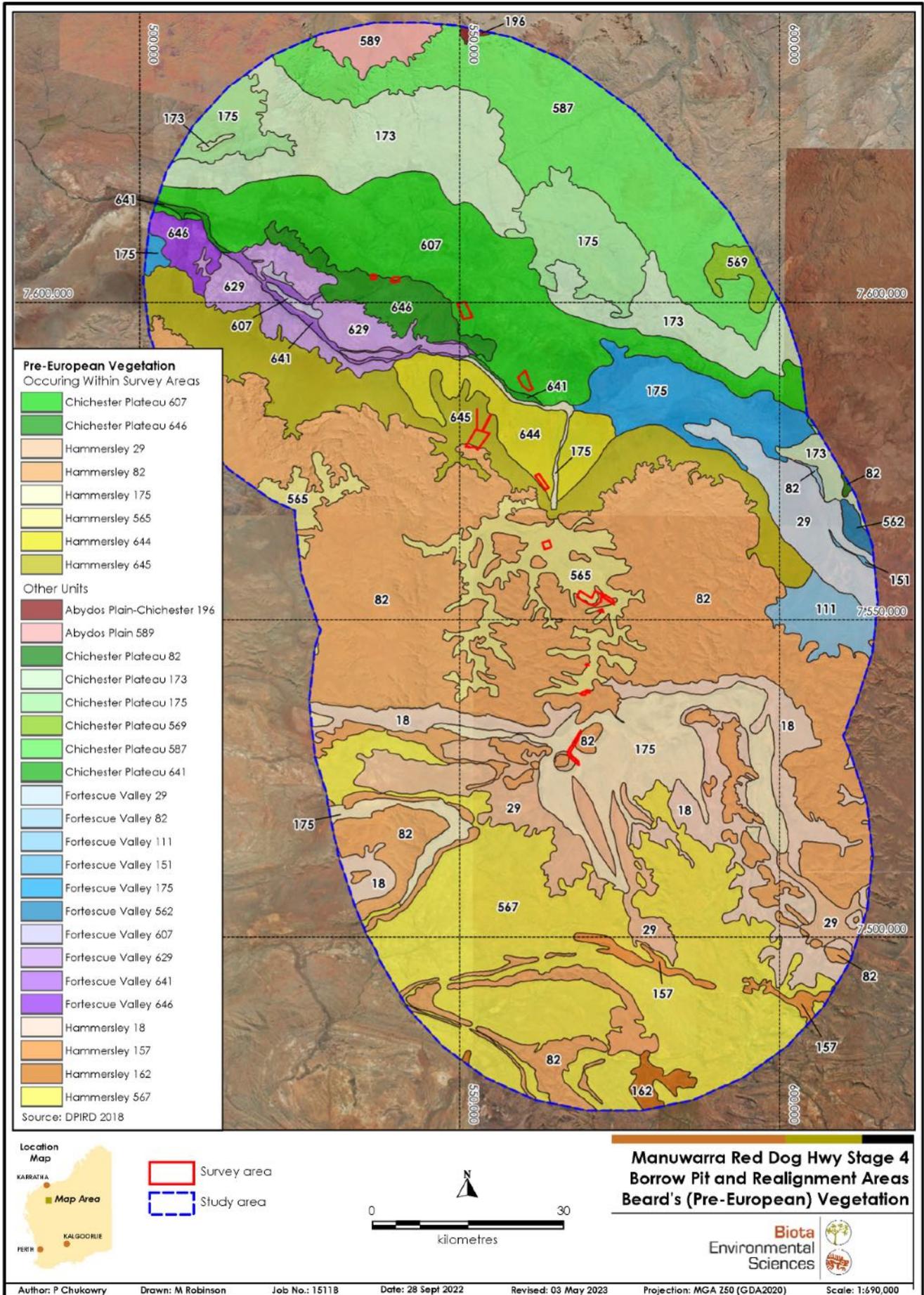


Figure 4.4: Beard's vegetation associations within the survey area and study area.

4.8 Previous Biological Surveys

Seven previous flora and vegetation surveys and 11 previous fauna surveys overlap the study area, in addition to the survey of the main project corridor completed in 2020 (Table 4.6 and Table 4.7).

Species and ecological communities of significance recorded during those past studies were used to inform the assessment of those likely to occur within the current survey area (Sections 4.9 and 4.10).

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Table 4.6: Previous relevant flora and vegetation surveys carried out within the study area.

Report/Document Title (Author)	Type of Survey/Study and Survey Effort	Survey Dates	No. Native Flora Species Recorded	No. Introduced Species	Features of Significance / TECs and PECs / Threatened and Priority Species	Survey Limitations
Nanutarra Munjina Road SLK 211.2-307.8 Biological Survey (Biota 2022)	<ul style="list-style-type: none"> Single phase detailed flora and vegetation survey and targeted flora searches. 55 quadrats and 16 relevés. 	19 th – 27 th July 2021 4 th – 12 th August 2021 25 th August – 1 st September 2021	521	25 species: *Aerva javanica, *Argemone ochroleuca subsp. ochroleuca, *Bidens bipinnata, *Bothriochloa pertusa, *Cenchrus ciliaris, *Cenchrus setiger, *Chloris virgata, *Citrullus colocynthis, *Cucurbita pepo, *Cynodon dactylon, *Datura leichhardtii subsp. leichhardtii, *Echinochloa colona, *Euphorbia hirta, *Flaveria trinervia, *Malvastrum americanum, *Passiflora foetida var. hispida, *Portulaca pilosa, *Rumex vesicarius, *Setaria verticillata, *Sisymbrium orientale, *Solanum nigrum, *Sonchus oleraceus, *Tribulus terrestris, *Tridax procumbens, *Vachellia farnesiana	14 Priority species: <ul style="list-style-type: none"> <i>Euphorbia inappendiculata</i> var. <i>queenslandica</i> (P2) <i>Ipomoea racemigera</i> (P2) <i>Dolichocarpa</i> sp. Hamersley Station (A.A. Mitchell PRP 1479) (P3) <i>Euphorbia australis</i> var. <i>glabra</i> (P3) <i>Glycine falcata</i> (P3) <i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP 727) (P3) <i>Iotasperma sessilifolium</i> (P3) <i>Ptilotus subspinescens</i> (P3) <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3) <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3) <i>Streptoglossa</i> sp. Cracking clays (S. van Leeuwen et al. PBS 7353) (P3) <i>Swainsona thompsoniana</i> (P3) <i>Bulbostylis burbridgeae</i> (P4) <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (P4) 	No significant limitations reported.
Manuwarra Red Dog Highway Stage 4 Biological Survey (Biota 2021).	<ul style="list-style-type: none"> Detailed and targeted flora and vegetation survey. 137 quadrats and 19 relevés. 	19 th – 27 th April 2020 22 nd – 29 th May 2020 19 th – 26 th October 2020 26 th – 30 th March 2021	590	16 species: *Aerva javanica, *Bidens bipinnata, *Cenchrus ciliaris, *Cenchrus setiger, *Cynodon dactylon, *Datura leichhardtii, *Echinochloa colona, *Flaveria trinervia, *Malvastrum americanum, *Portulaca pilosa, *Rumex vesicarius, *Setaria verticillata, *Sonchus oleraceus, *Tribulus terrestris, *Tridax procumbens, *Vachellia farnesiana	One TEC: <i>Themeda</i> grasslands on cracking clays (Hamersley Station, Pilbara) (Vulnerable) One PEC: Brockman Iron cracking clay communities of the Hamersley Range (Priority 1) 20 Priority species: <ul style="list-style-type: none"> <i>Hibiscus</i> sp. Mt Brockman (E. Thoma ET 1354) (P1) <i>Josephinia</i> sp. Woodstock (A.A. Mitchell PRP 989) (P1) <i>Aristida lazaridis</i> (P2) <i>Euphorbia inappendiculata</i> var. <i>inappendiculata</i> (P2) <i>Euphorbia inappendiculata</i> var. <i>queenslandica</i> (P2) <i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P3) <i>Astrebla lappacea</i> (P3) <i>Dolichocarpa</i> sp. Hamersley Station (A.A. Mitchell PRP 1479) (P3) <i>Euphorbia australis</i> var. <i>glabra</i> (P3) <i>Glycine falcata</i> (P3) <i>Gymnanthera cunninghamii</i> (P3) <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3) <i>Sida</i> sp. Hamersley Range (K. Newbey 10692) (P3) <i>Streptoglossa</i> sp. Cracking clays (S. van Leeuwen et al. PBS 7353) (P3) <i>Swainsona thompsoniana</i> (P3) <i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431) (P3) <i>Triodia basitricha</i> (P3) <i>Vittadinia</i> sp. Coondewanna Flats (S. van Leeuwen 4684) (P3) <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4) <i>Goodenia berringbinensis</i> (P4) 	No significant limitations reported.

Report/Document Title (Author)	Type of Survey/Study and Survey Effort	Survey Dates	No. Native Flora Species Recorded	No. Introduced Species	Features of Significance / TECs and PECs / Threatened and Priority Species	Survey Limitations
Eliwana Flora and Vegetation Survey – Phase 2 (Biota 2018).	<ul style="list-style-type: none"> Detailed, 1- or 2-phase flora and vegetation survey of rail survey area (RSA) and mine survey area (MSA). Desktop study and consolidation of data from 22 previous surveys conducted in and around the survey area. Resampling of many previously established sites. 554 quadrats and 143 relevés. 	18 th – 30 th April 2017 26 th June – 3 rd July 2017 21 st – 29 th August 2017 12 th – 23 rd September 2017	596 (from MSA and RSA)	27 species from MSA and RSA: *Aerva javanica, *Alternanthera pungens, *Argemone ochroleuca subsp. ochroleuca, *Bidens bipinnata, *Bothriochloa pertusa, *Cenchrus ciliaris, *Cenchrus setiger, *Chloris virgata, *Citrullus amarus, *Conyza bonariensis, *Cynodon dactylon, *Datura leichhardtii, *Digitaria ciliaris, *Echinochloa colona, *Euphorbia hirta, *Flaveria trinervia, *Lactuca serriola forma serriola, *Malvastrum Americanum, *Oxalis corniculata, *Portulaca pilosa, *Rumex vesicarius, *Setaria verticillata, *Sigesbeckia orientalis, *Solanum nigrum, *Sonchus oleraceus, *Tribulus terrestris, *Vachellia farnesiana	<p>One TEC: <i>Themeda</i> grasslands on cracking clays (Hamersley Station, Pilbara) (Vulnerable)</p> <p>Two PECs:</p> <ul style="list-style-type: none"> Brockman Iron cracking clay communities of the Hamersley Range (Priority 1) <i>Triodia pisoliticola</i> (previously <i>Triodia</i> sp. Robe River) assemblages of mesas of the West Pilbara) (Priority 3) <p>35 Priority species recorded from the RSA during this survey:</p> <ul style="list-style-type: none"> <i>Calotis squamigera</i> (P1) <i>Helichrysum oligochaetum</i> (P1) <i>Hibiscus</i> sp. Mt Brockman (E. Thoma ET 1354) (P1) <i>Triodia</i> sp. Silvergrass (P.-L. de Kock BES 00808) (P1) <i>Euphorbia inappendiculata</i> var. <i>inappendiculata</i> (P2) <i>Euphorbia inappendiculata</i> var. <i>queenslandica</i> (P2) <i>Gompholobium karjini</i> (P2) <i>Ipomoea racemigera</i> (P2) <i>Pentalepis trichodesmoides</i> subsp. <i>hispida</i> (P2) <i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (P3) <i>Astrebla lappacea</i> (P3) <i>Cyanthillium gracile</i> (P3) <i>Dolichocarpa</i> sp. Hamersley Station (A.A. Mitchell PRP 1479) (P3) <i>Eragrostis surreyana</i> (P3) <i>Eremophila magnifica</i> subsp. <i>velutina</i> (P3) <i>Euphorbia australis</i> var. <i>glabra</i> (P3) <i>Glycine falcata</i> (P3) <i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP 727) (P3) <i>Grevillea saxicola</i> (P3) <i>Indigofera gilesii</i> (P3) <i>Indigofera rivularis</i> (P3) <i>Lotasperma sessilifolium</i> (P3) <i>Ptilotus subspinescens</i> (P3) <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3) <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3) <i>Sida</i> sp. Hamersley Range (K. Newbey 10692) (P3) <i>Solanum albotellatum</i> (P3) <i>Stackhousia clementii</i> (P3) <i>Swainsona thompsoniana</i> (P3) <i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431) (P3) <i>Triodia basitricha</i> (P3) <i>Vittadinia</i> sp. Coondewanna Flats (S. van Leeuwen 4684) (P3) <i>Acacia bromilowiana</i> (P4) <i>Ptilotus mollis</i> (P4) <i>Rhynchosia bungarensis</i> (P4) 	Possible timing limitations – some parts of survey area only able to be sampled during one phase.
Koodaideri Iron Ore project – Vegetation and Flora Integration Report (Biota 2012).	<ul style="list-style-type: none"> Consolidation of data from five flora and vegetation surveys in the Koodaideri area. 403 quadrats and 30 relevés, many of which were sampled twice. 	NA – Desktop study	758 (consolidated from all five survey areas)	16 species: *Aerva javanica, *Bidens bipinnata, *Cenchrus ciliaris, *Cenchrus setiger, *Cenchrus sp., *Chloris virgata, *Citrullus amarus, *Flaveria trinervia, *Lactuca saligna, *Malvastrum americanum, *Rumex vesicarius, *Setaria verticillata, *Sigesbeckia orientalis, *Sonchus oleraceus, *Tribulus terrestris, *Vachellia farnesiana	<p>13 Priority species:</p> <ul style="list-style-type: none"> <i>Acacia subtiliformis</i> (P3) <i>Dolichocarpa</i> sp. Hamersley Station (A.A. Mitchell PRP 1479) (P3) <i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP 727) (P3) <i>Gymnanthera cunninghamii</i> (P3) <i>Nicotiana umbratica</i> (P3) <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3) <i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431) (P3) <i>Vittadinia</i> sp. Coondewanna Flats (S. van Leeuwen 4684) (P3) <i>Eremophila magnifica</i> subsp. <i>magnifica</i> (P4) <i>Lepidium catapycnon</i> (P4) <i>Ptilotus mollis</i> (P4) <i>Rhynchosia bungarensis</i> (P4) <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (P4) 	No significant limitations reported.
A Vegetation and Flora Survey of the Rio Tinto Rail Duplication – Emu Siding to Rosella Siding Development Areas (Biota 2010a).	<ul style="list-style-type: none"> Level 2 flora and vegetation survey. 35 quadrats and 3 relevés. 	5 th – 13 th May 2008 and 20 th July 2008	473	17 species: *Aerva javanica, *Bidens bipinnata, *Cenchrus ciliaris, *Cenchrus setiger, *Chloris virgata, *Citrullus colocynthis, *Crotalaria juncea, *Cucumis sp., *Cynodon dactylon, *Echinochloa colona, *Flaveria trinervia, *Lactuca sp., *Malvastrum americanum, *Rumex vesicarius, *Setaria verticillata, *Tribulus terrestris, *Vachellia farnesiana	<p>1 TEC: <i>Themeda</i> grasslands on cracking clays (Hamersley Station, Pilbara) (Vulnerable)</p> <p>1 PEC: Four plant assemblages of the Wona Land System (Priority 1-3)</p> <p>3 Priority species:</p> <ul style="list-style-type: none"> <i>Dolichocarpa</i> sp. Hamersley Station (A.A. Mitchell PRP 1479) (P3) <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3) <i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431) (P3) 	No significant limitations reported.

Report/Document Title (Author)	Type of Survey/Study and Survey Effort	Survey Dates	No. Native Flora Species Recorded	No. Introduced Species	Features of Significance / TECs and PECs / Threatened and Priority Species	Survey Limitations
Galah, Gull, Ibis-Koala and Rosella Rail Sidings Native Vegetation Clearing Permit Report (Biota 2010b).	<ul style="list-style-type: none"> Desktop review, collation of previous data from 6 detailed surveys in the Sidings areas. Site visit / reconnaissance survey. 	12th – 19th May 2010	574 (from previous data and 2010 survey)	15 species: <i>*Aerva javanica</i> , <i>*Bidens bipinnata</i> , <i>*Cenchrus ciliaris</i> , <i>*Cenchrus setiger</i> , <i>*Chloris virgata</i> , <i>*Citrullus colocynthis</i> , <i>*Cucumis sp.</i> , <i>*Cynodon dactylon</i> , <i>*Echinochloa colona</i> , <i>*Malvastrum americanum</i> , <i>*Parkinsonia aculeata</i> , <i>*Rumex vesicarius</i> , <i>*Trianthema portulacastrum</i> , <i>*Tribulus terrestris</i> , <i>*Vachellia farnesiana</i>	3 Priority species recorded: <ul style="list-style-type: none"> <i>Astrebla lappacea</i> (P3) <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3) <i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431) (P3) 	Drier than usual conditions during 2010 survey.
Ti Tree Rail Construction Camp: Native Vegetation Clearing Permit Report (Biota 2008a).	<ul style="list-style-type: none"> Desktop and site visit / reconnaissance survey. 1 quadrat and 3 relevés. 	20th March 2008	68	1 species: <i>*Cenchrus ciliaris</i>	None	No significant limitations reported.
A Vegetation and Flora Survey of the Rio Tinto Rail Duplication project – Bellbird Siding to Juna Downs (Biota 2008b).	<ul style="list-style-type: none"> Level 2 flora and vegetation survey. 28 quadrats. 	23rd May – 1st June 2008	331	10 species: <i>*Bidens bipinnata</i> , <i>*Cenchrus ciliaris</i> , <i>*Cenchrus setiger</i> , <i>*Chloris virgata</i> , <i>*Datura leichhardtii</i> , <i>*Malvastrum americanum</i> , <i>*Rumex vesicarius</i> , <i>*Setaria verticillata</i> , <i>*Sonchus oleraceus</i> , <i>*Vachellia farnesiana</i>	5 Priority species: <ul style="list-style-type: none"> <i>Calotis squamigera</i> (P1) <i>Astrebla lappacea</i> (P3) <i>Goodenia lyrata</i> (P3) <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3) <i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3) 	Dry conditions.

Table 4.7: Previous relevant fauna surveys carried out within the study area.

Report/Document Title (Author)	Type of Survey/Study and Survey Effort	Survey Dates	Taxonomic Groups Documented	Species of Significance †	Habitat Identified that may Support Significant Fauna	Survey Limitations
Nanutarra Munjina Road SLK 211.2-307.8 Biological Survey (Biota 2022)	<ul style="list-style-type: none"> Basic and targeted fauna survey 	19 th – 27 th July 2021 6 th – 11 th September 2021	<ul style="list-style-type: none"> Reptiles (3) Avifauna (38) Mammals (17) 	4 species of significance were recorded: <ul style="list-style-type: none"> Pilbara Leaf-nosed Bat (VU) Ghost Bat (VU) Western Pebble-Mound Mouse (P4; secondary signs) 	<ul style="list-style-type: none"> Rolling stony hills for Western Pebble-mound Mouse and Long-tailed Dunnart. Outcropping in contextual areas may support Northern Quoll and Pilbara Olive Python. Drainage lines with large trees may represent nesting habitat for Grey Falcon and Peregrine Falcon. Major drainage lines may support Northern Quoll and Pilbara Olive Python. Permanent water may support Pilbara Leaf-nosed Bats and migratory birds. Small areas of clay plain habitat may support Short-tailed Mouse. 	<ul style="list-style-type: none"> No significant limitations reported.
Manuwarra Red Dog Highway Stage 4 Biological Survey (Biota 2021).	<ul style="list-style-type: none"> Basic and targeted fauna survey 	19 th – 27 th April 2020 22 nd – 31 st May 2020	<ul style="list-style-type: none"> Amphibians (4) Reptiles (15) Avifauna (75) Mammals (16) 	4 species of significance were recorded: <ul style="list-style-type: none"> Pilbara Leaf-nosed Bat (VU) Ghost Bat (VU; secondary signs) Western Pebble-Mound Mouse (P4; secondary signs) Grey Falcon (VU) 	<ul style="list-style-type: none"> Cracking clay habitat suitable for Short-tailed Mouse. Gorges, gullies and rocky free faces present which may provide potential habitat for the Northern Quoll and Pilbara Olive Python. Cliff faces, caves and crevices suitable for Northern Quolls, Pilbara Leaf-nosed Bats, and Ghost Bats. Rocky slopes and hummock grassland suitable for the Western Pebble-mound Mouse, Pilbara Barking Gecko and Long-tailed Dunnart. 	<ul style="list-style-type: none"> No significant limitations reported.
Karratha Tom Price Road (K-TP3 and KTP4a to Rio Access) Northern Quoll Reconnaissance Survey (GHD 2017)	<ul style="list-style-type: none"> Reconnaissance. 	26 th – 31 st July 2017	<ul style="list-style-type: none"> Reptiles (5) Avifauna (11) Mammals (7) 	No significant species were recorded	<ul style="list-style-type: none"> It is unlikely that the Northern Quoll regularly utilise the study area but may transition through the area during dispersal to surrounding suitable habitat. Floodplain, low rocky hills and Fortescue River were regarded as marginal habitat for Northern Quoll. 	<ul style="list-style-type: none"> Single phase reconnaissance survey.
Red Hill Campground (Biota 2016)	<ul style="list-style-type: none"> Level 1 fauna survey. SRE searches. 	19 th May 2016	<ul style="list-style-type: none"> Reptiles (2) Avifauna (14) Mammals (1) 	<ul style="list-style-type: none"> Rainbow Bee-eater (M) 	<ul style="list-style-type: none"> Potential foraging habitat for Pilbara Leaf-nosed Bat but no suitable denning or roosting areas. 	<ul style="list-style-type: none"> Survey timing adequate but not optimal for the detection of cryptic species. No systematic trapping was undertaken in accordance with expectations for Level 1 survey.
West Turner Syncline Section 10 Below Water Table and Satellite Ore Bodies Targeted Terrestrial Fauna Survey (Biota 2015)	<ul style="list-style-type: none"> Targeted field survey for threatened vertebrate fauna Cage traps and large Elliott traps deployed at 4 locations. Motion cameras at 7 locations Searching secondary signs (e.g. scats, tracks) 	7 th – 13 th April 2014	Includes historical records within study area as well as those recorded by field survey: <ul style="list-style-type: none"> Reptiles (17) Avifauna (50) Mammals (20) 	The presence of 1 significant species was confirmed and secondary evidence of 1 other was recorded: <ul style="list-style-type: none"> Pilbara Leaf-nosed Bat (VU) Western Pebble-mound Mouse (P4; mound recorded) 	<ul style="list-style-type: none"> Gorges, gullies and rocky free faces present which may provide potential habitat for the Northern Quoll and Pilbara Olive Python. Transitory or foraging habitat may be present for Pilbara Leaf-nosed Bat given echolocation records but no evidence of suitable roost caves in study area or wider area. 	<ul style="list-style-type: none"> Not all sections of the study area were equally ground-truthed or sampled for fauna due to accessibility. Single phase survey. Additional sampling would augment the number of species recorded.
Solomon Hub Vertebrate Fauna Assessment (Ecologia 2014a)	<ul style="list-style-type: none"> Single phase Level 2 fauna survey. Targeted survey for threatened fauna. 1,120 pitfall trap nights. 2,792 cage/Elliott trap nights. 36 hours avifauna censuses across 16 trapping sites and additional opportunistic sites. 	Level 2 Survey: 22 nd April – 4 th May 2014 Targeted Survey: 1 st – 11 th July 2014	<ul style="list-style-type: none"> Amphibians (3) Reptiles (69) Avifauna (81) Mammals (23) 	5 species of significance were recorded: <ul style="list-style-type: none"> Pilbara Leaf-nosed Bat (VU) Short-tailed Mouse (P4) Pilbara Barking Gecko (P2) Rainbow Bee-eater (M) Northern Quoll (EN) 	<ul style="list-style-type: none"> Gorges/gullies, drainage lines, hilltops/ridges/plateaus present and known habitat for Northern Quoll and Pilbara Olive Python. Transitory or foraging habitat may be present for Pilbara Leaf-nosed Bat but no evidence of suitable roost caves in study area or wider area. Cracking clay habitat suitable for Short-tailed Mouse. 	<ul style="list-style-type: none"> None listed in report.
Stingray project Terrestrial Vertebrate Fauna Assessment (Ecologia 2014b)	<ul style="list-style-type: none"> Single phase Level 2 survey. 3,672 trap nights (pit traps, funnels, Elliott traps and cage traps). 18 hours of avifauna surveys. 8.8 hours nocturnal searching. 	P1: 3 rd – 13 th May 2013	<ul style="list-style-type: none"> Amphibians (2) Reptiles (48) Avifauna (79) Mammals (21) 	5 species of significance were recorded: <ul style="list-style-type: none"> Pilbara Leaf-nosed Bat (VU) Ghost Bat (VU) Short-tailed Mouse (P4) Rainbow Bee-eater (M) Western Pebble-mound Mouse (P4; potentially active mounds) 	<ul style="list-style-type: none"> Drainage lines utilised as foraging habitat for Pilbara Leaf-nosed Bat present but no suitable roosting habitat. Cracking clay habitat present which is suitable for Short-tailed Mouse. 	<ul style="list-style-type: none"> No significant limitations reported.

Report/Document Title (Author)	Type of Survey/Study and Survey Effort	Survey Dates	Taxonomic Groups Documented	Species of Significance †	Habitat Identified that may Support Significant Fauna	Survey Limitations
Central Pilbara project - Mine Vertebrate Fauna Assessment (Ecologia 2012)	<ul style="list-style-type: none"> Two phase Level 2 survey. 24 systematic trapping locations. 14,592 trap nights (pit traps, funnels, Elliott traps and cage traps) across two phases. 74.5 hours of avifauna censuses over two phases. Motion cameras and ultrasonic ARUs. Targeted searches for threatened fauna. 	<p>P1: 3rd – 15th March 2011</p> <p>P2 -1: 25th August – 6th September 2011 and</p> <p>P2-2: 23rd September – 5th October 2011</p>	<ul style="list-style-type: none"> Amphibians (4) Reptiles (84) Avifauna (100) Mammals (28) 	<p>11 species of significance were recorded:</p> <ul style="list-style-type: none"> Northern Quoll (EN) Pilbara Leaf-nosed Bat (VU) Long-tailed Dunnart (P4) Ghost Bat (VU) Western Pebble-mound Mouse (P4) Fork-tailed Swift (MI) Rainbow Bee-eater (M) Peregrine Falcon (OS) Pilbara Olive Python (VU) <i>Anilius ganeii</i> (P1) <i>Notoscincus butleri</i> (P4) 	<ul style="list-style-type: none"> Rocky ridges, breakaways and creekline habitats present which are considered suitable for Northern Quoll denning and foraging. Major creekline with fringing Eucalypt habitat suitable for Pilbara Leaf-nosed Bat foraging. 	<ul style="list-style-type: none"> None listed in report.
A Two Phase Fauna Survey of the Hamersley Agriculture project (Biota 2011)	<ul style="list-style-type: none"> Two-phase Level 2 survey. 14 pit tapping transects. 2 funnel trapping transects. 2 Elliott trapping transects. Total of 2,508 trap nights. Ultrasonic ARUs. SRE targeted searching. 68 avifauna censuses. 	<p>P1: 25th May – 4th June 2010</p> <p>P2: 3rd – 13th May 2011</p>	<ul style="list-style-type: none"> Amphibians (1) Reptiles (44) Avifauna (68) Mammals (18) 	<p>2 fauna of significance were recorded in the study area:</p> <ul style="list-style-type: none"> Western Pebble-mound Mouse (P4) (Inactive and active mounds) Rainbow Bee-eater (M) 	<ul style="list-style-type: none"> While core habitat for Northern Quoll (such as rocky breakaways and gorges) is absent from the study area, secondary, or transitory habitat, including ephemeral rivers and creek lines occur. 	<ul style="list-style-type: none"> Not all sections of the study area were equally ground-truthed or sampled for fauna due to accessibility.
Tom Price Power Line West Detritals: Two-phase fauna survey (Biota 2009a)	<ul style="list-style-type: none"> Two phase Level 2 survey. 10 pit trapping sites. 1 funnel trapping line. 2 Elliott trap lines. Harp nets. Ultrasonic ARUs. SRE targeted searching. 46 avifauna censuses. 	<p>P1: 17th – 25th September 2007</p> <p>P2: 3rd – 10th September 2008</p>	<ul style="list-style-type: none"> Amphibians (1) Reptiles (43) Avifauna (52) Mammals (14) 	<p>1 species of significance was recorded:</p> <ul style="list-style-type: none"> Western Pebble-mound Mouse (P4) (mounds and individuals) 	<ul style="list-style-type: none"> Gorges, gullies and rocky free faces present which may provide potential habitat for the Northern Quoll and Pilbara Olive Python. Transitory or foraging habitat may be present for Pilbara Leaf-nosed Bat but no evidence of suitable roost caves in study area. 	<ul style="list-style-type: none"> Not all sections of the study area were equally ground-truthed or sampled for fauna due to accessibility. Both survey phases were carried out in September so the two-phase survey cannot be considered a seasonal survey.
Rio Tinto Rail Duplication Fauna Assessment: Bellbird Siding to Juna Downs (Biota 2008c)	<ul style="list-style-type: none"> 14 pit trapping transects. 38 avifauna censuses. 3 harp net sites, with combined total of 13 nights. Ultrasonic ARUs at 3 sites. Searching secondary signs (e.g. scats, tracks). 	<p>6th – 12th May 2008</p>	<ul style="list-style-type: none"> Amphibians (2) Reptiles (33) Avifauna (67) Mammals (18) 	<p>3 fauna of significance were recorded:</p> <ul style="list-style-type: none"> Peregrine Falcon (OS) Western Pebble-mound Mouse (P4) Rainbow Bee-eater (M) 	<ul style="list-style-type: none"> Ghost Bat foraging habitat present but suitable roosting caves have not been observed. Gilgai clay and cracking clay habitats common; suitable for Short-tailed Mouse. Likely the species would be recorded in a seasonal survey over winter. 	<ul style="list-style-type: none"> Not all sections of the study area were equally ground-truthed or sampled for fauna due to accessibility.

† EN = Endangered; VU = Vulnerable; M = Marine; MI = Migratory; OS = Other specially protected fauna; P = Priority.

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4.9 Significant Communities Known from the Study Area

This section describes vegetation of significance previously recorded within the survey area, or known from the study area, based on the desktop study (see Section 3.2 and Table 4.6).

4.9.1 Threatened Ecological Communities

One TEC listed as Vulnerable at State level intersects approximately half of the southern-most polygon (Tom Price realignment) of the survey area (DBCA 2020a) (Figure 4.5):

- “*Themeda* grasslands on cracking clays (Hamersley Station, Pilbara)” (hereafter referred to as the *Themeda* grasslands TEC) is described as “grassland plains dominated by the perennial *Themeda* (kangaroo grass) and many annual herbs and grasses” (DBCA 2018).

No other TECs are likely to occur within either the survey area or the study area.

4.9.2 Priority Ecological Communities

Forty-three PECs are listed for the Pilbara bioregion (DBCA 2022). One of these intersects most of the southern-most polygon (Tom Price realignment) of the survey area (DBCA 2020a) (Figure 4.5):

- The Priority 1 “Brockman Iron cracking clay communities of the Hamersley Range” PEC (hereafter referred to as Brockman Iron cracking clay communities PEC) is described as a “rare tussock grassland dominated by *Astrebla lappacea* (not every site has presence of *Astrebla*) in the Hamersley Range, on the Brockman land system. Tussock grassland on cracking clays-derived in valley floors, depositional floors. This is a rare community and the landform is rare. Known from near West Angelas, Newman, Tom Price and boundary of Hamersley and Brockman Stations” (DBCA 2022).

Three additional PECs are known to occur within the study area, but not the survey area (Figure 4.5):

- The Priority 3 “Kumina Land System” PEC, which is described as “Duricrust plains and plateau remnants supports hard spinifex grasslands”, occurs approximately 15 km east of one of the central polygons of the survey area;
- The Priority 3 “Kanjenjie Land System” PEC is described as “Stony clay plains supporting Snakewood (*Acacia xiphophylla*) shrublands with tussock grasses”; the closest occurrence is located approximately 12 km west of the far northern polygon of the survey area; and
- The Priority 1/3 “Four Plant Assemblages of the Wona Land System” PEC has four components, described as “Cracking clays of the Chichester and Mungaroona Range”, “Annual *Sorghum* grasslands on self mulching clays with a moderate-dense overlay or rocks”, “Mitchell grass plains (*Astrebla* spp.) on gilgai”, and “Mitchell grass and Roebourne Plain grass (*Eragrostis xerophila*) plain on gilgai”. This PEC occurs approximately 27 km northwest of the northern-most polygon of the survey area.

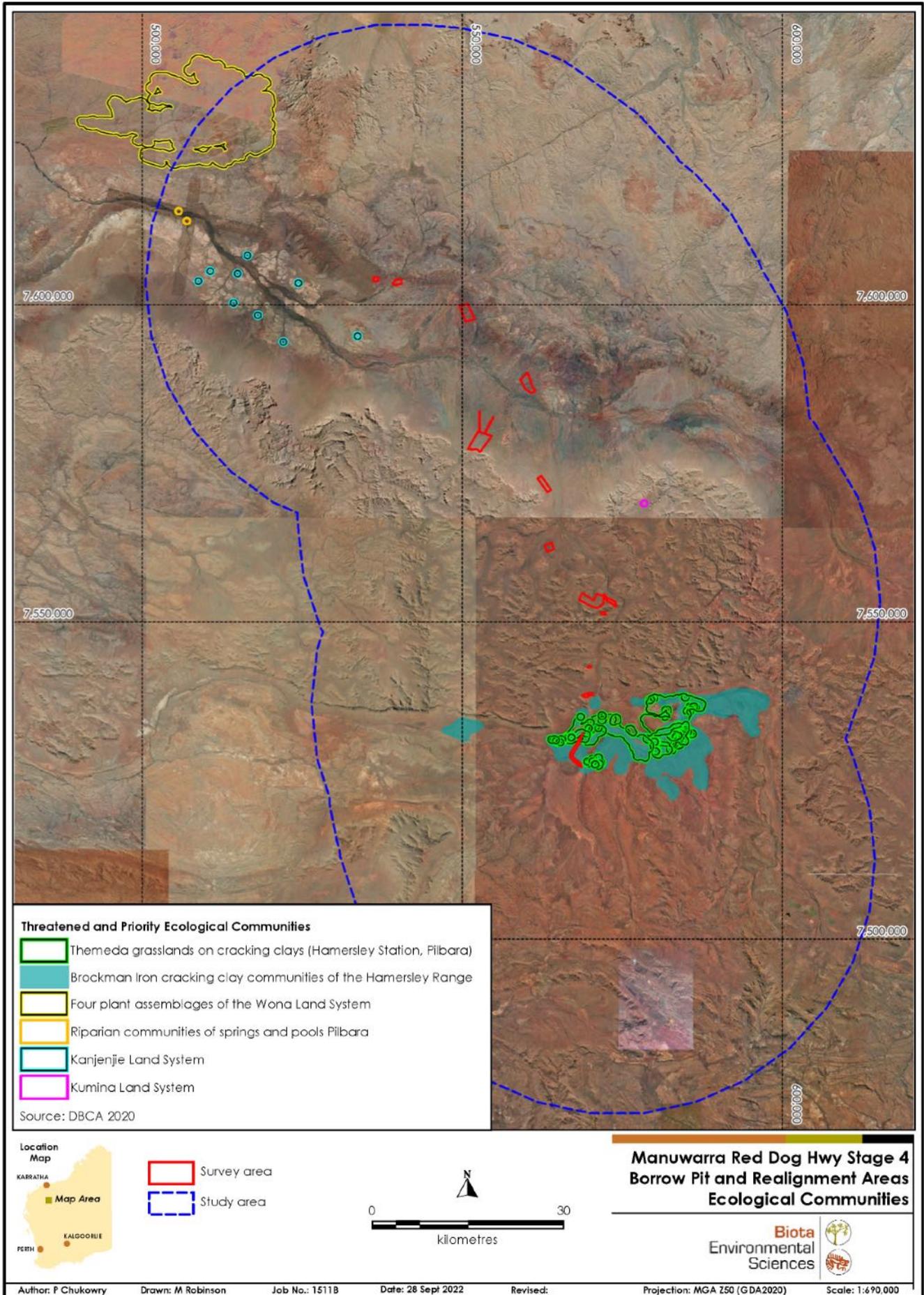


Figure 4.5: TECs and PECs intersecting the survey area and study area.

4.10 Significant Species Known from the Study Area

The framework for ranking species of significance in WA is presented in Appendix 1. This section describes flora and fauna of significance previously recorded within the survey area, or assessed as having the potential to occur, based on the desktop study (see Table 4.6, Appendix 7 and Appendix 13).

4.10.1 Threatened Flora

Four flora species, *Aluta quadrata*, *Quoya zonalis*, *Seringia exastia* and *Thryptomene wittweri*, are listed under the EPBC Act (except *A. quadrata* which is listed under the BC Act) as Threatened for the Pilbara bioregion. With the exception of *Seringia exastia*, none of these species would be expected to occur in the survey area based on their known distribution and/or habitat preferences.

Seringia exastia was recorded during the survey of the main project corridor (Biota 2021) from four locations, the closest of these (recorded as *Seringia ? exastia* due to insufficient material for full determination) being 750 m from the current survey area. This species may occur in the survey area based on the locations of previous collections relative to the survey area and its broad habitat preferences (see Appendix 7). However, a genetic study and taxonomic revision of this species was undertaken by Binks et al. (2020), resulting in the common and widespread species *S. elliptica* being synonymized with *S. exastia*, which was previously considered to be rare but is in fact not. Binks et al. (2020) clearly stated that the resulting taxon was not of conservation concern. The current conservation listing of the species (Critically Endangered under the EPBC Act) is in review and it will be de-listed in the near future; this species is therefore not mapped or discussed further in detail.

4.10.2 Priority Flora

A total of 67 Priority flora species have previously been recorded from the study area (Table 4.6 and Figure 4.6). An assessment of their likelihood of occurrence in the survey area is presented in Appendix 7.

During the desktop study, 12 species were ranked as “likely to occur” in the survey area, comprising:

- Three Priority 2 species:
 - *Aristida lazaridis*,
 - *Euphorbia inappendiculata* var. *inappendiculata*, and
 - *Euphorbia inappendiculata* var. *queenslandica*.
- Nine Priority 3 species:
 - *Astrebla lappacea*,
 - *Dolichocarpa* sp. Hamersley Station (A.A. Mitchell PRP 1479),
 - *Euphorbia australis* var. *glabra*,
 - *Glycine falcata*,
 - *Streptoglossa* sp. Cracking clays (S. van Leeuwen et al. PBS 7353),
 - *Swainsona thompsoniana*,
 - *Themeda* sp. Hamersley Station (M.E. Trudgen 11431),
 - *Triodia basitricha*, and
 - *Vittadinia* sp. Coondewanna Flats (S. van Leeuwen 4684).

It was considered that 14 additional species “may occur”, comprising:

- Three Priority 1 species:
 - *Calotis squamigera*,

- *Helichrysum oligochaetum*, and
- *Josephinia* sp. Woodstock (A.A. Mitchell PRP 989).
- Three Priority 2 species:
 - *Paspalidium retiglume*,
 - *Pentalepis trichodesmoides* subsp. *hispida*, and
 - *Teucrium pilbaranum*.
- Eight Priority 3 species:
 - *Aristida jerichoensis* var. *subspinulifera*
 - *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727),
 - *Indigofera gilesii*,
 - *Indigofera rivularis*,
 - *Iotasperma sessilifolium*,
 - *Rhagodia* sp. Hamersley (M. Trudgen 17794),
 - *Rostellularia adscendens* var. *latifolia*, and
 - *Solanum albostellatum*.

The 27 Threatened and Priority flora species assessed as being “likely to occur” or that “may occur” in the survey area informed the targeted significant flora searches during the survey.

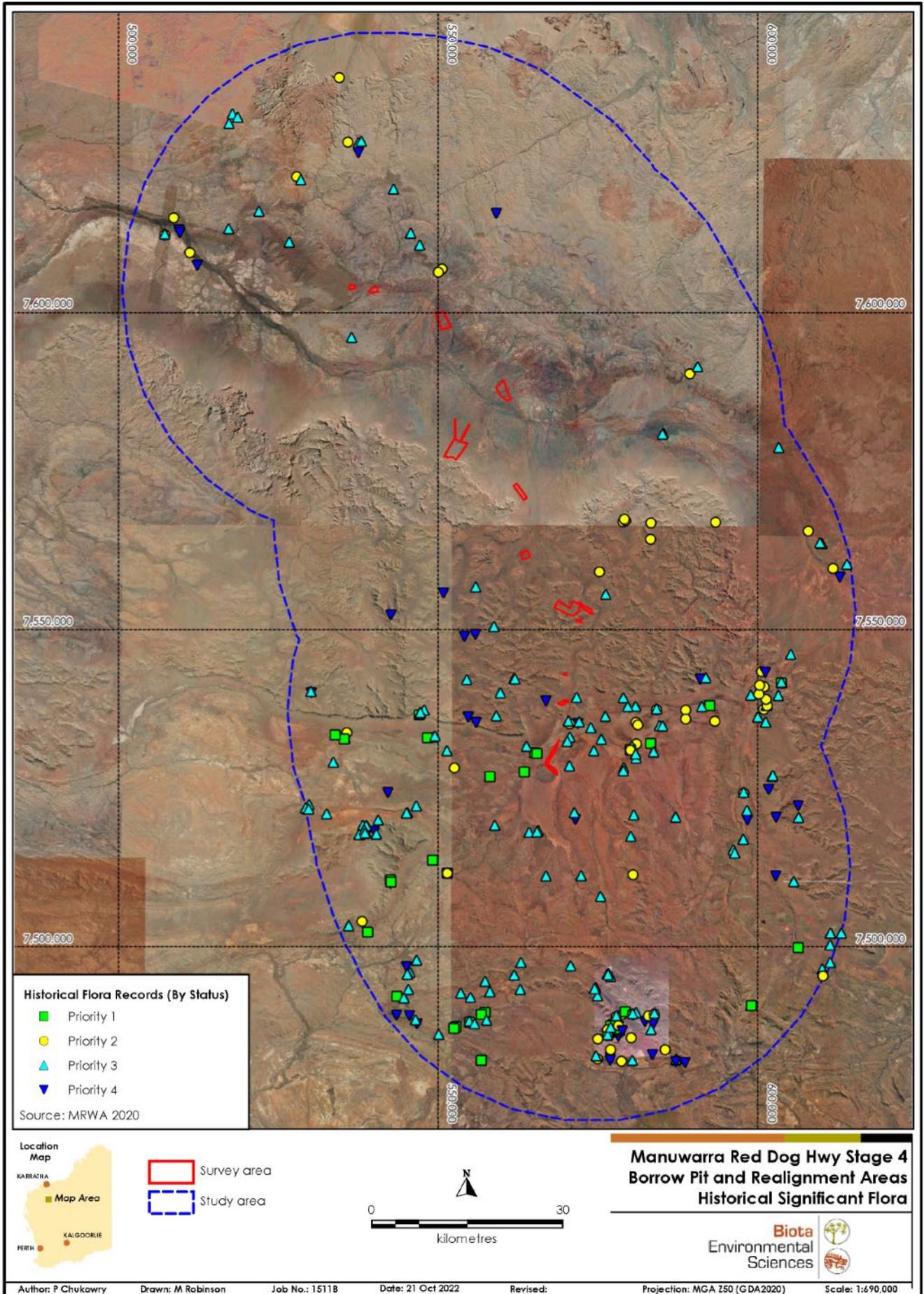


Figure 4.6: Locations of Priority flora recorded previously from the study area.

4.10.3 Fauna

The study area has been historically well surveyed, with 11 relevant surveys carried out between 2007 and 2021 (see Table 4.7). Reviews of these past studies and database and literature searches yielded a total of 300 vertebrate species with the potential to occur in the survey area. The consolidated potential species list is provided in Appendix 12.

Seventeen of the species in the potential assemblage are listed as significant (Table 4.8), consisting of six ground-dwelling mammals, two bat species, four avifauna species, and five reptiles. A further 23 avifauna species are listed as 'Marine' under the EPBC Act, despite these species not using marine habitats. As the survey area does not encompass any marine habitats, these taxa are not considered further in this report.

Table 4.8 Overview of vertebrate fauna species with potential to occur in the survey area.

Fauna Group	Status	No. of Species	No. of Significant Species
Ground-dwelling Mammals	Native	25	6
	Introduced	9	-
Bats	Native	13	2
Birds*	Native	133	4
Reptiles	Native	111	5
Amphibians	Native	9	0
Total		300	17*

*Excluding Marine

Six of the 11 reports reviewed cited the presence of primary habitat for Northern Quoll and/or Pilbara Olive Python within the survey area or the study area (see Table 4.7). Seven reports documented the presence of secondary or transitory habitat for the Pilbara Leaf-nosed Bat but did not detect any suitable cave or roost sites. Five studies noted the presence of cracking clay habitat suitable for the Short-tailed Mouse. These potential significant fauna species were targeted by the survey methodology (Section 3.5). Based on the desktop assessment, 11 species were considered likely to occur in the study area. This consisted of four ground-dwelling mammals, two bat species, three bird species and two reptiles. The likelihood assessments for conservation significant fauna species within the survey area are provided in Appendix 13.

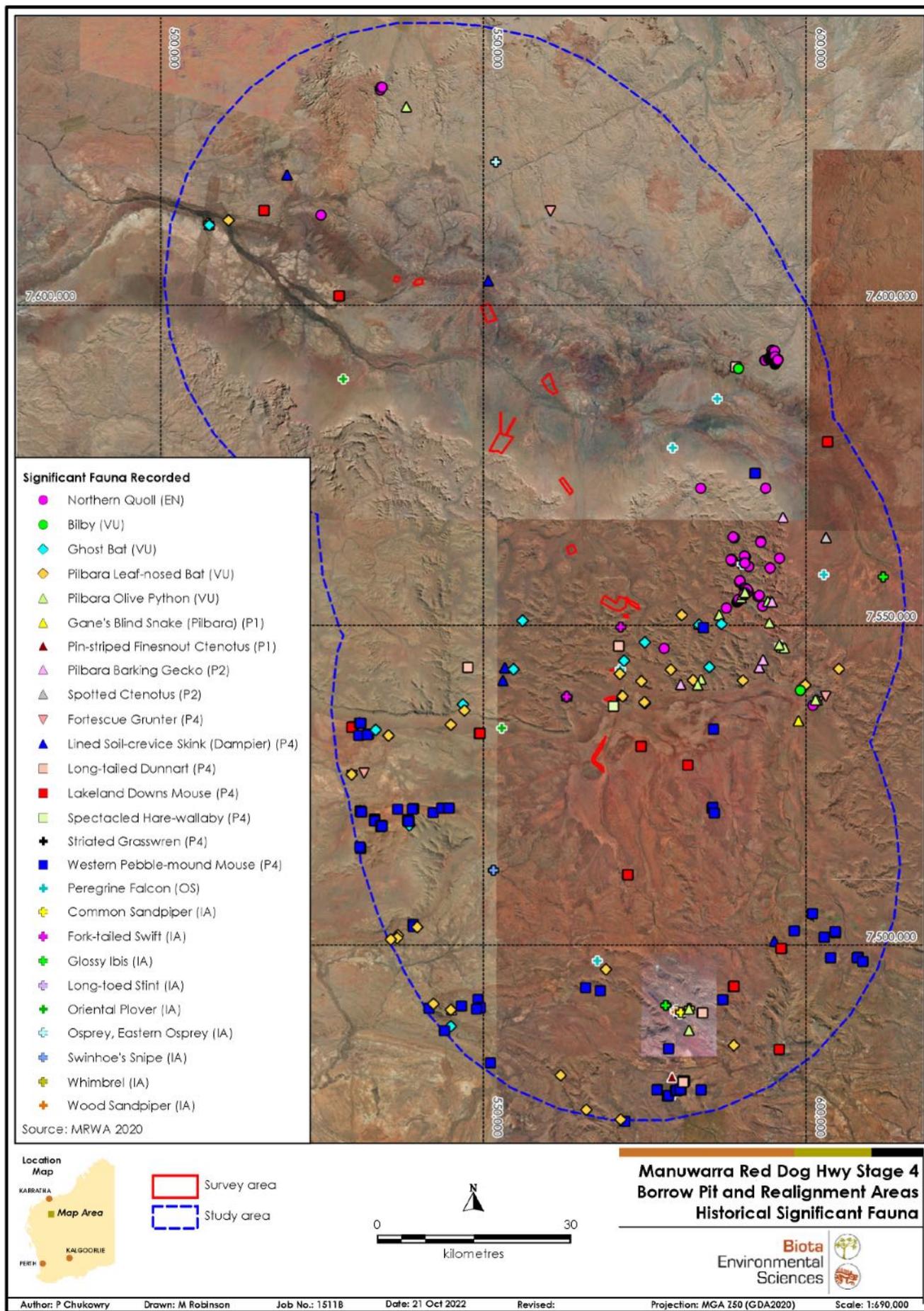


Figure 4.7: Locations of significant fauna recorded previously from the study area.

EN = Endangered; VU = Vulnerable; OS = Other specially protected fauna; IA = Migratory species (protected under international agreements); P = Priority.

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5.0 Vegetation

5.1 Overview

Twenty vegetation types were mapped across the survey area. The extent of each mapping unit is presented in Table 5.1 and mapped in Appendix 5.

The survey area generally traversed low-lying areas within the landscape, with the exception of some borrow pits located further away from the highway, which included sections of larger hills. Broad landforms and vegetation types in the survey area and surrounds comprised:

- Cracking clay plains supporting perennial tussock grasses, annual grasses and herbs, including some communities of significant vegetation; i.e. the “*Themeda* grasslands on cracking clays (Hamersley Station, Pilbara)” TEC and the “Brockman Iron cracking clay communities of the Hamersley Range” PEC (see Section 4.9);
- Drainage lines, ranging in scale from major to minor creeks and tributaries, supporting riparian Eucalypt and *Acacia* open forests and woodlands;
- Low hills with stony substrates supporting spinifex hummock grasslands, typically dominated by *Triodia wiseana*, usually with a sparse overstorey of shrubs and trees (*Eucalyptus leucophloia* subsp. *leucophloia* or *Corymbia hamersleyana*);
- Mulga (*Acacia* ‘*aneura*’ species complex) low woodlands;
- Stony to gravelly plains supporting spinifex hummock grasslands, usually dominated by *Triodia epactia* and *T. wiseana*, with a sparse to open cover of shrubs and trees; and
- Floodplains of major drainages to minor tributaries supporting *Corymbia hamersleyana* woodlands with mixed wattles and hummock grasses.

Individual vegetation types are further described in Section 5.2.

Table 5.1: Summary of vegetation types and other units mapped for the survey area.

Unit Code	Mapping Unit Description	Area in Survey Area (ha) (Proportion of Survey Area)
Clay Vegetation		
C2	<i>Acacia xiphophylla</i> low woodland over <i>Triodia epactia</i> very open hummock grassland over <i>Eragrostis xerophila</i> scattered tussock grasses.	0.5 (<0.1%)
C3	Mixed <i>Astrelba</i> tussock grassland over <i>Urochloa occidentalis</i> var. <i>occidentalis</i> bunch grassland.	49.6 (1.8%)
C4	<i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431) tussock grassland.	14.9 (0.5%)
C5	<i>Eucalyptus victrix</i> scattered low trees over <i>Eriachne benthamii</i> , (<i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431)) very open tussock grassland over mixed open herbland.	<0.1 (<0.1%)
Vegetation of Drainage Lines		
D1	<i>Eucalyptus victrix</i> (<i>E. camaldulensis</i> subsp. <i>refulgens</i>) woodland over <i>Melaleuca glomerata</i> tall open shrubland over <i>Triodia epactia</i> scattered hummock grasses over mixed tussock grasses and sedges.	2.7 (0.1%)
D3	<i>Eucalyptus victrix</i> low open woodland over * <i>Vachellia farnesiana</i> scattered tall shrubs over mixed tussock grasses and bunch grasses.	5.5 (0.2%)
Vegetation of Stony Hillslopes, Hillcrests and Foothills		
H1	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> scattered low trees over <i>Triodia wiseana</i> hummock grassland.	6.6 (0.2%)
H3	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> , (<i>Corymbia hamersleyana</i>) low open woodland over mixed <i>Acacia</i> shrubs over <i>Triodia wiseana</i> open hummock grassland.	207.3 (7.7%)
H5	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> , (<i>Corymbia hamersleyana</i>) low open woodland over mixed <i>Acacia</i> shrubs over <i>Triodia basitricha</i> (<i>T. wiseana</i>) open hummock grassland.	454.3 (16.8%)
Mulga Vegetation		
M4	<i>Acacia aptaneura</i> , <i>A. ? macraneura</i> (<i>Hakea lorea</i> subsp. <i>lorea</i>) low open woodland over mixed tussock grasses and herbs.	63.7 (2.4%)
M5	<i>Acacia macraneura</i> (<i>A. incurvaneura</i>), <i>Acacia citrinoviridis</i> low open forest over <i>Triodia epactia</i> open hummock grassland.	15.2 (0.6%)

Vegetation of Stony Plains and Sloping Plains		
P1	<i>Corymbia deserticola</i> subsp. <i>deserticola</i> , <i>C. hamersleyana</i> , <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> low open woodland over <i>Triodia wiseana</i> open hummock grassland.	124.1 (4.6%)
P2	<i>Corymbia hamersleyana</i> low open woodland over mixed <i>Acacia</i> shrubland over <i>Triodia epactia</i> hummock grassland.	1,316.4 (48.6%)
P7	<i>Triodia wiseana</i> hummock grassland with <i>Eriachne flaccida</i> scattered tussock grasses.	15.3 (0.6%)
P8	* <i>Vachellia farnesiana</i> scattered tall shrubs over <i>Chrysopogon fallax</i> very open tussock grassland over mixed annual grassland and herbland.	71.7 (2.6%)
Vegetation of Floodplains		
F1	<i>Corymbia hamersleyana</i> low open woodland over <i>Acacia inaequilatera</i> tall open shrubland over <i>Triodia wiseana</i> (<i>T. epactia</i>) open hummock grassland with mixed tussock grasses.	79.6 (2.9%)
F2	<i>Corymbia hamersleyana</i> low woodland over mixed <i>Acacia</i> tall open shrubland over <i>Triodia wiseana</i> , (<i>T. epactia</i>) open hummock grassland.	210.7 (7.8%)
F3	<i>Corymbia hamersleyana</i> low open woodland over mixed <i>Acacia</i> open shrubland over <i>Triodia epactia</i> very open hummock grassland with <i>Chrysopogon fallax</i> very open tussock grassland.	50.8 (1.9%)
F4	<i>Acacia citrinoviridis</i> low woodland over <i>Triodia epactia</i> open hummock grassland and <i>Chrysopogon fallax</i> scattered tussock grasses.	0.9 (<0.1%)
F5	* <i>Vachellia farnesiana</i> tall open shrubland over <i>Eriachne benthamii</i> (<i>Dichanthium sericeum</i> subsp. <i>sericeum</i> , <i>Chrysopogon fallax</i> , * <i>Cenchrus ciliaris</i>) tussock grassland.	5.1 (0.2%)
Other Mapping Units		
Disturbed	Disturbed.	12.7 (0.5%)
Cleared	Cleared roads and tracks.	2.3 (0.1%)

5.2 Description of Vegetation Types

NB. Where descriptions are based on sites outside the survey area, these sometimes include species that were not recorded by the current surveys, but which would be expected to occur.

5.2.1 Clay Vegetation

C2	<i>Acacia xiphophylla</i> low woodland over <i>Triodia epactia</i> very open hummock grassland over <i>Eragrostis xerophila</i> scattered tussock grasses.
Distribution and habitat	A small area of C2 was present in the northern borrow pit, PMPSB03. It occurred on cracking clay soils and had a tree overstorey dominated by <i>Acacia xiphophylla</i> , while the ground layer was a mixture of perennial tussock grasses, annual bunch grasses and herb species (Plate 5.1 and Plate 5.2).
Other associated species	<u>Shrubs:</u> <i>Rhagodia eremaea</i> , <i>Senna notabilis</i> , <i>Ptilotus exaltatus</i> , <i>Senna hamersleyensis</i> , <i>Enchylaena tomentosa</i> var. <i>tomentosa</i> . <u>Grasses:</u> <i>Triodia wiseana</i> , <i>Sporobolus australasicus</i> , <i>Eriachne flaccida</i> , <i>Cynodon convergens</i> , <i>Aristida latifolia</i> . <u>Herbs:</u> <i>Sida fibulifera</i> , <i>Corchorus tridens</i> , <i>Boerhavia burbridgeana</i> , <i>Nellica maderaspatensis</i> , <i>Notoleptopus decaisnei</i> .
Vegetation condition	Very Good: occasional weeds; some cattle activity.
Sites	KTF15, KTF25, KTF68 (Biota 2021); none from current survey, as area very small.



Plate 5.1: Unit C2 (KTF15).



Plate 5.2: Unit C2 (KTF68).

C3	Mixed <i>Astrelba</i> tussock grassland over <i>Urochloa occidentalis</i> var. <i>occidentalis</i> bunch grassland.
Distribution and habitat	This vegetation type occurred on the cracking clay plains in the Tom Price realignment area (Plate 5.3 and Plate 5.4). Occasional <i>Vachellia farnesiana</i> shrubs were dotted throughout the landscape. The ground layer in this unit was a mixture of <i>Astrelba</i> tussock grasses, annual bunch grasses and herb species including <i>Operculina aequisejala</i> and <i>Rhynchosia minima</i> . This unit is recognised as the "Brockman Iron cracking clay communities of the Hamersley Range" PEC.

Other associated species	<u>Grasses:</u> <i>Astrebla elymoides</i> , <i>A. pectinata</i> , <i>Iseilema vaginiflorum</i> , <i>Urochloa occidentalis</i> var. <i>ciliata</i> , <i>Chrysopogon fallax</i> , <i>Cynodon convergens</i> , <i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431). <u>Herbs:</u> <i>Alysicarpus muelleri</i> , <i>Blumea tenella</i> , <i>Cucumis picrocarpus</i> , <i>Boerhavia burbridgeana</i> , <i>Indigofera linifolia</i> , <i>Plantago cunninghamii</i> , <i>Rostellularia adscendens</i> var. <i>clementii</i> , <i>Wahlenbergia tumidifruca</i> , <i>Vigna</i> sp. Hamersley Clay (A.A. Mitchell PRP 113).
Vegetation condition	Very Good: occasional weeds; some cattle activity.
Sites	KTF08, KTF59, KTF60 (Biota 2021); MRO12.



Plate 5.3: Unit C3 (KTF08).



Plate 5.4: Unit C3 (MRO12).

C4	<i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431) tussock grassland.
Distribution and habitat	This vegetation type occurred on cracking clay plains in the Tom Price realignment area (see Plate 5.5 and Plate 5.6). While this unit was dominated by the perennial <i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431) tussock grass, a variety of annual grasses and herbs were also present, including <i>Polymeria longifolia</i> , <i>Cullen cinereum</i> , <i>Streptoglossa bubakii</i> and <i>Cynodon convergens</i> . This unit is recognised as the " <i>Themeda</i> grasslands on cracking clays (Hamersley Station, Pilbara)" TEC.
Other associated species	<u>Grasses:</u> <i>Chrysopogon fallax</i> , <i>Dichanthium sericeum</i> subsp. <i>humilius</i> , <i>Urochloa occidentalis</i> var. <i>ciliata</i> , <i>Panicum laevinode</i> . <u>Herbs:</u> <i>Cucumis picrocarpus</i> , <i>Indigofera linifolia</i> , <i>Ptilotus gomphrenoides</i> , <i>Sida spinosa</i> , <i>Cullen graveolens</i> .
Vegetation condition	Very Good: occasional weeds; some cattle activity.
Sites	KTF21, KTF22, KTF72 (Biota 2021); none from current survey.



Plate 5.5: Unit C4 (KTF21).



Plate 5.6: Unit C4 (KTF72).

C5	<i>Eucalyptus victrix</i> scattered low trees over <i>Eriachne benthamii</i>, (<i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431)) very open tussock grassland over mixed open hermland.
Distribution and habitat	This vegetation type occurred in a minor flowline intersecting the C4 vegetation unit, on the cracking clay plains in the Tom Price realignment area (Plate 5.7) where it occupied only 0.02 ha. Scattered tall shrubs of <i>*Vachellia farnesiana</i> were present throughout, as well a variety of herbs including <i>Polymeria longifolia</i> , <i>Cullen graveolens</i> and <i>Ptilotus gomphrenoides</i> . This unit is recognised as the "Themeda grasslands on cracking clays (Hamersley Station, Pilbara)" TEC.
Other associated species	<u>Shrubs:</u> <i>Rhagodia eremaea</i> , <i>Pimelea holroydii</i> . <u>Grasses:</u> <i>Iseilema macratherum</i> , <i>Panicum laevinode</i> , <i>Eragrostis tenellula</i> . <u>Herbs:</u> <i>Blumea tenella</i> , <i>Stemodia kingii</i> , <i>Vigna</i> sp. Hamersley Clay (A.A. Mitchell PRP 113).
Vegetation condition	Very Good: occasional weeds; some cattle activity.
Sites	KTF13 (Biota 2021); none from current survey.



Plate 5.7: Unit C5 (KTF13).

5.2.2 Vegetation of Drainage Lines

D1	<i>Eucalyptus victrix</i> (<i>E. camaldulensis</i> subsp. <i>refulgens</i>) woodland over <i>Melaleuca glomerata</i> tall open shrubland over <i>Triodia epactia</i> scattered hummock grasses over mixed tussock grasses and sedges.
Distribution and habitat	This vegetation occurred in very minor portions of two borrow pits (PMP5B01 and PMPBC02) in the central section of the survey area (Plate 5.8 and Plate 5.9). The woodland overstorey included the phreatophyte <i>Eucalyptus camaldulensis</i> subsp. <i>refulgens</i> (River Gum), with scattered <i>Corymbia hamersleyana</i> and <i>Atalaya hemiglauca</i> . The scattered tall shrub layer comprised a variety of species including <i>Melaleuca glomerata</i> , <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> and <i>Acacia tumida</i> var. <i>pilbarensis</i> . The low shrub layer typically included <i>Corchorus crozophorifolius</i> and <i>Tephrosia rosea</i> var. <i>Fortescue</i> creeks (M.I.H. Brooker 2186). Introduced tussock grasses were common (e.g. <i>*Cenchrus setiger</i> and <i>*C. ciliaris</i>), along with occasional sedge species such as <i>Cyperus difformis</i> , <i>Schoenoplectiella laevis</i> and <i>Eleocharis atropurpurea</i> .
Other associated species	<u>Shrubs:</u> <i>Acacia coleii</i> , <i>A. pyrifolia</i> var. <i>pyrifolia</i> , <i>Aeschynomene indica</i> , <i>Carissa lanceolata</i> , <i>Indigofera monophylla</i> , <i>Sesbania cannabina</i> , <i>Waltheria indica</i> . <u>Grasses:</u> <i>Bothriochloa ewartiana</i> , <i>Elytrophorus spicatus</i> , <i>Eragrostis tenellula</i> , <i>Eriachne benthamii</i> , <i>Eulalia aurea</i> , <u>Herbs:</u> <i>Alternanthera nudiflora</i> , <i>Arivela viscosa</i> , <i>Boerhavia coccinea</i> , <i>Corchorus tridens</i> , <i>Tribulus macrocarpus</i> .
Vegetation condition	Excellent to Very Good; evidence of cattle activity, weeds.
Sites	KTF37, KTF62, KTF63, KTF65, KTF66, KTF67, KTF104, KTF112, KTF143, KTF144, KTFREL08, KTFREL09 (Biota 2021); none from current survey.



Plate 5.8: Unit D1 (KTF66).



Plate 5.9: Unit D1 (KTF112).

D3	<i>Eucalyptus victrix</i> low open woodland over <i>*Vachellia farnesiana</i> scattered tall shrubs over mixed tussock grasses and bunch grasses.
Distribution and habitat	This vegetation was restricted to the Tom Price alignment area, south of the "Themeda grasslands on cracking clays (Hamersley Station, Pilbara)" TEC (Plate 5.10 and Plate 5.11). The sparse shrub layer typically included <i>*Vachellia farnesiana</i> and <i>Sesbania cannabina</i> . The ground layer generally comprised an open to closed tussock grassland of <i>Bothriochloa ewartiana</i> , <i>Eriachne benthamii</i> and introduced <i>*Cenchrus</i> species. This vegetation type supported patches of <i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431) in some areas (e.g. KTF17 (Biota 2021)) and it is considered to be important for the maintenance and functioning of the "Themeda grasslands on cracking clays (Hamersley Station, Pilbara)" TEC while not being of conservation significance itself.

Other associated species	<p><u>Shrubs:</u> <i>Abutilon malvifolium</i>, <i>Acacia xiphophylla</i>, <i>Aeschynomene indica</i>, <i>Santalum lanceolatum</i>.</p> <p><u>Grasses:</u> <i>Chrysopogon fallax</i>, *<i>Cenchrus ciliaris</i>, <i>Dichanthium sericeum</i> subsp. <i>sericeum</i>, <i>Iseilema vaginiflorum</i>, <i>Eragrostis xerophila</i>, <i>E. tenellula</i>, <i>Cynodon convergens</i>, <i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431).</p> <p><u>Herbs:</u> <i>Alternanthera nodiflora</i>, <i>Blumea tenella</i>, <i>Boerhavia paludosa</i>, <i>Rhynchosia minima</i>, <i>Ipomoea muelleri</i>, <i>Cullen graveolens</i>, <i>Rostellularia adscendens</i> var. <i>clementii</i>.</p>
Vegetation condition	Very Good: low cover of * <i>Cenchrus ciliaris</i> and * <i>Vachellia farnesiana</i> dominant; evidence of cattle.
Sites	KTF17, KTFREL11 (Biota 2021); MRO-R06.



Plate 5.10: Unit D3 (KTF17).



Plate 5.11: Unit D3 (KTFREL11).

5.2.3 Vegetation of Stony Hillslopes, Hillcrests and Foothills

H1	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> scattered low trees over <i>Triodia wiseana</i> hummock grassland.
Distribution and habitat	This vegetation type occurred on clay loams and sandy clay loams on stony rises, low hills, footslopes and undulating stony plains, particularly in the areas surrounding the Hamersley Ranges (Plate 5.12 and Plate 5.13). <i>Corymbia hamersleyana</i> was scattered throughout the landscape and <i>Eucalyptus gamophylla</i> was occasionally present as scattered low mallees. Scattered shrubs of various <i>Acacia</i> species and <i>Senna glutinosa</i> subsp. <i>glutinosa</i> were also typically present.
Other associated species	<p><u>Shrubs:</u> <i>Acacia ancistrocarpa</i>, <i>A. atkinsiana</i>, <i>A. bivenosa</i>, <i>A. inaequilatera</i>, <i>A. ptychophylla</i>, <i>Gompholobium oreophilum</i>, <i>Ptilotus calostachyus</i>, <i>Senna glutinosa</i> subsp. <i>glutinosa</i>.</p> <p><u>Grasses:</u> <i>Amphipogon sericeus</i>, <i>Eriachne pulchella</i>, <i>Eriachne mucronata</i>, <i>Schizachyrium fragile</i>.</p> <p><u>Herbs:</u> <i>Bonamia erecta</i>.</p> <p><u>Sedges:</u> <i>Fimbristylis dichotoma</i>, <i>Bulbostylis barbata</i>.</p>
Vegetation condition	Excellent.
Sites	KTF89, KTF92, KTF103, KTF106, KTF107, KTF111, KTF118 (Biota 2021); MRO08.



Plate 5.12: Unit H1 (KTF114).



Plate 5.13: Unit H1 (MRO08).

H3	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i>, (<i>Corymbia hamersleyana</i>) low open woodland over mixed <i>Acacia</i> shrubs over <i>Triodia wiseana</i> open hummock grassland.
Distribution and habitat	This vegetation type occurred on moderate hill crests, mid-slopes of spurs, moderate hills and hillslopes in the central section in borrow pits PMPBC03, PMPBC12 and the Hamersley realignment area (Plate 5.14 and Plate 5.15). Scattered shrubs of <i>Acacia inaequilatera</i> and <i>Senna glutinosa</i> subsp. <i>glutinosa</i> were typically present. <i>Eriachne mucronata</i> scattered tussock grasses were also common.
Other associated species	<u>Shrubs:</u> <i>Acacia inaequilatera</i> , <i>A. trudgeniana</i> , <i>A. hilliana</i> , <i>A. adoxa</i> var. <i>adoxo</i> , <i>Grevillea pyramidalis</i> subsp. <i>leucadendron</i> , <i>Mirbelia viminalis</i> , <i>Hakea chordophylla</i> , <i>Goodenia stobbsiana</i> . <u>Grasses:</u> <i>Eriachne ciliata</i> , <i>E. pulchella</i> , <i>Paraneurachne muelleri</i> , <i>Schizachyrium fragile</i> . <u>Herbs:</u> <i>Dolichocarpa crouchiana</i> , <i>Bonamia pilbarensis</i> , <i>Polycarpaea holtzei</i> . <u>Sedges:</u> <i>Bulbostylis barbata</i> , <i>Fimbristylis simulans</i> .
Vegetation condition	Excellent.
Sites	KTF26, KTF39, KTF71, KTF76, KTF77, KTF79, KTF83, KTF85, KTF113, KTF114, KTF115, KTF117, KTF135 (Biota 2021); MRO05, MRO11, MRO-R01.



Plate 5.14: Unit H3 (KTF115).



Plate 5.15: Unit H3 (MRO11).

H5	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i>, (<i>Corymbia hamersleyana</i>) low open woodland over mixed <i>Acacia</i> shrubs over <i>Triodia basitricha</i>, (<i>T. wiseana</i>) open hummock grassland.
Distribution and habitat	This vegetation type occurred in borrow pits PMPBC05 and PMPBC06 in the central section of the survey area, on low hillslopes and the flats directly beneath these (Plate 5.16 and Plate 5.17).
Other associated species	<u>Shrubs:</u> <i>Acacia adoxa</i> var. <i>adoxo</i> , <i>A. maitlandii</i> , <i>A. monticola</i> , <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> , <i>Gompholobium oreophilum</i> , <i>Ptilotus astrolasius</i> , <i>Hakea lorea</i> subsp. <i>lorea</i> . <u>Grasses:</u> <i>Amphipogon sericeus</i> , <i>Aristida holathera</i> var. <i>holathera</i> , <i>Eriachne aristidea</i> , <i>E. mucronata</i> , <i>E. tenuiculmis</i> , * <i>Cenchrus ciliaris</i> . <u>Herbs:</u> <i>Dolichocarpa crouchiana</i> , <i>Euphorbia careyi</i> , <i>Trigastrotheca molluginea</i> , <i>Rhynchosia minima</i> .
Vegetation condition	Excellent to Very Good; scattered weeds and recent fire.
Sites	MRO01, MRO02, MRO10.



Plate 5.16: Unit H5 (MRO01).



Plate 5.17: Unit H5 (MRO10).

5.2.4 Mulga Vegetation

M4	<i>Acacia aptaneura</i>, A ? <i>macraneura</i> (<i>Hakea lorea</i> subsp. <i>lorea</i>) low open woodland over mixed tussock grasses, bunch grasses and herbs.
Distribution and habitat	This vegetation occurred on self-mulching clay flats of the Tom Price realignment area (Plate 5.18). Various tussock grasses, bunch grasses and herbs including <i>Eriachne benthamii</i> , <i>Eragrostis pergracilis</i> and <i>Arivela viscosa</i> dominated the ground layer.
Other associated species	<u>Shrubs:</u> <i>Grevillea berryana</i> , <i>Acacia pruinocarpa</i> , <i>Abutilon lepidum</i> , <i>A. otocarpum</i> . <u>Grasses:</u> <i>Chrysopogon fallax</i> , * <i>Cenchrus ciliaris</i> , <i>Digitaria ctenantha</i> , <i>Urochloa occidentalis</i> var. <i>occidentalis</i> , <i>Enneapogon polyphyllus</i> , <i>Eragrostis leptocarpa</i> , <i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 1143). <u>Herbs:</u> <i>Goodenia nuda</i> , <i>Calotis hispidula</i> , <i>Portulaca oleracea/intraterranea</i> , <i>Alternanthera denticulata</i> , <i>Ipomoea muelleri</i> , <i>Boerhavia coccinea</i> , <i>Spermacoce brachystema</i> , <i>Ptilotus exaltatus</i> , <i>P. polystachyus</i> , <i>Rhodanthe charsleyae</i> , <i>Indigofera linifolia</i> , <i>Polygala glaucifolia</i> , <i>Peripleura arida</i> .
Vegetation condition	Very Good; scattered weeds; old cattle scats.
Sites	KTF11, KTF12 (Biota 2021); MRO13.



Plate 5.18: Unit M4 (KTF12).

M5	<i>Acacia macraneura</i> (<i>A. incurvaneura</i>), <i>A. citrinoviridis</i> low open forest over <i>Triodia epactia</i> open hummock grassland.
Distribution and habitat	This vegetation type was restricted to three areas within central borrow pit PMPSB01 in broad drainages or plains (Plate 5.19 and Plate 5.20). It was dominated by woodlands made up of species in the ' <i>Acacia aneura</i> ' complex, sometimes with <i>Corymbia hamersleyana</i> , together with other mixed <i>Acacia</i> species in the middle shrub layer and soft spinifex at ground level.
Other associated species	<u>Shrubs:</u> <i>Acacia pruinocarpa</i> , <i>Ptilotus obovatus</i> var. <i>obovatus</i> , <i>Bonamia erecta</i> , <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>E. latrobei</i> subsp. <i>filiformis</i> , <u>Grasses:</u> <i>Chrysopogon fallax</i> , <i>Themeda triandra</i> , <i>Paraneurachne muelleri</i> . <u>Herbs:</u> <i>Goodenia forrestii</i> , <i>Rhynchosia minima</i> , <i>Duperreya commixta</i> , <i>Cheilanthes sieberi</i> subsp. <i>sieberi</i> , <i>Vincetoxicum lineare</i> .
Vegetation condition	Excellent.
Sites	MRO-R02, MRO-R03, MRO-R04.



Plate 5.19: Unit M5 (MRO-R02).



Plate 5.20: Unit M5 (MRO-R04).

5.2.5 Vegetation of Stony Plains and Sloping Plains

P1	<i>Corymbia deserticola</i> subsp. <i>deserticola</i> , <i>C. hamersleyana</i> , <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> low open woodland over <i>Triodia wiseana</i> open hummock grassland.
Distribution and habitat	This vegetation type occurred on stony undulating plains throughout the central borrow pits (Plate 5.21). <i>Corymbia deserticola</i> subsp. <i>deserticola</i> , <i>C. hamersleyana</i> and <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> were dominant in the tree layer, with <i>Acacia pruinocarpa</i> also scattered throughout the landscape. The sparse mallee layer was dominated by <i>Eucalyptus gamophylla</i> . Various species from the Fabaceae family were present in the shrub layer including <i>Senna glutinosa</i> subsp. <i>glutinosa</i> , <i>Acacia ancistrocarpa</i> and <i>A. tenuissima</i> . <i>Triodia wiseana</i> was the dominant hummock grass, with occasional <i>T. epactia</i> .
Other associated species	<u>Shrubs:</u> <i>Acacia bivenosa</i> , <i>Dodonaea coriacea</i> , <i>Hakea chordophylla</i> , <i>Senna artemisioides</i> subsp. <i>oligophylla</i> . <u>Grasses:</u> <i>Amphipogon sericeus</i> , <i>Aristida holathera</i> var. <i>holathera</i> , <i>Paraneurachne muelleri</i> . <u>Herbs:</u> <i>Trichodesma zeylanicum</i> var. <i>zeylanicum</i> , <i>Trachymene oleracea</i> subsp. <i>oleracea</i> , <i>Dolichocarpa crouchiana</i> .
Vegetation condition	Excellent.
Sites	KTF75, KTF82, KTF86, KTF116, KTF123, KTF124, KTF128, KTF137, KTF142, KTF145 (Biota 2021); none from current survey.



Plate 5.21: Unit P1 (KTF124)

P2	<i>Corymbia hamersleyana</i> low open woodland over mixed <i>Acacia</i> shrubland over <i>Triodia epactia</i> hummock grassland.
Distribution and habitat	This vegetation type was found on gently undulating plains supporting minor drainages, throughout the survey area but concentrated in the northern section (Plate 5.22 and Plate 5.23). The shrub layer comprised a mixture of <i>Acacia</i> species, including <i>A. ancistrocarpa</i> , <i>A. atkinsiana</i> and <i>A. trachycarpa</i> . <i>Triodia epactia</i> was the dominant hummock grass, however <i>T. wiseana</i> was also present in sparse patches.
Other associated species	<u>Shrubs:</u> <i>Acacia sclerosperma</i> subsp. <i>sclerosperma</i> , <i>A. dictyophleba</i> , <i>A. tenuissima</i> , <i>A. maitlandii</i> , <i>A. trudgeniana</i> , <i>Grevillea wickhamii</i> subsp. <i>hispidula</i> , <i>Carissa lanceolata</i> , <i>Eremophila longifolia</i> , <i>Indigofera monophylla</i> . <u>Grasses:</u> <i>Eriachne aristidea</i> , <i>E. pulchella</i> , <i>Aristida holathera</i> var. <i>holathera</i> , <i>Eulalia aurea</i> , <i>Sporobolus australasicus</i> , <i>Paspalidium clementii</i> . <u>Herbs:</u> <i>Duperreya commixta</i> , <i>Dysphania kalpari</i> , <i>Rhynchosia minima</i> , <i>Evolvulus alsinoides</i> var. <i>villosicalyx</i> , <i>Trianthema glossostigmum</i> .
Vegetation condition	Excellent.
Sites	KTF18, KTF30, KTF31, KTF32, KTF40, KTF41, KTF43, KTF44, KTF48, KTF49, KTF51 (Biota 2021); MRO03, MRO06.



Plate 5.22: Unit P2 (KTF43).



Plate 5.23: Unit P2 (MRO06).

P7	<i>Triodia wiseana</i> hummock grassland with <i>Eriachne flaccida</i> scattered tussock grasses.
Distribution and habitat	This vegetation type was restricted to the northern section of the survey area (borrow pit PMPSB03), on stony plains with isolated patches of cracking clay (Plate 5.24 and Plate 5.25). The open hummock grassland layer was dominated by <i>Triodia wiseana</i> , but typically also included scattered <i>T. epactia</i> . Tussock grasses were scattered throughout the landscape, most commonly featuring <i>Eriachne flaccida</i> and <i>Eragrostis xerophila</i> .
Other associated species	<u>Shrubs:</u> <i>Acacia xiphophylla</i> , <i>Senna notabilis</i> , <i>Dolichandrone occidentalis</i> , <i>Stemodia kingii</i> . <u>Grasses:</u> <i>Dichanthium sericeum</i> subsp. <i>sericeum</i> , <i>Eriachne pulchella</i> , <i>Chrysopogon fallax</i> , <i>Eragrostis tenellula</i> , <i>Sporobolus australasicus</i> . <u>Herbs:</u> <i>Alysicarpus muelleri</i> , <i>Neptunia dimorphantha</i> , <i>Streptoglossa bubakii</i> , <i>Boerhavia burbridgeana</i> , <i>B. paludosa</i> , <i>Cucumis picrocarpus</i> .
Vegetation condition	Excellent.
Sites	KTF14, KTF16, KTF73 (Biota 2021); MRO04.



Plate 5.24: Unit P7 (KTF14).



Plate 5.25: Unit P7 (MRO04).

P8	*<i>Vachellia farnesiana</i> scattered tall shrubs over <i>Chrysopogon fallax</i> very open tussock grassland over mixed annual grassland and herbland.
Distribution and habitat	This vegetation type occurred on cracking clay plains in the Tom Price realignment area (Plate 5.26 and Plate 5.27). The tussock grassland layer was dominated by <i>Chrysopogon fallax</i> , but typically also included * <i>Cenchrus ciliaris</i> , and * <i>C. setiger</i> . A variety of bunch grasses were present in the ground layer, including <i>Urochloa occidentalis</i> var. <i>ciliata</i> , <i>Dactyloctenium radulans</i> and <i>Chloris pectinata</i> . An open mixed herb layer contained species including <i>Cullen cinereum</i> , <i>Trianthema triquetrum</i> and <i>Boerhavia burbridgeana</i> .
Other associated species	<u>Shrubs:</u> <i>Acacia victoriae</i> subsp. <i>victoriae</i> , <i>A. synchronicia</i> , <i>Ptilotus exaltatus</i> . <u>Grasses:</u> <i>Dichanthium sericeum</i> subsp. <i>humilius</i> , <i>Enneapogon polyphyllus</i> , <i>Iseilema macratherum</i> , <i>I. dolichotrichum</i> , <i>Sporobolus australasicus</i> , <i>Eragrostis setifolia</i> . <u>Herbs:</u> <i>Convolvulus clementii</i> , <i>Cucumis picrocarpus</i> , <i>Cullen graveolens</i> , <i>Ipomoea lonchophylla</i> , <i>Rhynchosia minima</i> .
Vegetation condition	Very Good; evidence of cattle grazing, presence of weeds.
Sites	KTF04, KTF07 (Biota 2021); MRO-R05.



Plate 5.26: Unit P8 (KTF07).



Plate 5.27: Unit P8 (MRO-R05).

5.2.6 Vegetation of Floodplains

F1	<i>Corymbia hamersleyana</i> low open woodland over <i>Acacia inaequilatera</i> tall open shrubland over <i>Triodia wiseana</i> (<i>T. epactia</i>) open hummock grassland with mixed tussock grasses.
Distribution and habitat	This vegetation occurred in borrow pit PMPBC02 and the Hamersley realignment area in the central section of the survey area (Plate 5.28 and Plate 5.29). The low open woodland layer comprised mainly <i>Corymbia hamersleyana</i> with <i>Hakea lorea</i> subsp. <i>lorea</i> . The shrub layer typically contained a variety of Fabaceae species, including <i>Acacia ancistrocarpa</i> and <i>A. dictyophleba</i> . In addition to hummock grasses, a mixture of scattered tussock grasses included <i>Eriachne tenuiculmis</i> and <i>Chrysopogon fallax</i> .
Other associated species	<u>Trees:</u> <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> . <u>Shrubs:</u> <i>Grevillea pyramidalis</i> subsp. <i>leucadendron</i> , <i>Senna glaucifolia</i> , <i>Gossypium australe</i> , <i>Eremophila longifolia</i> . <u>Grasses:</u> <i>Eragrostis eriopoda</i> , <i>Eragrostis cumingii</i> , <i>Eulalia simonii</i> , <i>Enneapogon caerulescens</i> . <u>Herbs:</u> <i>Evolvulus alsinoides</i> var. <i>villosicalyx</i> , <i>Goodenia forrestii</i> , <i>Bonamia erecta</i> , <i>Alysicarpus muelleri</i> .
Vegetation condition	Excellent to Very Good; evidence of cattle, scattered weeds.
Sites	KTF45, KTF53, KTF54, KTF55, KTF57, KTF58, KTF69, KTF81, KTF84, KTF99, KTF100, KTF140, KTF141 (Biota 2021); MRO09.



Plate 5.28: Unit F1 (KTF81).



Plate 5.29: Unit F1 (KTF99).

F2	<i>Corymbia hamersleyana</i> low woodland over mixed <i>Acacia</i> tall open shrubland over <i>Triodia wiseana</i>, (<i>T. epactia</i>) open hummock grassland.
Distribution and habitat	This vegetation type was associated with minor drainages through the middle of the survey area in borrow pits PMPSB01, PMPSB02 and PMPBC12 (Plate 5.30 and Plate 5.31). <i>Corymbia hamersleyana</i> was the dominant tree species, with occasional <i>Eucalyptus victrix</i> . The tall shrub and shrubland layers typically comprised <i>Acacia</i> species, with <i>Grevillea wickhamii</i> subsp. <i>aprica</i> and <i>Clerodendrum floribundum</i> var. <i>angustifolium</i> . In addition to hummock grasses, there were scattered tussocks of <i>Themeda triandra</i> .
Other associated species	<u>Shrubs:</u> <i>Acacia pyrifolia</i> , <i>A. maitlandii</i> , <i>Indigofera monophylla</i> , <i>Abutilon</i> sp. Dioicum (A.A. Mitchell PRP 1618). <u>Grasses:</u> <i>Cymbopogon ambiguus</i> , <i>Sporobolus australasicus</i> , <i>Paspalidium clementii</i> , <i>Eulalia aurea</i> . <u>Herbs:</u> <i>Afrohybanthus aurantiacus</i> , <i>Boerhavia coccinea</i> , <i>Arivela viscosa</i> , <i>Duperreya commixta</i> , <i>Gomphrena cunninghamii</i> .

Vegetation condition	Excellent to Very Good: occasional evidence of cattle; scattered weeds.
Sites	KTF19, KTF20, KTF28, KTF29, KTF42, KTF46, KTF47, KTF88, KTF90, KTF101, KTF105, KTFREL02, KTFREL06, KTFREL10, KTFREL12, KTFREL18 (Biota 2021); none from current survey.



Plate 5.30: Unit F2 (KTF19).



Plate 5.31: Unit F2 (KTF47).

F3	<i>Corymbia hamersleyana</i> low open woodland over mixed <i>Acacia</i> open shrubland over <i>Triodia epactia</i> very open hummock grassland with <i>Chrysopogon fallax</i> very open tussock grassland.
Distribution and habitat	This vegetation type occurred on the broad open floodplains of minor tributaries in the middle of the survey area in borrow pits PMPB02 and PMPBC06 (Plate 5.32 and Plate 5.33). The open woodland layer was dominated by <i>Corymbia hamersleyana</i> , and typically occurred over a tall shrubland of <i>Acacia ancistrocarpa</i> , <i>A. atkinsiana</i> and <i>A. sclerosperma</i> subsp. <i>sclerosperma</i> . The ground layer comprised a variety of open hummock grasses and tussock grasses.
Other associated species	<u>Shrubs:</u> <i>Acacia coleii</i> , <i>A. pyriformis</i> var. <i>pyriformis</i> , <i>A. trachycarpa</i> , <i>Senna artemisioides</i> subsp. <i>helmsii</i> , <i>Hakea lorea</i> subsp. <i>lorea</i> , <i>Carissa lanceolata</i> . <u>Grasses:</u> <i>Triodia wiseana</i> , <i>Chrysopogon fallax</i> , <i>Themeda triandra</i> , <i>Chrysopogon fallax</i> , <i>Sporobolus australasicus</i> . <u>Herbs:</u> <i>Boerhavia coccinea</i> , <i>Arivela viscosa</i> , <i>Dysphania kalpari</i> .
Vegetation condition	Excellent.
Sites	KTF24, KTF27, KTF33, KTF36, KTF38 (Biota 2021); none from current survey.



Plate 5.32: Unit F3 (KTF33).



Plate 5.33: Unit F3 (KTF38).

F4	<i>Acacia citrinoviridis</i> low woodland over <i>Triodia epactia</i> open hummock grassland and <i>Chrysopogon fallax</i> scattered tussock grasses.
Distribution and habitat	Two small areas of this vegetation occurred on broad floodplains in the central borrow pit PMPSB01 (Plate 5.34 and Plate 5.35). The low woodland layer was dominated by <i>Acacia citrinoviridis</i> , with occasional <i>Eucalyptus victrix</i> and <i>Corymbia hamersleyana</i> . The ground layer generally consisted of a <i>Triodia epactia</i> open hummock grassland, with tussocks of <i>Chrysopogon fallax</i> and <i>Eriachne benthamii</i> .
Other associated species	<u>Shrubs:</u> <i>Acacia bivenosa</i> , <i>Senna artemisioides</i> subsp. <i>oligophylla</i> , <i>Isotropis atropurpurea</i> , <i>Solanum lasiophyllum</i> , * <i>Malvastrum americanum</i> . <u>Grasses:</u> * <i>Cenchrus ciliaris</i> , * <i>C. setiger</i> , <i>Eriachne benthamii</i> , * <i>Setaria verticillata</i> , <i>Urochloa occidentalis</i> var. <i>occidentalis</i> . <u>Herbs:</u> * <i>Bidens bipinnata</i> , <i>Rostellularia adscendens</i> var. <i>clementii</i> .
Vegetation condition	Excellent.
Sites	KTF56, KTF61, KTF98, KTFREL13 (Biota 2021); none from current survey.



Plate 5.34: Unit F4 (KTF56).



Plate 5.35: Unit F4 (KTF61).

F5	*<i>Vachellia farnesiana</i> tall open shrubland over <i>Eriachne benthamii</i>, (<i>Dichanthium sericeum</i> subsp. <i>sericeum</i>, <i>Chrysopogon fallax</i>, *<i>Cenchrus ciliaris</i>) tussock grassland.
Distribution and habitat	This vegetation occurred in a minor drainage and its associated floodplains in the Tom Price realignment area. It differed from surrounding P8 vegetation by having denser * <i>Vachellia farnesiana</i> and a higher cover of * <i>Cenchrus ciliaris</i> (Plate 5.36).
Other associated species	<u>Grasses:</u> <i>Bothriochloa ewartiana</i> , <i>Dichanthium sericeum</i> subsp. <i>humilis</i> <u>Herbs:</u> <i>Cullen graveolens</i>
Vegetation condition	Very Good; high weed cover.
Sites	Mapping note ALMN-70.



Plate 5.36: Unit F5 (ALMN-70).

5.2.7 Disturbed Areas

The survey area contained various disturbed areas associated with minor tracks, laydown and other infrastructure. These areas typically contained sparse or scattered native vegetation regrowth, interspersed with weed species, and did not in their current state represent a cohesive vegetation type. Disturbed areas made up 0.5% of the survey area (Table 5.1, Appendix 5).

5.2.8 Cleared Areas

These areas, which were completely devoid of native vegetation, had been cleared for active tracks and drill pads, pastoral fences, roads and other infrastructure. Cleared areas made up 0.1% of the survey area (Table 5.1, Appendix 5).

5.3 Vegetation Condition

Mapping of vegetation condition is provided in Appendix 6 using condition categories from EPA (2016a). The condition of the vegetation ranged from 'Excellent' to 'Poor', however the vast majority of the vegetation was in 'Excellent' or 'Very Good' condition (Table 5.2).

The survey area contained various disturbed areas associated with infrastructure, historical mining exploration tracks and drill pads; these areas were mapped as 'Poor' as they would likely be able to regenerate with native vegetation. Areas completely devoid of vegetation were considered 'Cleared' and were not assigned a condition rating. Weeds were uncommon and were mainly confined to drainage lines and associated floodplains. Evidence of cattle was recorded in some areas, particularly along drainage lines.

Table 5.2: Extent of vegetation condition categories within the survey area.

Condition Rating	Area (ha)	Proportion of Survey Area
Excellent	1,876.1	69.2%
Excellent to Very Good	577.6	21.3%
Very Good	240.7	8.9%
Poor	13.8	0.5%
Cleared	1.4	0.1%

5.4 Vegetation of Significance

Vegetation types C4 (*Themeda* sp. Hamersley Station (M.E. Trudgen 11431) tussock grassland; at KTF21, KF22 and KTF72 (Biota 2021)), and C5 (*Eucalyptus victrix* scattered low trees over *Eriachne*

benthamii, (*Themeda* sp. Hamersley Station (M.E. Trudgen 11431) very open tussock grassland over mixed open herbland; at KTF13 (Biota 2021)) found in the Tom Price realignment area are considered to represent the *Themeda* grasslands TEC, which is characterised by grassland plains with dominant *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) (Table 5.3; Figure 5.1). A small portion (15.3 ha) of C3 vegetation also falls within the buffer zone of the *Themeda* grasslands TEC, however C3 was not considered to represent the TEC (see below).

A portion of the Brockman Iron cracking clay communities PEC also intersects the survey area. Characteristic features of this PEC include dominant *Astrelba lappacea* in a tussock grassland and occurrence of the community on the Brockman land system. Vegetation type C3 (Mixed *Astrelba* tussock grassland over *Urochloa occidentalis* var. *occidentalis* bunch grassland) was considered to represent this PEC (Table 5.3; Figure 5.1). Quadrat MRO12 located in this vegetation type had a dense cover (71%) of *Astrelba lappacea* and this area corresponds with the Brockman land system.

While not listed as either a TEC or PEC, groundwater dependent ecosystems (GDEs) in the survey area would be considered of local significance. Vegetation type D1, which contains the phreatophytic tree species *Eucalyptus camaldulensis*, would be considered a GDE. Vegetation type D3 contains *Eucalyptus victrix*, which may behave as a facultative phreatophyte, and is considered to be a potential GDE. Additionally, D3 contains patches of *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) in places, and would be considered fringing vegetation, which is important to the health and maintenance of the *Themeda* grasslands TEC.

Table 5.3: Summary of significant vegetation in the survey area.

Significant Vegetation Unit	Status	Location in Survey Area	Mapped Vegetation Unit	Extent (ha)
<i>Themeda</i> grasslands TEC	VU	Tom Price realignment	C4	14.9
<i>Themeda</i> grasslands TEC	VU	Tom Price realignment	C5	0.02
Brockman Iron cracking clay communities PEC	Priority 1	Tom Price realignment	C3	49.6
Groundwater dependent ecosystem	GDE	PMPSB01 and PMPBC02 borrow pits	D1	2.7
Potential groundwater dependent ecosystem	Potential GDE	Tom Price realignment	D3	5.5

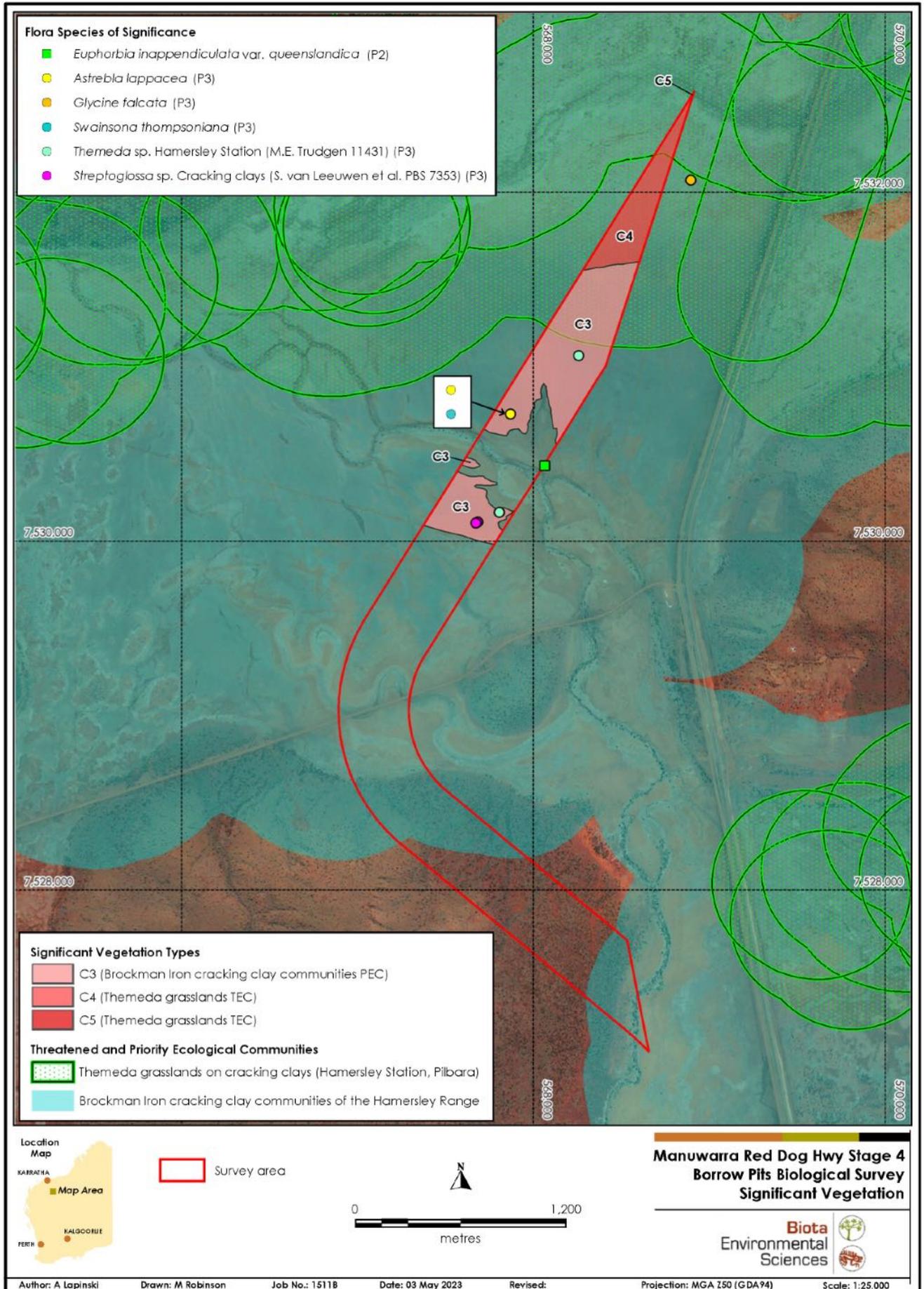


Figure 5.1: TEC and PEC occurrences and significant flora locations in the survey area.

6.0 Flora

6.1 Overview

A total of 280 native vascular flora species from 122 genera and 46 families were recorded from the survey area. The vascular flora species list for the survey area is provided in Appendix 8 and all raw quadrat data are provided in Appendix 9. The dominant native plant families and genera recorded from the survey area are presented in Table 6.1. These families and genera are typical of species lists from this region.

In addition to the above, five introduced flora species (weeds) were recorded from the survey area (see Section 6.3).

Table 6.1: Dominant families and genera recorded from the survey area.

Family	No. of Native Species	Genus	No. of Native Species
Fabaceae	58	<i>Acacia</i>	25
Poaceae	43	<i>Ptilotus</i>	14
Malvaceae	35	<i>Senna</i>	11
Amaranthaceae	20	<i>Sida</i>	11

6.2 Significant Flora

6.2.1 Threatened Flora

No Threatened species were recorded from the survey area.

6.2.2 Priority Flora

Eight Priority flora species were recorded during the field survey, with specimens of each taxon confirmed by Mike Hislop of the WA Herbarium. Locations of records are mapped in Appendix 5 and detailed further in Appendix 10. The species comprised:

- One Priority 2 species:
 - *Euphorbia inappendiculata* var. *queenslandica*.
- Seven Priority 3 species:
 - *Astrebla lappacea*,
 - *Dolichocarpa* sp. Hamersley Station (A.A. Mitchell PRP 1479),
 - *Glycine falcata* (outside survey area boundary),
 - *Streptoglossa* sp. Cracking clays (S. van Leeuwen et al. PBS 7353),
 - *Swainsona thompsoniana*,
 - *Themeda* sp. Hamersley Station (M. E. Trudgen 11431), and
 - *Triodia basitricha*.

***Euphorbia inappendiculata* var. *queenslandica* (Priority 2)**

This prostrate, annual herb typically occurs on clay. One opportunistic record was made in vegetation type P8 in the Tom Price realignment area, and this species would likely occur more widely through this area. This species is known from at least 13 populations within approximately 100 km of the survey area, which are primarily located in the southern portion, near Karijini National Park (WA Herbarium 2023). There are two further populations known from the Ord Victoria Plains bioregion to the northeast and the Central Ranges bioregion in the southeast, suggesting that the range of this species may be very broad.

***Astrebula lappacea* (Priority 3)**

This perennial tussock grass (Plate 6.1) grows up to 0.8 m tall and is usually found in clay or loam soils. It was recorded at site MRO12 in C3 vegetation in the Tom Price realignment area, in an area that falls within the buffer for the Brockman Iron cracking clay communities PEC. This species made up 71% of the tussock grass layer at MRO12. While there are known populations of this species in the eastern states of Australia, within WA is known from 10 populations west of Karijini National Park, with a relatively narrow range of approximately 60 km north to south and east to west (WA Herbarium 2023).



Plate 6.1: *Astrebula lappacea*.
Photo courtesy of Ausgrass (Sharp and Simon 2002).

***Dolichocarpa* sp. Hamersley Station (A.A. Mitchell PRP 1479) (Priority 3)**

This small annual herb is restricted to heavy clay soils. It was recorded once at site MRO04 in borrow pit PMPSB03, and would likely be more widespread on clay plains in the survey area, including through the Tom Price realignment area. This species is broadly distributed across the Pilbara, with 31 vouchered records from the Chichester, Hamersley, Fortescue and Roebourne subregions, but is generally restricted to heavy clay soils (WA Herbarium 2023).



Plate 6.2: *Dolichocarpa* sp. Hamersley Station (A.A. Mitchell PRP 1479) and preferred habitat. (photos not from survey area).

***Glycine falcata* (Priority 3)**

This mat-forming perennial herb with blue-purple flowers typically occurs on clay soils along drainage depressions and in crabhole plains, or on river floodplains. This species was recorded once just outside the boundary of the Tom Price realignment area in vegetation C4 within the buffer of the *Themeda* grasslands TEC. This species is known to occur in the Pilbara, Central Kimberley and Ord Victoria Plain bioregions from 13 known populations (WA Herbarium 2023).



Plate 6.3: *Glycine falcata* (photos not from survey area).

***Swainsona thompsoniana* (Priority 3)**

This prostrate annual herb with purple-pink flowers was recorded from one location in the Tom Price realignment area at site MRO12. It would be likely to be more widespread through this area. This species is distributed across all four subregions of the Pilbara, with a total of 26 vouchered records in WA extending over a broad range of approximately 400 km (WA Herbarium 2023).



Plate 6.4: *Swainsona thompsoniana* (photos not from survey area).

***Streptoglossa* sp. Cracking clays (*S. van Leeuwen et al. PBS 7353*) (Priority 3)**

This prostrate daisy was recorded from two opportunistic locations in the Tom Price realignment area. This taxon has only recently been distinguished as a separate entity, and would be likely to be more widespread through this area. The species is known from 10 populations from the Augustus, Fortescue and Hamersley subregions (WA Herbarium 2023).

***Themeda* sp. Hamersley Station (M. E. Trudgen 11431) (Priority 3)**

This tall grass, growing to 1.8 m tall, shares similarities to *Themeda triandra* however it is more robust, larger, has glaucous leaves, and grows on heavy clay soils. This species was recorded as a dominant grass at two opportunistic locations within vegetation type C3, which falls within the buffer of the *Themeda* grasslands TEC, and is a dominant species in vegetation types in the Tom Price realignment area. *T. sp. Hamersley Station (M. E. Trudgen 11431)* is known from at least 60 populations distributed across the majority of the Pilbara with a high concentration of population records around Karijini National Park, south of the survey area (WA Herbarium 2023).



Plate 6.5: *Themeda* sp. Hamersley Station (M. E. Trudgen 11431).
(Photo not from survey area.)

***Triodia basitricha* (Priority 3)**

This low, perennial hummock grass has a fine inflorescence, and is morphologically similar to *T. melvillei* and *T. bitextura*. This species was recorded at MRO01, MRO02 and MRO10 and at one opportunistic location, all from borrow pits PMPBC05 and PMPBC06 in the centre of the survey area in vegetation type H5. It made up between 4% and 7% of the hummock grassland layer at the quadrat locations. This species is known from 34 populations primarily in the central Pilbara with a broad range of approximately 500 km (WA Herbarium 2023).



Plate 6.6: *Triodia basitricha*.
(Photo not from survey area.)

6.3 Introduced Flora

Five weed species were recorded during the field survey:

- **Cenchrus ciliaris* (Buffel Grass);
- **Cenchrus setiger* (Birdwood Grass);
- **Malvastrum americanum* (Spiked Malvastrum);
- **Sonchus oleraceus* (Common Sowthistle); and
- **Vachellia farnesiana* (Mimosa Bush).

None of the species are listed as Declared Pests under the State BAM Act, nor are they WoNS. Locations of records are mapped in Appendix 6 and detailed further in Appendix 11.

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7.0 Fauna Results

7.1 Fauna Assemblage

7.1.1 Overview

A combined total of 53 vertebrate fauna species were recorded from the survey area during the field survey, four of which are considered to be significant (the Northern Quoll, Western Pebble-mound Mouse, Ghost Bat, and Pilbara Leaf-nosed Bat) (Table 7.1). A combined species list is presented in Appendix 12. Locations of significant fauna species are mapped in context with their fauna habitats in Appendix 14.

Table 7.1: Overview of vertebrate fauna species recorded during the field survey work.

Fauna Group	Status	No. of Species	No. of Significant Species
Ground-dwelling Mammals	Native	2	2*
	Introduced	0	0
Bats	Native	11	2
Birds	Native	36	0
Reptiles	Native	4	0
Amphibians	Native	0	0
	Total	53	4*

* Pebble-mound Mouse from secondary evidence only.

7.1.2 Significant Fauna Recorded from the Survey Area

7.1.2.1 Northern Quoll (*Dasyurus hallucatus*)

The Northern Quoll is listed as Endangered under both the EPBC Act and BC Act. It formerly occurred across much of northern Australia but is now restricted to six major areas. Two of these areas are in Western Australia: the northwest Kimberley and the Pilbara (Braithwaite and Griffiths 1994). The species is most abundant in open, rocky habitat and commonly utilises gorges, breakaways and hills, particularly for denning purposes, but also occurs near creek lines and drainage lines, where adjacent plains and vegetated areas provide habitats for foraging and dispersal of young (van Dyck and Strahan 2008). Many records from the Pilbara bioregion have come from rocky mesa habitats, particularly where in contact with dense vegetation along drainage areas (Garth Humphreys, Biota, pers. obs.), and from boulder tors of the Abydos-Woodstock Plain (How et al. 1991).

Two observations of Northern Quoll were made during the survey on motion cameras, one outside of the study area (MRD01MC) and one inside (MRD02MC; map 7 in Appendix 14). The Northern Quoll has been recorded previously on numerous occasions in close proximity to the survey area; 148 of these records are approximately 16 km to the east of the survey area, and suitable habitat for the species is present in the survey area (Appendix 13). The fauna habitats within the survey area that may be utilised by Northern Quoll are detailed in Table 7.3. There is limited information available on the dispersal ecology of Northern Quolls, as is acknowledged within the Referral guideline as the reason for the use of the relatively broad definition “foraging or dispersal habitat is recognised to be any land comprising predominately native vegetation in the immediate area (within 1 km) of denning / shelter habitat, quoll records or land comprising predominately native vegetation that is connected to denning / shelter habitat within the species range” (Department of the Environment 2016). Routes of dispersal are hypothetical only and inferred generally based on habitats present. Avenues of potential male dispersal are expected to occur between potential denning and breeding locations and it is reasonable to assume that drainages with suitable habitat complexity connecting denning habitat may represent potential dispersal and foraging habitat.



Plate 7.1: Northern Quoll on motion camera MRD01MC.

7.1.2.2 Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)

The Pilbara Leaf-nosed Bat is a sub-population of the Orange Leaf-nosed Bat, which is endemic to the Pilbara and Ashburton regions of WA and is listed as Vulnerable under both the EPBC Act and BC Act. The Pilbara population is isolated from the main tropical populations in the Kimberley, Northern Territory and Queensland by 400 km of unsuitable habitat in the Great Sandy Desert. The Pilbara Leaf-nosed Bat is semi-desert adapted and has specific roosting requirements, requiring roost sites in caves or mine adits with stable, very hot (28 – 32°C) and very humid (96 – 100 %) microclimates (Churchill 2008). Caves deep enough to create this environment are relatively uncommon in the Pilbara (van Dyck and Strahan 2008), which limits the availability of diurnal roosts for this species. Observed foraging habitat includes *Triodia* hummock grassland, sparse tree and shrub savannah and riparian vegetation along drainage lines (Duncan et al. 1999). The Pilbara Leaf-nosed Bat has a cryptic, high frequency call that has previously imparted low detectability of this species, and as such has potentially resulted in an underestimate of population size. However, McKenzie and Bullen (2009) found that this species is more common than previously recognised (Hancock and Timms 2002).

A total of five calls of the Pilbara Leaf-nosed Bat were recorded during this survey from the three ultrasonic ARU locations (map 7 in Appendix 14). Two of these ARU locations were outside of the survey area in suitable habitat (MRD01Bat, MRD03Bat). Suitable secondary (foraging) habitat is present within the survey area (Table 7.3), however there are no caves or adits suitable for roosting (Appendix 13). The absence of diurnal roosting habitat reduces the significance of the habitats present below a level that would be considered critical to survival (Bullen 2021b), with all previous surveys also indicating that only foraging habitat is present (Section 4.8).

7.1.2.3 Ghost Bat (*Macroderma gigas*)

The Ghost Bat is listed as Vulnerable under both the EPBC Act and BC Act. Ghost Bats previously occurred across most of inland and northern Australia, but are now restricted to the tropical north of the continent (Churchill 2008). The distribution of this species is fragmented, with each population showing some genetic differentiation (Armstrong and Wilmer 2004), and populations in the Pilbara bioregion appear to be isolated from those in the Kimberley and Northern Territory. Ghost Bats occur in a broad range of landforms, with distribution influenced by the availability of suitable caves for roost sites (Churchill 2008). Ghost Bats may forage over large areas, with foraging ranges of over ~60 ha (Churchill 1998), and the size of their foraging area is probably inversely related to the productivity of their landscape. Scat material from the Ghost Bat is quite

distinctive and can be used to identify temporary roosts or feeding sites. Feeding sites are also usually readily identifiable based on the accumulation of discarded remains of prey animals (van Dyck and Strahan 2008).

A total of 27 individual Ghost Bats calls were recorded both inside and outside of the survey area at two of the ultrasonic ARU locations during the survey (MRD01Bat, MRD02Bat). Previous records have been recorded in close proximity to the survey area, the closest record being within 2.1 km of the survey area boundary. There is suitable secondary (foraging) habitat in the survey area, but there are no caves suitable for roosting (Table 7.3, Appendix 13). Similar to the Pilbara Leaf-nosed Bat, the absence of diurnal roosting habitat reduces the habitats present below a level that would be defined as "critical to the survival of the species" (Bullen 2021a). Only one previous survey (Biota 2021, Section 4.8) has recorded potentially suitable roosting habitat in the study area. It is expected that individuals may occur within the survey area on an itinerant foraging basis and with the less stringent requirements for short-term roosting habitat, the species may use shallower caves and overhangs to rest or forage.

7.1.2.4 Western Pebble-mound Mouse (*Pseudomys chapmani*)

The Western Pebble-mound Mouse is listed as a Priority 4 species by the DBCA. Previously described as endemic to the central and eastern parts of the Pilbara (Menkhorst and Knight 2011), it is now known to occur much more widely across the entire Pilbara region and into the Gascoyne (DBCA 2020b), where it is commonly found on stony hillsides with hummock grasslands (Menkhorst and Knight 2011). This habitat occurs throughout a large proportion of the survey area and is continuous throughout the broader landscape (Table 7.3). The species is well known for the extensive mounds of small stones it constructs, which are the most obvious indication of the species' occurrence in an area. Mounds are most common on spurs and gentle slopes where suitably sized stones are present (van Dyck and Strahan 2008).

Ten active mounds constructed by this species were recorded opportunistically during the survey (Table 7.2 and Plate 7.2; see maps 7 and 8 in Appendix 14). The fauna habitats within the survey area that may be utilised by Western Pebble-mound Mouse are detailed in Table 7.3. This species is likely to occur through suitable habitat in the locality and has been recorded in previous surveys, including records in close proximity to the survey area, the closest record being 10 km away and recorded in 2014 (Appendix 13, Section 4.8).

Table 7.2: Location of active Western Pebble-mound Mouse mounds in the survey area.

Species	Zone	Easting (mE)	Northing (mN)
Western Pebble-mound Mouse (mound)	50S	571345	7553031
Western Pebble-mound Mouse (mound)	50S	571465	7552495
Western Pebble-mound Mouse (mound)	50S	571386	7552697
Western Pebble-mound Mouse (mound)	50S	572386	7551224
Western Pebble-mound Mouse (mound)	50S	568927	7538358
Western Pebble-mound Mouse (mound)	50S	569154	7538381
Western Pebble-mound Mouse (mound)	50S	569361	7538330
Western Pebble-mound Mouse (mound)	50S	569424	7538197
Western Pebble-mound Mouse (mound)	50S	569553	7538521
Western Pebble-mound Mouse (mound)	50S	569848	7542890



Plate 7.2: Active Western Pebble-mound Mouse mound.

7.1.3 Other Significant Fauna that are Likely to Occur in the Survey Area

7.1.3.1 Pacific Swift (*Apus pacificus*)

The Pacific Swift is listed as Migratory under both the EPBC Act and BC Act. It occurs as a non-breeding migrant across much of Australia from September to April, particularly in the northern half of the continent. In general, the species is most common closer to the coast, but occurs over much of the Pilbara. In Australia, the species is entirely aerial in habit, foraging for flying insects and even sleeping on the wing. It is highly mobile, often occurring in association with unsettled weather and low pressure systems (Johnstone and Storr 1998).

The Pacific Swift occurs widely over the Pilbara, including the Hamersley Range. It is likely to occur as a sporadic visitor to airspace over all parts of the survey area, particularly in association with thunderstorms and low-pressure systems.

7.1.3.2 Grey Falcon (*Falco hypoleucos*)

The Grey Falcon is listed as Vulnerable under the BC Act and EPBC Act. The species is sparsely distributed across much of arid inland Australia, including the Pilbara, occurring mainly on lightly wooded plains and along major watercourses (Johnstone et al. 2013). Breeding usually takes place in taller trees such as river red gums, or on isolated man-made structures such as communications towers.

The Grey Falcon has previously been recorded in close proximity, and is likely to occur in the survey area. All habitats would be likely to be used for foraging, at least on occasion, with waterholes or other features attracting aggregations of birds likely to be particularly attractive. Taller trees along the major drainage lines offer potentially suitable breeding opportunities.

7.1.3.3 Peregrine Falcon (*Falco peregrinus*)

The Peregrine Falcon is listed as Other Specially Protected Fauna under the BC Act. It occurs almost Australia-wide, but is absent from most deserts and the Nullabor Plain (Johnstone and Storr 1998). This species inhabits a wide range of habitats including forests, woodlands, wetlands and open country (Pizzey and Knight 2007). Individuals maintain large home ranges of up to 30 km², and nest in recesses of cliff faces, tree hollows and along rivers (Johnstone and Storr 1998).

The Peregrine Falcon has previously been recorded in close proximity, and is likely to occur within the survey area.

7.1.3.4 Pilbara Olive Python (*Liasis olivaceus barroni*)

The Pilbara Olive Python is listed as Vulnerable under the BC Act and EPBC Act. It's distribution roughly coincides with the Pilbara Bioregion (DSEWPaC 2012), with preferred habitat including gorges, escarpments, rocky outcrops and water holes where it may find suitable prey (DAWE 2020). It seeks shelter in caves, beneath boulders, in pools of water and occasionally in trees overhanging water (Bush and Maryan 2011). It is often associated with ephemeral or permanent water, but may also be recorded in rocky habitats some distance from these features (Biota

2009b), demonstrating that the species can have a large range (estimated between 88 ha and 449 ha) (DAWE 2020).

The Pilbara Olive Python has previously been recorded in close proximity, with the closest record 1.5 km from the nearest survey boundary in 2013, and is considered likely to occur within the survey area.

7.1.3.5 Pilbara Barking Gecko (*Underwoodisaurus seorsus*)

The Pilbara Barking Gecko is listed as a Priority 2 species by the DBCA. The species is a Hamersley Range endemic that was discovered in 2006 but was not described until 2011 (Doughty and Oliver 2011). It was initially thought to be an isolated population of its more southerly relative, the Barking Gecko (*Underwoodisaurus milii*) (Menz and Cullen 2006) before morphological and molecular analysis showed it to be taxonomically distinct. To date there are very few records of this species, which occurs in a band from north of Tom Price in the western Hamersley to West Angelas mine in the south-east (Doughty and Oliver 2011). The habitats used by this species vary in their topography and vegetation but are usually associated with rocky ridges, slopes and gullies.

A previous record of the Pilbara Barking Gecko exists in close proximity to the survey area, and it is likely to occur in the small amount of rocky hill slope habitat.

7.1.3.6 Western Striped Snake-eyed Skink (*Notoscincus butleri*)

The Western Striped Snake-eyed Skink is listed as a Priority 4 species by the DBCA. This species is endemic to Western Australia and restricted to the arid northwest (Storr et al. 1999) of the Pilbara bioregion. It has been associated with spinifex-dominated areas near creek and river margins (Wilson and Swan 2008). This small skink is diurnal and egg laying (Wilson and Knowles 1988).

There have been previous records in close proximity to the survey area and some suitable habitat is present in the survey area (see Appendix 13). It is therefore considered that this species is likely to occur.

7.1.4 Other Significant Fauna that May Occur in the Survey Area

7.1.4.1 Long-tailed Dunnart (*Sminthopsis longicaudata*)

The Long-tailed Dunnart is listed as Priority 4 by the DBCA. It inhabits rocky, rugged habitat from the Pilbara and adjacent upper Gascoyne region east to the central Northern Territory and South Australia (Menkhorst and Knight 2011). The species was once considered to be rare and possibly threatened, however research has shown that it is relatively common and widespread but is restricted to a specific habitat (Burbidge 2004). Core habitat includes rocky plateaus, breakaways and scree slopes with hummock grass and shrubs, and tall open *Acacia* shrubland and woodland (van Dyck and Strahan 2008).

This species is known from the study area, and may occur in the small amount of suitable rocky habitat within the survey area.

7.1.4.2 Northern Short-tailed Mouse (*Leggadina lakedownensis*)

The Short-tailed Mouse is listed as Priority 4 by the DBCA. In Western Australia, its distribution includes the Pilbara and Kimberley regions (Menkhorst and Knight 2011). This species is known to occur in areas of open tussock and hummock grassland, *Acacia* shrubland and savannah woodland, on sandy soils and cracking clays (Aplin et al. 2016). The species has been recorded from cracking clay communities from Cape Preston (60 km west of Dampier) in the west to the northern flanks of the Fortescue Marshes in the east (Halpern Glick Maunsell et al. 2001). It has also been recorded from hilltops (Dr Peter Kendrick, DBCA Karratha, pers. comm. 2003) and sandy coastal areas near Onslow (G. Humphreys, Biota, pers. obs.).

This species has been infrequently recorded in close proximity of the survey area and may occur; it would only be expected within the cracking clay plains in the Tom Price realignment area.

7.2 Fauna Habitats

7.2.1 Overview of Habitats

The fauna habitats defined for the survey area aligned broadly with the landforms present, with further delineation of some isolated habitats that supported distinct fauna assemblages.

Seven habitat types were described for the survey area. Details and attributes of these habitat types are presented in Table 7.4 and mapped in Appendix 14. The remainder of the survey area (14.9 ha) is made up of cleared or degraded areas.

7.2.2 Significant Fauna Habitats

The fauna habitats that are or would likely be utilised by the significant species recorded from, likely to occur or that may occur in the survey area, are detailed in Table 7.3.

Table 7.3: Likely fauna habitat utilisation by significant species.

Species	Common Name	Fauna Habitats
Recorded		
<i>Dasyurus hallucatus</i>	Northern Quoll	RHS and MDE
<i>Rhinonicteris aurantia</i>	Pilbara Leaf-nosed bat	RHS and MDE
<i>Macroderma gigas</i>	Ghost Bat	CP, RHS and MDE
<i>Pseudomys chapmani</i>	Western Pebble-mound Mouse	ASM and RHS
May occur		
<i>Leggadina lakedownensis</i>	Northern Short-tailed Mouse	GPPC
<i>Sminthopsis longicaudata</i>	Long-tailed Dunnart	RHS
<i>Falco hypoleucos</i>	Grey Falcon	All habitats
<i>Falco peregrinus</i>	Peregrine Falcon	All habitats
<i>Apus pacificus</i>	Pacific Swift	All habitats
<i>Underwoodisaurus seorsus</i>	Pilbara Barking Gecko	RHS
<i>Notoscincus butleri</i>	Western Striped Snake-eyed Skink	MDE

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Table 7.4: Fauna habitats described within the survey area.

Habitat	Description	Associated Veg Type	Area (ha) and Proportion of Survey Area	Habitat Quality	Fauna Associations	Aerial Photograph	Landscape Photograph
FLATS							
ASCC - <i>Acacia xiphophylla</i> shrublands over cracking clay	<i>Acacia xiphophylla</i> low woodland over <i>Triodia epactia</i> open hummock grassland with cracking clay substrates.	C2	0.5 (0.02%)	Excellent	The cracking clay substrate of this habitat may be used by the Priority species Northern Short-tailed Mouse (<i>Leggadina lakedownensis</i>), which burrows in deep cracks formed in clay.		
ASM - Mixed <i>Acacia</i> shrublands	<i>Corymbia</i> trees with mixed <i>Acacia</i> shrublands over <i>Triodia epactia</i> on stony substrates.	P1, P2, P7, P8	1,532.6 (56.6%)	Excellent	Species expected to occur in this habitat include those with particular associations to spinifex (e.g. mammals that forage on seeds, such as Sandy Inland Mouse <i>Pseudomys hermannsburgensis</i> and Desert Mouse <i>P. desertor</i>), or with associations to stony flats (e.g. the dragon species Fortescue Pebble-mimic Dragon <i>Tympanocryptis fortescuensis</i> , Hamersley Pebble-mimic Dragon <i>T. diabolicus</i> and Southern Pilbara Tree Dragon <i>Diphoriphora valens</i>), along with a wide range of species that utilise shrubs and spinifex for cover and/or foraging. Some shrublands support <i>Acacia</i> species that contain root-dwelling larvae, an important food resource for the threatened Bilby (<i>Macrotis lagotis</i>), however the substrates in the survey area are not considered optimal for burrowing by the Bilby.		
CP - Floodplain	<i>Corymbia hamersleyana</i> / <i>Eucalyptus victrix</i> low open woodland over mixed <i>Acacia</i> shrublands over scattered <i>Triodia</i> hummock grasses and mixed tussock grasses.	F1	79.6 (2.9%)	Excellent	Floodplain habitat is suitable foraging habitat for raptor species such as the Spotted Harrier, Grey Falcon and Peregrine Falcon. White-plumed Honeyeaters are associated with floodplain habitat and were observed during the field survey of the main project corridor. Tree hollows may provide shelter for owl and bat species.		

Habitat	Description	Associated Veg Type	Area (ha) and Proportion of Survey Area	Habitat Quality	Fauna Associations	Aerial Photograph	Landscape Photograph
GPCC - Grassland plains with cracking clay	<i>Themeda</i> grassland (TEC) and <i>Astrebla</i> grasslands (PEC), both on cracking clay substrates.	C3	64.5 (2.4%)	Good	A number of bird species have strong associations with open grasslands. In particular, the Brown Songlark was only recorded from this habitat type. The open habitat also provides ideal hunting opportunity for a range of raptor species, such as the Grey Falcon and Spotted Harrier, but these species would not be restricted to this habitat. Grassland plains with or without shrubs may potentially serve as foraging habitat for the Night Parrot. Species associated with cracking clay habitats include the Priority species Northern Short-tailed Mouse (<i>Leggadina lakedownensis</i>), which burrows in deep cracks formed in the clay; and <i>Diplodactylus mitchelli</i> , which is known to occur in habitats with grasslands on heavy cracking clay soils.		
MWP - Mulga woodland plain	<i>Acacia 'aneura'</i> open woodland plains over scattered shrubs over <i>Triodia</i> spp. open hummock grassland.	M4, M5	78.8 (2.9%)	Excellent	The Mulga Dragon (<i>Diporiphora amphiboluroides</i>) is associated with Mulga woodland habitat, where it camouflages against the Mulga bark. It relies heavily on crypsis rather than speed to avoid predators and therefore benefits from a more continuous woodland.		
HILLS AND SLOPES							
RHS – Rocky hills and slopes with low open spinifex and scattered trees.	<i>Eucalyptus leucophloia</i> over mixed acacia scattered-open shrubland over <i>Triodia wiseana</i> / <i>Triodia epactia</i> hummock grassland.	H1, H3	668.2 (24.7%)	Excellent	A number of fauna species are associated with low rocky slopes with hummock grasslands, including the Long-tailed Dunnart (<i>Sminthopsis longicaudata</i>) and the Pebble-mound Mouse (<i>Pseudomys chapmani</i>). The Pebble-mound Mouse builds mounds for shelter out of pebbles on rocky hillsides; these are prominent landscape features even after they become inactive. Other associated species may include the Pilbara Barking Gecko (<i>Underwoodisaurus seorsus</i>), which prefers habitat characterised by rocky areas with spinifex and low tree cover.		

Habitat	Description	Associated Veg Type	Area (ha) and Proportion of Survey Area	Habitat Quality	Fauna Associations	Aerial Photograph	Landscape Photograph
DRAINAGE							
MDE – Eucalyptus fringed major drainage lines and associated tributaries.	Open <i>Eucalyptus victrix</i> / <i>Eucalyptus camaldulensis</i> .	D1, D3, F2, F3, F4	270.6 (10.0%)	Excellent	<p>Species relying on water and moist refugia would be associated with this habitat type. This habitat also provides drinking resources for bats, and potential foraging and dispersal resources for the Northern Quoll (<i>Dasyurus hallucatus</i>) and Pilbara Olive Python (<i>Liasis olivaceus barroni</i>).</p> <p>The Priority species Western Striped Snake-eyed Skink (<i>Notoscincus butleri</i>) is also associated with river margins dominated by spinifex.</p>		

8.0 Conclusions and Discussion

8.1 Significant Vegetation Communities

The desktop study identified that the majority of the Tom Price realignment survey polygon in the south of the survey area intersected the *Themeda* grasslands TEC, and a small portion also intersected the Brockman Iron cracking clay communities PEC.

Following the survey, it was confirmed that vegetation types C3, C4 and C5 all represent vegetation of elevated significance (Section 5.4). Vegetation C4 (14.9 ha) and C5 (0.02 ha) represents the *Themeda* grasslands TEC, while C3 (49.6 ha) represents the Brockman Iron cracking clay communities PEC.

Additionally, vegetation type D1, supporting the phreatophytic tree species *Eucalyptus camaldulensis*, represents a GDE, while D3 potentially represents a GDE. These vegetation communities are locally significant. Vegetation type H5, found in two borrow pits in the central section of the survey area, is also considered to be locally significant as it supports *Triodia basitricha* (P3) as a dominant species.

The remainder of vegetation types in the survey area are common and widespread in the Pilbara and, while they are inherently valuable as examples of intact native vegetation, they are not of particular conservation significance.

8.2 Significant Flora Species

No Threatened flora species were recorded from the survey area. *Seringia exastia* (currently listed as Critically Endangered under the EPBC Act but not threatened in Western Australia) occurs in close proximity in the main project corridor and may occur in the survey area, however as discussed in Section 4.10.1, the conservation listing of the species is under review (due to the common and widespread species *S. elliptica* being synonymised with the *S. exastia*) and is very unlikely to be of conservation concern following review. No other Threatened flora species would occur (Section 6.2.1).

Seven Priority flora species were recorded from the survey area (Table 8.1), with one additional Priority 3 species (*Glycine falcata*) recorded just outside and considered likely to occur (see Section 6.2.2).

Table 8.1: Significant flora recorded within the survey area.

Species	Conservation Status
<i>Euphorbia inappendiculata</i> var. <i>queenslandica</i>	P2
<i>Astrebla lappacea</i>	P3
<i>Dolichocarpa</i> sp. Hamersley Station (A.A. Mitchell PRP 1479)	P3
<i>Streptoglossa</i> sp. Cracking clays (S. van Leeuwen et al. PBS 7353)	P3
<i>Swainsona thompsoniana</i>	P3
<i>Themeda</i> sp. Hamersley Station (M. E. Trudgen 11431)	P3
<i>Triodia basitricha</i>	P3

8.3 Significant Fauna Species

Four significant species were recorded from the survey area. Based on previous records from the study area, and an assessment of habitat within the survey area, no other significant species are considered likely to occur (Table 8.2).

Table 8.2: Significant fauna recorded within the survey area or assessed as likely to occur.

Species	Common Name	Conservation Status	
		State	Federal
<i>Pseudomys chapmani</i> *	Western Pebble-mound Mouse	P4	-
<i>Dasyurus hallucatus</i>	Northern Quoll	EN	EN
<i>Rhinonicteris aurantia</i>	Pilbara Leaf-nosed Bat	P4	-
<i>Macroderma gigas</i>	Ghost Bat	VU	VU

*Secondary evidence only

Seven fauna habitat types were described for the survey area overall. The fauna habitats that are being utilised by the significant species recorded in the survey area, comprise:

- RHS (Rocky hills and slopes with low open spinifex and scattered trees): utilised by Northern Quoll (*Dasyurus hallucatus*), Pilbara Leaf-nosed bat (*Rhinonicteris aurantia*), Ghost Bat (*Macroderma gigas*) and Western Pebble-mound Mouse (*Pseudomys chapmani*);
- MDE (*Eucalyptus* fringed major drainage lines and associated tributaries): utilised by Northern Quoll (*Dasyurus hallucatus*), Pilbara Leaf-nosed bat (*Rhinonicteris aurantia*) and Ghost Bat (*Macroderma gigas*);
- ASM (Mixed Acacia shrublands): utilised by Western Pebble-mound Mouse (*Pseudomys chapmani*); and
- CP (Floodplain): utilised by Ghost Bat (*Macroderma gigas*).

Although the remaining fauna habitats are inherently valuable for significant fauna species, no evidence of utilisation was found during this survey. Additionally, all fauna habitats described are not isolated to the survey or study area, and occur throughout the Pilbara.

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Appendix 1

Framework for Significance Ranking of Species and Communities in WA



A. Definitions, Categories and Criteria for Threatened and Priority Ecological Communities

Species and Communities Branch, Department of Environment and Conservation, December 2010.

1. General Definitions

Ecological Community

A naturally occurring biological assemblage that occurs in a particular type of habitat.

Note: The scale at which biological communities are defined will often depend on the level of detail in the information source, therefore no particular scale is specified.

A **threatened ecological community** (TEC) is one which is found to fit into one of the following categories; "presumed totally destroyed", "critically endangered", "endangered" or "vulnerable".

Possible threatened ecological communities that do not meet survey criteria are added to the Department of Parks and Wildlife's Priority Ecological Community Lists under Priorities 1, 2 and 3. Ecological Communities that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

An **assemblage** is a defined group of biological entities.

Habitat is defined as the areas in which an organism and/or assemblage of organisms lives. It includes the abiotic factors (e.g. substrate and topography), and the biotic factors.

Occurrence: a discrete example of an ecological community, separated from other examples of the same community by more than 20 metres of a different ecological community, an artificial surface or a totally destroyed community.

By ensuring that every discrete occurrence is recognised and recorded future changes in status can be readily monitored.

Adequately Surveyed is defined as follows:

"An ecological community that has been searched for thoroughly in most likely habitats, by relevant experts."

Community structure is defined as follows:

"The spatial organisation, construction and arrangement of the biological elements comprising a biological assemblage" (e.g. *Eucalyptus salmonophloia* woodland over scattered small shrubs over dense herbs; structure in a faunal assemblage could refer to trophic structure, e.g. dominance by feeders on detritus as distinct from feeders on live plants).

Definitions of **Modification** and **Destruction** of an ecological community:

Modification: "changes to some or all of ecological processes (including abiotic processes such as hydrology), species composition and community structure as a direct or indirect result of human activities. The level of damage involved could be ameliorated naturally or by human intervention."

Destruction: "modification such that reestablishment of ecological processes, species composition and community structure within the range of variability exhibited by the original community is unlikely within the foreseeable future even with positive human intervention."

Note: Modification and destruction are difficult concepts to quantify, and their application will be determined by scientific judgement. Examples of modification and total destruction are cited below:

Modification of ecological processes: The hydrology of Toolibin Lake has been altered by clearing of the catchment such that death of some of the original flora has occurred due to dependence on fresh water. The system may be bought back to a semblance of the original state by redirecting saline runoff and pumping waters of the rising underground watertable away to restore the hydrological balance. Total destruction of downstream lakes has occurred due to hydrology being altered to the point that few of the original flora or fauna species are able to tolerate the level of salinity and/or water logging.

Modification of structure: The understorey of a plant community may be altered by weed invasion due to nutrient enrichment by addition of fertiliser. Should the additional nutrients be removed from the system the balance may be restored, and the original plant species better able to compete. Total destruction may

occur if additional nutrients continue to be added to the system causing the understorey to be completely replaced by weed species, and death of overstorey species due to inability to tolerate high nutrient levels. Modification of species composition: Pollution may cause alteration of the invertebrate species present in a freshwater lake. Removal of pollutants may allow the return of the original inhabitant species. Addition of residual highly toxic substances may cause permanent changes to water quality, and total destruction of the community.

Threatening processes are defined as follows:

"Any process or activity that threatens to destroy or significantly modify the ecological community and/or affect the continuing evolutionary processes within any ecological community."

Examples of some of the continuing threatening processes in Western Australia include: general pollution; competition, predation and change induced in ecological communities as a result of introduced animals; competition and displacement of native plants by introduced species; hydrological changes; inappropriate fire regimes; diseases resulting from introduced micro-organisms; direct human exploitation and disturbance of ecological communities.

Restoration is defined as returning an ecological community to its pre-disturbance or natural state in terms of abiotic conditions, community structure and species composition.

Rehabilitation is defined as the re-establishment of ecological attributes in a damaged ecological community although the community will remain modified.

2. Definitions and Criteria for Presumed Totally Destroyed, Critically Endangered, Endangered and Vulnerable Ecological Communities

ECOLOGICAL COMMUNITIES

Presumed Totally Destroyed (PD)

An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future.

An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant and either of the following applies (A or B):

- A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats or
- B) All occurrences recorded within the last 50 years have since been destroyed

Critically Endangered (CR)

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated.

An ecological community will be listed as Critically Endangered when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting any one or more of the following criteria (A, B or C):

- A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% and either or both of the following apply (i or ii):
 - i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years);
 - ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated.
- B) Current distribution is limited, and one or more of the following apply (i, ii or iii):
 - i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years);

- ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes;
 - iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes.
- C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

Endangered (EN)

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.

An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B, or C):

- A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement and either or both of the following apply (i or ii):
 - i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years);
 - ii) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.
- B) Current distribution is limited, and one or more of the following apply (i, ii or iii):
 - i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years);
 - ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes;
 - iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.
- C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

Vulnerable (VU)

An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

An ecological community will be listed as Vulnerable when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting any one or more of the following criteria (A, B or C):

- A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.
- B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.
- C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

3. Definitions and Criteria for Priority Ecological Communities

PRIORITY ECOLOGICAL COMMUNITY LIST

Possible threatened ecological communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community Lists under Priorities 1, 2 and 3. These three categories are ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as threatened ecological communities. Ecological Communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

Priority One: Poorly-known ecological communities

Ecological communities with apparently few, small occurrences, all or most not actively managed for conservation (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) and for which current threats exist. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.

Priority Two: Poorly-known ecological communities

Communities that are known from few small occurrences, all or most of which are actively managed for conservation (e.g. within national parks, conservation parks, nature reserves, State forest, unallocated Crown land, water reserves, etc.) and not under imminent threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.

Priority Three: Poorly known ecological communities

- (i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or:
- (ii) communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or;
- (iii) communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes.

Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.

Priority Four: Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring.

- (a) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands.
- (b) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
- (c) Ecological communities that have been removed from the list of threatened communities during the past five years.

Priority Five: Conservation Dependent ecological communities

Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

B. Categories for Flora and Fauna Species

1. Western Australian Biodiversity Conservation Act 2016, and Priority Species Classification

In Western Australia, 'Threatened', 'Extinct' and 'Specially Protected' fauna and flora species are protected under the *Biodiversity Conservation Act 2016* (the BC Act), making it an offence to take or disturb these species without Ministerial approval. The definition of 'take' is broad, and includes killing, injuring, harvesting or capturing fauna, and gathering, cutting, destroying, harvesting or damaging flora.

Such species are classified within a framework of several categories.

Species of the highest significance are designated as Threatened species and are protected under sections 19(1)(a), 19(1)(b) and 19(1)(c) of the BC Act. Species are listed within one of three categories:

- Critically endangered (CR), Endangered (EN), or Vulnerable (V), representing those species listed in Schedules 1 to 3 respectively of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* or the *Wildlife Conservation (Rare Flora) Notice 2018*.

Presumed extinct species are protected under sections 24 and 25 of the BC Act and are listed in one of two categories:

- Extinct (EX), representing those species listed in Schedule 4 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018* or the *Wildlife Conservation (Rare Flora) Notice 2018*; or
- Extinct in the wild (EW); there are currently no listed species under this category.

Specially protected species are protected under section 13(1) of the BC Act, and include species of special conservation interest, migratory species, cetaceans, species subject to international agreement, or species otherwise in need of special protection. Of these:

- Migratory species (MI) are those listed under schedule 5 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*;
- Species of special conservation interest (conservation dependent fauna) (CD) are those listed under schedule 6 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*; and
- Other specially protected fauna (OS) are those listed under schedule 7 of the *Wildlife Conservation (Specially Protected Fauna) Notice 2018*;

In addition to the species formally designated as protected under the BC Act, the WA Department of Biodiversity, Conservation and Attractions (DBCA) also maintains a list of 'Priority species'.

Species that appear to be rare or threatened, but for which there is insufficient information to properly evaluate their significance, are assigned to one of three Priority categories (Priority 1 to Priority 3), while species that are adequately known but require regular monitoring are assigned to Priority 4.

Note that of the above classifications, only 'Threatened', 'Extinct' and 'Specially Protected' species have statutory standing. The Priority flora and fauna classifications are employed by the WA DBCA to manage and classify their database of species considered potentially rare or at risk, but these categories have no legislative status.

Further explanations of the categories is provided in more detail in the following pages.

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CONSERVATION CODES

For Western Australian Fauna and Flora

Threatened, Extinct and Specially Protected fauna or flora¹ are species² which have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection, and have been gazetted as such.

The *Wildlife Conservation (Specially Protected Fauna) Notice 2018* and the *Wildlife Conservation (Rare Flora) Notice 2018* have been transitioned under regulations 170, 171 and 172 of the *Biodiversity Conservation Regulations 2018* to be the lists of Threatened, Extinct and Specially Protected species³ under Part 2 of the *Biodiversity Conservation Act 2016*.

Categories of Threatened, Extinct and Specially Protected fauna and flora are:

T **Threatened species**

Listed by order of the Minister as Threatened in the category of critically endangered, endangered or vulnerable under section 19(1), or is a rediscovered species to be regarded as threatened species under section 26(2) of the *Biodiversity Conservation Act 2016* (BC Act).

Threatened fauna is the species of fauna that are listed as critically endangered, endangered or vulnerable threatened species.

Threatened flora is the species of flora that are listed as critically endangered, endangered or vulnerable threatened species.

The assessment of the conservation status of threatened species is in accordance with the BC Act listing criteria and the requirements of Ministerial Guideline (Number 1) and Ministerial Guideline (Number 2) that adopts the use of the International Union for Conservation of Nature (IUCN) Red List of Threatened Species Categories and Criteria⁴, and is based on the national distribution of the species.

CR **Critically endangered species**

Threatened species considered to be “*facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines*”.

Listed as critically endangered under section 19(1)(a) of the BC Act in accordance with the criteria set out in section 20 and the ministerial guidelines.

Examples of use:

- The western ringtail possum (*Pseudocheirus occidentalis*) is listed as a critically endangered threatened species under the *Biodiversity Conservation Act 2016*.
- Western ringtail possum is listed as critically endangered under the *Biodiversity Conservation Act 2016*.
- Listing reference in a table: column heading: BC Act, row text: CR.

EN **Endangered species**

Threatened species considered to be “*facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines*”.

Listed as endangered under section 19(1)(b) of the BC Act in accordance with the criteria set out in section 21 and the ministerial guidelines.

Examples of use:

- *Caladenia hopperiana* is listed as an endangered threatened species under the *Biodiversity Conservation Act 2016*.
- *Caladenia hopperiana* is listed as endangered under the *Biodiversity Conservation Act 2016*.
- Listing reference in a table: column heading: BC Act, row text: EN.

VU Vulnerable species

Threatened species considered to be “facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines”.

Listed as vulnerable under section 19(1)(c) of the BC Act in accordance with the criteria set out in section 22 and the ministerial guidelines.

Examples of use:

- The forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*) is listed as a vulnerable threatened species under the *Biodiversity Conservation Act 2016*.
- Forest red-tailed black cockatoo is listed as vulnerable under the *Biodiversity Conservation Act 2016*.
- Listing reference in a table: column heading: BC Act, row text: VU.

Extinct species

Listed by order of the Minister as extinct under section 23(1) of the BC Act as extinct or extinct in the wild.

EX Extinct species

Species where “there is no reasonable doubt that the last member of the species has died”, and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).

Examples of use:

- *Acacia kingiana* is listed as an extinct species under the *Biodiversity Conservation Act 2016*.
- *Acacia kingiana* is listed as extinct under the *Biodiversity Conservation Act 2016*.
- Listing reference in a table: column heading: BC Act, row text: EX.

EW Extinct in the wild species

Species that “is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and it has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form”, and listing is otherwise in accordance with the ministerial guidelines (section 25 of the BC Act).

Currently there are no fauna or flora species listed as extinct in the wild.

SP Specially protected species

Listed by order of the Minister as specially protected under section 13(1) of the BC Act. Meeting one or more of the following categories: species of special conservation interest; migratory species; cetaceans; species subject to international agreement; or species otherwise in need of special protection.

Species that are listed as threatened species (critically endangered, endangered, or vulnerable) or extinct species under the BC Act cannot also be listed as specially protected species.

MI Migratory species

Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act).

Migratory species include birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA)⁵, China (CAMBA)⁶ or The Republic of Korea (ROKAMBA)⁷, and fauna subject to the *Convention on the Conservation of Migratory Species of Wild Animals* (Bonn Convention)⁸, an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species.

Examples of use:

- The wedge-tailed shearwater (*Ardenna pacifica*) is listed as a specially protected migratory species under the *Biodiversity Conservation Act 2016*.
- Wedge-tailed shearwater is listed as migratory under the *Biodiversity Conservation Act 2016*.
- Listing reference in a table: column heading: BC Act, row text: MI.

CD Species of special conservation interest (conservation dependent)

Species of special conservation need that are dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act).

Currently only fauna are listed as species of special conservation interest.

Examples of use:

- The wambenger, south-western brush-tailed phascogale (*Phascogale tapoatafa wambenger*) is listed as a specially protected species of special conservation interest under the *Biodiversity Conservation Act 2016*.
- Wambenger, south-western brush-tailed phascogale, is listed as conservation dependent under the *Biodiversity Conservation Act 2016*.
- Listing reference in a table: column heading: BC Act, row text: CD.

OS Species otherwise in need of special protection (other specially protected)

Species otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).

Currently only fauna are listed as species otherwise in need of special protection.

Examples of use:

- The dugong (*Dugong dugon*) is listed as a specially protected species otherwise in need of special protection under the *Biodiversity Conservation Act 2016*.
- Dugong is listed as other specially protected fauna under the *Biodiversity Conservation Act 2016*.
- Listing reference in a table: column heading: BC Act, row text: OS.

P Priority species

Priority is not a listing category under the BC Act.

All fauna and flora are protected in WA following the provisions in Part 10 of the BC Act. The protection applies even when a species is not listed as threatened or specially protected, and regardless of land tenure (State managed land (Crown land), private land, or Commonwealth land).

Species that may possibly be threatened species that do not meet the criteria for listing under the BC Act because of insufficient survey or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of prioritisation for survey and evaluation of conservation status so that consideration can be given to potential listing as threatened.

Species that are adequately known, meet criteria for near threatened, or are rare but not threatened, or that have been recently removed from the threatened species list or conservation dependent or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of priority status is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

1 Priority 1: Poorly-known species - known from few locations, none on conservation lands

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, for example, agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation.

Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements for threatened listing and appear to be under immediate threat from known threatening processes. These species are in urgent need of further survey.

Examples of use:

- *Borya stenophylla* is listed as a Priority 1 species by the Department of Biodiversity, Conservation and Attractions.
- *Borya stenophylla* is listed as Priority 1 on the DBCA Priority Flora List.
- Listing reference in a table: column heading: DBCA, row text: P1.

2 Priority 2: Poorly-known species - known from few locations, some on conservation lands

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, for example, national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation.

Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements for threatened listing and appear to be under threat from known threatening processes. These species are in urgent need of further survey.

Examples of use:

- *Caladenia nivalis* is listed as a Priority 2 species by the Department of Biodiversity, Conservation and Attractions.
- *Caladenia nivalis* is listed as Priority 2 on the DBCA Priority Flora List.
- Listing reference in a table: column heading: DBCA, row text: P2.

3 Priority 3: Poorly-known species - known from several locations

Species that are known from several locations and the species does not appear to be under imminent threat or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat.

Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. These species need further survey.

Examples of use:

- *Acacia nitidula* is listed as a Priority 3 species by the Department of Biodiversity, Conservation and Attractions.
- *Acacia nitidula* is listed as Priority 3 on the DBCA Priority Flora List.
- Listing reference in a table: column heading: DBCA, row text: P3.

4 Priority 4: Rare, Near Threatened and other species in need of monitoring

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands.

(b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as a conservation dependent specially protected species.

(c) Species that have been removed from the list of threatened species or lists of conservation dependent or other specially protected species, during the past five years for reasons other than taxonomy.

(d) Other species in need of monitoring.

Examples of use:

- *Banksia aculeata* is listed as a Priority 4 species by the Department of Biodiversity, Conservation and Attractions.
- *Banksia aculeata* is listed as Priority 4 on the DBCA Priority Flora List.
- Listing reference in a table: column heading: DBCA, row text: P4.

¹ The definition of flora includes algae, fungi, and lichens.

² Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies or variety, or a distinct population).

³ Schedules are not referred to when stating the listing status of threatened, extinct or specially protected species under the BC Act. See the examples provided under each listing category.

⁴ Western Australia has assigned species to threat categories using the *IUCN Red List of Threatened Species Categories and Criteria* since 1996 (referencing all criteria). At the national level, threatened species listings under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) reference only some of the IUCN criteria (<http://www.environment.gov.au/biodiversity/threatened/nominations/forms-and-guidelines>).

⁵ JAMBA - first included in the WA migratory species list in 1980.

⁶ CAMBA - first included in the WA migratory species list in 2010.

⁷ ROKAMBA - first included in the WA migratory species list in 2010.

⁸ Bonn Convention (Birds) - first included in the WA migratory species list in 2015.

2. Commonwealth Environment Protection and Biodiversity Conservation Act 1999

Many of the species that are specially protected at State level are also listed as Threatened species at the Federal level, as one of the Matters of National Environmental Significance (MNES) identified under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (the EPBC Act). These may be classified as 'critically endangered', 'endangered', 'vulnerable' or 'lower risk', consistent with IUCN categories:

1. **Critically Endangered (CR):** a taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future.
2. **Endangered (EN):** a taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future.
3. **Vulnerable (VU):** a taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future.
4. **Lower Risk (LR):** a taxon is Lower Risk when it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories:
 - **Conservation Dependent (CD).** Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation program targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.
 - **Near Threatened (NT).** Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.
 - **Least Concern (LC).** Taxa which do not qualify for Conservation Dependent or Near Threatened.

In addition, numerous Migratory species are listed as MNES under the EPBC Act (some of which are also listed as Threatened). Migratory species are those animals that migrate to Australia and its external territories, or pass through or over Australian waters during their annual migrations. The list of migratory species consists of those species listed under the following international conventions:

1. Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention);
2. China-Australia Migratory Bird Agreement (CAMBA);
3. Japan-Australia Migratory Bird Agreement (JAMBA); and,
4. Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

Marine species are also protected under the EPBC Act, and are listed to ensure the long-term conservation of the species. Marine species include all Australian sea snakes, seals, crocodiles, dugongs, marine turtles, seahorses and seabirds that naturally occur in the Commonwealth marine area.

Under the terms of the EPBC Act, an action (e.g. a project or development) is required to be referred to the Australian Government Environment Minister for approval if it has, will have, or is likely to have, a significant impact on an MNES. The term 'action' includes projects and developments subsequent to commencement of the Act, however there are a number of exemptions (e.g. projects in Commonwealth areas). According to Department of the Environment (2013), a 'significant impact' is an impact which is important, notable, or of consequence, having regard to its context or intensity. Whether or not an action is likely to have a significant impact depends upon the sensitivity, value, and quality of the environment which is impacted, and upon the intensity, duration, magnitude and geographic extent of the impacts.

References:

Department of the Environment (2013). Matters of National Environmental Significance - Significant Impact Guidelines 1.1 *Environment Protection and Biodiversity Conservation Act 1999*. Department of the Environment, Canberra, Australia.

Appendix 2

Database Searches





EPBC Act Protected Matters Report

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

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

Information is available about [Environment Assessments](#) and the EPBC Act including significance guidelines, forms and application process details.

Report created: 02/12/20 14:40:44

[Summary](#)

[Details](#)

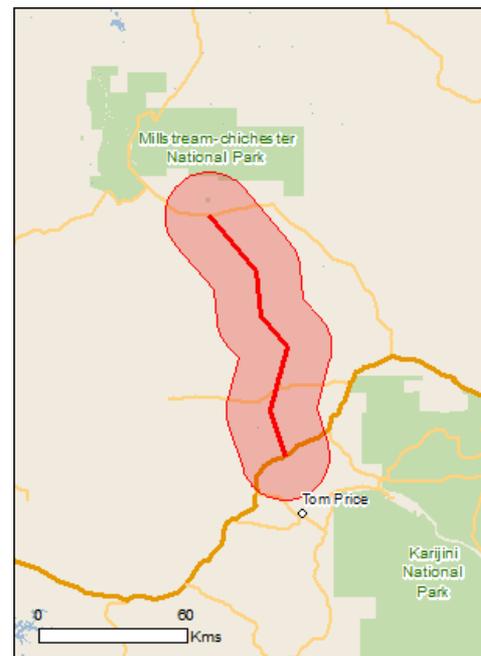
[Matters of NES](#)

[Other Matters Protected by the EPBC Act](#)

[Extra Information](#)

[Caveat](#)

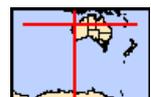
[Acknowledgements](#)



This map may contain data which are
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[Coordinates](#)

Buffer: 18.0Km



Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	10
Listed Migratory Species:	12

Other Matters Protected by the EPBC Act

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

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at <http://www.environment.gov.au/heritage>

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

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	18
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	12
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Falco hypoleucos Grey Falcon [929]	Vulnerable	Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat known to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Breeding known to occur within area
Macrotis lagotis Greater Bilby [282]	Vulnerable	Species or species habitat may occur within area
Rhinonictis aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat known to occur within area
Reptiles		
Liasis olivaceus barroni Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat known to occur within area
Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur

Name	Threatened	Type of Presence within area
Migratory Terrestrial Species		
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species		[Resource Information]
Name	Threatened	Type of Presence
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species

Name	Threatened	Type of Presence
Calidris acuminata Sharp-tailed Sandpiper [874]		habitat may occur within area Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans Black-eared Cuckoo [705]		Species or species habitat likely to occur within area
Glareola maldivarum Oriental Pratincole [840]		Species or species habitat may occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

State and Territory Reserves [\[Resource Information \]](#)

Name	State
Millstream Chichester	WA

Invasive Species [\[Resource Information \]](#)

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

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Mammals		
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area
Parkinsonia aculeata Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area

Caveat

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

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

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

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

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-21.674296 117.446276,-21.863438 117.617909,-22.017518 117.634518,-22.122148 117.731687,-22.337121 117.668409,-22.493854 117.723366

Acknowledgements

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

- [-Office of Environment and Heritage, New South Wales](#)
- [-Department of Environment and Primary Industries, Victoria](#)
- [-Department of Primary Industries, Parks, Water and Environment, Tasmania](#)
- [-Department of Environment, Water and Natural Resources, South Australia](#)
- [-Department of Land and Resource Management, Northern Territory](#)
- [-Department of Environmental and Heritage Protection, Queensland](#)
- [-Department of Parks and Wildlife, Western Australia](#)
- [-Environment and Planning Directorate, ACT](#)
- [-Birdlife Australia](#)
- [-Australian Bird and Bat Banding Scheme](#)
- [-Australian National Wildlife Collection](#)
- [-Natural history museums of Australia](#)
- [-Museum Victoria](#)
- [-Australian Museum](#)
- [-South Australian Museum](#)
- [-Queensland Museum](#)
- [-Online Zoological Collections of Australian Museums](#)
- [-Queensland Herbarium](#)
- [-National Herbarium of NSW](#)
- [-Royal Botanic Gardens and National Herbarium of Victoria](#)
- [-Tasmanian Herbarium](#)
- [-State Herbarium of South Australia](#)
- [-Northern Territory Herbarium](#)
- [-Western Australian Herbarium](#)
- [-Australian National Herbarium, Canberra](#)
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- [-Ocean Biogeographic Information System](#)
- [-Australian Government, Department of Defence Forestry Corporation, NSW](#)
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- [-Australian Tropical Herbarium, Cairns](#)
- [-eBird Australia](#)
- [-Australian Government – Australian Antarctic Data Centre](#)
- [-Museum and Art Gallery of the Northern Territory](#)
- [-Australian Government National Environmental Science Program](#)
- [-Australian Institute of Marine Science](#)
- [-Reef Life Survey Australia](#)
- [-American Museum of Natural History](#)
- [-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania](#)
- [-Tasmanian Museum and Art Gallery, Hobart, Tasmania](#)
- [-Other groups and individuals](#)

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

Please feel free to provide feedback via the [Contact Us](#) page.

NatureMap Species Report

Created By Guest user on 02/12/2020

Kingdom Plantae

Conservation Status Conservation Taxon (T, X, IA, S, P1-P5)

Current Names Only Yes

Core Datasets Only Yes

Method 'By Line'

Vertices 21° 40' 27" S, 117° 26' 47" E 21° 51' 48" S, 117° 37' 04" E 22° 01' 03" S, 117° 38' 04" E 22° 07'

Group By 20° S, 117° 43' 54" E 22° 20' 14" S, 117° 40' 06" E 22° 29' 38" S, 117° 43' 24" E

Conservation Status

Conservation Status	Species	Records
Priority 1	3	9
Priority 2	5	20
Priority 3	21	70
Priority 4	3	15
TOTAL	32	114

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
Priority 1				
1.	42861 <i>Euphorbia inappendiculata</i> var. <i>queenslandica</i>		P1	
2.	8030 <i>Helichrysum oligochaetum</i>		P1	
3.	33026 <i>Vittadinia</i> sp. <i>Coondewanna Flats</i> (S. van Leeuwen 4684)		P1	
Priority 2				
4.	42843 <i>Euphorbia australis</i> var. <i>glabra</i>		P2	
5.	20856 <i>Gompholobium karijini</i>		P2	
6.	13895 <i>Paspalidium retiglume</i>		P2	
7.	20263 <i>Scaevola</i> sp. <i>Hammersley Range basalts</i> (S. van Leeuwen 3675)		P2	
8.	19366 <i>Teucrium pilbaranum</i>		P2	
Priority 3				
9.	228 <i>Astrebula lappacea</i> (<i>Curly Mitchell Grass, Wheat Mitchell</i>)		P3	
10.	20381 <i>Dampiera anonyma</i>		P3	
11.	38505 <i>Eragrostis surreyana</i>		P3	
12.	14894 <i>Eremophila magnifica</i> subsp. <i>velutina</i>		P3	
13.	4482 <i>Geijera salicifolia</i>		P3	
14.	3940 <i>Glycine falcata</i>		P3	
15.	29381 <i>Goodenia</i> sp. <i>East Pilbara</i> (A.A. Mitchell PRP 727) (<i>O'Meara's Goodenia</i>)		P3	
16.	44441 <i>Grevillea saxicola</i>		P3	
17.	19594 <i>Iotasperma sessilifolium</i>		P3	
18.	19640 <i>Oldenlandia</i> sp. <i>Hammersley Station</i> (A.A. Mitchell PRP 1479)		P3	
19.	9232 <i>Polymeria distigma</i>		P3	
20.	31596 <i>Ptilotus subspinescens</i>		P3	
21.	20168 <i>Rhagodia</i> sp. <i>Hammersley</i> (M. Trudgen 17794)		P3	
22.	11556 <i>Rostellularia adscendens</i> var. <i>latifolia</i>		P3	
23.	16616 <i>Sida</i> sp. <i>Barlee Range</i> (S. van Leeuwen 1642)		P3	
24.	33697 <i>Sida</i> sp. <i>Hammersley Range</i> (K. Newbey 10692)		P3	
25.	41820 <i>Solanum albostellatum</i>		P3	
26.	4729 <i>Stackhousia clementii</i>		P3	
27.	42142 <i>Swainsona thompsoniana</i>		P3	
28.	17820 <i>Themeda</i> sp. <i>Hammersley Station</i> (M.E. Trudgen 11431)		P3	
29.	45769 <i>Triodia basitricha</i> (<i>Pilbara Curly Spinifex</i>)		P3	
Priority 4				
30.	14893 <i>Eremophila magnifica</i> subsp. <i>magnifica</i>		P4	
31.	7530 <i>Goodenia nuda</i>		P4	
32.	20862 <i>Rhynchosia bungarensis</i>		P4	

Conservation Codes

T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
S	Other specially protected fauna			
1	Priority 1			
2	Priority 2			
3	Priority 3			
4	Priority 4			
5	Priority 5			

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

NatureMap Species Report

Created By Jacinta King on 27/03/2020

Kingdom Animalia
Current Names Only Yes
Core Datasets Only Yes
Method 'By Line'
Vertices 21° 40' 27" S, 117° 26' 47" E 21° 51' 48" S, 117° 37' 04" E 22° 01' 03" S, 117° 38' 04" E 22° 07'
Group By 20° S, 117° 43' 54" E 22° 20' 14" S, 117° 40' 06" E 22° 29' 38" S, 117° 43' 24" E
 Species Group

Species Group	Species	Records
Amphibian	5	12270
Bird	127	2127
Fish	4	53
Invertebrate	240	845
Mammal	37	1333
Reptile	117	6375
TOTAL	530	23003

Name ID	Species Name	Naturalised	Conservation Code	Endemic To Query Area
Amphibian				
1.	25375 <i>Cyclorana maini</i> (Sheep Frog)			
2.	25392 <i>Litoria rubella</i> (Little Red Tree Frog)			
3.	25432 <i>Pseudophryne douglasi</i> (Gorge Toadlet)			
4.	25445 <i>Uperoleia russelli</i> (Northwest Toadlet)			
5.	41428 <i>Uperoleia saxatilis</i> (Pilbara Toadlet)			
Bird				
6.	24559 <i>Acanthagenys rufogularis</i> (Spiny-cheeked Honeyeater)			
7.	24260 <i>Acanthiza apicalis</i> (Broad-tailed Thornbill, Inland Thornbill)			
8.	24261 <i>Acanthiza chrysorrhoa</i> (Yellow-rumped Thornbill)			
9.	24264 <i>Acanthiza robustirostris</i> (Slaty-backed Thornbill)			
10.	24265 <i>Acanthiza uropygialis</i> (Chestnut-rumped Thornbill)			
11.	25535 <i>Accipiter cirrocephalus</i> (Collared Sparrowhawk)			
12.	25536 <i>Accipiter fasciatus</i> (Brown Goshawk)			
13.	24282 <i>Accipiter fasciatus</i> subsp. <i>fasciatus</i> (Brown Goshawk)			
14.	25755 <i>Acrocephalus australis</i> (Australian Reed Warbler)			
15.	25544 <i>Aegotheles cristatus</i> (Australian Owllet-nightjar)			
16.	25647 <i>Amytornis striatus</i> (Striated Grasswren)			
17.	24312 <i>Anas gracilis</i> (Grey Teal)			
18.	24316 <i>Anas superciliosa</i> (Pacific Black Duck)			
19.	25670 <i>Anthus australis</i> (Australian Pipit)			
20.	25554 <i>Apus pacificus</i> (Fork-tailed Swift, Pacific Swift)		IA	
21.	24285 <i>Aquila audax</i> (Wedge-tailed Eagle)			
22.	41324 <i>Ardea modesta</i> (great egret, white egret)			
23.	24340 <i>Ardea novaehollandiae</i> (White-faced Heron)			
24.	24341 <i>Ardea pacifica</i> (White-necked Heron)			
25.	24610 <i>Ardeotis australis</i> (Australian Bustard)			
26.	25566 <i>Artamus cinereus</i> (Black-faced Woodswallow)			
27.	24355 <i>Artamus minor</i> (Little Woodswallow)			
28.	24356 <i>Artamus personatus</i> (Masked Woodswallow)			
29.	24357 <i>Artamus superciliosus</i> (White-browed Woodswallow)			
30.	<i>Barnardius zonarius</i>			
31.	24359 <i>Burhinus grallarius</i> (Bush Stone-curler)			
32.	25715 <i>Cacatua roseicapilla</i> (Galah)			
33.	25716 <i>Cacatua sanguinea</i> (Little Corella)			
34.	42307 <i>Cacomantis pallidus</i> (Pallid Cuckoo)			
35.	25600 <i>Centropus phasianinus</i> (Pheasant Coucal)			
36.	24564 <i>Certhionyx variegatus</i> (Pied Honeyeater)			
37.	24378 <i>Charadrius veredus</i> (Oriental Plover)		IA	
38.	24321 <i>Chenonetta jubata</i> (Australian Wood Duck, Wood Duck)			
39.	24431 <i>Chrysococcyx basalis</i> (Horsfield's Bronze Cuckoo)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
40.	24434 <i>Chrysococcyx osculans</i> (Black-eared Cuckoo)			
41.	24289 <i>Circus assimilis</i> (Spotted Harrier)			
42.	25675 <i>Colluricincla harmonica</i> (Grey Shrike-thrush)			
43.	24361 <i>Coracina maxima</i> (Ground Cuckoo-shrike)			
44.	25568 <i>Coracina novaehollandiae</i> (Black-faced Cuckoo-shrike)			
45.	24363 <i>Coracina novaehollandiae</i> subsp. <i>subpallida</i> (Black-faced Cuckoo-shrike)			
46.	24416 <i>Corvus bennetti</i> (Little Crow)			
47.	25593 <i>Corvus orru</i> (Torresian Crow)			
48.	24671 <i>Coturnix pectoralis</i> (Stubble Quail)			
49.	25701 <i>Coturnix ypsilophora</i> (Brown Quail)			
50.	24420 <i>Cracticus nigrogularis</i> (Pied Butcherbird)			
51.	25595 <i>Cracticus tibicen</i> (Australian Magpie)			
52.	25596 <i>Cracticus torquatus</i> (Grey Butcherbird)			
53.	25547 <i>Dacelo leachii</i> (Blue-winged Kookaburra)			
54.	25673 <i>Daphoenositta chrysoptera</i> (Varied Sittella)			
55.	24325 <i>Dendrocygna eytoni</i> (Plumed Whistling Duck)			
56.	25607 <i>Dicaeum hirundinaceum</i> (Mistletoebird)			
57.	24470 <i>Dromaius novaehollandiae</i> (Emu)			
58.	<i>Egretta novaehollandiae</i>			
59.	<i>Elanus axillaris</i>			
60.	25540 <i>Elanus caeruleus</i> (Black-shouldered Kite)			
61.	24631 <i>Emblema pictum</i> (Painted Finch)			
62.	24570 <i>Epthianura tricolor</i> (Crimson Chat)			
63.	24837 <i>Eremiornis carteri</i> (Spinifex-bird)			
64.	24368 <i>Eurostopodus argus</i> (Spotted Nightjar)			
65.	25621 <i>Falco berigora</i> (Brown Falcon)			
66.	25622 <i>Falco cenchroides</i> (Australian Kestrel, Nankeen Kestrel)			
67.	24473 <i>Falco hypoleucos</i> (Grey Falcon)			T
68.	25623 <i>Falco longipennis</i> (Australian Hobby)			
69.	24474 <i>Falco longipennis</i> subsp. <i>longipennis</i> (Australian Hobby)			
70.	25624 <i>Falco peregrinus</i> (Peregrine Falcon)			S
71.	24475 <i>Falco peregrinus</i> subsp. <i>macropus</i> (Australian Peregrine Falcon)			S
72.	25730 <i>Gallirallus philippensis</i> (Buff-banded Rail)			
73.	42314 <i>Gavialis virescens</i> (Singing Honeyeater)			
74.	24401 <i>Geopelia cuneata</i> (Diamond Dove)			
75.	25585 <i>Geopelia striata</i> (Zebra Dove)			
76.	24404 <i>Geophaps plumifera</i> (Spinifex Pigeon)			
77.	25530 <i>Gerygone fusca</i> (Western Gerygone)			
78.	24271 <i>Gerygone fusca</i> subsp. <i>fusca</i> (Western Gerygone)			
79.	47959 <i>Gerygone fusca</i> subsp. <i>mungi</i> (Desert Gerygone)			
80.	24443 <i>Grallina cyanoleuca</i> (Magpie-lark)			
81.	24295 <i>Haliastur sphenurus</i> (Whistling Kite)			
82.	24296 <i>Hamirostra isura</i> (Square-tailed Kite)			
83.	24297 <i>Hamirostra melanosternon</i> (Black-breasted Buzzard)			
84.	25734 <i>Himantopus himantopus</i> (Black-winged Stilt)			
85.	24491 <i>Hirundo neoxena</i> (Welcome Swallow)			
86.	24572 <i>Lacustroica whitei</i> (Grey Honeyeater)			
87.	24367 <i>Lalage tricolor</i> (White-winged Triller)			
88.	25661 <i>Lichmera indistincta</i> (Brown Honeyeater)			
89.	25651 <i>Malurus lamberti</i> (Variegated Fairy-wren)			
90.	25652 <i>Malurus leucopterus</i> (White-winged Fairy-wren)			
91.	24583 <i>Manorina flavigula</i> (Yellow-throated Miner)			
92.	47997 <i>Melanodryas cucullata</i> (Hooded Robin)			
93.	25665 <i>Melithreptus gularis</i> (Black-chinned Honeyeater)			
94.	24736 <i>Melopsittacus undulatus</i> (Budgerigar)			
95.	24598 <i>Merops ornatus</i> (Rainbow Bee-eater)			
96.	<i>Microcarbo melanoleucos</i>			
97.	25545 <i>Mirafra javanica</i> (Horsfield's Bushlark, Singing Bushlark)			
98.	24302 <i>Mirafra javanica</i> subsp. <i>horsfieldii</i> (Horsfield's Bushlark, Singing Bushlark)			
99.	25685 <i>Neochmia ruficauda</i> (Star Finch)			
100.	24737 <i>Neophema bourkii</i> (Bourke's Parrot)			
101.	<i>Neopsephotus bourkii</i>			
102.	25564 <i>Nycticorax caledonicus</i> (Rufous Night Heron)			
103.	24742 <i>Nymphicus hollandicus</i> (Cockatiel)			
104.	24407 <i>Ocyphaps lophotes</i> (Crested Pigeon)			
105.	24618 <i>Oreoica gutturalis</i> (Crested Bellbird)			
106.	25680 <i>Pachycephala rufiventris</i> (Rufous Whistler)			
107.	24624 <i>Pachycephala rufiventris</i> subsp. <i>rufiventris</i> (Rufous Whistler)			
108.	24627 <i>Pardalotus rubricatus</i> (Red-browed Pardalote)			
109.	25682 <i>Pardalotus striatus</i> (Striated Pardalote)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
110.	24648 <i>Pelecanus conspicillatus</i> (Australian Pelican)			
111.	48060 <i>Petrochelidon ariel</i> (Fairy Martin)			
112.	48061 <i>Petrochelidon nigricans</i> (Tree Martin)			
113.	24659 <i>Petroica goodenovii</i> (Red-capped Robin)			
114.	25699 <i>Phalacrocorax varius</i> (Pied Cormorant)			
115.	24409 <i>Phaps chalcoptera</i> (Common Bronzewing)			
116.	25721 <i>Platycercus zonarius</i> (Australian Ringneck, Ring-necked Parrot)			
117.	25703 <i>Podargus strigoides</i> (Tawny Frogmouth)			
118.	25706 <i>Pomatostomus temporalis</i> (Grey-crowned Babbler)			
119.	24769 <i>Porzana fluminea</i> (Australian Spotted Crane)			
120.	24771 <i>Porzana tabuensis</i> (Spotless Crane)			
121.	<i>Ptilonorhynchus guttatus</i>			
122.	24757 <i>Ptilonorhynchus maculatus</i> subsp. <i>guttatus</i> (Western Bowerbird)			
123.	42323 <i>Ptilotula keartlandi</i> (Grey-headed Honeyeater)			
124.	25614 <i>Rhipidura leucophrys</i> (Willie Wagtail)			
125.	30948 <i>Smicromis brevirostris</i> (Weebill)			
126.	25656 <i>Stipiturus ruficeps</i> (Rufous-crowned Emu-wren)			
127.	30870 <i>Taeniopygia guttata</i> (Zebra Finch)			
128.	24845 <i>Threskiornis spinicollis</i> (Straw-necked Ibis)			
129.	42351 <i>Todiramphus pyrrhopygius</i> (Red-backed Kingfisher)			
130.	25549 <i>Todiramphus sanctus</i> (Sacred Kingfisher)			
131.	24851 <i>Turnix velox</i> (Little Button-quail)			
132.	24386 <i>Vanellus tricolor</i> (Banded Lapwing)			

Fish

133.	<i>Amniataba percoides</i>			
134.	<i>Leiopotherapon unicolor</i>			
135.	<i>Melanotaenia australis</i>			
136.	<i>Nematalosa</i> sp.			

Invertebrate

137.	<i>Acariformes</i> sp.			
138.	<i>Aeolosoma</i> sp. 1 (PSS)			
139.	<i>Aeshnidae</i> sp.			
140.	<i>Allodessus bistrigatus</i>			
141.	<i>Aname marae</i>			
142.	<i>Aname mellosa</i>			
143.	<i>Anax papuensis</i>			
144.	<i>Ancylidae</i> sp.			
145.	<i>Anisops canaliculatus</i>			
146.	<i>Anisops gratus</i>			
147.	<i>Anisops hackeri</i>			
148.	<i>Anisops stali</i>			
149.	<i>Anopheles annulipes</i> s.l.			
150.	<i>Antichiropus</i> sp.			
151.	<i>Aphodius lividus</i>			
152.	<i>Areacandona</i> 'korallion' (PSS)			
153.	<i>Areacandona</i> 'weelumurrae' (PSS)			Y
154.	<i>Areacandona</i> sp.			
155.	<i>Argiope protensa</i>			
156.	<i>Atyidae</i> sp.			
157.	<i>Austropeplea lessoni</i>			
158.	<i>Austrostrophus stictopygus</i>			
159.	<i>Axonopsella</i> sp. P2 (PSW)			
160.	<i>Baetidae</i> sp.			
161.	<i>Bathynella</i> sp.			
162.	<i>Belostomatidae</i> sp.			
163.	<i>Bennelongia australis</i> OrdX (PSW)			
164.	<i>Bennelongia barangaroo</i> lineage			
165.	<i>Bennelongia nimala</i>			
166.	<i>Berosus dallasae</i>			
167.	<i>Berosus pulchellus</i>			
168.	<i>Berosus</i> sp.			
169.	<i>Bidessodes denticulatus</i>			
170.	<i>Boeckella triarticulata</i>			
171.	<i>Bolboleaus trifoveicollis</i>			
172.	<i>Bolboleaus truncatus</i>			
173.	<i>Brachionus bidentatus</i>			
174.	<i>Brachionus quadridentatus</i>			
175.	<i>Buddelundia</i> sp.			
176.	<i>Caenidae</i> sp.			

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177.	<i>Calamoecia tasmanica subattenuata</i>			
178.	<i>Calanoida sp.</i>			
179.	<i>Calosoma schayeri</i>			
180.	<i>Canthocamptidae sp.</i>			
181.	<i>Carenum pulchrum</i>			
182.	<i>Carenum venustum</i>			
183.	<i>Catadromus lacordairei</i>			
184.	<i>Ceratopogonidae sp.</i>			
185.	<i>Ceryerda cursitans</i>			
186.	<i>Chaoboridae sp.</i>			
187.	<i>Cherax quadricarinatus</i>			
188.	<i>Chironomidae sp.</i>			
189.	<i>Chironominae sp.</i>			
190.	<i>Chlaenius australis</i>			
191.	<i>Chydaekata sp.</i>			
192.	<i>Coelopynia pruinosa</i>			
193.	<i>Coenagrionidae sp.</i>			
194.	<i>Conchostraca (unident.)</i>			
195.	<i>Copelatus irregularis</i>			
196.	<i>Corduliidae sp.</i>			
197.	<i>Corixidae sp.</i>			
198.	<i>Cryptochironomus griseidorsum</i>			
199.	<i>Culicidae sp.</i>			
200.	<i>Cybister tripunctatus</i>			
201.	<i>Cyprætta seurati</i>			
202.	<i>Cyprætta sp PSW074</i>			
203.	<i>Dasyheleinae sp. P1 (PSW)</i>			
204.	<i>Dero furcata</i>			
205.	<i>Diacyclops cockingi</i>			
206.	<i>Diacyclops humphreysi humphreysi</i>			
207.	<i>Diacyclops scanloni</i>			
208.	<i>Diacyclops sobeprolatus</i>			
209.	<i>Diaphanosoma excisum</i>			
210.	<i>Diaphanosoma unguiculatum</i>			
211.	<i>Dicrotendipes jobetus</i>			
212.	<i>Dineutus australis</i>			
213.	<i>Diplacodes bipunctata</i>			
214.	<i>Diplacodes haematodes</i>			
215.	<i>Dytiscidae sp.</i>			
216.	<i>Ecnomidae sp.</i>			
217.	<i>Ecnomus pilbarensis</i>			
218.	<i>Encentridophorus sarasini</i>			
219.	<i>Enchytraeidae sp.</i>			
220.	<i>Enochrus deserticola</i>			
221.	<i>Eodiaptomus lumholtzi</i>			
222.	<i>Epistylis sp</i>			
223.	<i>Epithemia smithii Carruthers</i>			
224.	<i>Eunotia bilunaris (Ehr.) Mills.</i>			
225.	<i>Fittkauiomyia disparipes</i>			
226.	<i>Fragilaria ulna (Nitz.) Lange Bertalot</i>			
227.	<i>Gastropoda marine sp. RCM1</i>			
228.	<i>Geoscaptus laevissimus</i>			
229.	<i>Gerridae sp.</i>			
230.	<i>Gigadema bostocki</i>			
231.	<i>Glacidorbis sp.</i>			
232.	<i>Gomphidae sp.</i>			
233.	<i>Gomphodella sp. 6 (PSS)</i>			
234.	<i>Gyrinidae sp.</i>			
235.	<i>Haliplidae sp.</i>			
236.	<i>Haliplus halsei</i>			
237.	<i>Harpacticoida sp</i>			
238.	<i>Hemicordulia koomina</i>			
239.	<i>Hemicordulia tau</i>			
240.	<i>Heteroceridae sp.</i>			
241.	<i>Hexarthra mira</i>			
242.	<i>Hoggicosa bicolor</i>			
243.	<i>Humphreyscandona 'janeae' (PSS)</i>			Y
244.	<i>Hydaticus consanguineus</i>			
245.	<i>Hydra sp.</i>			
246.	<i>Hydraena barbipes</i>			

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247.	<i>Hydraenidae</i> sp.			
248.	<i>Hydrodroma</i> sp.			
249.	<i>Hydroglyphus grammopterus</i> (=trilineatus)			
250.	<i>Hydroglyphus leai</i>			
251.	<i>Hydroglyphus orthogrammus</i>			
252.	<i>Hydrometra strigosa</i>			
253.	<i>Hydrophilidae</i> sp.			
254.	<i>Hydroptilidae</i> sp.			
255.	<i>Hyphydrus elegans</i>			
256.	<i>Hyphydrus lyratus</i>			
257.	<i>Ilyocypris australiensis</i>			
258.	<i>Ilyodromus</i> sp. PB			
259.	<i>Indolpium</i> sp.			
260.	<i>Ischnura aurora aurora</i>			
261.	<i>Isidorella egraria</i>			
262.	<i>Isocypris williamsi</i> (ex <i>Ilyodromus</i> sp. 413)			
263.	<i>Isostictidae</i> sp.			
264.	<i>Keratella slacki</i>			
265.	<i>Kiefferulus intertinctus</i>			
266.	<i>Laccophilus sharpi</i>			
267.	<i>Laccotrephes tristis</i>			
268.	<i>Lamponata daviesae</i>			
269.	<i>Lamponina scutata</i>			
270.	<i>Larsia albiceps</i>			
271.	<i>Leptoceridae</i> sp.			
272.	<i>Libellulidae</i> sp.			
273.	<i>Limnebius</i> sp.			
274.	<i>Limnesia</i> sp. 4 (PSW)			
275.	<i>Limnesia</i> sp. 7 (PSW)			
276.	<i>Limnocythere stationis</i>			
277.	<i>Lychas</i> sp. 1			
278.	<i>Lychas</i> sp. 2			
279.	<i>Lycidas</i> sp. 1			
280.	<i>Lycidas</i> sp. 2			
281.	<i>Macrothrix indistincta</i>			
282.	<i>Masasteron sampeyae</i>			
283.	<i>Meedo houstoni</i>			
284.	<i>Melitidae</i> sp.			
285.	<i>Mesocyclops brooksi</i>			
286.	<i>Mesovelgia vittigera</i>			
287.	<i>Microcyclops varicans</i>			
288.	<i>Micronecta robusta</i>			
289.	<i>Microvelia</i> (<i>Austromicrovelia</i>) <i>peramoena</i>			
290.	<i>Monohelea</i> sp. P2 (PSW)			
291.	<i>Muscidae</i> sp.			
292.	<i>Necterosoma regulare</i>			
293.	<i>Necterosoma wollastoni</i>			
294.	<i>Nedsia</i> sp.			
295.	<i>Nedsia</i> sp. 5 (PSS)			
296.	<i>Nedsia</i> sp. 6 (PSS)			Y
297.	<i>Nematoda</i> sp.			
298.	<i>Nematoda</i> sp. P2/P4 (PSW)			
299.	<i>Neohydrocoptus subfasciatus</i>			
300.	<i>Nepidae</i> sp.			
301.	<i>Nilobezzia</i> sp. P2 (PSW)			
302.	<i>Nitzschia vitrea</i> (cf) Norman			Y
303.	No invertebrates			
304.	<i>Notobathynella</i> sp.			
305.	<i>Notonectidae</i> sp.			
306.	<i>Oecetis</i> sp. Pilbara 4 (PSW)			
307.	<i>Oecetis</i> sp. Pilbara 5 (PSW)			
308.	<i>Oecobius putus</i>			
309.	<i>Oligochaeta</i> sp.			
310.	<i>Onthophagus consentaneus</i>			
311.	<i>Onthophagus margaretensis</i>			
312.	<i>Onthophagus mjobergi</i>			
313.	<i>Onthophagus neboissi</i>			
314.	<i>Onthophagus pugnacior</i>			
315.	<i>Onthophagus villosus</i>			
316.	<i>Orthertrum caledonicum</i>			

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317.	<i>Orthocladinae</i> sp.			
318.	<i>Ostracoda</i> (unident.)			
319.	<i>Ozestheria packardi</i>			
320.	<i>Paracymus spenceri</i>			
321.	<i>Paramelitidae</i> sp.			
322.	<i>Paramelitidae</i> sp. 2 (PSS)			
323.	<i>Paramerina</i> sp. D (PSW)			
324.	<i>Parastenocaris jane</i>			
325.	<i>Pezidae</i> sp.			
326.	<i>Phreodrilid</i> with dissimilar ventral chaetae			
327.	<i>Pilbarascutigera incola</i>			
328.	<i>Pilbarophreatoicus platyarthuricus</i>			
329.	<i>Pilbarus milsi</i>			
330.	<i>Pilbarus</i> sp.			
331.	<i>Pinnularia</i> nov sp.			Y
332.	<i>Piona cumberlandensis</i>			
333.	<i>Planorbidae</i> sp.			
334.	<i>Platycoelus melliei</i>			
335.	<i>Pleidae</i> sp.			
336.	<i>Polycentropodidae</i> sp.			
337.	<i>Polypedilum nubifer</i>			
338.	<i>Polypedilum watsoni</i>			
339.	<i>Procladius paludicola</i>			
340.	<i>Prodidomus woodleigh</i>			
341.	<i>Pygolabis</i> sp.			
342.	<i>Pygolabis weeliwolli</i>			
343.	<i>Pyralidae</i> sp.			
344.	<i>Ranatra diminuta</i>			
345.	<i>Regimbartia attenuata</i>			
346.	<i>Rhantaticus congestus</i>			
347.	<i>Schizopera</i> sp. 5 (PSS)			Y
348.	<i>Scolopendra morsitans</i>			
349.	<i>Scopodes rugatus</i>			
350.	<i>Simuliidae</i> sp.			
351.	<i>Spinasteron woodstock</i>			
352.	<i>Spongillidae</i> sp.			
353.	<i>Staphylinidae</i> sp.			
354.	<i>Sternopriscus multimaculatus</i>			
355.	<i>Sternopriscus</i> sp.			
356.	<i>Synsphyronus gracilis</i>			
357.	<i>Tanypodinae</i> sp.			
358.	<i>Tanytarsus</i> sp. P12 (PSW)			
359.	<i>Tasmanocoenis arcuata</i>			
360.	<i>Teinogenys aurilegulus</i>			
361.	<i>Temnocephalidea</i> sp.			
362.	<i>Testudinella patina</i>			
363.	<i>Thermocyclops decipiens</i>			
364.	<i>Tiporus lachlani</i>			
365.	<i>Tiporus tambreyi</i>			
366.	<i>Trachyspina capensis</i>			
367.	<i>Trichocerca similis</i>			
368.	<i>Triplectides australis</i>			
369.	<i>Tubificidae stygo morphotype 2</i> (PSS)			
370.	<i>Tubificidae stygo type 1</i> (imm <i>Ainudrilus</i> WA25/26?) (PSS)			
371.	<i>Turbellaria</i> sp.			
372.	<i>Tyrannochthonius aridus</i>			
373.	<i>Veliidae</i> sp.			
374.	<i>Wydundra kennedy</i>			
375.	<i>Xenochironomus</i> sp P1 (PSW)			
376.	<i>Zenodorus orbiculatus</i>			

Mammal

377.	24251	<i>Bos taurus</i> (European Cattle)	Y	
378.	24181	<i>Chaerephon jobensis</i> (Greater Northern Freetail-bat, Northern Mastiff Bat)		
379.	24186	<i>Chalinolobus gouldii</i> (Gould's Wattled Bat)		
380.	24091	<i>Dasykaluta rosamondae</i> (Little Red Kaluta)		
381.	24093	<i>Dasyurus hallucatus</i> (Northern Quoll)		T
382.	24041	<i>Felis catus</i> (Cat)	Y	
383.	24122	<i>Lagorchestes conspicillatus</i> subsp. <i>leichardti</i> (Spectacled Hare-wallaby (mainland))		P4
384.	24217	<i>Leggadina lakedownensis</i> (Northern Short-tailed Mouse, Lakeland Downs Mouse, Kerakenga)		P4

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385.	24180 <i>Macroderma gigas</i> (Ghost Bat)		T	
386.	25489 <i>Macropus robustus</i> (Euro, Biggada)			
387.	24135 <i>Macropus robustus</i> subsp. <i>erubescens</i> (Euro, Biggada)			
388.	24136 <i>Macropus rufus</i> (Red Kangaroo, Marlu)			
389.	24168 <i>Macrotis lagotis</i> (Bilby, Dalgyte, Ninu)		T	
390.	24223 <i>Mus musculus</i> (House Mouse)	Y		
391.	24095 <i>Ningau timealeyi</i> (Pilbara Ningau)			
392.	24194 <i>Nyctophilus geoffroyi</i> (Lesser Long-eared Bat)			
393.	48034 <i>Osphranter robustus</i> (Euro, Biggada)			
394.	24144 <i>Petrogale rothschildi</i> (Rothschild's Rock-wallaby)			
395.	24101 <i>Planigale ingrami</i> (Long-tailed Planigale)			
396.	24102 <i>Planigale maculata</i> (Common Planigale)			
397.	24106 <i>Pseudantechinus woolleyae</i> (Woolley's Pseudantechinus)			
398.	24233 <i>Pseudomys chapmani</i> (Western Pebble-mound Mouse, Ngadji)		P4	
399.	24234 <i>Pseudomys delicatulus</i> (Delicate Mouse)			
400.	24235 <i>Pseudomys desertor</i> (Desert Mouse)			
401.	24237 <i>Pseudomys hermannsburgensis</i> (Sandy Inland Mouse)			
402.	24172 <i>Pteropus alecto</i> (Black Flying-fox)			
403.	43368 <i>Rhinonicteris aurantia</i> (Orange Leaf-nosed bat)		P4	
404.	24174 <i>Saccolaimus flaviventris</i> (Yellow-bellied Sheath-tailed Bat)			
405.	24200 <i>Scotorepens greyii</i> (Little Broad-nosed Bat)			
406.	24115 <i>Sminthopsis longicaudata</i> (Long-tailed Dunnart)		P4	
407.	24116 <i>Sminthopsis macroura</i> (Stripe-faced Dunnart)			
408.	24207 <i>Tachyglossus aculeatus</i> (Short-beaked Echidna)			
409.	24175 <i>Taphozous georgianus</i> (Common Sheath-tailed Bat)			
410.	24176 <i>Taphozous hilli</i> (Hill's Sheath-tail-bat)			
411.	24157 <i>Trichosurus vulpecula</i> subsp. <i>arnhemensis</i> (northern brushtail possum (Kimberley))		T	
412.	24205 <i>Vespadelus finlaysoni</i> (Finlayson's Cave Bat)			
413.	24248 <i>Zyzomys argurus</i> (Common Rock-rat)			

Reptile

414.	25243 <i>Acanthophis pyrrhus</i> (Desert Death Adder)			
415.	25332 <i>Acanthophis wellsi</i> (Pilbara Death Adder)			
416.	30833 <i>Amphibolurus longirostris</i> (Long-nosed Dragon)			
417.	25318 <i>Antaresia perthensis</i> (Pygmy Python)			
418.	25448 <i>Antaresia stimsoni</i> (Stimson's Python)			
419.	25241 <i>Antaresia stimsoni</i> subsp. <i>stimsoni</i> (Stimson's Python)			
420.	25320 <i>Aspidites melanocephalus</i> (Black-headed Python)			
421.	25331 <i>Brachyurophis approximans</i> (North-western Shovel-nosed Snake)			
422.	25015 <i>Carlia munda</i> (Shaded-litter Rainbow Skink)			
423.	25017 <i>Carlia triacantha</i> (Desert Rainbow Skink)			
424.	25339 <i>Chelodina steindachneri</i> (Flat-shelled Turtle)			
425.	25456 <i>Crenadactylus ocellatus</i> (Clawless Gecko)			
426.	30893 <i>Cryptoblepharus buchananii</i>			
427.	25020 <i>Cryptoblepharus plagiocephalus</i>			
428.	30892 <i>Cryptoblepharus ustulatus</i>			
429.	25458 <i>Ctenophorus caudicinctus</i> (Ring-tailed Dragon)			
430.	24865 <i>Ctenophorus caudicinctus</i> subsp. <i>caudicinctus</i> (Ring-tailed Dragon)			
431.	25459 <i>Ctenophorus isolepis</i> (Crested Dragon, Military Dragon)			
432.	24876 <i>Ctenophorus isolepis</i> subsp. <i>isolepis</i> (Crested Dragon, Military Dragon)			
433.	24886 <i>Ctenophorus reticulatus</i> (Western Netted Dragon)			
434.	25036 <i>Ctenotus duricola</i>			
435.	25462 <i>Ctenotus grandis</i>			
436.	25041 <i>Ctenotus grandis</i> subsp. <i>grandis</i>			
437.	25043 <i>Ctenotus grandis</i> subsp. <i>titan</i>			
438.	25044 <i>Ctenotus hanloni</i>			
439.	25045 <i>Ctenotus helenae</i>			
440.	25052 <i>Ctenotus leonhardii</i>			
441.	25463 <i>Ctenotus pantherinus</i> (Leopard Ctenotus)			
442.	25064 <i>Ctenotus pantherinus</i> subsp. <i>ocellifer</i> (Leopard Ctenotus)			
443.	25070 <i>Ctenotus robustus</i>			
444.	25072 <i>Ctenotus rubicundus</i>			
445.	25071 <i>Ctenotus rutilans</i>			
446.	25073 <i>Ctenotus saxatilis</i> (Rock Ctenotus)			
447.	25074 <i>Ctenotus schomburgkii</i>			
448.	25077 <i>Ctenotus serventyi</i>			
449.	25075 <i>Ctenotus severus</i>			
450.	<i>Ctenotus superciliaris</i>			
451.	25088 <i>Cyclodomorphus maximus</i> (Giant Slender Blue-tongue)			
452.	25466 <i>Cyclodomorphus melanops</i> (Slender Blue-tongue)			
453.	25090 <i>Cyclodomorphus melanops</i> subsp. <i>melanops</i> (Slender Blue-tongue)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
454.	24997 <i>Delma butleri</i>			
455.	24998 <i>Delma elegans</i>			
456.	25001 <i>Delma nasuta</i>			
457.	25002 <i>Delma pax</i>			
458.	25004 <i>Delma tincta</i>			
459.	25468 <i>Demansia psammophis</i> (Yellow-faced Whipsnake)			
460.	25295 <i>Demansia psammophis</i> subsp. <i>cupreiceps</i> (Yellow-faced Whipsnake)			
461.	25247 <i>Demansia psammophis</i> subsp. <i>psammophis</i> (Yellow-faced Whipsnake)			
462.	25297 <i>Demansia rufescens</i> (Rufous Whipsnake)			
463.	24926 <i>Diplodactylus conspicillatus</i> (Fat-tailed Gecko)			
464.	41404 <i>Diplodactylus galaxias</i> (Northern Pilbara Beak-faced Gecko)			
465.	24937 <i>Diplodactylus mitchelli</i>			
466.	24944 <i>Diplodactylus savagei</i> (Southern Pilbara Beak-faced Gecko)			
467.	24899 <i>Diporiphora valens</i> (Southern Pilbara Tree Dragon)			
468.	41406 <i>Egernia cygnitis</i> (Western Pilbara Spiny-tailed Skink)			
469.	25094 <i>Egernia formosa</i>			
470.	25109 <i>Eremiascincus richardsonii</i> (Broad-banded Sand Swimmer)			
471.	25301 <i>Furina ornata</i> (Moon Snake)			
472.	24956 <i>Gehyra pilbara</i>			
473.	24958 <i>Gehyra punctata</i>			
474.	24959 <i>Gehyra variegata</i>			
475.	24961 <i>Heteronotia binoei</i> (Bynoe's Gecko)			
476.	24962 <i>Heteronotia spelea</i> (Desert Cave Gecko, Pilbara Cave Gecko)			
477.	30929 <i>Lerista jacksoni</i>			
478.	25155 <i>Lerista muelleri</i>			
479.	42411 <i>Lerista timida</i>			
480.	25183 <i>Lerista zietzi</i>			
481.	25005 <i>Lialis burtonis</i>			
482.	25486 <i>Liasis olivaceus</i> (Olive Python)			
483.	25238 <i>Liasis olivaceus</i> subsp. <i>barroni</i> (Pilbara Olive Python)		T	
484.	30933 <i>Lucasium stenodactylum</i>			
485.	30934 <i>Lucasium wombeyi</i>			
486.	25184 <i>Menetia greyii</i>			
487.	25491 <i>Menetia surda</i>			
488.	25187 <i>Menetia surda</i> subsp. <i>surda</i>			
489.	25495 <i>Morethia ruficauda</i>			
490.	25193 <i>Morethia ruficauda</i> subsp. <i>exquisita</i>			
491.	25498 <i>Nephruus wheeleri</i>			
492.	24972 <i>Nephruus wheeleri</i> subsp. <i>cinctus</i>			
493.	25196 <i>Notoscincus butleri</i> (lined soil-crevice skink (Dampier))		P4	
494.	25499 <i>Notoscincus ornatus</i>			
495.	24976 <i>Oedura marmorata</i> (Marbled Velvet Gecko)			
496.	25254 <i>Parasuta monachus</i>			
497.	25255 <i>Parasuta nigriceps</i>			
498.	25510 <i>Pogona minor</i> (Dwarf Bearded Dragon)			
499.	24907 <i>Pogona minor</i> subsp. <i>minor</i> (Dwarf Bearded Dragon)			
500.	24908 <i>Pogona minor</i> subsp. <i>mitchelli</i> (Dwarf Bearded Dragon)			
501.	25199 <i>Proablepharus reginae</i>			
502.	25261 <i>Pseudechis australis</i> (Mulga Snake)			
503.	42416 <i>Pseudonaja mengdeni</i> (Western Brown Snake)			
504.	25263 <i>Pseudonaja modesta</i> (Ringed Brown Snake)			
505.	25264 <i>Pseudonaja nuchalis</i> (Gwardar, Northern Brown Snake)			
506.	25009 <i>Pygopus nigriceps</i>			
507.	24982 <i>Rhynchoedura ornata</i> (Western Beaked Gecko)			
508.	24927 <i>Strophurus elderi</i>			
509.	24946 <i>Strophurus strophurus</i>			
510.	24949 <i>Strophurus wellingtonae</i>			
511.	25269 <i>Suta fasciata</i> (Rosen's Snake)			
512.	25307 <i>Suta punctata</i> (Spotted Snake)			
513.	25202 <i>Tiliqua multifasciata</i> (Central Blue-tongue)			
514.	25203 <i>Tiliqua occipitalis</i> (Western Bluetongue)			
515.	30814 <i>Tympanocryptis cephalus</i> (Pebble Dragon)			
516.	24983 <i>Underwoodisaurus milii</i> (Barking Gecko)			
517.	41426 <i>Underwoodisaurus seorsus</i> (Pilbara Barking Gecko)		P2	
518.	25209 <i>Varanus acanthurus</i> (Spiny-tailed Monitor)			
519.	25210 <i>Varanus brevicauda</i> (Short-tailed Pygmy Monitor)			
520.	30825 <i>Varanus bushi</i> (Pilbara Mulga Monitor)			
521.	25211 <i>Varanus caudolineatus</i>			
522.	25212 <i>Varanus eremius</i> (Pygmy Desert Monitor)			
523.	25216 <i>Varanus giganteus</i> (Perentie)			

Name ID	Species Name	Naturalised	Conservation Code	¹ Endemic To Query Area
524.	25215 <i>Varanus gilleni</i> (Pygmy Mulga Monitor)			
525.	25218 <i>Varanus gouldii</i> (Bungarra or Sand Monitor)			
526.	25524 <i>Varanus panoptes</i> (Yellow-spotted Monitor)			
527.	25224 <i>Varanus pilbarensis</i> (Pilbara Rock Monitor, Northern Pilbara Rock Goanna)			
528.	25526 <i>Varanus tristis</i> (Racehorse Monitor)			
529.	25227 <i>Varanus tristis</i> subsp. <i>tristis</i> (Racehorse Monitor)			
530.	25311 <i>Vermicella snelli</i>			

Conservation Codes

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

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

Appendix 3

Vegetation Structural Classification and Condition Ranking



Vegetation structural classes based on modifications of the vegetation classification system of Specht (1970) by Muir (1977) and Aplin (1979).

Stratum	Canopy Cover (%)				
	70-100%	30-70%	10-30%	2-10%	<2%
Trees over 30 m	Tall closed forest	Tall open forest	Tall woodland	Tall open woodland	Scattered tall trees
Trees 10-30 m	Closed forest	Open forest	Woodland	Open woodland	Scattered trees
Trees under 10 m	Low closed forest	Low open forest	Low woodland	Low open woodland	Scattered low trees
Shrubs over 2 m	Tall closed scrub	Tall open scrub	Tall shrubland	Tall open shrubland	Scattered tall shrubs
Shrubs 1-2 m	Closed heath	Open heath	Shrubland	Open shrubland	Scattered shrubs
Shrubs under 1 m	Low closed heath	Low open heath	Low shrubland	Low open shrubland	Scattered low shrubs
Hummock grasses	Closed hummock grassland	Hummock grassland	Open hummock grassland	Very open hummock grassland	Scattered hummock grasses
Grasses, Sedges, Herbs	Closed tussock grassland / bunch grassland / sedgeland / herbland	Tussock grassland / bunch grassland / sedgeland / herbland	Open tussock grassland / bunch grassland / sedgeland / herbland	Very open tussock grassland / bunch grassland / sedgeland / herbland	Scattered tussock grasses / bunch grasses / sedges / herbs

Extracts from the NVIS framework (see NVIS Technical Working Group 2017) of relevance to the current study.

Table 1: The NVIS Information Hierarchy.

Hierarchical Level	Description	NVIS structural/floristic components required
I	Class*	Dominant growth form for the ecologically or structurally dominant stratum
II	Structural Formation*	Dominant growth form, cover and height for the ecologically or structurally dominant stratum.
III	Broad Floristic Formation**	Dominant growth form, cover, height and dominant land cover genus for the upper most or the ecologically or structurally dominant stratum.
IV	Sub-Formation**	Dominant growth form, cover, height and dominant genus for each of the three traditional strata. (i.e. Upper, Mid and Ground)
V	Association**	Dominant growth form, height, cover and species (3 species) for the three traditional strata. (i.e. Upper, Mid and Ground)
VI	Sub-Association**	Dominant growth form, height, cover and species (5 species) for all layers/sub-strata.

* Walker & Hopkins (1990)

** NVIS (defined for the NVIS Information Hierarchy)

Table 4: NVIS structural Formation Terminology.

		Cover Characteristics						
	Foliage cover *	70-100	30-70	10-30		» 0	0-5	unknown
	Crown cover **	>80	50-80	20-50	0.25-20		0-5	unknown
	% Cover ***	>80	50-80	20-50	0.25-20		0-5	unknown
	Cover code	d	c	i	r	bi	bc	unknown
Growth Form	Height Ranges (m)	Structural Formation Classes						
tree, palm	30	closed forest	open forest	woodland	open woodland	isolated trees	isolated clumps of trees	trees
shrub, cycad, grass-tree, tree-fern	2	closed shrubland	shrubland	open shrubland	sparse shrubland	isolated shrubs	isolated clumps of shrubs	shrubs
heath shrub	2	closed heathland	heathland	open heathland	sparse heathland	isolated heath shrubs	isolated clumps of heath shrubs	heath shrubs
tussock grass	0.5	closed tussock grassland	tussock grassland	open tussock grassland	sparse tussock grassland	isolated tussock grasses	isolated clumps of tussock grasses	tussock grasses
other grass	0.5	closed grassland	grassland	open grassland	sparse grassland	isolated grasses	isolated clumps of grasses	other grasses
sedge	0.5	closed sedgeland	sedgeland	open sedgeland	sparse sedgeland	isolated sedges	isolated clumps of sedges	sedges
rush	0.5	closed rushland	rushland	open rushland	sparse rushland	isolated rushes	isolated clumps of rushes	rushes
forb	0.5	closed forbland	forbland	open forbland	sparse forbland	isolated forbs	isolated clumps of forbs	forbs
fern	2	closed fernland	fernland	open fernland	sparse fernland	isolated ferns	isolated clumps of ferns	ferns
vine	30	closed vineland	vineland	open vineland	sparse vineland	isolated vines	isolated clumps of vines	vines

* Foliage Cover is defined for each stratum as 'the proportion of the ground that would be shaded if sunshine came from directly overhead'. It includes branches and leaves and is similar to the Crown type of Walker & Hopkins (1990) but is applied to a stratum or plot rather than an individual crown. It is generally not directly measured in the field for the upper stratum, although it can be measured by various line interception methods for ground layer vegetation. For the attribute COVER CODE in the Stratum table, the ground cover category refers to ground foliage cover not percentage cover.

** Crown Cover (canopy cover) as per Walker & Hopkins (1990). Although relationships between the two are dependent on season, species, species age etc (Walker & Hopkins (1990), the crown cover category classes have been adopted as the defining measure.

*** The percentage cover is defined as the percentage of a strictly defined plot area, covered by vegetation. This can be an estimate and is a less precise measure than using, for example, a point intercept transect methods on ground layer, or overstorey vegetative cover. That is for precisely measured values (e.g. crown densitometer or point intercept transects) the value measured would be 'foliage' cover. Where less precise or qualitative measures are used these will most probably be recorded as 'percentage' cover.

Table 6: Example usage of the NVIS Information Hierarchy (Note: For definitions of U, M, G, U1, U2, U3, M1, M2, M3, G1, and G2 refer to Table 1.)**

Level	Description	Species	Growth form	Cover	Height
I	CLASS	-	1 dominant growth form for the dominant stratum	-	-
	Example	<i>Tree</i>			
II	STRUCTURAL FORMATION	-	1 dominant growth form for the dominant stratum	1 cover class for the dominant stratum	1 height class for the dominant stratum
	Example	<i>Open woodland</i>			
III	BROAD FLORISTIC FORMATION	1 dominant genus name for the dominant stratum	1 dominant growth form for dominant stratum	1 cover class for dominant stratum	1 height class for dominant stratum
	Example	<i>Eucalyptus open woodland</i>			
IV	SUB-FORMATION	1 dominant genus name for each stratum ((max 3 strata; i.e. for U, M, G where substantially present)	1 dominant growth form for each stratum (max 3 strata)	1 cover class for each stratum (max 3 strata)	1 height class for each stratum (max 3 strata)
	Example	<i>+Eucalyptus open woodland\Acacia tall sparse shrubland\Aristida open tussock grassland</i>			
V	ASSOCIATION	Up to 3 dominant species for each stratum (max 3 strata; i.e. for U, M, G where present)	Up to 3 dominant growth forms for each stratum (max 3 strata; i.e. for U, M, G where present)	1 cover class code for each stratum (max 3 strata; i.e. for U, M, G where present)	1 height class code for each stratum (max 3 strata; i.e. for U, M, G where present)
	Example	<i>U+ ^Eucalyptus coolabah,Casuarina cristata,Flindersia maculosa\^tree\7\r;M ^Acacia salicina,Alectryon oleifolius,Acacia stenophylla\^shrub\4\r;G ^Aristida ramosa,Astrebla squarrosa,Bothriochloa decipiens\^tussock grass,forb,sedge\2\i</i>			
VI	SUB-ASSOCIATION	Up to 5 dominant species for each sub-stratum (i.e. for U1, U2, U3, M1, M2, M3, G1, G2 where present) <ul style="list-style-type: none"> Indicate characteristic genus in each sub-stratum with an up arrow or hat "^". Must match characteristic growth form. 	Up to 5 dominant growth forms for each sub-stratum. <ul style="list-style-type: none"> Indicate characteristic growth form with an up arrow or hat "^". Must match characteristic genus 	1 cover class code for each sub-stratum	1 height class code for each sub-stratum
	Example	<i>U1+ ^Eucalyptus coolabah,Casuarina cristata,Flindersia maculosa\Eucalyptus\^tree\7\r;M1 ^Acacia salicina,Alectryon oleifolius,Acacia stenophylla,Acacia victoriae subsp. victoriae,Eremophila bignoniiflora\Acacia\^shrub\4\b;M2 Eremophila longifolia,Muehlenbeckia florulenta\Eremophila\shrub\3\r;G1 ^Aristida ramosa,Astrebla squarrosa,Bothriochloa decipiens,Dichanthium sericeum,Enteropogon acicularis\Aristida\^tussock grass,forb,sedge\2\</i>			

Vegetation condition scale taken from EPA (2016a), based on scales developed by Keighery (1994) and Trudgen (1988).

Vegetation Condition	South West and Interzone Botanical Provinces	Eremaean and Northern Botanical Provinces
Pristine	Pristine or nearly so, no obvious signs of disturbance or damage caused by human activities since European settlement.	
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species. Damage to trees caused by fire, the presence of non-aggressive weeds and occasional vehicle tracks.	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Very Good	Vegetation structure altered, obvious signs of disturbance. Disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.	More obvious signs of damage caused by human activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
Poor		Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. Disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds at high density, partial clearing, dieback and grazing.	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees and shrubs.	Areas that are completely or almost completely without native species in the structure of their vegetation; i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

Appendix 4

Fauna Licence





FAUNA TAKING (BIOLOGICAL ASSESSMENT) LICENCE

Regulation 27, Biodiversity Conservation Regulations 2018

Licence Number: BA27000237

Licence Holder: Ms Jacinta Phillipa King
Biota Environmental Sciences P/L
Level 1, 228 Carr Place
Leederville WA 6007

Date of Issue: 08/04/2020

Date Valid From: 14/04/2020

Date of Expiry: 13/04/2021

LICENSED ACTIVITIES

Subject to the terms and conditions on this licence, the licence holder may –

1. Take and disturb fauna for level 1 survey using acoustic recorders (SM4), visual observation, spotlighting / head torches, secondary signs / evidence, habitat assessment and motion cameras for Main Roads Karratha to Tom Price road construction.

LOCATIONS

1. Karratha to Tom Price (110 km length of Karratha-Tom Price Road from Wallyinya Pool to the Nanutarra Munjina Road. The study area is a 400m wide corridor extending along the length of this road.).

AUTHORISED PERSONS

The following persons or persons of the specified class may assist in carrying out the licensed activities:

1. Stewart Ford
2. Michael Greenham
3. Penny Brooshooft
4. John Graff
5. Josh Keen
6. Nathan Beerkens
7. Brandon King
8. Daniel Kamien
9. Garth Humphreys
10. Roy Teale
11. Sylvie Schmidt

CONDITIONS

1. Fauna must not be taken on CALM land, (as defined in the Conservation and Land Management Regulations 2002), unless authorised by a written notice of a lawful authority issued under regulations 4 and 8 of the Conservation and Land Management Regulations 2002.



2. If persons, other than the licence holder, are authorised to carry out/assist in carrying out the activities under the licence, the licence holder must ensure those persons have read and understand the licence terms and conditions.
3. The written authorisation of the person in possession or occupation of the land accessed and upon which fauna is taken, as required under regulation 101(2) and referred to in “Additional information” below, must:
 - a) state location details (including lot or location number, street/road, suburb and local government authority);
 - b) state land owner or occupier name, and contact phone number;
 - c) specify the time period that the authorisation is valid for;
 - d) be signed and dated; and
 - e) be attached to this licence at all times.
4. This licence, and any written authorisation or lawful authority which authorises the take of fauna on specified locations must be carried at all times while conducting licensed activities and be produced on demand by a wildlife officer.
5. If a species of fauna listed as a threatened species under Section 19 of the *Biodiversity Conservation Act 2016* is inadvertently captured, that species is to be released immediately at the point of capture. If the fauna is injured or deceased, the licence holder shall contact the DBCA Wildlife Licensing Section (wildlifelicensing@dbca.wa.gov.au) for advice on treatment or disposal. Details of any capture of threatened fauna must be included in the “Return of Fauna Taken.”
6. The licence holder must not:
 - a) release any fauna in any area where it does not naturally occur;
 - b) transfer fauna to any other person or authority (other than the Western Australian Museum) unless approved in writing by the CEO; or
 - c) dispose of the remains of fauna in any manner likely to interfere the natural or present day distribution of the species.
7. The licence holder must not take and remove more than ten specimens of any one protected species of fauna from any location less than 20km apart. Where exceptional circumstances make it necessary to take a larger number of specimens from a particular location in order to obtain adequate statistical data, the collector must proceed with circumspection and justify their actions to the Director General in advance.
8. All holotypes and syntypes and a half share of paratypes of species or subspecies permitted to be permanently taken under this licence must be donated to the Western Australian Museum. Duplicates (one pair in each case) of any species collected, which represents a significant extension of geographic range must be offered to the Western Australian Museum.
9. All specimens and material retained under the authority of this licence must be offered to the Western Australian Museum for loan, for inclusion in its collection, or on request be made available to other persons involved in relevant scientific studies.
10. The licence holder must create, compile and maintain records and information as required in a DBCA approved “Return of Fauna Taken” of all fauna taking activities as they occur.
11. A DBCA approved “Return of Fauna Taken” must be completed in full (including nil taking details) and submitted to DBCA Wildlife Licensing Section (wildlifelicensing@dbca.wa.gov.au) prior to the end of each annual period of the licence (from the valid from date) (refer to “Additional Information” section below).



Danny Stefoni
LICENSING OFFICER
WILDLIFE PROTECTION BRANCH

Delegate of CEO

ADDITIONAL INFORMATION

1. It is an offence to take any species of fauna listed as a threatened species under Section 19 of the *Biodiversity Conservation Act 2016* unless the person is authorised under Section 40. The penalty ranges between \$300 000 and \$500 000; Section 150 Biodiversity Conservation Act 2016.
2. Regulation 82 empowers the CEO to add, substitute or delete a term or condition of a licence or to correct errors. Such power may be exercised on application of a licence holder or by the CEO's own initiative. If an amendment to a licence term or condition is required, please contact the CEO or the Licensing Section on wildlifelicensing@dbca.wa.gov.au in the first instance. The licence holder, if adversely affected by a condition imposed in this licence, may apply to the State Administrative Tribunal for review of the decision of the CEO to impose that condition on a licence: regulation 89(2) Biodiversity Conservation Regulations 2018.
3. A person must not contravene a condition of a licence. The penalty for an offence involving the contravention of a condition of a licence is a fine of \$10 000: regulation 84 of the Biodiversity Conservation Regulations 2018.
4. It is an offence for persons authorised by this licence to enter land that is not in their possession or under their control without first having the *prior* written authorisation of the current owner or occupier of the land to:
 - a) enter the land; and
 - b) carry out the activity authorised by this licence.

The penalty for this offence is a fine of \$5 000: regulation 101(2) of the Biodiversity Conservation Regulations 2018.

5. The licence holder must be able to produce for inspection upon request any information or records required by regulation 85(2) of the Biodiversity Conservation Regulations 2018 Penalty \$10 000. It is an offence to knowingly include false or misleading information or make statements in records: regulation 85(3) of the Biodiversity Conservation Regulations 2018 Penalty \$10 000. It is an offence to include any information or make any statement in a return that the licence holder knows to be false or misleading in a material particular: regulation 86 (2) of the Biodiversity Conservation Regulations 2018 Penalty \$10 000.
6. The approved DBCA "Return of Fauna Taken" data file can be downloaded from the DBCA webpage (<https://www.dpaw.wa.gov.au/plants-and-animals/licences-and-authorities>).
7. The issuing of a licence under the Biodiversity Conservation Regulations 2018 does not constitute an animal ethics approval or a licence to use animals for scientific purposes as required under the *Animal Welfare Act 2002*, Animal Welfare (Scientific Purposes) Regulations 2003. It is the responsibility of a licence applicant / licence holder to ensure that they comply with the requirements of all applicable legislation. Enquiries relating to the Animal Welfare Act licences and animal ethics approvals are to be



directed to the Department of Primary Industries and Regional Development (<https://www.agric.wa.gov.au/animalwelfare>).

8. Threatened fauna can only be taken under a *Biodiversity Conservation Act 2016* Section 40 authorisation, Occurrences of threatened species must be reported to the CEO. For more information please see <https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-animals>.
9. Any interaction involving Nationally Listed Threatened Fauna that may be invasive and/or harmful to the fauna may require approval from the Commonwealth Department of the Environment and Energy <http://www.environment.gov.au/about-us/business-us/permits-assessments-licences>. Interaction with such species is controlled by the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and Environment Protection and Biodiversity Conservation Regulations 2000 as well as the *Biodiversity Conservation Act 2016* and Biodiversity Conservation Regulations 2018.

Appendix 5

Mapping of Vegetation Types and Significant Flora



Manuwarra Red Dog Hwy Stage 4 Borrow Pits Biological Vegetation Mapping Descriptions

Vegetation of Stony Hillslopes, Hillcrests and Foothills

-  H1 *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Triodia wiseana* hummock grassland.
-  H3 *Eucalyptus leucophloia* subsp. *leucophloia*, (*Corymbia hamersleyana*) low open woodland over mixed *Acacia* shrubs over *Triodia wiseana* open hummock grassland.
-  H5 *Eucalyptus leucophloia* subsp. *leucophloia*, (*Corymbia hamersleyana*) low open woodland over mixed *Acacia* shrubs over *Triodia basitricha* (*Triodia wiseana*) open hummock grassland.

Mulga Vegetation

-  M4 *Acacia aptaneura*, *A. ?macraneura* (*Hakea lorea* subsp. *lorea*) low open woodland over mixed tussock grasses and herbs.
-  M5 *Acacia macraneura* (*A. incurvaneura*), *Acacia citrinoviridis* low open forest over *Triodia epactia* open hummock grassland.

Vegetation of Stony Plains and Sloping Plains

-  P1 *Corymbia deserticola* subsp. *deserticola*, *C. hamersleyana*, *Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Triodia wiseana* open hummock grassland.
-  P2 *Corymbia hamersleyana* low open woodland over mixed *Acacia* shrubland over *Triodia epactia* hummock grassland.
-  P7 *Triodia wiseana* hummock grassland with *Eriachne flaccida* scattered tussock grasses.
-  P8 **Vachellia farnesiana* scattered tall shrubs over *Chrysopogon fallax* very open tussock grassland over mixed annual grassland and herbland.

Vegetation of Floodplains

-  F1 *Corymbia hamersleyana* low open woodland over *Acacia inaequilatera* tall open shrubland over *Triodia wiseana* (*T. epactia*) open hummock grassland with mixed tussock grasses.
-  F2 *Corymbia hamersleyana* low woodland over mixed *Acacia* tall open shrubland over *Triodia wiseana*, (*T. epactia*) open hummock grassland.
-  F3 *Corymbia hamersleyana* low open woodland over mixed *Acacia* open shrubland over *Triodia epactia* very open hummock grassland with *Chrysopogon fallax* very open tussock grassland.
-  F4 *Acacia citrinoviridis* low woodland over *Triodia epactia* open hummock grassland and *Chrysopogon fallax* scattered tussock grasses.
-  F5 **Vachellia farnesiana* tall open shrubland over *Eriachne benthamii* (*Dichanthium sericeum* subsp. *sericeum*, *Chrysopogon fallax*, **Cenchrus ciliaris*) tussock grassland.

Manuwarra Red Dog Hwy Stage 4 Borrow Pits Biological Vegetation Mapping Descriptions

Clay Vegetation

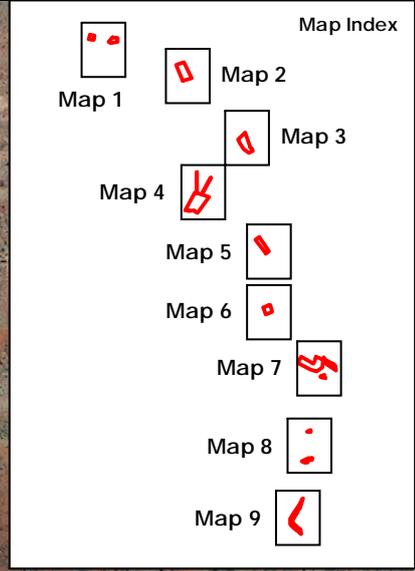
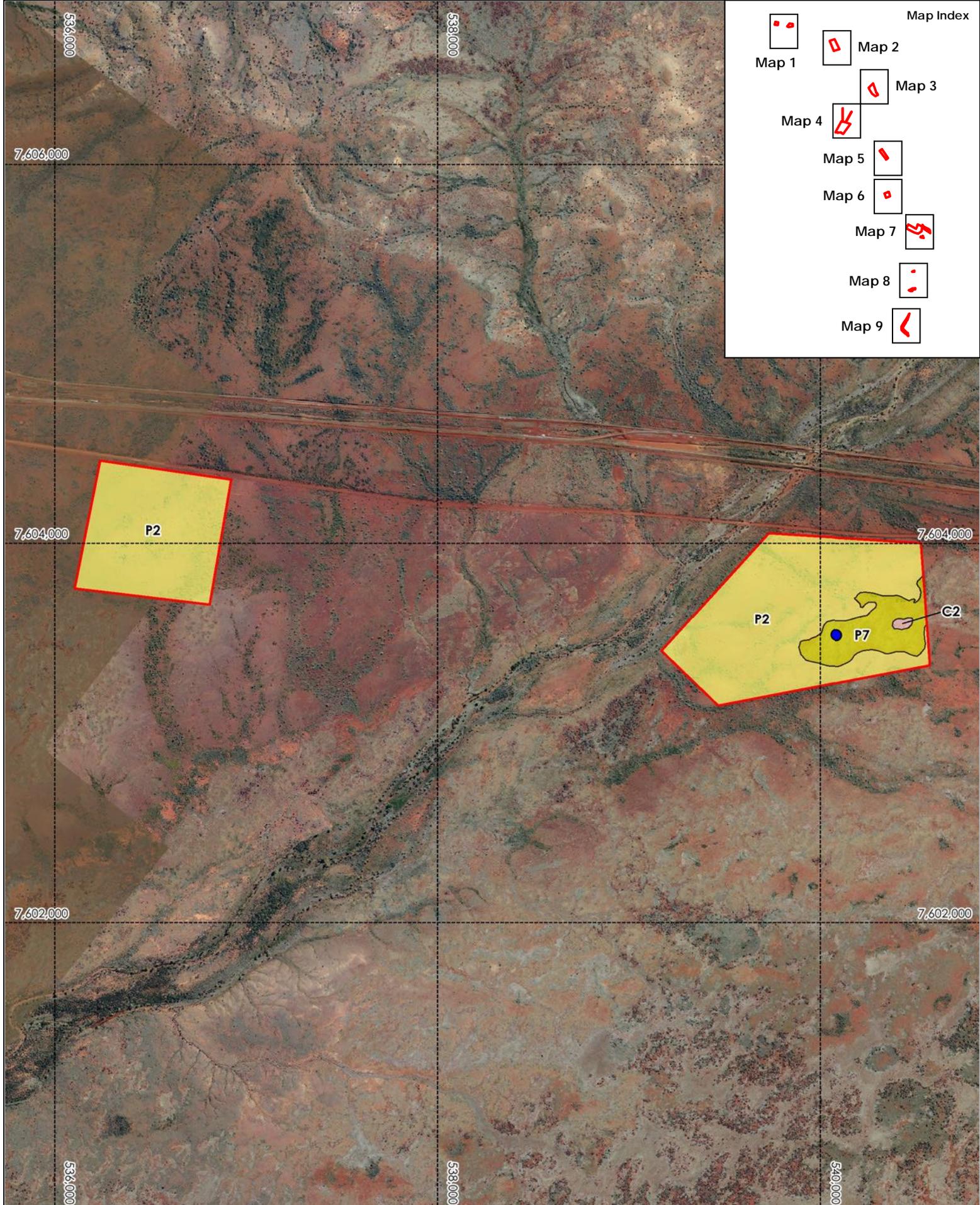
-  C2 *Acacia xiphophylla* low woodland over *Triodia epactia* very open hummock grassland over *Eragrostis xerophila* scattered tussock grasses.
-  C3 Mixed *Astrebla* tussock grassland over *Urochloa occidentalis* var. *occidentalis* bunch grassland.
-  C4 *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) tussock grassland.
-  C5 *Eucalyptus victrix* scattered low trees over *Eriachne benthamii*, (*Themeda* sp. Hamersley Station (M.E. Trudgen 11431)) very open tussock grassland over mixed open herbland.

Vegetation of Drainage Lines

-  D1 *Eucalyptus victrix* (*E.camaldulensis* subsp. *refulgens*) woodland over *Melaleuca glomerata* tall open shrubland over *Triodia epactia* scattered hummock grasses over mixed tussock grasses and sedges.
-  D3 *Eucalyptus victrix* low open woodland over **Vachellia farnesiana* scattered tall shrubs over mixed tussock grasses and bunch grasses.

Other Mapping Units

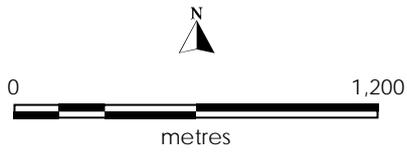
-  **Disturbed** Disturbed.
-  **Cleared** Cleared roads and tracks.



Survey area

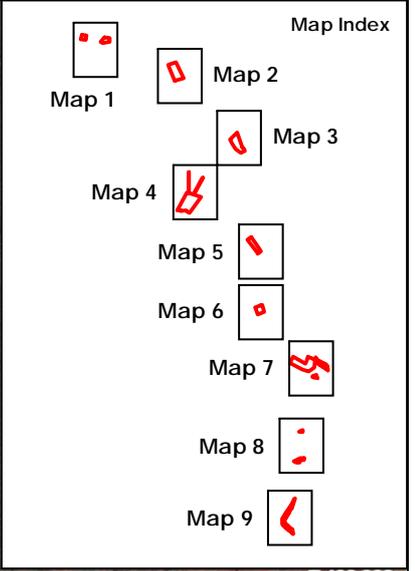
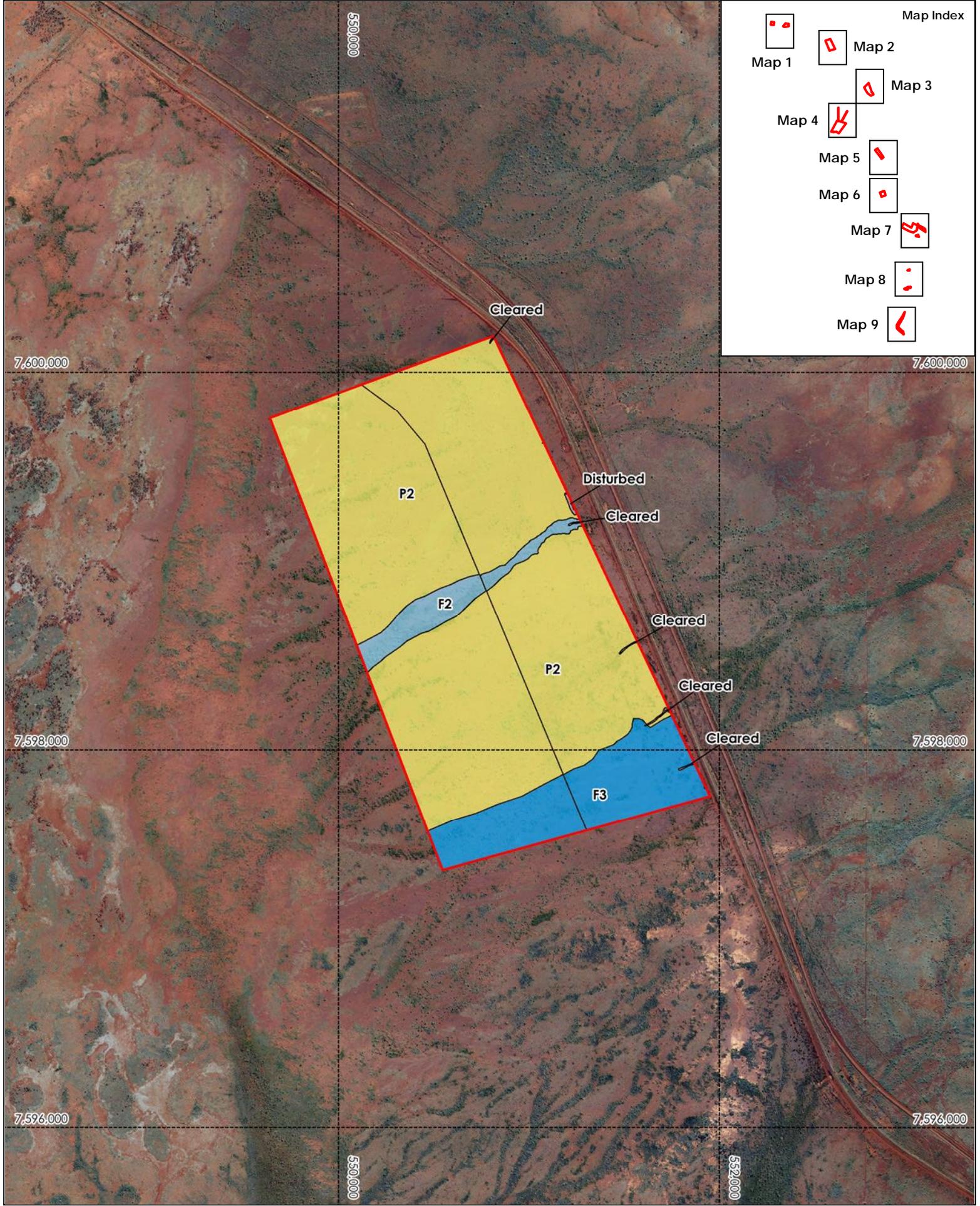
Flora Species of Significance

Dolichocarpa sp. Hamersley Station (A.A. Mitchell PRP 1479) (P3)

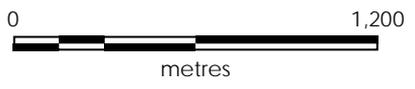


Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Vegetation Map 1



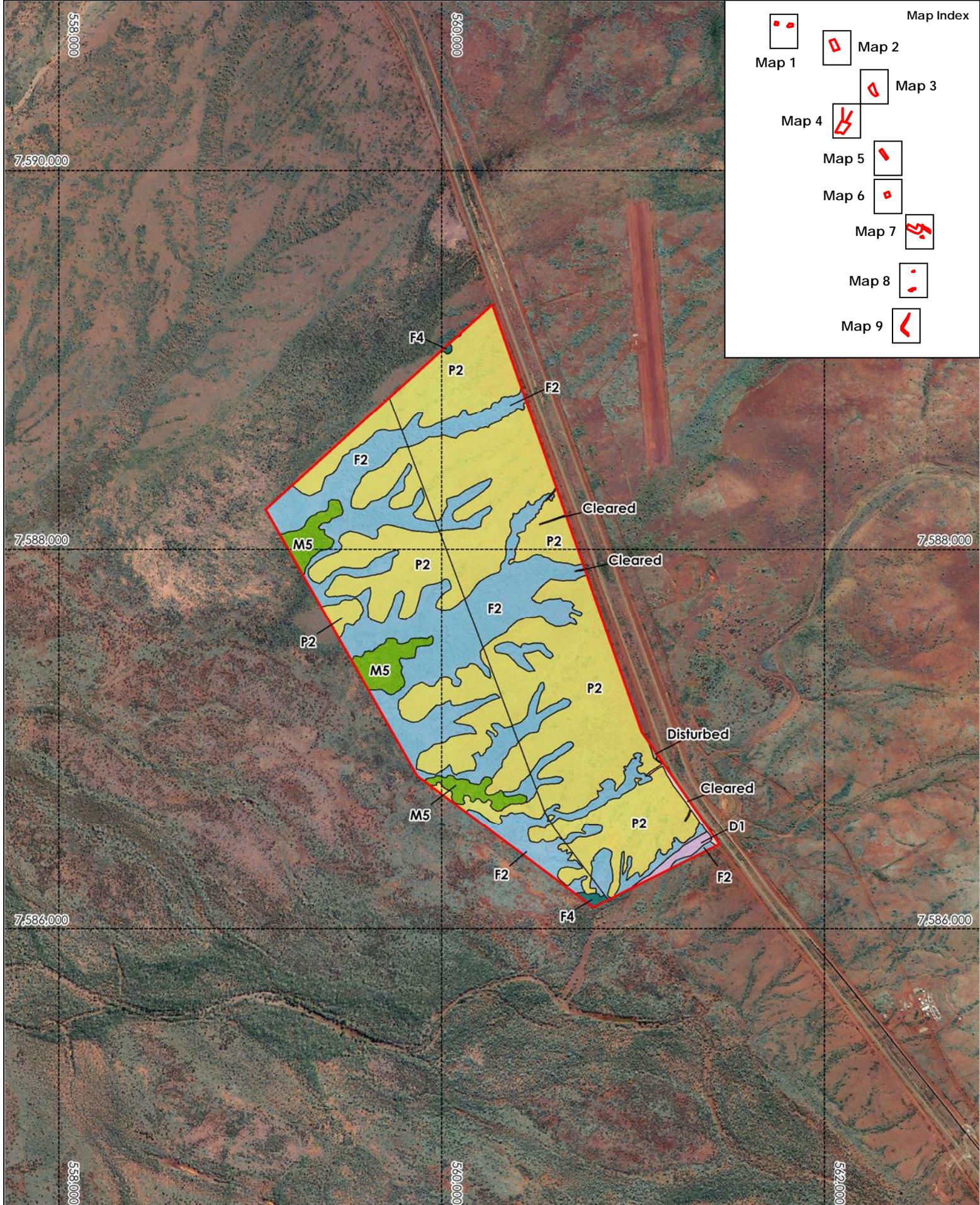


Survey area



**Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Vegetation Map 2**



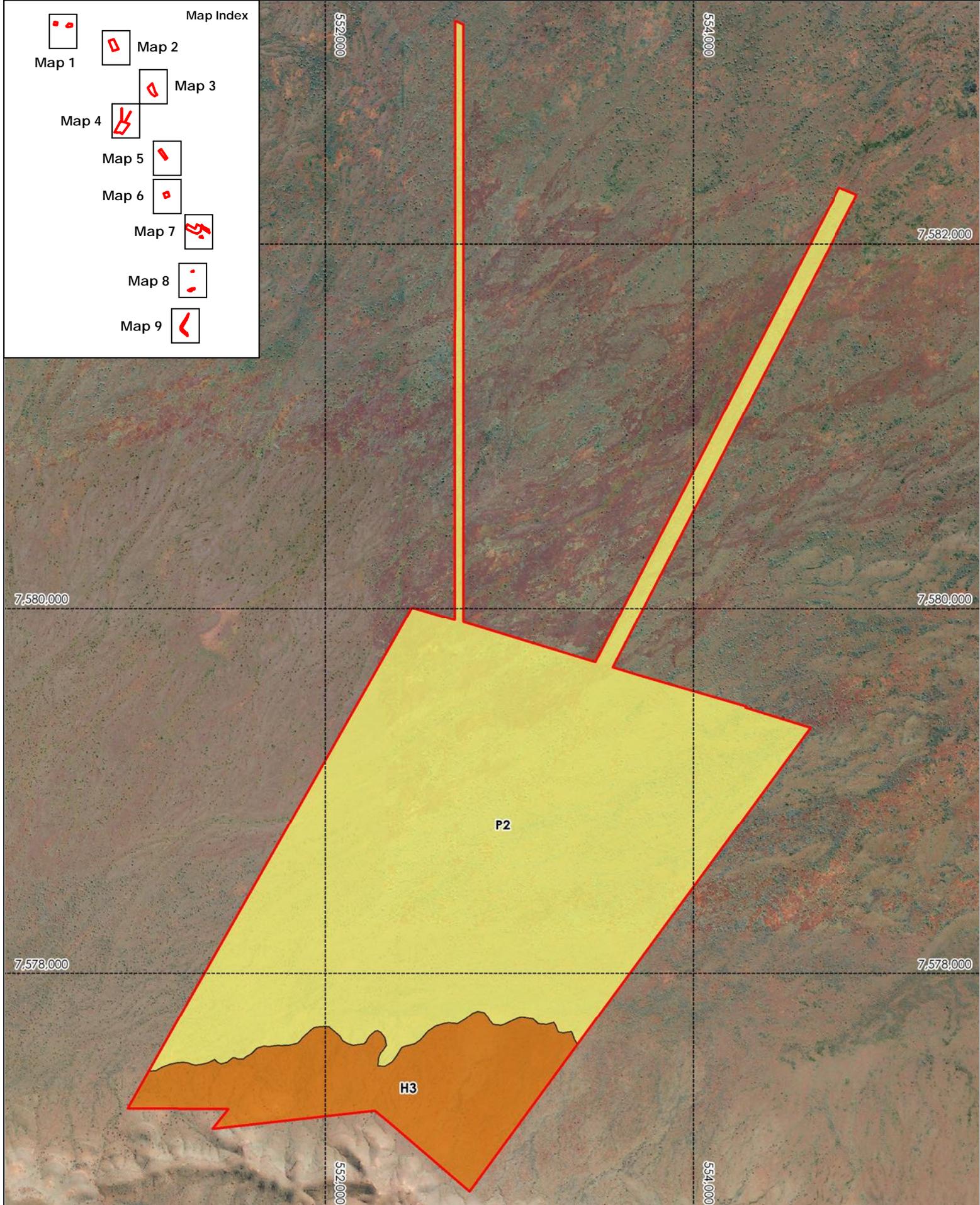
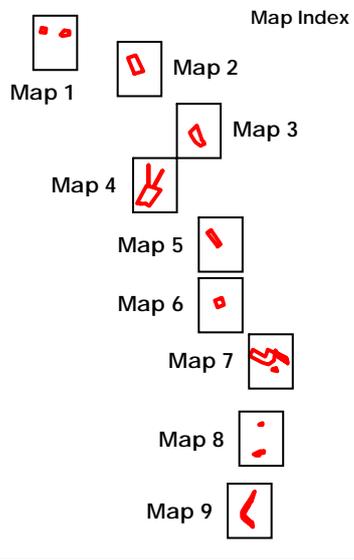


Survey area

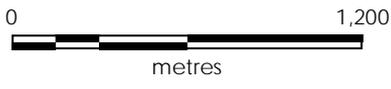


Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Vegetation Map 3



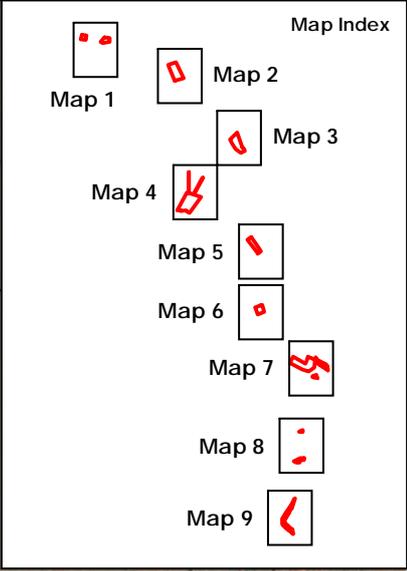
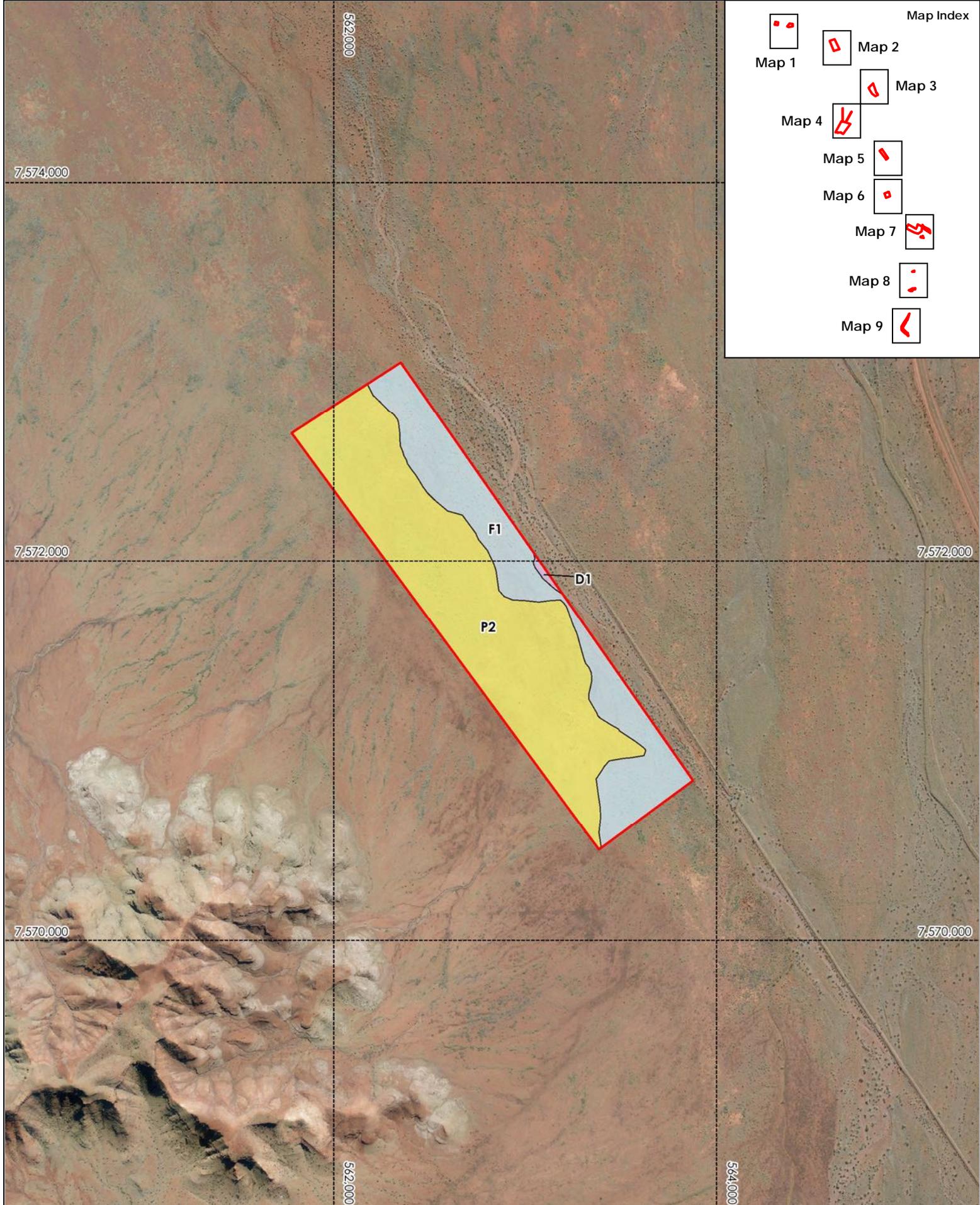


Survey area



**Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Vegetation Map 4**



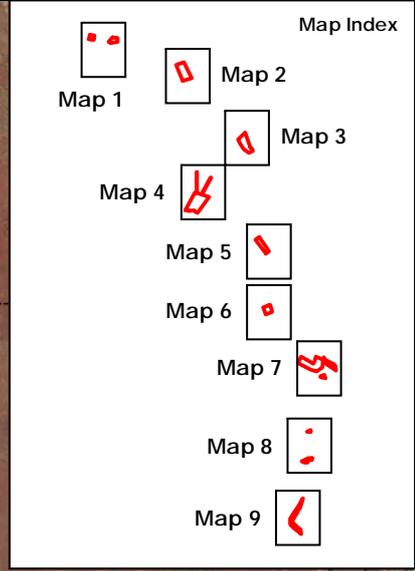
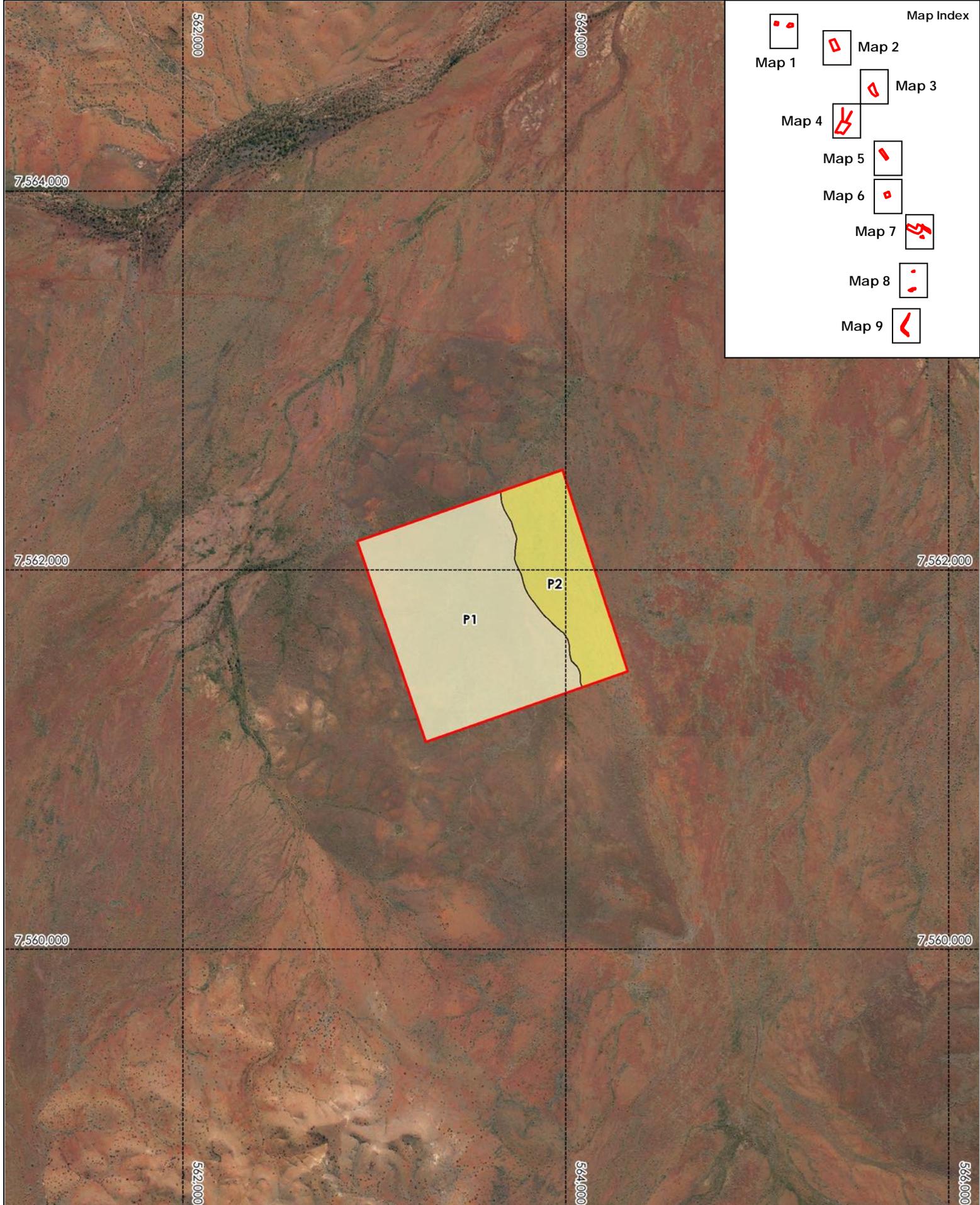


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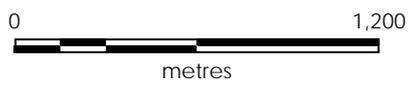


**Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Vegetation Map 5**



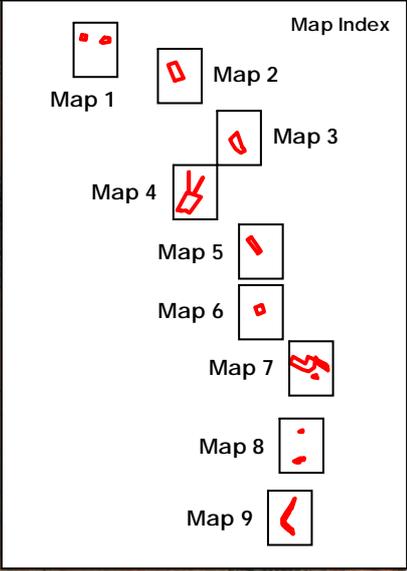
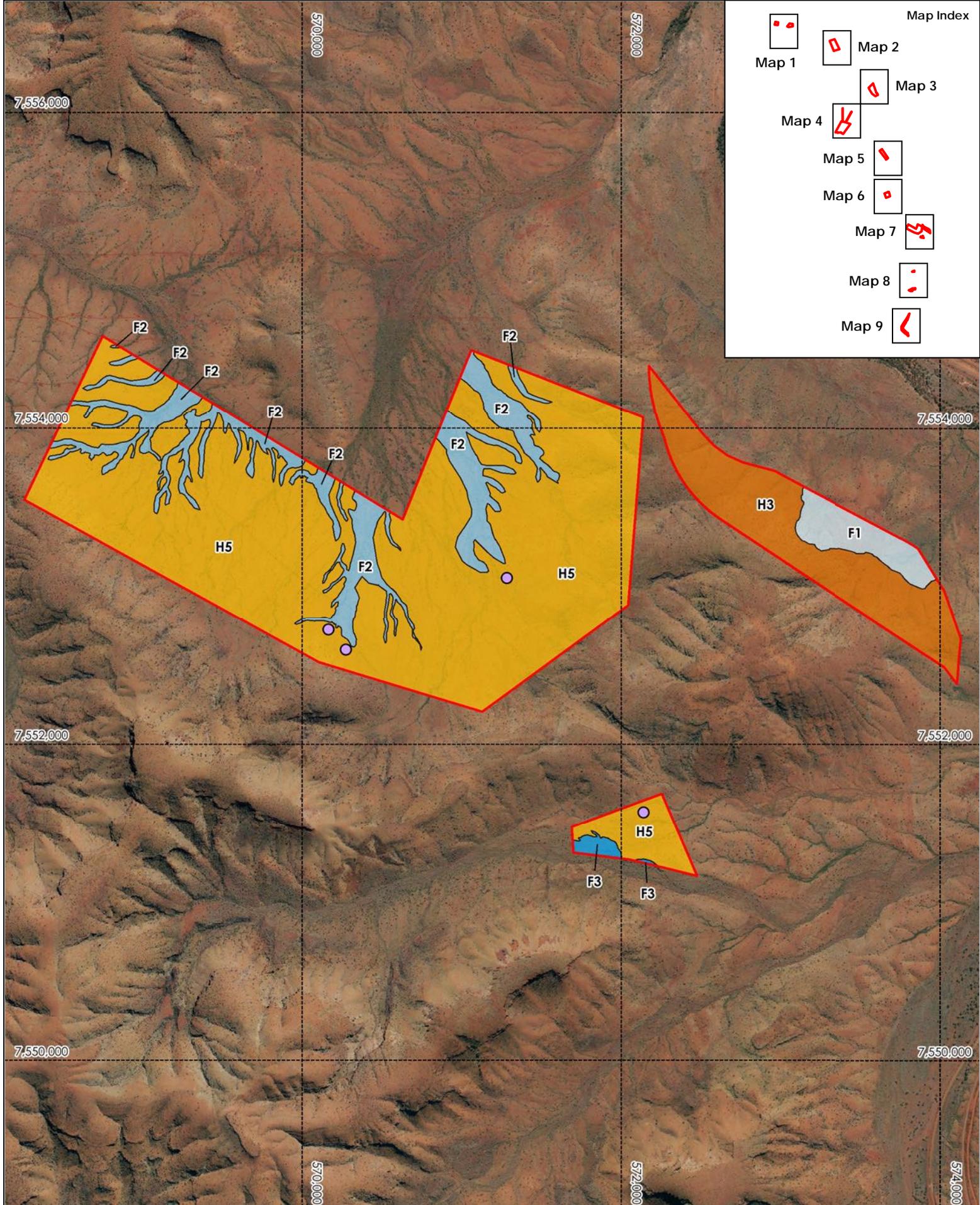


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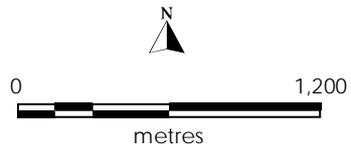
**Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Vegetation Map 6**





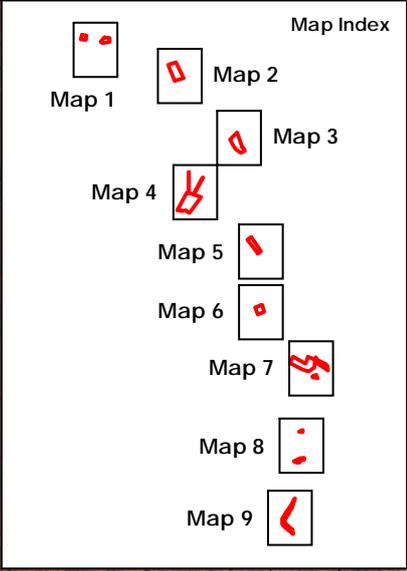
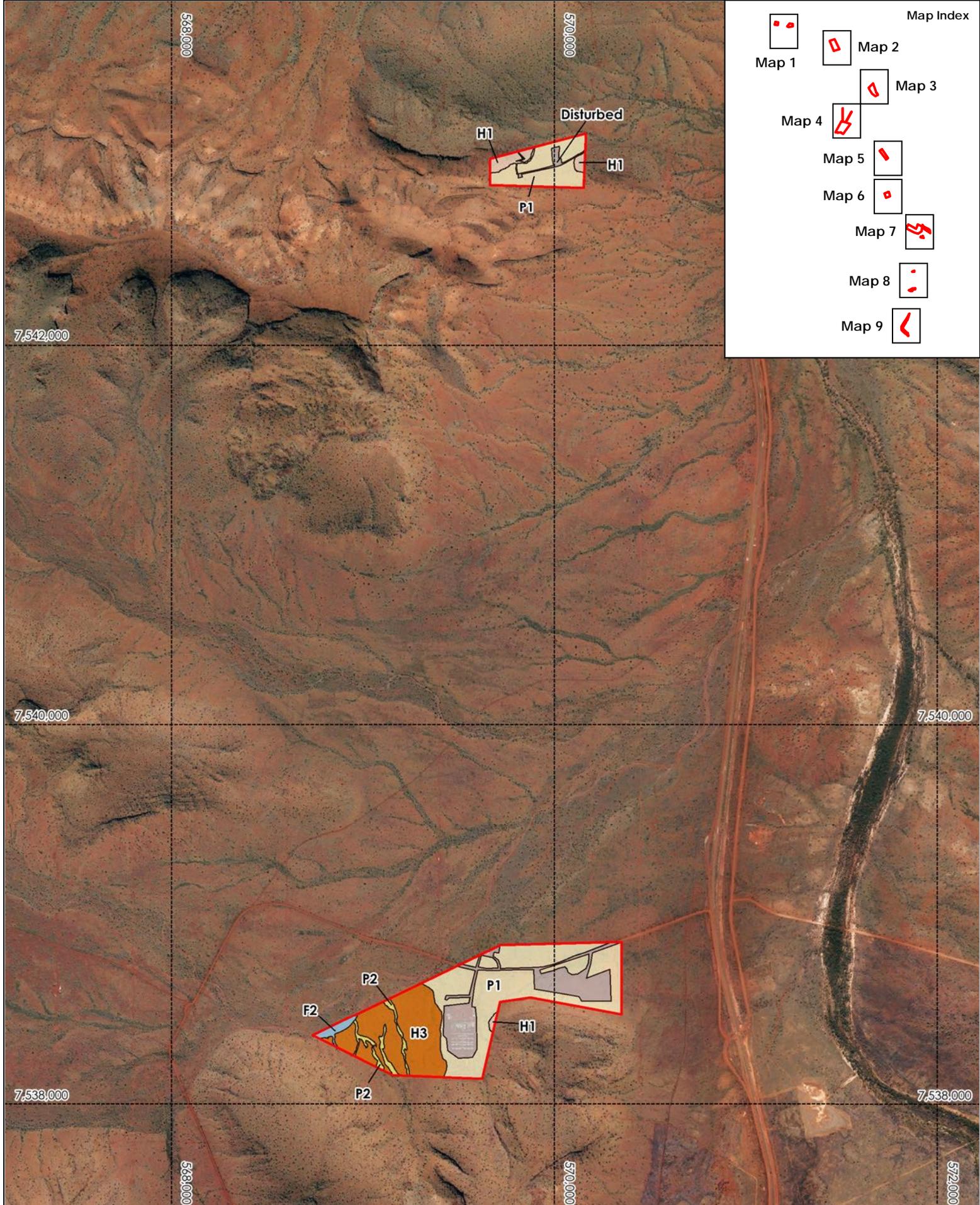
Survey area

Flora Species of Significance
● *Triodia basitricha* (P3)

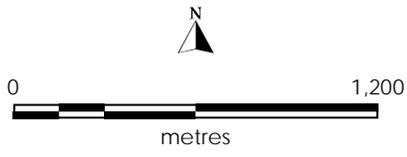


**Manuwarra Red Dog Hwy Stage 4
 Borrow Pits Biological Survey
 Vegetation Map 7**





Survey area



**Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Vegetation Map 8**



Flora Species of Significance

- *Euphorbia inappendiculata* var. *queenslandica* (P2)
- *Astrebla lappacea* (P3)
- *Glycine falcata* (P3)
- *Swainsona thompsoniana* (P3)
- *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) (P3)
- *Streptoglossa* sp. Cracking clays (S. van Leeuwen et al. PBS 7353) (P3)

Map Index

Map 1: Two red dots in a box.

Map 2: A red outline of a shape in a box.

Map 3: A red outline of a shape in a box.

Map 4: A red outline of a shape in a box.

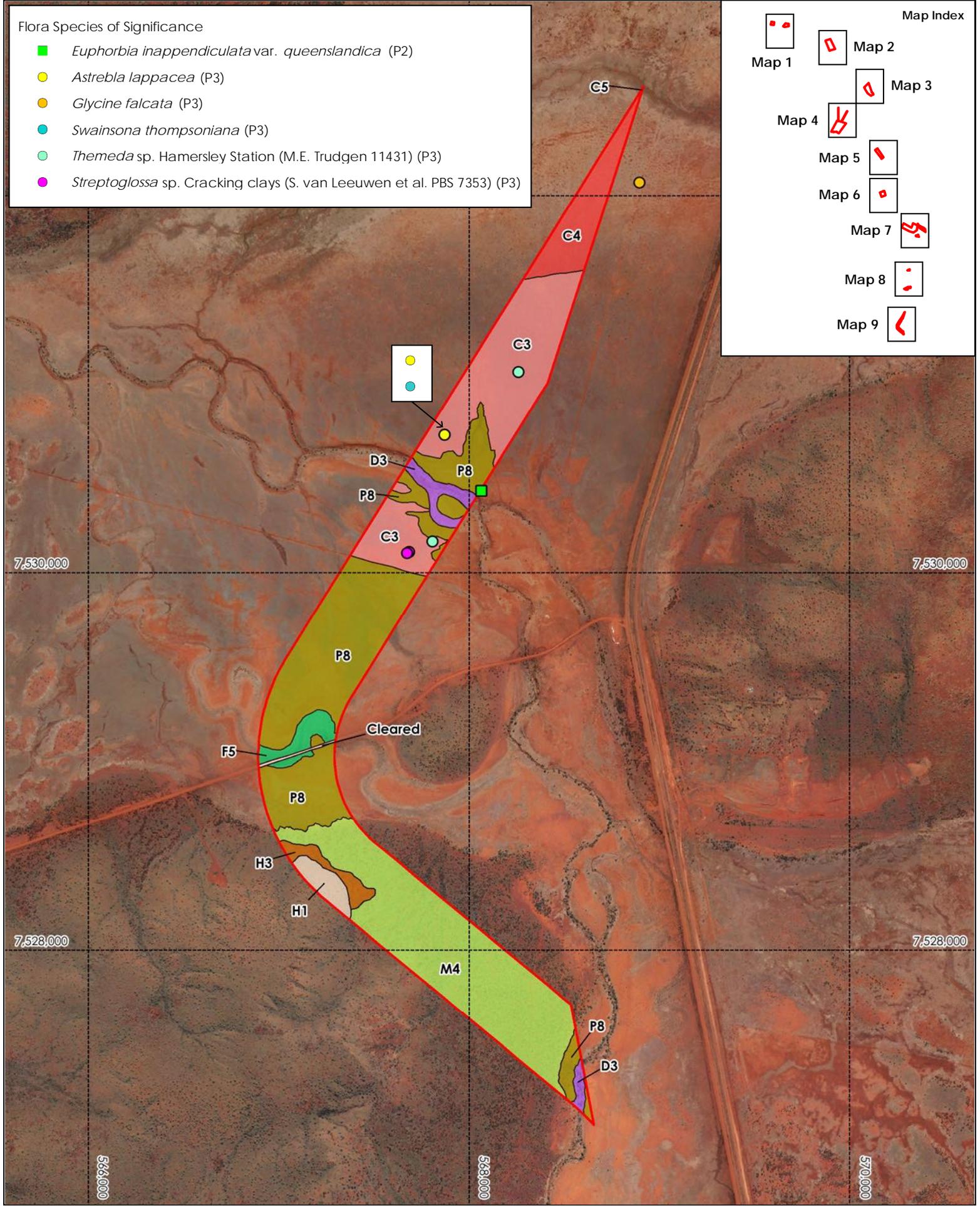
Map 5: A red outline of a shape in a box.

Map 6: A red outline of a shape in a box.

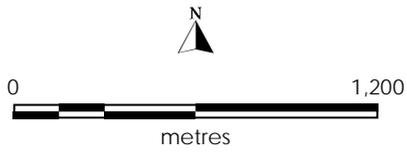
Map 7: A red outline of a shape in a box.

Map 8: A red outline of a shape in a box.

Map 9: A red outline of a shape in a box.



Survey area



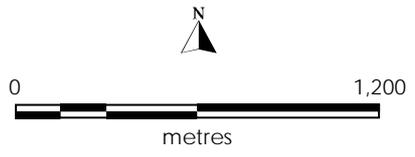
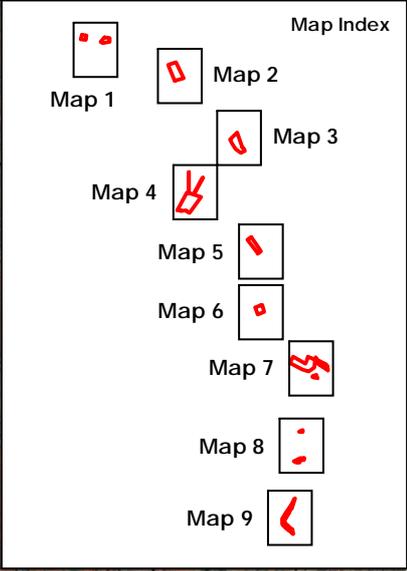
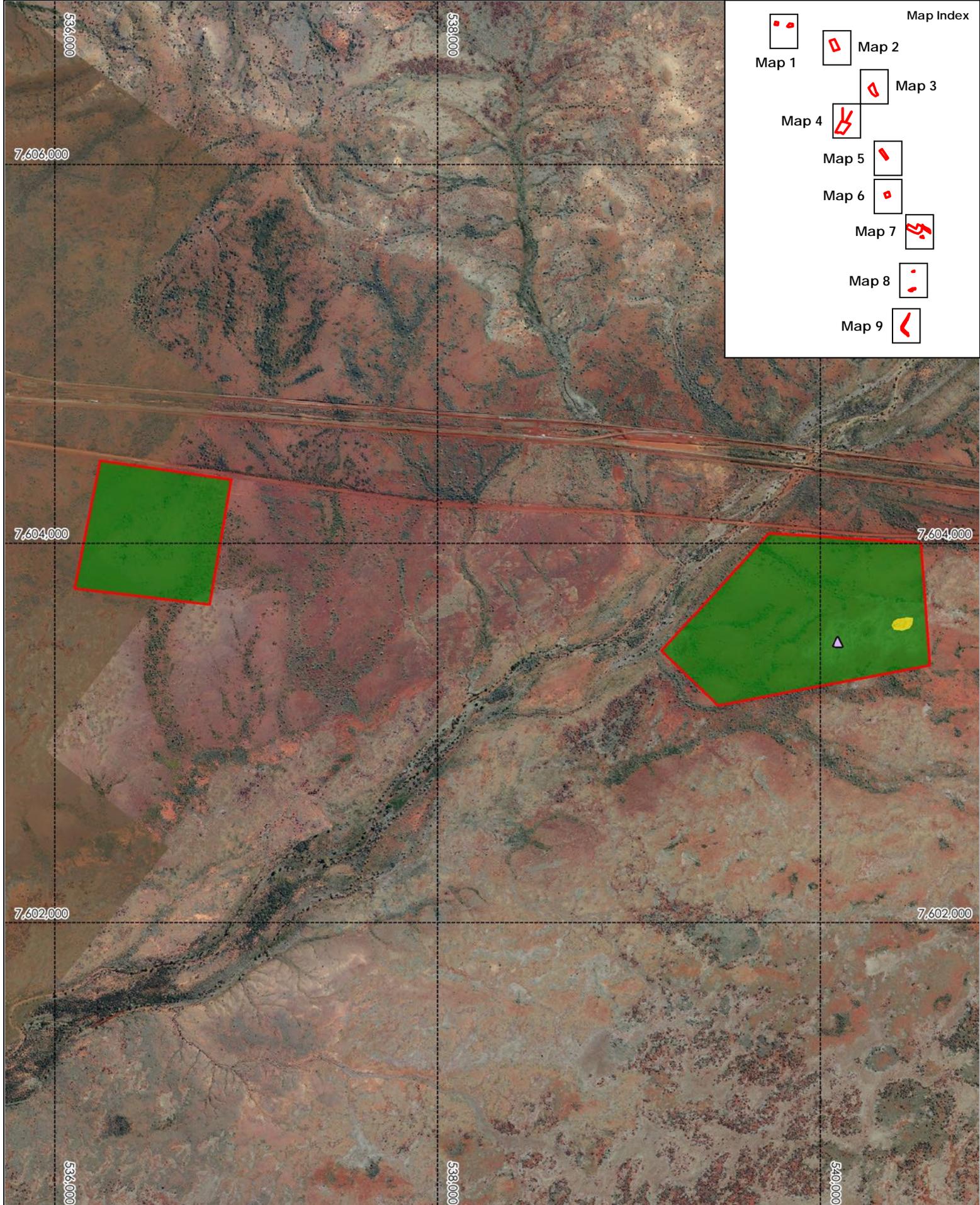
Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Vegetation Map 9



Appendix 6

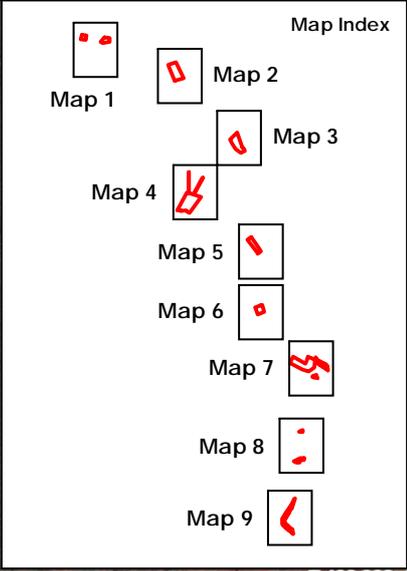
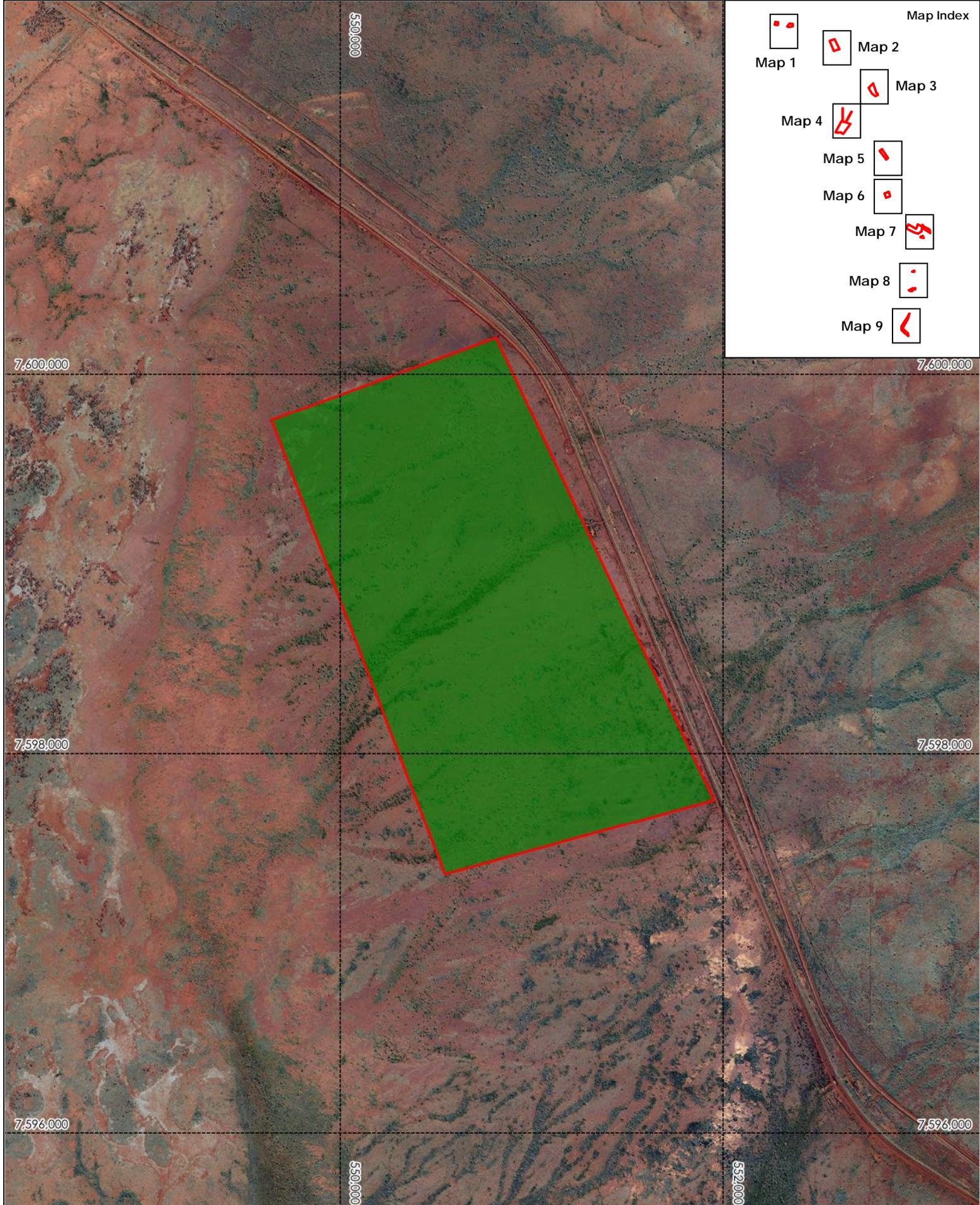
Mapping of Vegetation Condition and Weeds





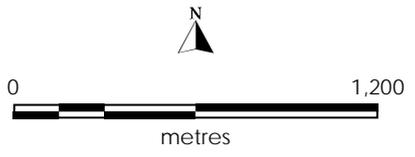
**Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Vegetation Condition Map 1**





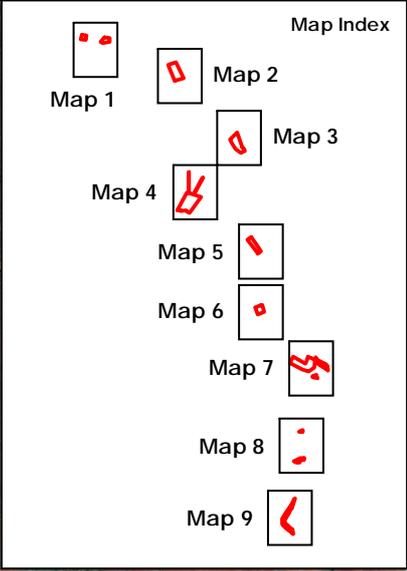
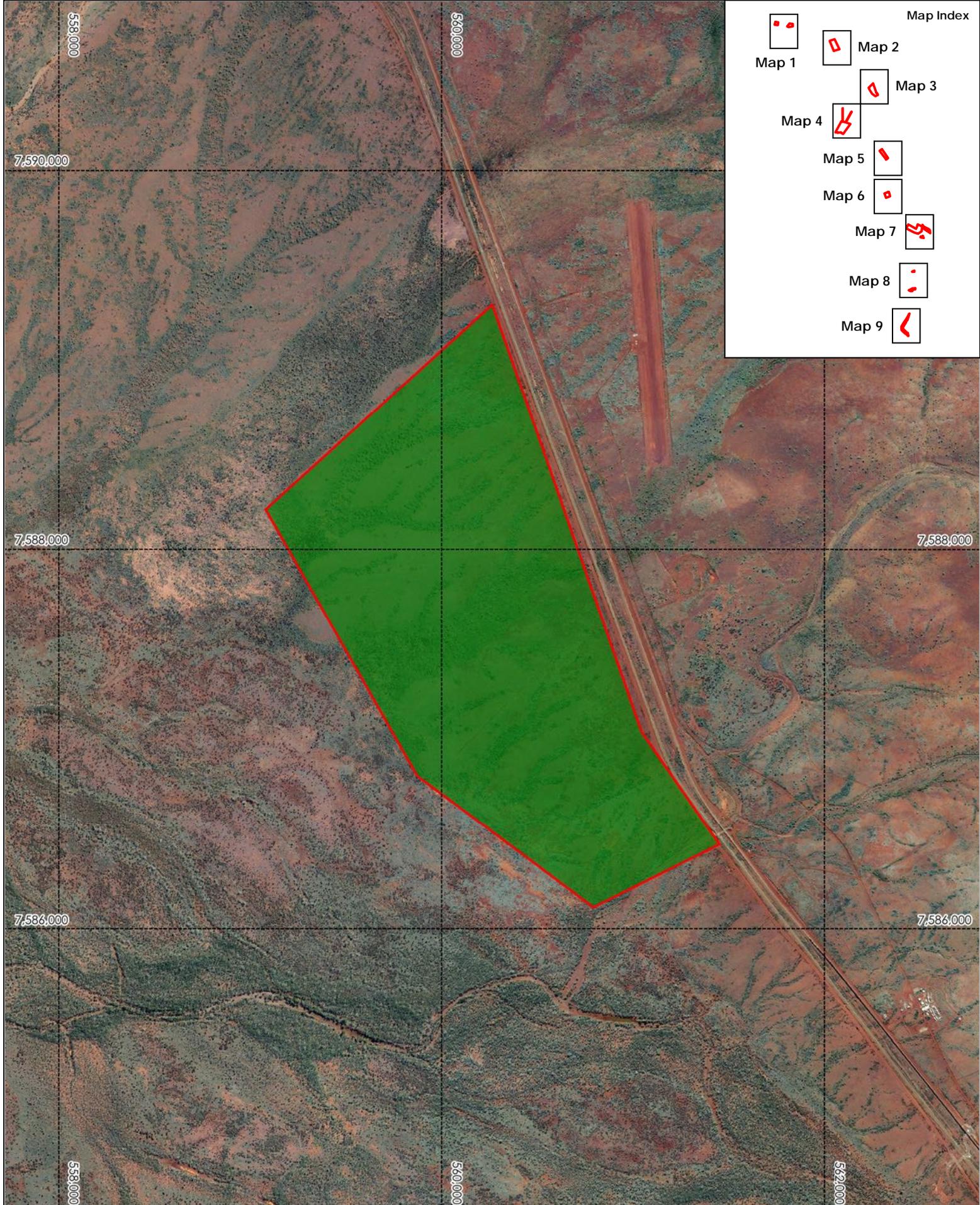
Survey area

Vegetation Condition
 Excellent



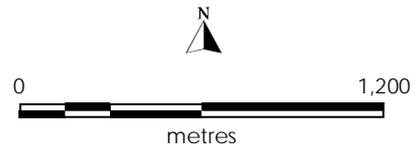
**Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Vegetation Condition Map 2**





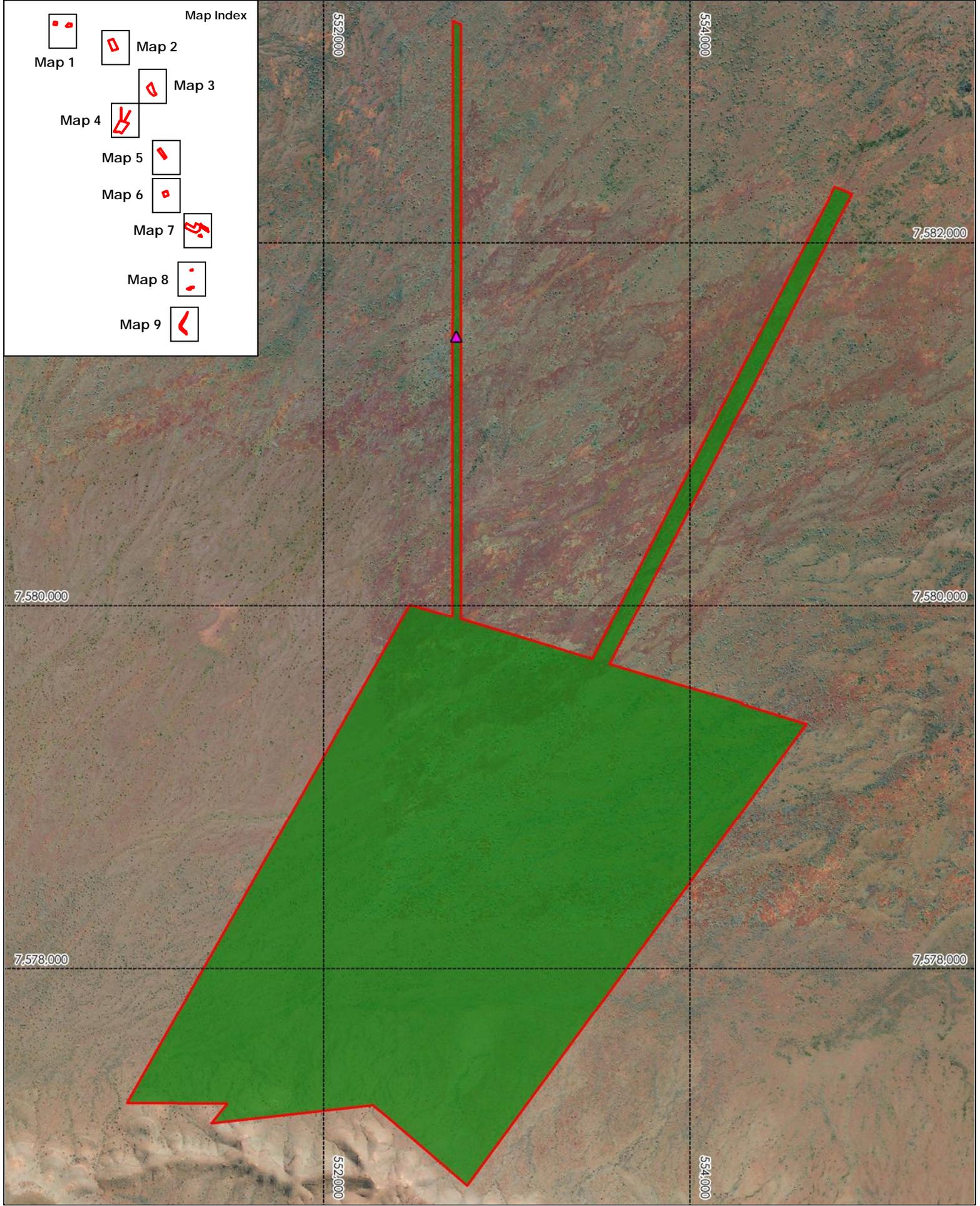
Survey area

Vegetation Condition
 Excellent



**Manuwarra Red Dog Hwy Stage 4
 Borrow Pits Biological Survey
 Vegetation Condition Map 3**



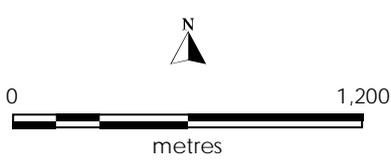


Map Index

- Map 1
- Map 2
- Map 3
- Map 4
- Map 5
- Map 6
- Map 7
- Map 8
- Map 9



- Survey area
- Vegetation Condition**
- Excellent
- Introduced Flora Species**
- **Malvastrum americanum*



**Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Vegetation Condition Map 4**

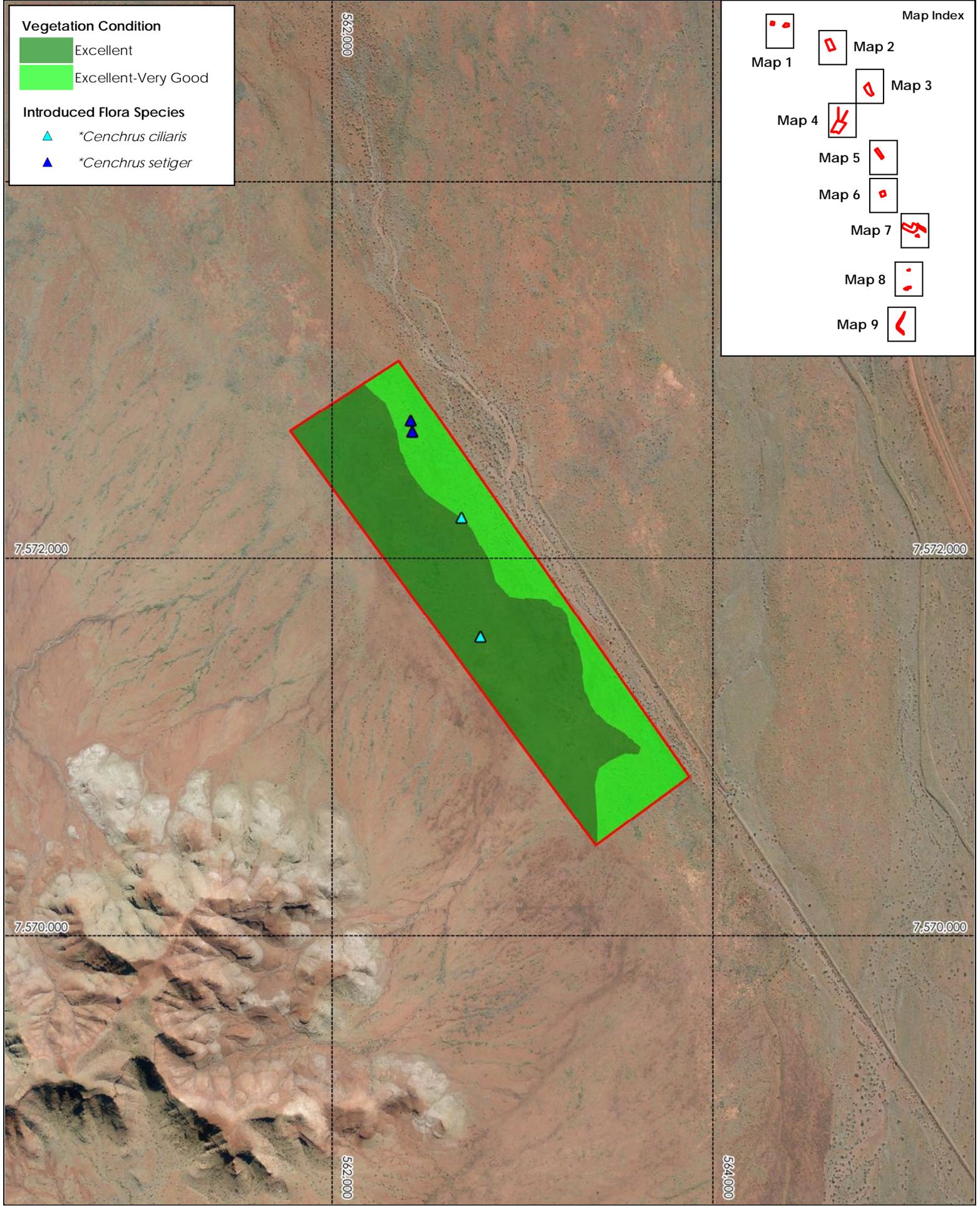
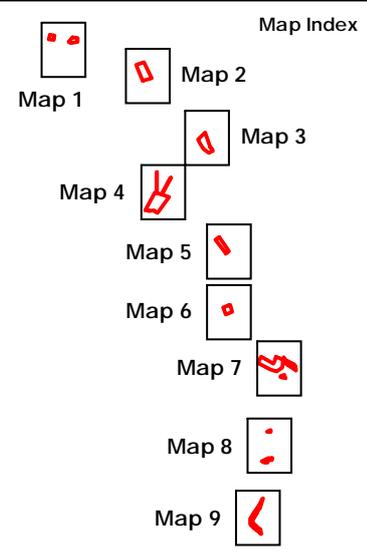


Vegetation Condition

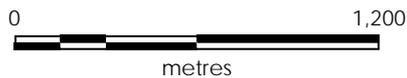
- Excellent
- Excellent-Very Good

Introduced Flora Species

- **Cenchrus ciliaris*
- **Cenchrus setiger*

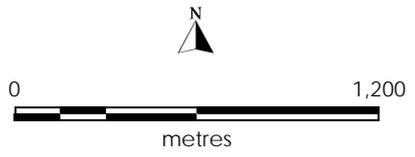
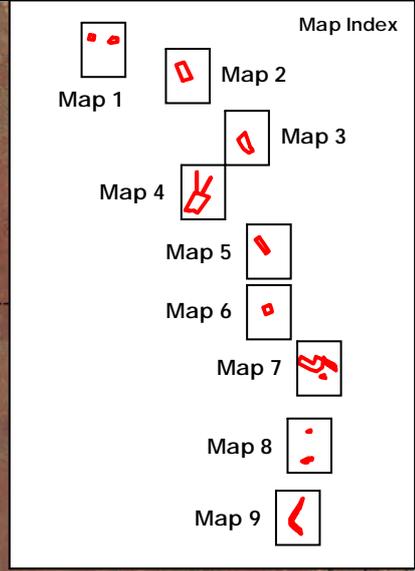
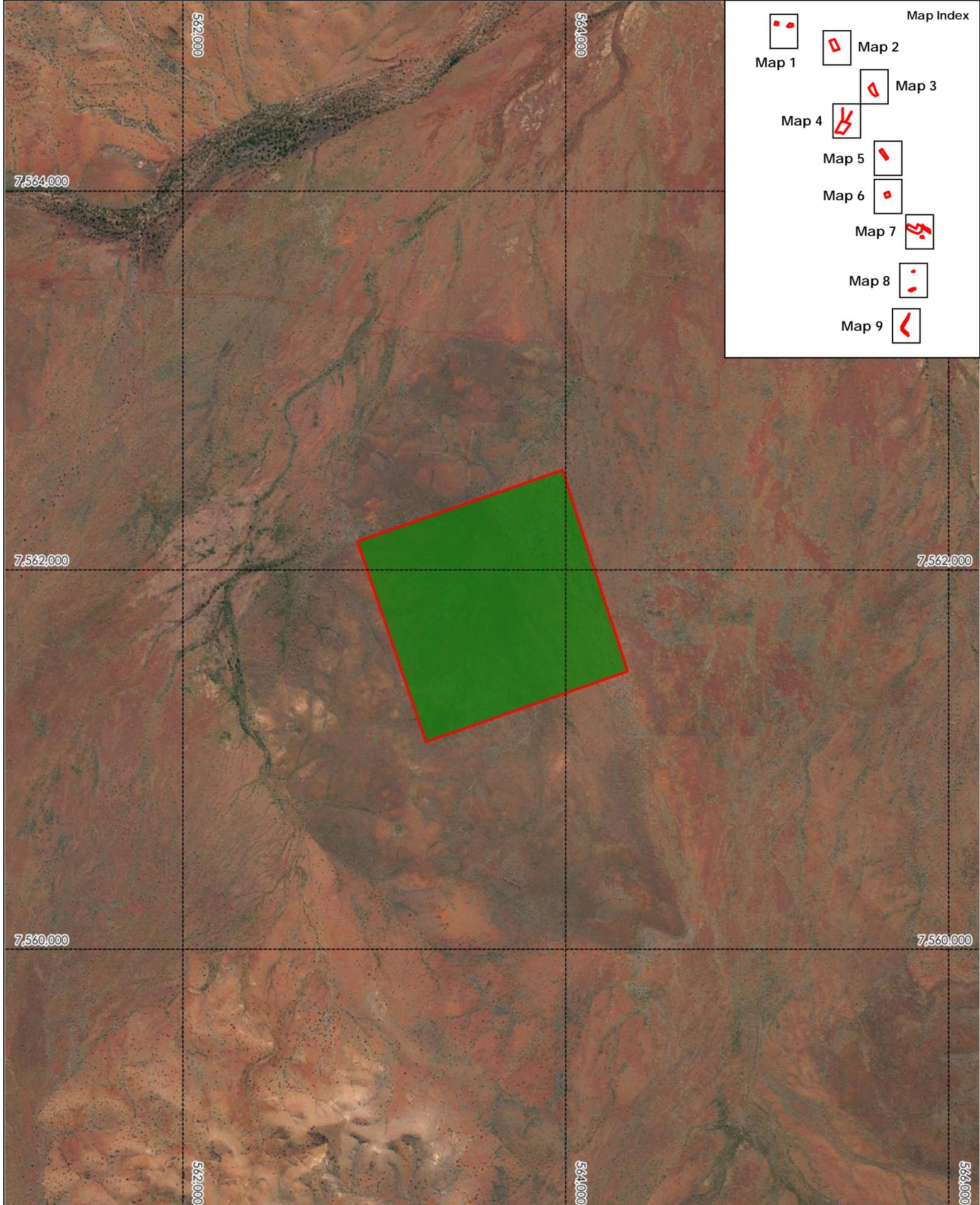


Survey area



**Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Vegetation Condition Map 5**





**Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Vegetation Condition Map 6**



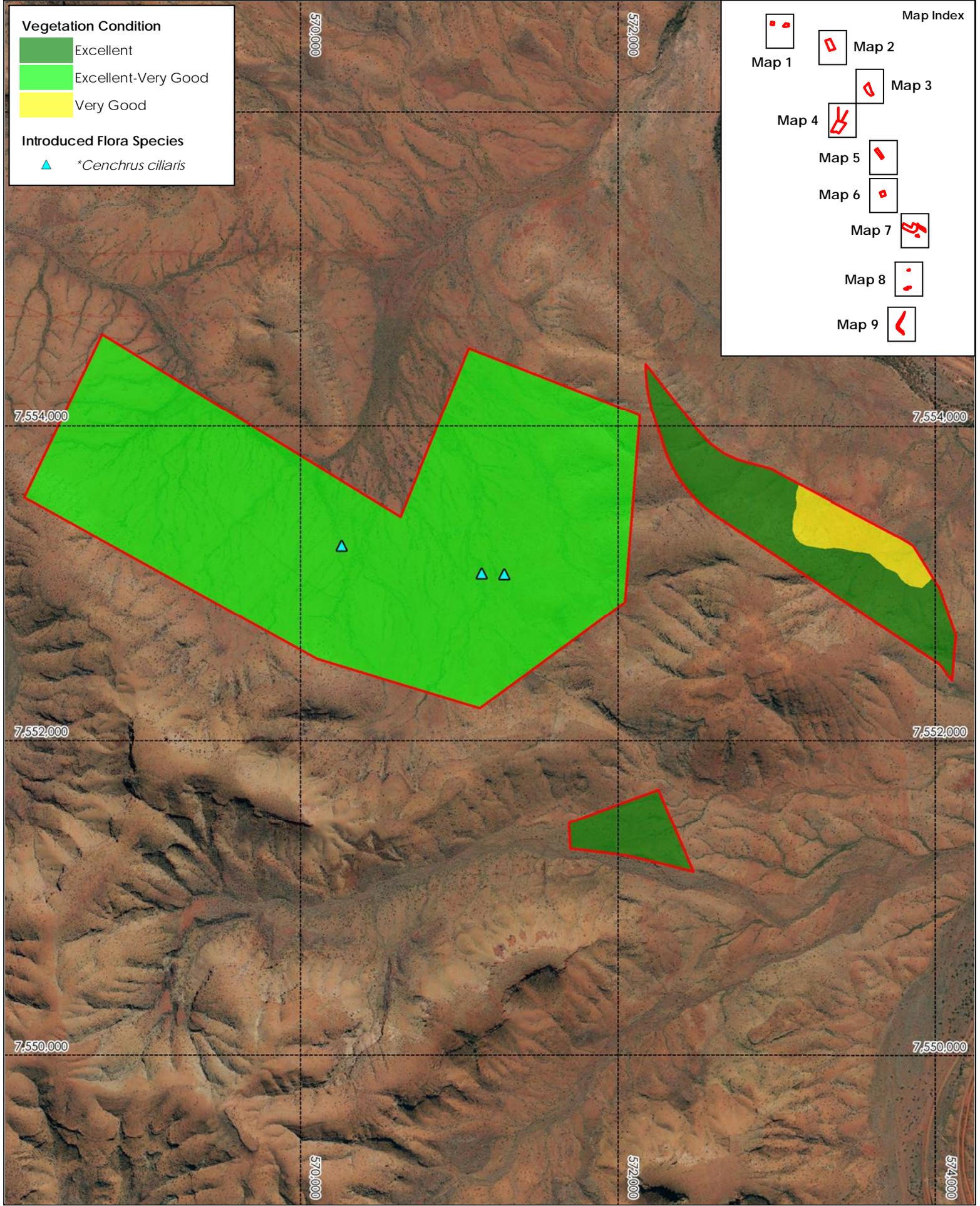
Vegetation Condition

- Excellent
- Excellent-Very Good
- Very Good

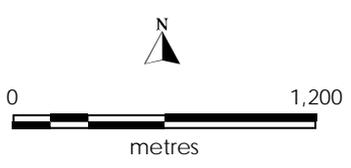
Introduced Flora Species

- **Cenchrus ciliaris*

Map Index

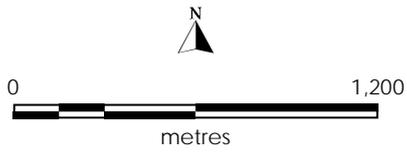
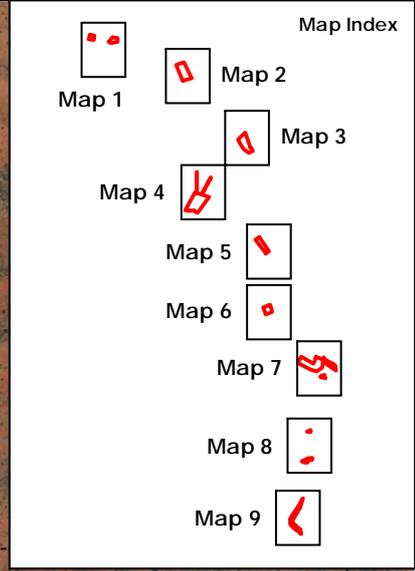
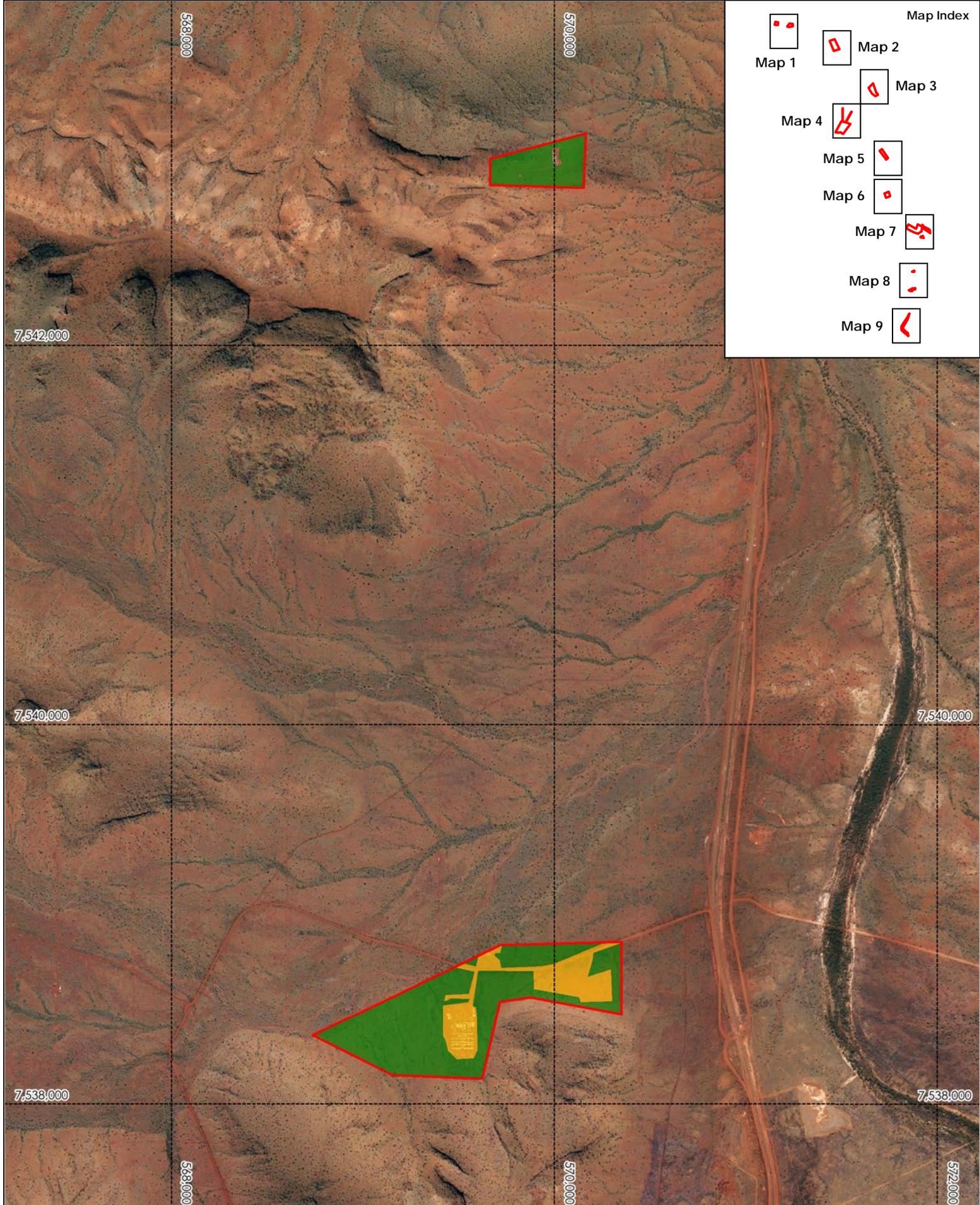


Survey area



**Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Vegetation Condition Map 7**





**Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Vegetation Condition Map 8**

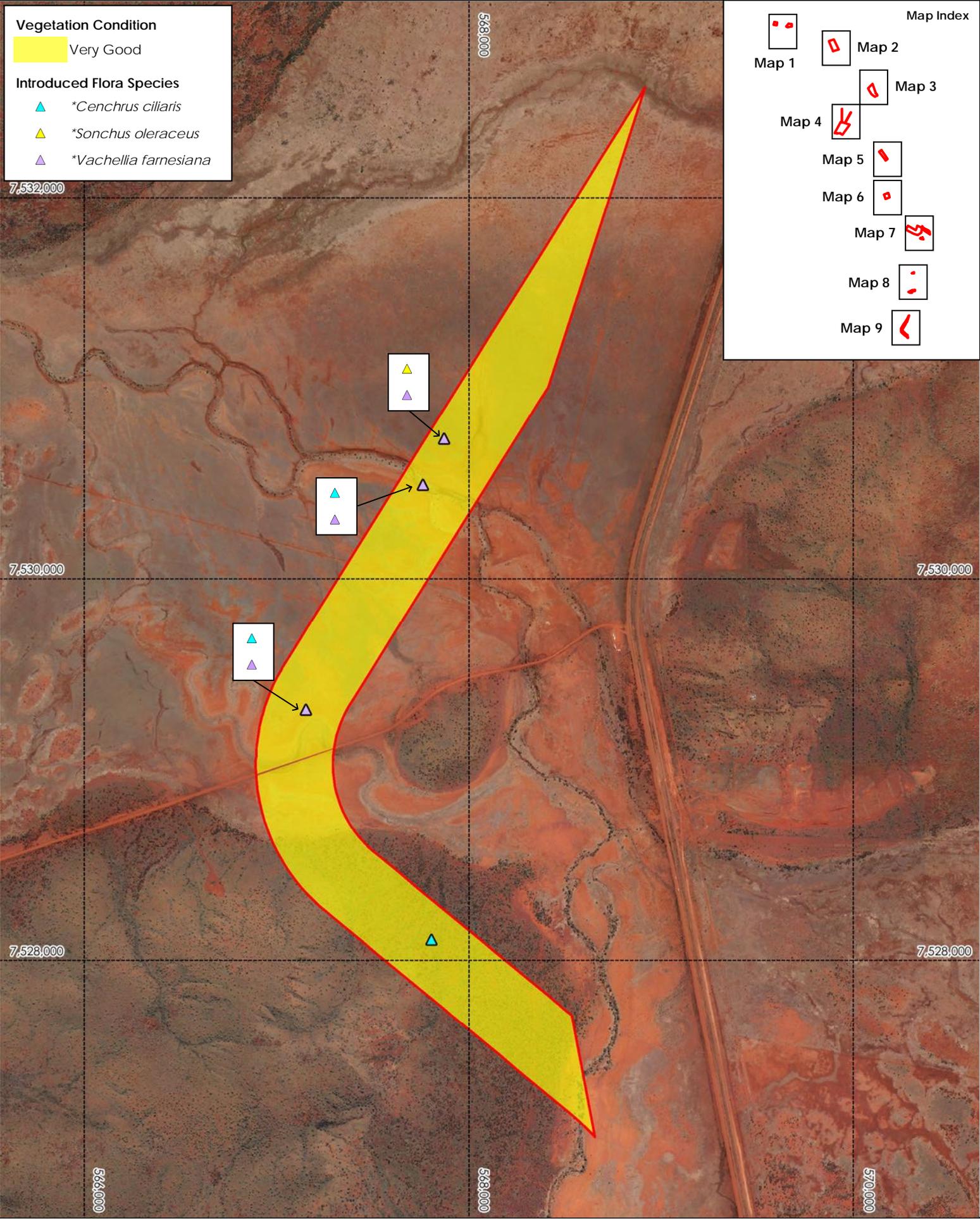
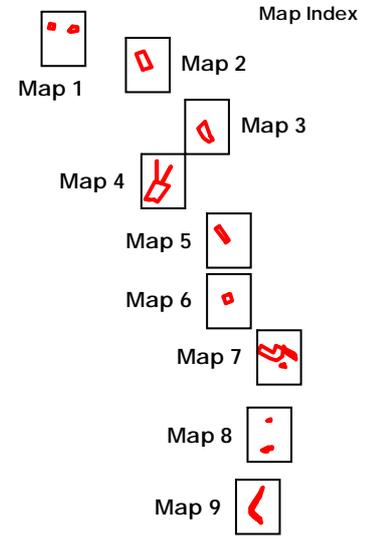


Vegetation Condition

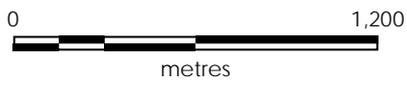
Very Good

Introduced Flora Species

- ▲ **Cenchrus ciliaris*
- ▲ **Sonchus oleraceus*
- ▲ **Vachellia farnesiana*



Survey area



**Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Vegetation Condition Map 9**



Appendix 7

Likelihood of Occurrence of Significant Flora



Taxon	Habit (Florabase)	Habitat (Florabase)	Database Searches (inc DBCA, WA Herbarium; as supplied by Main Roads in 2020)	Previous Surveys‡					Likelihood of Occurrence in the Survey Area	
				Manuwarra Hwy	Eliwana	Bellbird-Juna	Koodaideri Int.	Nanutarra Munjina	Initial Ranking Based on Desktop Review (NR = nearest record; SA = survey area)	Final Ranking After Field Survey
Threatened										
<i>Seringia exastia</i>	Erect or compact shrub to 90 cm tall. Hairy stems and leaves, prominent venation and purple calyx.	Relict desert dune swales in deep red sand (Pindan soil), <i>Triodia</i> hummock grassland and dominant <i>Acacia</i> shrubland.	-	✓	-	-	-	✓	May occur. Suitable habitat present and four records from the main project corridor (Biota 2021) in close proximity. NR 750 m N of central polygon.	May occur.
Priority 1										
<i>Bothriochloa decipiens</i> var. <i>cloncurrensis</i>	Perennial grass to 1.4 m tall.	Seasonally damp depressions, clay plains.	✓	-	-	-	-	-	Unlikely to occur. Some suitable habitat present however this species is infrequently recorded in the locality and there are no records in close proximity. NR 39 km S of the southern-most polygon of SA.	Unlikely to occur.
<i>Calotis squamigera</i>	Procumbent annual daisy to 20 cm tall.	Pebbly loam.	✓	-	✓	✓	-	-	May occur. Some suitable habitat present; infrequently recorded but this species is difficult to find due to its small annual growth form. Nearest vouchered record 46 km SE of the southern-most SA polygon of SA, but also recorded during previous surveys at Bellbird-Juna Downs (Biota 2008b) and Eliwana (Biota 2018).	May occur.
<i>Eucalyptus lucens</i>	Mallee to 4.5 m tall.	Ironstone; rocky slopes and mountain tops, high in the landscape.	✓	-	-	-	-	-	Would not occur; no suitable habitat present and infrequently recorded in the locality. NR 40 km SSE of the southern-most polygon of SA.	Would not occur.
<i>Helichrysum oligochaetum</i>	Erect annual daisy to 25 cm tall.	Red clay on alluvial plains.	✓	-	✓	-	-	-	May occur; some suitable habitat present. NR 4 km W of the southern-most polygon of SA.	May occur.
<i>Hibiscus</i> sp. Mt Brockman (E. Thoma ET 1354)	Erect shrub to 2.5 m tall.	Creek lines, gullies, hilltops, hill slopes.	✓	✓	✓	-	-	-	Unlikely to occur; suitable habitat does not appear to be present. Nearest vouchered record 21 km W of the southern-most polygon of SA; seven records also made during the Manuwarra Hwy corridor survey (Biota 2021), with the closest being approximately 4.5 km from the SA.	Unlikely to occur; no suitable habitat.
<i>Josephinia</i> sp. Woodstock (A.A. Mitchell PRP 989)	Woolly-stemmed perennial shrub to 0.5 m.	Rocky creek lines and plains.	-	✓	-	-	-	-	May occur; some suitable habitat present. While nearest vouchered records are approximately 130 km NNE of SA, this species was recorded from one location along the Manuwarra Hwy corridor (Biota 2021) from Mulga vegetation, approximately 7 km from the closest polygon of the SA.	May occur.
<i>Tetradlea butcheriana</i>	Small sub-shrub.	Northeast-facing cliff faces and breakaways.	✓	-	-	-	-	-	Unlikely to occur; no suitable habitat likely to be present and species has not previously been recorded in the locality. NR 30 km SW of southern-most polygon of SA.	Would not occur; no suitable habitat.
Priority 2										
<i>Aristida lazariadis</i>	Tufted perennial grass.	Sand or loam substrates on plains and foothills.	-	✓	-	-	-	-	Likely to occur. Suitable habitat present and was recorded opportunistically in the Manuwarra Hwy corridor (Biota 2021), in the foothills of the Hamersley Range. NR 3 km E of southern polygons of SA.	May occur.
<i>Adiantum capillus-veneris</i>	Rhizomatous, perennial fern to 20 cm tall.	Moist, sheltered sites in gorges and on cliff walls.	✓	-	-	-	-	-	Would not occur; no suitable habitat. NR 31 km E of the southern polygons of the SA.	Would not occur.
<i>Cladium procerum</i>	Densely tufted perennial sedge.	Perennial pools.	✓	-	-	-	-	-	Would not occur; no suitable habitat. NR 30 km NNW from the northern-most SA polygon.	Would not occur.
<i>Euphorbia inappendiculata</i> var. <i>inappendiculata</i>	Prostrate annual herb.	Cracking clay plains.	✓	✓	✓	-	-	-	Likely to occur; some suitable habitat in the southern section of SA. Nearest vouchered record 30 km E of the southern-most SA polygon. Five records (127 individuals) also made in the Manuwarra Hwy corridor (Biota 2021), from cracking clay and stony plains; NR 470 m E of northern SA polygon.	May occur.

Taxon	Habit (Florabase)	Habitat (Florabase)	Database Searches (inc DBCA, WA Herbarium; as supplied by Main Roads in 2020)	Previous Surveys‡					Likelihood of Occurrence in the Survey Area	
				Manuwarra Hwy	Eliwana	Bellbird-Juna	Koodaideri Int.	Nanutarra Munjina	Initial Ranking Based on Desktop Review (NR = nearest record; SA = survey area)	Final Ranking After Field Survey
<i>Euphorbia inappendiculata</i> var. <i>queenslandica</i>	Prostrate annual herb.	Dark reddish brown cracking clay plains.	✓	✓	✓	-	-	✓	Likely to occur; some suitable habitat in the southern section of SA. Nearest vouchered record is 5 km SSW of SA. Also recorded from seven quadrats in the Manuwarra Hwy corridor (Biota 2021) from various habitats; NR 250 m from SA.	Recorded. Recorded opportunistically in the Tom Price realignment area.
<i>Gompholobium karjini</i>	Shrub with coarsely fibrous, grey bark, growing to 70 cm tall.	Red-brown loam. Rocky hill tops, hill sides.	✓	-	✓	-	-	-	Unlikely to occur; recorded at several locations in the locality but limited suitable habitat likely to be present in the SA. NR is 6 km NE of SA.	Unlikely to occur; no suitable habitat.
<i>Hibiscus</i> sp. Gurinbidy Range (M.E. Trudgen MET 15708)	Tall spindly shrub.	Crests and upper slopes of hills.	✓	-	-	-	-	-	Unlikely to occur; no suitable habitat appears to be present, and species is infrequently recorded in the locality. NR 40 km S of the southern-most SA polygon.	Unlikely to occur; no suitable habitat.
<i>Indigofera ixocarpa</i>	Shrub to 1 m tall.	Skeletal red soils over massive ironstone.	✓	-	-	-	-	-	Unlikely to occur, no particularly suitable habitat present in SA. NR 39 km S of the southern-most SA polygon.	Unlikely to occur; no suitable habitat.
<i>Ipomoea racemigera</i>	Annual creeper with white flowers.	Creeklines and floodplains.	✓	-	✓	-	-	✓	Unlikely to occur; no particularly suitable habitat appears present in the SA. NR 31 km NNW of the northern-most SA polygon.	Unlikely to occur.
<i>Oxalis</i> sp. Pilbara (M.E. Trudgen 12725)	Annual herb.	Hillslopes and gorges on loam.	✓	-	-	-	-	-	Unlikely to occur; no suitable habitat appears present in the SA. NR 38 km SW of southern-most SA polygon.	Unlikely to occur.
<i>Paspalidium retiglume</i>	Tufted annual grass to 0.5 m tall.	Clay.	✓	-	-	-	-	-	May occur; some suitable habitat present but infrequently recorded. NR 6.5 km N of a northern SA polygon.	May occur.
<i>Pentalepis trichodesmoides</i> subsp. <i>hispida</i>	Erect perennial shrub to 1 m tall.	Skeletal red-brown gravelly loam. Hilltops, hill slopes, creeklines.	✓	-	✓	-	-	-	May occur; some suitable habitat likely to be present. NR 19 km N of northern-most SA polygon.	Unlikely to occur; limited suitable habitat and not recorded during field survey.
<i>Scaevola</i> sp. Hamersley Range basalts (S. van Leeuwen 3675)	Shrub to 1 m tall.	Skeletal, brown gritty soil over basalt. Summits of hills, steep hills.	✓	-	-	-	-	-	Unlikely to occur; no particularly suitable habitat appears present in the SA. NR 20 km SE of southern-most SA polygon.	Unlikely to occur.
<i>Teucrium pilbaranum</i>	Low perennial herb or shrub.	Clay, floodplains, margins of calcrete.	✓	-	-	-	-	-	May occur; some suitable habitat in the S section of the SA. NR 11 km E of the southern polygons of the SA.	Unlikely to occur; not recorded during field survey.
Priority 3										
<i>Acacia daweana</i>	Spreading shrub to 2 m tall.	Stony red loamy soils. Low rocky rises, along drainage lines.	✓	-	-	-	-	-	Unlikely to occur; limited suitable habitat present and this species is infrequently recorded in the locality. NR 49 km SE of the southern-most SA polygon.	Unlikely to occur.
<i>Acacia effusa</i>	Low, dense, spreading, somewhat viscid shrub to 1 m tall.	Stony red loam. Scree slopes of low ranges.	✓	-	-	-	-	-	Unlikely to occur; limited suitable habitat present in the SA and this species is infrequently recorded in the locality. NR 50 km SE of the southern-most SA polygon.	Unlikely to occur.
<i>Aristida jerichoensis</i> var. <i>subspinulifera</i>	Compactly tufted perennial grass to 0.8 m tall; lemma groove muricate.	Hardpan plains.	✓	✓	✓	-	-	-	May occur; some suitable habitat likely to be present in the SA. NR 24 km WSW of the southern-most SA polygon. Also recorded in the Manuwarra Hwy Corridor (Biota 2021), approximately 3 km S of the southern-most SA polygon.	Unlikely to occur; no particularly suitable habitat and not recorded during field survey.
<i>Astrebla lappacea</i>	Tufted perennial grass to 0.8 m tall.	Clay, loam.	✓	✓	✓	✓	-	-	Likely to occur; some suitable habitat in the S part of the SA. Nearest vouchered record from 3 km S of a southern SA polygon; five records also made within the southern section of the Manuwarra Hwy survey (Biota 2021), NR 500 m east of SA.	Recorded. Recorded once as a dominant grass at MRO12 in the Tom Price realignment area.
<i>Cyanthillium gracile</i>	Perennial herb to 40 cm tall.	Skeletal red gritty soil over ironstone.	-	-	✓	-	-	-	Unlikely to occur; no particularly suitable habitat in the SA. Species was recorded in the MSA during the Eliwana survey (Biota 2018).	Unlikely to occur.
<i>Dampiera anonyma</i>	Multi-stemmed perennial herb to 1 m tall.	Hill summits, upper slopes (above 1,000 m).	✓	-	-	-	-	-	Would not occur; no suitable habitat in the SA. NR is summit of Mt Sheila, 7.5 km W from the S section polygons of the SA.	Would not occur.

Taxon	Habit (Florabase)	Habitat (Florabase)	Database Searches (inc DBCA, WA Herbarium; as supplied by Main Roads in 2020)	Previous Surveys‡					Likelihood of Occurrence in the Survey Area	
				Manuwarra Hwy	Eliwana	Bellbird-Juna	Koodaideri Int.	Nanutarra Munjina	Initial Ranking Based on Desktop Review (NR = nearest record; SA = survey area)	Final Ranking After Field Survey
<i>Dolichocarpa</i> sp. Hamersley Station (A.A. Mitchell PRP 1479)	Spreading annual herb to 10 cm tall.	Cracking clay plains.	✓	✓	✓	-	✓	✓	Likely to occur; suitable habitat present, particularly in the S section of the SA, and recorded frequently in the locality, including nine records from the Manuwarra Hwy corridor (Biota 2021). NR 300 m E of the southern-most SA polygon.	Recorded. Recorded once at MRO04 in the northern borrow pits.
<i>Eragrostis crateriformis</i>	Annual grass to 40 cm tall.	Clayey loam or clay. Creek banks, depressions.	✓	-	-	-	-	-	Unlikely to occur; some suitable habitat present, but NR is 37 km N of the northern-most SA polygon and there are no other records nearby.	Unlikely to occur.
<i>Eragrostis surreyana</i>	Tufted annual grass to 15 cm tall.	Seasonally wet, shallow, grey alluvial soils over rock; some records from deeper soils in seasonal drainage areas.	✓	-	✓	-	-	-	Unlikely to occur, no particularly suitable habitat likely to be present. NR 1.5 km E of the southern polygons of SA.	Unlikely to occur.
<i>Eremophila magnifica</i> subsp. <i>velutina</i>	Shrub to 1.5 m tall.	Skeletal soils over ironstone. Summits.	✓	-	✓	-	-	-	Unlikely to occur; limited suitable habitat present in the SA. NR 4 km E of the central SA polygons.	Unlikely to occur; not recorded during the field survey.
<i>Euphorbia australis</i> var. <i>glabra</i>	Prostrate annual herb.	Moderately drained, red clay loam. Extensive sub-saline flats.	✓	✓	✓	-	-	✓	Likely to occur; suitable habitat present in the S section of SA. Nearest vouchered record 3 km S of the southern SA polygons; also recorded 28 times in the Manuwarra Hwy corridor (Biota 2021), NR 350 m E.	Likely to occur.
<i>Fimbristylis sieberiana</i>	Shortly rhizomatous, tufted perennial sedge to 0.6 m tall.	Mud, skeletal soil pockets. Pool edges, sandstone cliffs.	✓	-	-	-	-	-	Would not occur; no suitable habitat present. NR 31 km E of the SA.	Would not occur.
<i>Geijera salicifolia</i>	Tree to 6 m tall.	Skeletal soils, stony soils. Massive rock scree, gorges.	✓	-	-	-	-	-	Would not occur; no suitable habitat present. NR 32 km S of southern-most SA polygon.	Would not occur.
<i>Glycine falcata</i>	Mat-forming perennial herb to 20 cm tall.	Black clayey sand. Along drainage depressions in crabhole plains on river floodplains.	✓	✓	✓	-	-	✓	Likely to occur; suitable habitat in the S section of SA and several records in locality. Nearest vouchered record is 14 km E of SA but eight records also made from Manuwarra Hwy corridor (Biota 2021), the closest being 600 m from southern SA polygons.	Likely to occur. Recorded once opportunistically just outside the boundary of the survey area (northern tip of the Tom Price realignment).
<i>Goodenia</i> sp. East Pilbara (A.A. Mitchell PRP 727)	Open, erect annual or biennial herb to 20 cm tall.	Red-brown clay soil, calcrete pebbles. Low undulating plain, swampy plains.	✓	-	✓	-	✓	✓	May occur; limited suitable habitat likely to be present, but NR 1.6 km E of southern polygons of SA.	Unlikely to occur; no particularly suitable habitat.
<i>Grevillea saxicola</i>	Shrub or tree growing to 7 m tall.	Skeletal red-brown sandy loam. Steep slopes, rocky hills, ridges.	✓	-	✓	-	-	-	Unlikely to occur; limited suitable habitat in the SA. NR 30 km S of the southern-most SA polygon.	Unlikely to occur; not recorded during field survey.
<i>Gymnanthera cunninghamii</i>	Erect shrub to 2 m tall.	Sandy soils in major drainages.	✓	✓	-	-	✓	-	Unlikely to occur; limited suitable habitat present and infrequently recorded. Nearest vouchered record 30 km S of the southern-most SA polygon; also recorded in the Manuwarra Hwy corridor (Biota 2021), 3 km NW of northern SA polygon.	Unlikely to occur.
<i>Indigofera gilesii</i>	Spindly shrub to 1.5 m tall.	Pebbly loam amongst boulders and outcrops, hills.	-	-	✓	-	-	-	May occur; some suitable habitat present. Species was recorded at Eliwana (Biota 2018).	Unlikely to occur; not recorded during field survey.
<i>Indigofera rivularis</i>	Erect shrub to 2 m tall.	Drainage lines.	✓	-	✓	-	-	-	May occur; some suitable habitat present. NR 21 km W of the southern polygons of the SA.	Unlikely to occur; not recorded during field survey.
<i>Iotasperma sessilifolium</i>	Erect annual daisy.	Cracking clay plains.	✓	-	✓	-	-	✓	May occur; suitable habitat in the S of the SA and several records in the locality. NR 5 km W of the southern-most polygon of SA.	May occur.
<i>Olearia mucronata</i>	Densely branched, unpleasantly aromatic shrub to 1 m tall.	Schistose hills, along drainage channels.	✓	-	-	-	-	-	Unlikely to occur; no particularly suitable habitat in the SA. NR 42 km S of the southern-most SA polygon.	Unlikely to occur.
<i>Owenia acidula</i>	Tree to 8 m tall.	Clay.	✓	-	-	-	-	-	Unlikely to occur; some suitable habitat in the S of the SA, but species is infrequently recorded. NR 30 km WNW of the northern-most SA polygon.	Unlikely to occur.

Taxon	Habit (Florabase)	Habitat (Florabase)	Database Searches (inc DBCA, WA Herbarium; as supplied by Main Roads in 2020)	Previous Surveys‡					Likelihood of Occurrence in the Survey Area	
				Manuwarra Hwy	Eilwana	Bellbird-Juna	Koodaideri Int.	Nanutarra Munjina	Initial Ranking Based on Desktop Review (NR = nearest record; SA = survey area)	Final Ranking After Field Survey
<i>Ptilotus subspinescens</i>	Compact shrub to 0.8 m tall.	Gentle rocky slopes, screes and the bases of screes, usually on calcareous soils.	✓	-	✓	-	-	-	Unlikely to occur; suitable habitat does not appear to be present. Several records in the locality; NR 14 km SE of the southern-most SA polygon.	Unlikely to occur; not recorded during the field survey.
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)	Slender spindly chenopod shrub to 2 m tall.	Hardpan plains and stony plains, typically associated with mulga.	✓	✓	✓	✓	-	✓	May occur. Some suitable habitat in the survey area; several vouchered records in locality and recorded nine times in S section of Manuwarra Hwy corridor (Biota 2021). NR 1.5 km SW of central polygons.	Unlikely to occur; not recorded during field survey.
<i>Rostellularia adscendens</i> var. <i>latifolia</i>	Perennial herb or low shrub to 30 cm tall.	Various habitats, including ironstone soils near creeks, rocky hills.	✓	-	✓	✓	✓	✓	May occur; suitable habitat present; several records in the locality but infrequently recorded. NR 12 km E of the southern-most SA polygon.	May occur.
<i>Sida</i> sp. Hamersley Range (K. Newbey 10692)	Low shrub.	Skeletal stony soils on rocky hills, breakaways.	✓	✓	-	-	-	-	Unlikely to occur; no suitable habitat present. Nearest voucher 15 km W of the central SA polygons. Also recorded 19 times within the Manuwarra Hwy corridor (Biota 2021), the closest record being 2.6 km SW of a southern SA polygon.	Unlikely to occur.
<i>Solanum albostellatum</i>	Low perennial herb or shrub.	Red-brown cracking clay. Open floodplains, crabholed plains.	✓	-	✓	-	-	-	May occur; suitable habitat in the S of the SA. NR 8 km S of the northern-most SA polygon.	Unlikely to occur; not recorded during field survey.
<i>Solanum kentrocaule</i>	Erect shrub.	Basalt scree, gorges, slopes and crests of hills.	✓	-	-	-	-	-	Unlikely to occur; limited suitable habitat and species is infrequently recorded in the locality. NR 40 km S of the southern-most SA polygon.	Unlikely to occur.
<i>Solanum</i> sp. Red Hill (S. van Leeuwen et al. PBS 5415)	Perennial, upright or spreading resinous shrub to 0.3 m tall.	Hillslopes, summits or gorges.	✓	-	-	-	-	-	Unlikely to occur; no suitable habitat and species is infrequently recorded in locality. NR 29 km E of the SA.	Unlikely to occur.
<i>Stackhousia clementii</i>	Dense broom-like perennial herb to 0.45 m tall.	Skeletal soils, hills.	✓	-	✓	-	-	-	Unlikely to occur; limited suitable habitat present in the SA and species is infrequently recorded. NR 5 km E of the SA.	Unlikely to occur.
<i>Streptoglossa</i> sp. Cracking clays (S. van Leeuwen et al. PBS 7353)	Annual, multi-stemmed herb with pink flowers.	Cracking clay, damp areas, floodplains.	-	✓	-	-	-	✓	Likely to occur; suitable habitat in the S of the SA. No vouchered records within 150 km of the SA, however taxon has only recently been distinguished; recorded from six locations on cracking clay in the Manuwarra Hwy corridor (Biota 2021), and six locations along the Nanutarra-Munjina Rd corridor, the closest being 360 m E of the SA.	Recorded. Recorded opportunistically at two locations in the Tom Price realignment area.
<i>Swainsona thompsoniana</i>	Small erect annual herb.	Cracking clay plains.	✓	✓	✓	-	-	✓	Likely to occur; suitable habitat in the S of the SA, and several records in close proximity. Nearest voucher 1.3 km W of southern-most SA polygon. Also recorded in the Manuwarra Hwy corridor (Biota 2021); NR 200 m E of the northern SA polygon.	Recorded. Recorded at one location in the Tom Price realignment area: MRO12.
<i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431)	Perennial tussock grass to 1.8 m tall.	Red clay (often cracking) in clay pans and on plains, sometimes along creeklines.	✓	✓	✓	-	✓	-	Likely to occur; suitable habitat in the S of the SA, and several records in the locality; a dominant species in the nearby Themeda grasslands TEC. Nearest voucher 1 km E of the SA; also recorded 20 times in the Manuwarra Hwy corridor (Biota 2021) with the closest record being 340 m from SA.	Recorded. Recorded opportunistically at two locations in the Tom Price realignment area.
<i>Triodia basitricha</i>	Hummock grass.	Rocky hillslopes and gravelly lower slopes.	✓	✓	✓	-	-	-	Likely to occur. Recorded once in the Manuwarra Hwy corridor (Biota 2021) and several vouchered records in locality. NR 850 m N of central SA polygons.	Recorded. Recorded four times in the central borrow pits; as a dominant grass at sites MRO01, MRO02, MRO10, and once opportunistically.
<i>Triodia pisoliticola</i>	Hummock grass.	Rocky skeletal slopes and free-faces of mesas and hills.	✓	-	-	-	-	-	Unlikely to occur; no suitable habitat present, and species is infrequently recorded in the locality. NR 30 km E of SA.	Unlikely to occur.
<i>Vittadinia</i> sp. Coondewanna Flats (S. van Leeuwen 4684)	Erect annual herb.	Red sandy clay loam. Plains, low in the landscape.	✓	✓	✓	-	-	-	Likely to occur; suitable habitat in the S of the SA. Nearest vouchered record 13 km SSW of the southern section of SA. Recorded from one location in the southern section of the Manuwarra Hwy corridor (Biota 2021), 9 km W of the southern-most SA polygon.	May occur.

Taxon	Habit (Florabase)	Habitat (Florabase)	Database Searches (inc DBCA, WA Herbarium; as supplied by Main Roads in 2020)	Previous Surveys‡					Likelihood of Occurrence in the Survey Area	
				Manuwarra Hwy	Eliwana	Bellbird-Juna	Koodaideri Int.	Nanutarra Munjina	Initial Ranking Based on Desktop Review (NR = nearest record; SA = survey area)	Final Ranking After Field Survey
Priority 4										
<i>Acacia bromilowiana</i>	Tree or shrub to 12 m tall.	Red skeletal stony loam, orange-brown pebbly, gravel loam, laterite, banded ironstone, basalt. Rocky hills, breakaways, scree slopes, gorges, creek beds.	✓	-	✓	-	-	-	Unlikely to occur; no suitable habitat in the SA, NR 29 km SW of the southern-most SA polygon.	Unlikely to occur.
<i>Bulbostylis burbridgeae</i>	Small tufted annual sedge to 0.25 m tall.	Seepages around granite outcrops and cliff bases.	-	-	-	-	-	✓	Unlikely to occur; no particularly suitable habitat, and species is infrequently recorded in the locality. NR from Nanutarra-Munjina Rd corridor (Biota 2022), 18 km S of the southern-most SA polygon.	Unlikely to occur.
<i>Eremophila magnifica</i> subsp. <i>magnifica</i>	Shrub to 1.5 m tall.	Skeletal soils over ironstone. Rocky screes.	✓	✓	-	-	✓	-	Unlikely to occur; limited suitable habitat present. Species has been recorded numerous times in the locality, including seven times in the Manuwarra Hwy corridor (Biota 2021); NR 3 km SW of southern SA polygon.	Unlikely to occur.
<i>Goodenia berringbinensis</i>	Ascending annual herb with yellow flowers.	Seasonally inundated areas, claypans.	-	✓	-	-	-	-	Unlikely to occur, limited suitable habitat, and no vouchered records in close proximity to the SA. This species was recorded twice (53 individuals) from the Manuwarra Hwy corridor (Biota 2021), 6 km E of the northern SA polygons.	Unlikely to occur.
<i>Lepidium catapycnon</i>	Open, woody perennial shrub to 0.3 m tall.	Skeletal soils. Hillsides.	✓	-	-	-	✓	-	Unlikely to occur; limited suitable habitat, and NR 42 km S of the southern-most SA polygon.	Unlikely to occur.
<i>Livistona alfredii</i>	Tree-like palm.	Permanent pools and watercourses.	✓	-	-	-	-	-	Would not occur, no suitable habitat present in the SA. NR 24 km W of the northern-most SA polygon.	Would not occur.
<i>Ptilotus mollis</i>	Compact perennial shrub to 50 cm tall.	Stony hills and screes.	✓	-	✓	-	✓	-	Unlikely to occur; minimal suitable habitat present and species is infrequently recorded in locality. NR is 45 km SW of southern-most SA polygon.	Unlikely to occur.
<i>Ptilotus trichocephalus</i>	Prostrate, spreading perennial herb.	Sandy soils. Colluvial plains.	✓	-	-	-	-	-	Unlikely to occur; some suitable habitat present, however the species is infrequently recorded in the locality and there are no records in close proximity. NR 33 km E of southern-most SA polygon.	Unlikely to occur.
<i>Rhynchosia bungarensis</i>	Compact, prostrate perennial herb to shrub to 0.5 m tall.	Banks of flow lines, mouth of a gully, valley wall.	✓	-	✓	-	✓	-	Unlikely to occur; no particularly suitable habitat and species is infrequently recorded in the vicinity of the SA. NR 21 km E of southern polygons of SA.	Unlikely to occur.
<i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642)	Low spreading shrub.	Skeletal soils on steep rocky slopes.	✓	-	-	-	✓	✓	Unlikely to occur; no particularly suitable habitat present. Several records in the locality; NR 9 km W of SA.	Unlikely to occur.

‡ Data from the most relevant (e.g., survey area size and location) and most comprehensive previous surveys has been utilised for this purpose.

Biota (2008b). A Vegetation and Flora Survey of the Rio Tinto Rail Duplication - Bellbird Siding to Juna Downs. Unpublished report prepared for Rio Tinto Iron Ore, August 2008, Biota Environmental Sciences, Western Australia.

Biota (2018). Eliwana Consolidated Detailed Flora and Vegetation Phase 2. Unpublished report prepared for Fortescue Metals Group, January 2018, Biota Environmental Sciences, Western Australia.

Biota (2021). Manuwarra - Red Dog Highway Stage 4 Biological Survey. Unpublished report prepared for Main Roads WA, Biota Environmental Sciences, Leederville, Western Australia.

Biota (2022). Nanutarra Munjina Road SLK 211.2 – 307.8: Biological Survey. Unpublished report prepared for Hancock Prospecting Pty Ltd, Biota Environmental Sciences, Leederville, Western Australia.

Appendix 8

List of Vascular Flora Species Recorded by the Current Survey



Family	Species	Status
Acanthaceae	<i>Rostellularia adscendens</i> var. <i>clementii</i>	
Aizoaceae	<i>Trianthema glossostigmum</i>	
Aizoaceae	<i>Trianthema triquetrum</i>	
Aizoaceae	<i>Zaleya galericulata</i>	
Amaranthaceae	<i>Alternanthera nana</i>	
Amaranthaceae	<i>Alternanthera nodiflora</i>	
Amaranthaceae	<i>Amaranthus cuspidifolius</i>	
Amaranthaceae	<i>Amaranthus</i> aff. <i>undulatus</i> (round leaves, short tepals)	
Amaranthaceae	<i>Gomphrena cunninghamii</i>	
Amaranthaceae	<i>Gomphrena kanisii</i>	
Amaranthaceae	<i>Ptilotus astrolasius</i>	
Amaranthaceae	<i>Ptilotus calostachyus</i>	
Amaranthaceae	<i>Ptilotus clementii</i>	
Amaranthaceae	<i>Ptilotus exaltatus</i>	
Amaranthaceae	<i>Ptilotus fusiformis</i>	
Amaranthaceae	<i>Ptilotus gaudichaudii</i>	
Amaranthaceae	<i>Ptilotus gomphrenoides</i>	
Amaranthaceae	<i>Ptilotus helipteroides</i>	
Amaranthaceae	<i>Ptilotus incanus</i>	
Amaranthaceae	<i>Ptilotus obovatus</i> var. <i>obovatus</i>	
Amaranthaceae	<i>Ptilotus polystachyus</i>	
Amaranthaceae	<i>Ptilotus roei</i>	
Amaranthaceae	<i>Ptilotus rotundifolius</i>	
Amaranthaceae	<i>Ptilotus schwartzii</i> var. <i>schwartzii</i>	
Apocynaceae	<i>Vincetoxicum lineare</i>	
Araliaceae	<i>Trachymene oleracea</i> subsp. <i>oleracea</i>	
Asphodelaceae	<i>Bulbine pendula</i>	
Asteraceae	<i>Blumea tenella</i>	
Asteraceae	<i>Calocephalus beardii</i>	
Asteraceae	<i>Calocephalus knappii</i>	
Asteraceae	<i>Calotis hispidula</i>	
Asteraceae	<i>Calotis plumulifera</i>	
Asteraceae	<i>Minuria integerrima</i>	
Asteraceae	<i>Peripleura arida</i>	
Asteraceae	<i>Pterocaulon serrulatum</i> var. <i>velutinum</i>	
Asteraceae	<i>Pterocaulon sphacelatum</i>	
Asteraceae	<i>Roebuckiella similis</i>	
Asteraceae	* <i>Sonchus oleraceus</i>	Weed
Asteraceae	<i>Streptoglossa bubakii</i>	
Asteraceae	<i>Streptoglossa</i> sp. Cracking clays (S. van Leeuwen et al. PBS 7353)	Priority 3
Boraginaceae	<i>Euploca pachyphylla</i>	
Boraginaceae	<i>Trichodesma zeylanicum</i> var. <i>zeylanicum</i>	
Brassicaceae	<i>Lepidium pedicellosum</i>	
Brassicaceae	<i>Lepidium phlebopetalum</i>	
Campanulaceae	<i>Wahlenbergia tumidifruta</i>	
Capparaceae	<i>Capparis spinosa</i> subsp. <i>nummularia</i>	
Capparaceae	<i>Capparis umbonata</i>	
Caryophyllaceae	<i>Polycarpaea holtzei</i>	
Caryophyllaceae	<i>Polycarpaea longiflora</i>	
Chenopodiaceae	<i>Dysphania kalpari</i>	
Chenopodiaceae	<i>Dysphania rhadinostachya</i>	
Chenopodiaceae	<i>Maireana melanocoma</i>	
Chenopodiaceae	<i>Maireana</i> ? <i>planifolia</i>	
Chenopodiaceae	<i>Maireana villosa</i>	
Chenopodiaceae	<i>Salsola australis</i>	

Family	Species	Status
Chenopodiaceae	<i>Sclerolaena bicornis</i> var. <i>bicornis</i>	
Cleomaceae	<i>Arivela viscosa</i>	
Convolvulaceae	<i>Bonamia erecta</i>	
Convolvulaceae	<i>Bonamia pilbarensis</i>	
Convolvulaceae	<i>Duperreya commixta</i>	
Convolvulaceae	<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	
Convolvulaceae	<i>Ipomoea lonchophylla</i>	
Convolvulaceae	<i>Ipomoea muelleri</i>	
Convolvulaceae	<i>Operculina aequisejala</i>	
Convolvulaceae	<i>Polymeria longifolia</i>	
Cucurbitaceae	<i>Cucumis picrocarpus</i>	
Cucurbitaceae	<i>Cucumis variabilis</i>	
Cyperaceae	<i>Bulbostylis barbata</i>	
Cyperaceae	<i>Cyperus hesperius</i>	
Cyperaceae	<i>Cyperus</i> sp. (inadequate material)	
Cyperaceae	<i>Fimbristylis dichotoma</i>	
Cyperaceae	<i>Fimbristylis simulans</i>	
Euphorbiaceae	<i>Euphorbia australis</i> var. <i>subtomentosa</i>	
Euphorbiaceae	<i>Euphorbia careyi</i>	
Euphorbiaceae	<i>Euphorbia ferdinandi</i> var. <i>ferdinandi</i>	
Euphorbiaceae	<i>Euphorbia inappendiculata</i> var. <i>queenslandica</i>	Priority 2
Euphorbiaceae	<i>Euphorbia tannensis</i> subsp. <i>eremophila</i>	
Euphorbiaceae	<i>Euphorbia trigonosperma</i>	
Euphorbiaceae	<i>Euphorbia</i> sp. (<i>boophthona/tannensis</i>)	
Fabaceae	<i>Acacia adoxa</i> var. <i>adoxo</i>	
Fabaceae	<i>Acacia ancistrocarpa</i>	
Fabaceae	<i>Acacia aptaneura</i>	
Fabaceae	<i>Acacia arrecta</i>	
Fabaceae	<i>Acacia atkinsiana</i>	
Fabaceae	<i>Acacia bivenosa</i>	
Fabaceae	<i>Acacia citrinoviridis</i>	
Fabaceae	<i>Acacia colei</i> var. <i>ileocarpa</i>	
Fabaceae	<i>Acacia dictyophleba</i>	
Fabaceae	<i>Acacia elachantha</i>	
Fabaceae	<i>Acacia inaequilatera</i>	
Fabaceae	<i>Acacia</i> ? <i>incurvaneura</i>	
Fabaceae	<i>Acacia macraneura</i>	
Fabaceae	<i>Acacia maitlandii</i>	
Fabaceae	<i>Acacia monticola</i>	
Fabaceae	<i>Acacia orthocarpa</i>	
Fabaceae	<i>Acacia pruinocarpa</i>	
Fabaceae	<i>Acacia ptychophylla</i>	
Fabaceae	<i>Acacia pyrifolia</i> var. <i>pyrifolia</i>	
Fabaceae	<i>Acacia spondylophylla</i>	
Fabaceae	<i>Acacia tenuissima</i>	
Fabaceae	<i>Acacia trachycarpa</i>	
Fabaceae	<i>Acacia tumida</i> var. <i>pilbarensis</i>	
Fabaceae	<i>Acacia victoriae</i>	
Fabaceae	<i>Acacia</i> sp. (inadequate material; possibly aff. <i>sibirica</i>)	
Fabaceae	<i>Crotalaria dissitiflora</i> subsp. <i>benthamiana</i>	
Fabaceae	<i>Crotalaria novae-hollandiae</i> subsp. <i>novae-hollandiae</i>	
Fabaceae	<i>Cullen graveolens</i>	
Fabaceae	<i>Cullen leucochaites</i>	
Fabaceae	<i>Glycine canescens</i>	
Fabaceae	<i>Glycine falcata</i>	Priority 3

Family	Species	Status
Fabaceae	<i>Gompholobium oreophilum</i>	
Fabaceae	<i>Indigofera monophylla</i>	
Fabaceae	<i>Isotropis atropurpurea</i>	
Fabaceae	<i>Lotus cruentus</i>	
Fabaceae	<i>Mirbelia viminalis</i>	
Fabaceae	<i>Neptunia dimorphantha</i>	
Fabaceae	<i>Petalostylis labicheoides</i>	
Fabaceae	<i>Rhynchosia minima</i>	
Fabaceae	<i>Senna artemisioides</i> subsp. <i>oligophylla</i>	
Fabaceae	<i>Senna artemisioides</i> subsp. <i>oligophylla</i> (thinly sericeous form MET 15,035)	
Fabaceae	<i>Senna artemisioides</i> subsp. <i>oligophylla</i> x subsp. <i>helmsii</i>	
Fabaceae	<i>Senna glutinosa</i> subsp. <i>glutinosa</i>	
Fabaceae	<i>Senna glutinosa</i> subsp. <i>glutinosa</i> ? x <i>S. glaucifolia</i>	
Fabaceae	<i>Senna glutinosa</i> subsp. <i>x luerksenii</i>	
Fabaceae	<i>Senna glutinosa</i> subsp. <i>pruinosa</i>	
Fabaceae	<i>Senna hamersleyensis</i>	
Fabaceae	<i>Senna notabilis</i>	
Fabaceae	<i>Senna symonii</i>	
Fabaceae	<i>Senna venusta</i>	
Fabaceae	<i>Swainsona leeana</i>	
Fabaceae	<i>Swainsona thompsoniana</i>	Priority 3
Fabaceae	<i>Tephrosia densa</i>	
Fabaceae	<i>Tephrosia oxalidea</i>	
Fabaceae	<i>Tephrosia rosea</i> var. <i>clementii</i>	
Fabaceae	<i>Tephrosia virens</i>	
Fabaceae	<i>Tephrosia</i> sp. Bungaroo Creek (M.E. Trudgen 11601)	
Fabaceae	* <i>Vachellia farnesiana</i>	Weed
Fabaceae	<i>Vigna</i> sp. Hamersley Clay (A.A. Mitchell PRP 113)	
Goodeniaceae	<i>Dampiera candidans</i>	
Goodeniaceae	<i>Goodenia cusackiana</i>	
Goodeniaceae	<i>Goodenia forrestii</i>	
Goodeniaceae	<i>Goodenia microptera</i>	
Goodeniaceae	<i>Goodenia muelleriana</i>	
Goodeniaceae	<i>Goodenia nuda</i>	
Goodeniaceae	<i>Goodenia stobbsiana</i>	
Goodeniaceae	<i>Goodenia triodiophila</i>	
Goodeniaceae	<i>Scaevola parvifolia</i> (sterile)	
Goodeniaceae	<i>Scaevola parvifolia</i> subsp. <i>parvifolia</i>	
Gyrostemonaceae	<i>Codonocarpus cotinifolius</i>	
Haloragaceae	<i>Haloragis</i> sp. (inadequate material)	
Lamiaceae	<i>Clerodendrum floribundum</i> var. <i>angustifolium</i>	
Lauraceae	<i>Cassytha capillaris</i>	
Loranthaceae	<i>Amyema preissii</i>	
Loranthaceae	<i>Amyema sanguinea</i> var. <i>pulcher</i>	
Loranthaceae	<i>Amyema</i> sp. (? <i>miquelii</i> / <i>sanguinea</i> var. <i>sanguinea</i> ; too high to collect)	
Loranthaceae	<i>Lysiana casuarinae</i>	
Malvaceae	<i>Abutilon cunninghamii</i>	
Malvaceae	<i>Abutilon lepidum</i>	
Malvaceae	<i>Abutilon macrum</i>	
Malvaceae	<i>Abutilon malvifolium</i>	
Malvaceae	<i>Abutilon otocarpum</i>	
Malvaceae	<i>Abutilon</i> sp. Pilbara (W.R. Barker 2025)	
Malvaceae	<i>Corchorus lasiocarpus</i> subsp. <i>lasiocarpus</i>	
Malvaceae	<i>Corchorus tectus</i>	
Malvaceae	<i>Corchorus</i> sp. (inadequate material)	

Family	Species	Status
Malvaceae	<i>Gossypium australe</i>	
Malvaceae	<i>Gossypium robinsonii</i>	
Malvaceae	<i>Hibiscus burtonii</i>	
Malvaceae	<i>Hibiscus coatesii</i>	
Malvaceae	<i>Hibiscus sturtii</i> (inadequate material for further determination)	
Malvaceae	<i>Hibiscus sturtii</i> var. <i>campylochlamys</i>	
Malvaceae	<i>Hibiscus sturtii</i> var. <i>grandiflorus</i>	
Malvaceae	<i>Hibiscus sturtii</i> var. <i>platychlams</i>	
Malvaceae	<i>Hibiscus verdcourtii</i>	
Malvaceae	* <i>Malvastrum americanum</i>	Weed
Malvaceae	<i>Seringia nephrosperma</i>	
Malvaceae	<i>Sida arenicola</i>	
Malvaceae	<i>Sida arsinata</i>	
Malvaceae	<i>Sida cardiophylla</i>	
Malvaceae	<i>Sida echinocarpa</i>	
Malvaceae	<i>Sida fibulifera</i>	
Malvaceae	<i>Sida platycalyx</i>	
Malvaceae	<i>Sida trichopoda</i>	
Malvaceae	<i>Sida</i> sp. Articulation below (A.A. Mitchell PRP 1605)	
Malvaceae	<i>Sida</i> sp. L (A.M. Ashby 4202)	
Malvaceae	<i>Sida</i> sp. Pilbara (A.A. Mitchell PRP 1543)	
Malvaceae	<i>Sida</i> sp. spiciform panicles (E. Leyland s.n. 14/8/90)	
Malvaceae	<i>Triumfetta leptacantha</i>	
Malvaceae	<i>Triumfetta maconochieana</i>	
Malvaceae	<i>Triumfetta propinqua</i>	
Malvaceae	<i>Waltheria indica</i>	
Malvaceae	<i>Waltheria virgata</i>	
Menispermaceae	<i>Tinospora smilacina</i>	
Molluginaceae	<i>Trigastrotheca molluginea</i>	
Moraceae	<i>Ficus brachypoda</i>	
Myrtaceae	<i>Calytrix carinata</i>	
Myrtaceae	<i>Corymbia deserticola</i> subsp. <i>deserticola</i>	
Myrtaceae	<i>Corymbia hamersleyana</i>	
Myrtaceae	<i>Corymbia zygophylla</i>	
Myrtaceae	<i>Eucalyptus gamophylla</i>	
Myrtaceae	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i>	
Myrtaceae	<i>Eucalyptus victrix</i>	
Myrtaceae	<i>Eucalyptus xerothermica</i>	
Nyctaginaceae	<i>Boerhavia paludosa</i>	
Nyctaginaceae	<i>Boerhavia</i> sp. (inadequate material)	
Oleaceae	<i>Jasminum didymum</i> subsp. <i>lineare</i>	
Phrymaceae	<i>Mimulus gracilis</i>	
Phyllanthaceae	<i>Flueggea virosa</i> subsp. <i>melanthesoides</i>	
Phyllanthaceae	<i>Nellica maderaspatensis</i>	
Plantaginaceae	<i>Plantago cunninghamii</i>	
Plantaginaceae	<i>Stemodia grossa</i>	
Plantaginaceae	<i>Stemodia kingii</i>	
Poaceae	<i>Amphipogon sericeus</i>	
Poaceae	<i>Aristida burbridgeae</i>	
Poaceae	<i>Aristida holathera</i> var. <i>holathera</i>	
Poaceae	<i>Aristida inaequiglumis</i>	
Poaceae	<i>Aristida latifolia</i>	
Poaceae	<i>Aristida obscura</i>	
Poaceae	<i>Aristida pruinosa</i>	
Poaceae	<i>Astrelba lappacea</i>	Priority 3

Family	Species	Status
Poaceae	<i>Bothriochloa ewartiana</i>	
Poaceae	* <i>Cenchrus ciliaris</i>	Weed
Poaceae	* <i>Cenchrus setiger</i>	Weed
Poaceae	<i>Chloris pectinata</i>	
Poaceae	<i>Chrysopogon fallax</i>	
Poaceae	<i>Cymbopogon ambiguus</i>	
Poaceae	<i>Dactyloctenium radulans</i>	
Poaceae	<i>Dichanthium sericeum</i> subsp. <i>humilius</i>	
Poaceae	<i>Dichanthium sericeum</i> subsp. <i>sericeum</i>	
Poaceae	<i>Digitaria brownii</i>	
Poaceae	<i>Enneapogon caeruleus</i>	
Poaceae	<i>Enneapogon lindleyanus</i>	
Poaceae	<i>Enneapogon polyphyllus</i>	
Poaceae	<i>Eragrostis eriopoda</i>	
Poaceae	<i>Eragrostis xerophila</i>	
Poaceae	<i>Eriachne aristidea</i>	
Poaceae	<i>Eriachne benthamii</i>	
Poaceae	<i>Eriachne ciliata</i>	
Poaceae	<i>Eriachne mucronata</i>	
Poaceae	<i>Eriachne pulchella</i>	
Poaceae	<i>Eriachne tenuiculmis</i>	
Poaceae	<i>Eulalia aurea</i>	
Poaceae	<i>Iseilema membranaceum</i>	
Poaceae	<i>Iseilema vaginiflorum</i>	
Poaceae	<i>Panicum australiense</i> var. <i>australiense</i>	
Poaceae	<i>Panicum laevinode</i>	
Poaceae	<i>Paraneurachne muelleri</i>	
Poaceae	<i>Paspalidium clementii</i>	
Poaceae	<i>Paspalidium tabulatum</i>	
Poaceae	<i>Schizachyrium fragile</i>	
Poaceae	<i>Sporobolus australasicus</i>	
Poaceae	<i>Themeda triandra</i>	
Poaceae	<i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431)	Priority 3
Poaceae	<i>Tragus australianus</i>	
Poaceae	<i>Triodia basitricha</i>	Priority 3
Poaceae	<i>Triodia epactia</i>	
Poaceae	<i>Triodia wiseana</i>	
Polygalaceae	<i>Polygala glaucifolia</i>	
Portulacaceae	<i>Portulaca oleracea</i>	
Portulacaceae	<i>Portulaca</i> sp. (inadequate material)	
Proteaceae	<i>Grevillea pyramidalis</i> subsp. <i>leucadendron</i>	
Proteaceae	<i>Grevillea wickhamii</i> (sterile)	
Proteaceae	<i>Grevillea wickhamii</i> subsp. <i>hispidula</i>	
Proteaceae	<i>Hakea chordophylla</i>	
Proteaceae	<i>Hakea lorea</i> subsp. <i>lorea</i>	
Pteridaceae	<i>Cheilanthes brownii</i>	
Pteridaceae	<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	
Rubiaceae	<i>Dolichocarpa crouchiana</i>	
Rubiaceae	<i>Dolichocarpa</i> sp. Hamersley Station (A.A. Mitchell PRP 1479)	Priority 3
Rubiaceae	<i>Psyrax suaveolens</i>	
Sapindaceae	<i>Dodonaea coriacea</i>	
Sapindaceae	<i>Dodonaea viscosa</i>	
Scrophulariaceae	<i>Eremophila cuneifolia</i>	
Scrophulariaceae	<i>Eremophila forrestii</i> subsp. <i>forrestii</i>	
Scrophulariaceae	<i>Eremophila latrobei</i> subsp. <i>filiformis</i>	

Family	Species	Status
Solanaceae	<i>Nicotiana benthamiana</i>	
Solanaceae	<i>Nicotiana obliqua</i>	
Solanaceae	<i>Solanum cleistogamum</i>	
Solanaceae	<i>Solanum diversiflorum</i>	
Solanaceae	<i>Solanum elatius</i>	
Solanaceae	<i>Solanum lasiophyllum</i>	
Solanaceae	<i>Solanum piceum</i>	
Violaceae	<i>Afrohybanthus aurantiacus</i>	
Zygophyllaceae	<i>Tribulus hirsutus</i>	
Zygophyllaceae	<i>Tribulus macrocarpus</i>	

Appendix 9

Flora Site Data and Photographs



Manuwarra Red-Dog Stage 4 - Borrow Pits and realignment Areas 2022

Site MRO01

Described by: AL **Date:** 26/04/22 **Type:** Quadrat 50 x 50 m

MGA Zone: 50 S 571258 mE 7553083 mN

Habitat: Braided drainage.

Rock Type: Ironstone.

Vegetation: *Corymbia hamersleyana* low open woodland over *Acacia monticola*, (*Grevillea wickhamii* subsp. *hispidula*) scattered tall shrubs over *Acacia spondylophylla* scattered low shrubs over *Triodia wiseana*, (*T. basitricha*) open hummock grassland.

Veg Condition: Very Good; **Cenchrus ciliaris*.

Fire Age: Burnt 3-5 years ago.

Species	Cover (%)	Height	Specimen	Notes
<i>Acacia monticola</i>	1	260 cm	MRO01-14	
<i>Acacia spondylophylla</i>	0.5	110 cm	MRO01-13	
<i>Afrohybanthus aurantiacus</i>	0.1	25 cm	MRO01-16	
<i>Aristida holathera</i> var. <i>holathera</i>	0.1	30 cm	MRO01-09	
<i>Aristida inaequiglumis</i>	0.1	75 cm	MRO01-03	
* <i>Cenchrus ciliaris</i>	0.1	50 cm		
<i>Corymbia hamersleyana</i>	2.5	450 cm		
<i>Eriachne mucronata</i>	0.1	50 cm	MRO01-08	Typical form.
<i>Eriachne tenuiculmis</i>	0.1	55 cm	MRO01-07	
<i>Euphorbia careyi</i>	0.1	20 cm	MRO01-11	
<i>Goodenia stobbsiana</i>	0.1	10 cm		
<i>Grevillea wickhamii</i> subsp. <i>hispidula</i>	0.5	250 cm	MRO01-12	
<i>Hakea lorea</i> subsp. <i>lorea</i>	0.1	420 cm	MRO01-18	
<i>Indigofera monophylla</i>	0.1	60 cm		
<i>Jasminum didymum</i> subsp. <i>lineare</i>	0.1	230 cm		
<i>Ptilotus astrolasius</i>	0.1	20 cm	MRO01-15	
<i>Ptilotus calostachyus</i>	0.1	120 cm		
<i>Ptilotus fusiformis</i>	0.1	40 cm	MRO01-20	
<i>Rhynchosia minima</i>	0.1	25 cm	MRO01-04	
<i>Senna glutinosa</i> subsp. <i>glutinosa</i>	0.1	175 cm	MRO01-17	
<i>Tephrosia virens</i>	0.1	160 cm	MRO01-19	
<i>Themeda triandra</i>	0.1	60 cm	MRO01-05	
<i>Triodia basitricha</i>	5	25 cm	MRO01-01,6	
<i>Triodia wiseana</i>	18	90 cm	MRO01-02	
<i>Waltheria virgata</i>	0.1	120 cm	MRO01-10	



Site MRO02**Described by:** AL **Date:** 26/04/22 **Type:** Quadrat 50 x 50 m**MGA Zone:** 50 S 572159 mE 7551606 mN**Habitat:** Braided drainage.**Rock Type:** Ironstone.**Vegetation:** *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Triodia basitricha* very open hummock grassland.**Veg Condition:** Excellent. Some possible ripping in southern section of quadrat.**Fire Age:** Burnt 3-5 years ago.**Notes:** Fire scars.

Species	Cover (%)	Height	Specimen	Notes
<i>Acacia adoxa</i> var. <i>adoxo</i>	0.1	30 cm	MRO02-10	
<i>Acacia maitlandii</i>	0.1	120 cm	MRO02-11	
<i>Acacia monticola</i>	0.1	75 cm	MRO01-14=	
<i>Aristida holathera</i> var. <i>holathera</i>	0.1	50 cm		
<i>Bonamia pilbarensis</i>	0.1	5 cm	MRO02-09	
<i>Corchorus lasiocarpus</i> subsp. <i>lasiocarpus</i>	0.1	65 cm	MRO02-08	
<i>Corymbia hamersleyana</i>	0.1	400 cm		
<i>Dampiera candicans</i>	0.1	50 cm		
<i>Dolichocarpa crouchiana</i>	0.1	15 cm	MRO02-01	
<i>Eriachne aristidea</i>	0.1	15 cm	MRO02-07	
<i>Eriachne mucronata</i>	0.1	30 cm	MRO02-06	Typical form.
<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i>	1	490 cm		
<i>Gompholobium oreophilum</i>	0.1	60 cm		
<i>Goodenia stobbsiana</i>	0.1	6 cm		
<i>Grevillea wickhamii</i> subsp. <i>hispidula</i>	0.1	120 cm	MRO01-12=	
<i>Hakea lorea</i> subsp. <i>lorea</i>	0.1	210 cm	MRO01=	
<i>Ptilotus astrolasius</i>	0.1	7 cm	MRO02-13	
<i>Ptilotus calostachyus</i>	0.1	85 cm		
<i>Tephrosia oxalidea</i>	0.1	17 cm	MRO02-12	
<i>Trigastrotheca molluginea</i>	0.1	10 cm		
<i>Triodia basitricha</i>	4	25 cm	MRO02-03,4	
<i>Triodia wiseana</i>	0.1	25 cm	MRO02-02	
<i>Triumfetta maconochieana</i>	0.1	50 cm	MRO02-05	



Site MRO03**Described by:** MMAL **Date:** 05/06/22 **Type:** Quadrat 50 x 50 m**MGA Zone:** 50 S 536361 mE 7603927 mN**Habitat:** Plain; sloping gently to NNW.**Soil:** Dark reddish brown (2.5YR 3/4) sandy clay loam.**Vegetation:** *Corymbia hamersleyana* scattered low trees over *Acacia ancistrocarpa*, (*Hakea lorea* subsp. *lorea*) tall open shrubland over *Triodia epactia* open hummock grassland.**Veg Condition:** Excellent.**Fire Age:** No sign of recent fire.

Species	Cover (%)	Height	Specimen
<i>Acacia ancistrocarpa</i>	2	350 cm	
<i>Acacia coleii</i> var. <i>ileocarpa</i>	0.1	170 cm	MRO03-02
<i>Acacia tenuissima</i>	0.1	140 cm	
<i>Acacia trachycarpa</i>	0.1	210 cm	
<i>Amphipogon sericeus</i>	0.1	45 cm	
<i>Bonamia erecta</i>	0.1	25 cm	
<i>Bonamia pilbarensis</i>	0.1	2 cm	
<i>Corymbia hamersleyana</i>	1.5	600 cm	
<i>Dodonaea coriacea</i>	0.1	105 cm	
<i>Duperreya commixta</i>	0.1	110 cm	
<i>Fimbristylis simulans</i>	0.1	8 cm	MRO03-03
<i>Goodenia stobbsiana</i>	0.1	35 cm	
<i>Grevillea wickhamii</i>	0.1	170 cm	Sterile.
<i>Hakea lorea</i> subsp. <i>lorea</i>	0.5	430 cm	MRO03-01
<i>Ptilotus calostachyus</i>	0.1	140 cm	
<i>Ptilotus exaltatus</i>	0.1	15 cm	
<i>Senna glutinosa</i> subsp. <i>glutinosa</i>	0.1	15 cm	
<i>Seringia nephrosperma</i>	0.1	70 cm	
<i>Triodia epactia</i>	25	85 cm	



Site MRO04**Described by:** MMAL **Date:** 05/06/22 **Type:** Quadrat 50 x 50 m**MGA Zone:** 50 S 540116 mE 7603540 mN**Habitat:** Slightly undulating clay plain with crabholes.**Soil:** Dark red (2.5YR 3/6) medium clay.**Vegetation:** *Triodia wiseana* hummock grassland with *Dichanthium sericeum* subsp. *sericeum* scattered tussock grasses.**Veg Condition:** Excellent.**Fire Age:** No sign of recent fire.

Species	Cover (%)	Height	Specimen	Notes
<i>Acacia bivenosa</i>	0.1	185 cm		
<i>Arivela viscosa</i>	0.1	30 cm		
<i>Boerhavia paludosa</i>	0.1	10 cm	MRO04-11	
<i>Cucumis picrocarpus</i>	0.1	5 cm	MRO04-03	
<i>Dichanthium sericeum</i> subsp. <i>sericeum</i>	1	35 cm	MRO04-12	
<i>Dolichocarpa</i> sp. Hamersley Station (A.A. Mitchell PRP 1479)	0.1	10 cm	MRO04-06	Confirmed by M. Hislop. N=5.
<i>Eragrostis xerophila</i>	0.1	25 cm	MRO04-08	
<i>Fimbristylis dichotoma</i>	0.1	10 cm	MRO04-09	
<i>Hibiscus sturtii</i>	0.1	30 cm	MRO04-10	M. Hislop: var. <i>grandiflorus</i> or var. <i>platychlamsys</i> ; flowers immature.
<i>Neptunia dimorphantha</i>	0.1	20 cm	MRO04-04	
<i>Portulaca</i> sp.	0.1	1 cm		ISM.
<i>Ptilotus exaltatus</i>	0.1	70 cm		
<i>Sida fibulifera</i>	0.1	25 cm	MRO04-05	Sens. lat. dkBot
<i>Sporobolus australasicus</i>	0.1	1 cm		
<i>Stemodia kingii</i>	0.1	20 cm	MRO04-07	
<i>Streptoglossa bubakii</i>	0.1	30 cm		
<i>Triodia wiseana</i>	46	80 cm	MRO04-01	



Site MRO05**Described by:** MMAL **Date:** 06/06/22 **Type:** Quadrat 50 x 50 m**MGA Zone:** 50 S 552363 mE 7577359 mN**Habitat:** Foothlope; sloping gently to NE.**Soil:** Dark reddish brown (2.5YR 2.5/3) light sandy clay loam.**Vegetation:** *Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Acacia atkinsiana* tall shrubland over *Triodia wiseana* open hummock grassland.**Veg Condition:** Excellent.**Fire Age:** Very long unburnt.

Species	Cover (%)	Height	Specimen
<i>Acacia atkinsiana</i>	11	240 cm	
<i>Acacia bivenosa</i>	0.1	120 cm	
<i>Acacia spondylophylla</i>	0.1	110 cm	
<i>Aristida holathera</i> var. <i>holathera</i>	0.1	15 cm	
<i>Dysphania rhadinostachya</i>	0.1	8 cm	
<i>Eriachne mucronata</i>	0.1	35 cm	Typical form.
<i>Eriachne pulchella</i>	0.1	5 cm	
<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i>	2.5	650 cm	
<i>Fimbristylis simulans</i>	0.1	12 cm	
<i>Goodenia stobbsiana</i>	0.1	20 cm	
<i>Hibiscus sturtii</i> var. <i>campylochlamys</i>	0.1	35 cm	MRO05-02
<i>Indigofera monophylla</i>	0.1	40 cm	
<i>Jasminum didymum</i> subsp. <i>lineare</i>	0.1	60 cm	
<i>Ptilotus astrolasius</i>	0.1	30 cm	
<i>Ptilotus calostachyus</i>	0.1	80 cm	
<i>Ptilotus exaltatus</i>	0.1	5 cm	
<i>Senna glutinosa</i> subsp. <i>glutinosa</i>	0.1	110 cm	
<i>Senna glutinosa</i> subsp. <i>pruinosa</i>	0.1	20 cm	
<i>Sida</i> sp. Pilbara (A.A. Mitchell PRP 1543)	0.1	20 cm	MRO05-03
<i>Trianthema glossostigmum</i>	0.1	2 cm	MRO05-01
<i>Triodia wiseana</i>	27	85 cm	

Site MRO06**Described by:** MMAL **Date:** 07/06/22 **Type:** Quadrat 50 x 50 m**MGA Zone:** 50 S 562807 mE 7571562 mN**Habitat:** Broad stony plain to W of moderate drainage line.**Soil:** Dark reddish brown (2.5YR 2.5/4) sandy clay loam.**Rock Type:** Continuous surface layer of ironstone pebbles and stones.**Vegetation:** *Corymbia hamersleyana* low open woodland over *Acacia atkinsiana*, (*A. tumida* var. *pilbarensis*, *Grevillea wickhamii* subsp. *hispidula*, *A. bivenosa*) tall open shrubland over *Triodia epactia* open hummock grassland with *Cassytha capillaris* scattered herbs.**Veg Condition:** Very Good; **Cenchrus ciliaris*.**Fire Age:** No sign of recent fire.

Species	Cover (%)	Height	Specimen	Notes
<i>Abutilon otocarpum</i>	0.1	45 cm		
<i>Abutilon</i> sp. Pilbara (W.R. Barker 2025)	0.1	25 cm		
<i>Acacia ancistrocarpa</i>	0.1	210 cm		
<i>Acacia atkinsiana</i>	2.5	250 cm		
<i>Acacia bivenosa</i>	0.5	300 cm		
<i>Acacia tumida</i> var. <i>pilbarensis</i>	1.5	420 cm		
<i>Alternanthera nana</i>	0.1	20 cm	MRO06-04	
<i>Amphipogon sericeus</i>	0.1	30 cm		
<i>Aristida holathera</i> var. <i>holathera</i>	0.1	50 cm		
<i>Arivela viscosa</i>	0.1	50 cm		
<i>Boerhavia</i> sp.	0.1	10 cm	MRO06-07	ISM.
<i>Cassytha capillaris</i>	0.5	50 cm	MRO06-01	
* <i>Cenchrus ciliaris</i>	0.1	50 cm		N=1.
<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	0.1	25 cm	MRO06-05	
<i>Corchorus tectus</i>	0.1	55 cm	MRO06-06	
<i>Corymbia hamersleyana</i>	3.5	550 cm		
<i>Cucumis variabilis</i>	0.1	50 cm		
<i>Cymbopogon ambiguus</i>	0.1	130 cm	MRO06-08	
<i>Duperreya commixta</i>	0.1	350 cm		
<i>Dysphania rhadinostachya</i>	0.1	10 cm		Dead.
<i>Eriachne pulchella</i>	0.1	15 cm		
<i>Eulalia aurea</i>	0.1	50 cm		
<i>Euphorbia</i> sp. (<i>boophthona/tannensis</i>)	0.1	15 cm		ISM; sterile.
<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	0.1	25 cm		
<i>Goodenia microptera</i>	0.1	10 cm		
<i>Gossypium australe</i>	0.1	80 cm		
<i>Grevillea wickhamii</i> subsp. <i>hispidula</i>	1	420 cm	MRO06-03	
<i>Indigofera monophylla</i>	0.1	70 cm		
<i>Jasminum didymum</i> subsp. <i>lineare</i>	0.1	60 cm		
<i>Lysiana casuarinae</i>	0.1	50 cm		
<i>Paraneurachne muelleri</i>	0.1	40 cm		
<i>Pterocaulon serrulatum</i> var. <i>velutinum</i>	0.1	80 cm		
<i>Pterocaulon sphacelatum</i>	0.1	130 cm		
<i>Ptilotus astrolasius</i>	0.1	50 cm		
<i>Ptilotus calostachyus</i>	0.1	110 cm		
<i>Ptilotus exaltatus</i>	0.1	60 cm		Dead.
<i>Rhynchosia minima</i>	0.1	60 cm		
<i>Senna notabilis</i>	0.1	30 cm		Dead.
<i>Sida echinocarpa</i>	0.1	130 cm		
<i>Sida</i> sp. L (A.M. Ashby 4202)	0.1	20 cm		
<i>Sporobolus australasicus</i>	0.1	1 cm		
<i>Themeda triandra</i>	0.1	70 cm		
<i>Trianthema glossostigmum</i>	0.1	1 cm		
<i>Triodia epactia</i>	25	90 cm		
<i>Vincetoxicum lineare</i>	0.1	80 cm		



Site MRO07**Described by:** MMAL **Date:** 07/06/22 **Type:** Quadrat 50 x 50 m**MGA Zone:** 50 S 563195 mE 7562013 mN**Habitat:** Stony undulating plain; merges down into a fine gravel plain/broad flow area at E edge where goes into the lower-lying areas that have more *Triodia epactia*.**Soil:** Dark reddish brown (5YR 3/4) sandy loam.**Rock Type:** Continuous surface layer of fine ironstone gravel, pebbles and stones.**Vegetation:** *Eucalyptus gamophylla*, *E. leucophloia* subsp. *leucophloia* low open mallee woodland/woodland over *Acacia atkinsiana* tall open shrubland over *Acacia spondylophylla* scattered shrubs over *Triodia wiseana*, (*T. epactia*) open hummock grassland.**Veg Condition:** Excellent.**Fire Age:** No sign of recent fire.

Species	Cover (%)	Height	Specimen	Notes
<i>Acacia adoxa</i> var. <i>adoxo</i>	0.1	55 cm		
<i>Acacia ancistrocarpa</i>	0.1	120 cm		
<i>Acacia atkinsiana</i>	5	300 cm		
<i>Acacia bivenosa</i>	0.1	170 cm		
<i>Acacia dictyophleba</i>	0.1	220 cm		
<i>Acacia inaequilatera</i>	0.1	210 cm		
<i>Acacia spondylophylla</i>	0.5	110 cm		
<i>Acacia trachycarpa</i>	0.1	160 cm		
<i>Acacia</i> sp.	0.1	80 cm	MRO07-02	M. Hislop: inadequate material.
<i>Amphipogon sericeus</i>	0.1	30 cm		
<i>Aristida holathera</i> var. <i>holathera</i>	0.1	50 cm		
<i>Cassytha capillaris</i>	0.1	30 cm	MRO07-01	
<i>Codonocarpus cotinifolius</i>	0.1	170 cm		
<i>Corchorus tectus</i>	0.1	50 cm	MRO06-06=	
<i>Corymbia hamersleyana</i>	0.1	400 cm		
<i>Dodonaea coriacea</i>	0.1	30 cm		
<i>Dysphania rhadinostachya</i>	0.1	15 cm		Dead.
<i>Eriachne mucronata</i>	0.1	25 cm		Typical form.
<i>Eucalyptus gamophylla</i>	1.5	450 cm		
<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i>	1	420 cm		
<i>Eulalia aurea</i>	0.1	50 cm		
<i>Euploca pachyphylla</i>	0.1	10 cm	MRO07-04	
<i>Goodenia microptera</i>	0.1	5 cm		
<i>Goodenia stobbsiana</i>	0.1	30 cm		
<i>Hakea lorea</i> subsp. <i>lorea</i>	0.1	230 cm		
<i>Paraneurachne muelleri</i>	0.1	30 cm		
<i>Ptilotus astrolasius</i>	0.1	40 cm		
<i>Ptilotus calostachyus</i>	0.1	50 cm		
<i>Ptilotus exaltatus</i>	0.1	70 cm		Dead.
<i>Scaevola parvifolia</i>	0.1	10 cm		
<i>Senna artemisioides</i> subsp. <i>oligophylla</i>	0.1	80 cm	MRO07-03	
<i>Senna glutinosa</i> subsp. <i>glutinosa</i>	0.1	140 cm		
<i>Senna glutinosa</i> subsp. <i>pruinosa</i>	0.1	180 cm		
<i>Solanum diversiflorum</i>	0.1	15 cm		
<i>Themeda triandra</i>	0.1	70 cm		
<i>Tribulus hirsutus</i>	0.1	5 cm		
<i>Triodia epactia</i>	5	70 cm		
<i>Triodia wiseana</i>	20	50 cm		
<i>Vincetoxicum lineare</i>	0.1	60 cm		



Site MRO08

Described by: MMAL **Date:** 07/06/22 **Type:** Quadrat 50 x 50 m
MGA Zone: 50 S 570162 mE 7542994 mN
Habitat: Crest of low rocky hill, gentle slope to W.
Soil: Dark reddish brown (2.5YR 2.5/4) sandy clay loam.
Rock Type: Continuous surface layer of ironstone pebbles, stones and some outcropping rocks.
Vegetation: *Eucalyptus leucophloia* subsp. *leucophloia*, *Corymbia hamersleyana* low open woodland over *Triodia wiseana* hummock grassland.
Veg Condition: Very Good.
Fire Age: No sign of recent fire.

Species	Cover (%)	Height	Specimen	Notes
<i>Acacia adoxa</i> var. <i>adoxo</i>	0.1	35 cm		
<i>Acacia orthocarpa</i>	0.1	270 cm	MRO08-01	
<i>Acacia ptychophylla</i>	0.1	70 cm		
<i>Acacia pyrifolia</i> var. <i>pyrifolia</i>	0.1	170 cm		
<i>Acacia tenuissima</i>	0.1	110 cm		
<i>Corchorus lasiocarpus</i> subsp. <i>lasiocarpus</i>	0.1	60 cm	MRO08-03	
<i>Corymbia hamersleyana</i>	1	550 cm		
<i>Dampiera candidans</i>	0.1	50 cm		
<i>Eriachne mucronata</i>	0.1	25 cm		Typical form.
<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i>	1.5	550 cm		
<i>Gompholobium oreophilum</i>	0.1	50 cm		
<i>Goodenia stobbsiana</i>	0.1	10 cm		
<i>Grevillea wickhamii</i> subsp. <i>hispidula</i>	0.1	380 cm	MRO08-02	
<i>Hakea chordophylla</i>	0.1	300 cm		
<i>Ptilotus calostachyus</i>	0.1	110 cm		
<i>Senna glutinosa</i> subsp. <i>glutinosa</i>	0.1	190 cm		
<i>Triodia wiseana</i>	35	45 cm		



Site MRO09

Described by: MM **Date:** 08/06/22 **Type:** Quadrat 25 x 100 m
MGA Zone: 50 S 573202 mE 7553393 mN
Habitat: Moderately steep rocky hillslope, facing NE.
Soil: Dark reddish brown sandy clay loam.
Rock Type: Continuous surface layer of pebbles, stones and considerable outcropping rock.
Vegetation: *Corymbia hamersleyana*, (*Eucalyptus leucophloia* subsp. *leucophloia*) low open woodland over *Triodia wiseana*, (*T. epactia*) open hummock grassland with *Eriachne mucronata* (typical form) scattered tussock grasses.
Veg Condition: Excellent.
Fire Age: No sign of recent fire.

Species	Cover (%)	Height	Specimen	Notes
<i>Acacia monticola</i>	0.1	190 cm		
<i>Arivela viscosa</i>	0.1	50 cm		
<i>Bonamia pilbarensis</i>	0.1	3 cm		
<i>Corymbia hamersleyana</i>	2.5	500 cm		
<i>Cymbopogon ambiguus</i>	0.1	70 cm		
<i>Dampiera candidans</i>	0.1	50 cm		
<i>Dolichocarpa crouchiana</i>	0.1	20 cm		
<i>Eriachne ciliata</i>	0.1	15 cm	MRO09-03	
<i>Eriachne mucronata</i>	0.5	35 cm		Typical form.
<i>Eriachne pulchella</i>	0.1	5 cm		
<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i>	1.5	600 cm		
<i>Euphorbia trigonosperma</i>	0.1	25 cm	MRO09-02	
<i>Fimbristylis dichotoma</i>	0.1	20 cm		
<i>Fimbristylis simulans</i>	0.1	10 cm		
<i>Goodenia stobbsiana</i>	0.1	5 cm		
<i>Goodenia triodiophila</i>	0.1	30 cm		
<i>Grevillea wickhamii</i> subsp. <i>hispidula</i>	0.1	150 cm	MRO09-01	
<i>Hakea chordophylla</i>	0.1	80 cm		
<i>Jasminum didymum</i> subsp. <i>lineare</i>	0.1	60 cm		
<i>Polycarpaea holtzei</i>	0.1	3 cm		
<i>Polycarpaea longiflora</i>	0.1	25 cm		
<i>Ptilotus astrolasius</i>	0.1	50 cm		
<i>Ptilotus calostachyus</i>	0.1	90 cm		
<i>Senna glutinosa</i> subsp. <i>glutinosa</i>	0.1	140 cm		
<i>Sida</i> sp. Articulation below (A.A. Mitchell PRP 1605)	0.1	150 cm		
<i>Tephrosia rosea</i> var. <i>clementii</i>	0.1	80 cm	MRO09-04	
<i>Triodia epactia</i>	3	25 cm		
<i>Triodia wiseana</i>	22	50 cm		



Site MRO10

Described by: AL **Date:** 08/06/22 **Type:** Quadrat 50 x 50 m
MGA Zone: 50 S 570128 mE 7552722 mN
Habitat: Slope off range; gentle N-facing aspect.
Soil: Dark reddish brown (2.5YR 2.5/4) sandy clay loam.
Vegetation: *Corymbia hamersleyana* low open woodland over *Triodia basitricha*,
(*T. wiseana*) open hummock grassland.
Veg Condition: Excellent.
Fire Age: Burnt 3-5 years ago.

Species	Cover (%)	Height	Specimen	Notes
<i>Acacia adoxa</i> var. <i>adoxo</i>	0.1	35 cm		
<i>Acacia inaequilatera</i>	0.1	135 cm		
<i>Acacia maitlandii</i>	0.1	190 cm	ALop40=	
<i>Acacia tenuissima</i>	0.1	160 cm	MRO10-10	
<i>Acacia tumida</i> var. <i>pilbarensis</i>	0.1	175 cm		
<i>Amphipogon sericeus</i>	0.1	25 cm		
<i>Aristida holathera</i> var. <i>holathera</i>	0.1	35 cm	MRO10-04	
<i>Aristida inaequiglumis</i>	0.1	30 cm	MRO10-06	
<i>Bonamia pilbarensis</i>	0.1	3 cm		
<i>Corymbia deserticola</i> subsp. <i>deserticola</i>	0.1	310 cm		Scattered in this veg type.
<i>Corymbia hamersleyana</i>	2.5	650 cm		
<i>Dampiera candicans</i>	0.1	60 cm		
<i>Dodonaea coriacea</i>	0.1	120 cm	MRO10-09	
<i>Eriachne aristidea</i>	0.1	15 cm		
<i>Eriachne mucronata</i>	0.1	30 cm		Typical form.
<i>Euphorbia trigonosperma</i>	0.1	25 cm	MRO10-08	
<i>Gompholobium oreophilum</i>	0.1	90 cm		
<i>Goodenia stobbsiana</i>	0.1	20 cm		
<i>Grevillea pyramidalis</i> subsp. <i>leucadendron</i>	0.1	180 cm		
<i>Grevillea wickhamii</i>	0.1	220 cm		Inadequate material.
<i>Hakea lorea</i> subsp. <i>lorea</i>	0.1	95 cm		
<i>Isotropis atropurpurea</i>	0.1	70 cm	MRO10-02	
<i>Jasminum didymum</i> subsp. <i>lineare</i>	0.1	140 cm		
<i>Ptilotus calostachyus</i>	0.1	80 cm		
<i>Schizachyrium fragile</i>	0.1	20 cm	MRO10-12	
<i>Seringia nephrosperma</i>	0.1	25 cm		
<i>Sida arenicola</i>	0.1	190 cm	MRO10-07	
<i>Tephrosia oxalidea</i>	0.1	10 cm	MRO10-11	
<i>Tephrosia virens</i>	0.1	80 cm	MRO10-05	
<i>Themeda triandra</i>	0.1	75 cm		
<i>Trigastrotheca molluginea</i>	0.1	15 cm		
<i>Triodia basitricha</i>	7	40 cm	MRO10-01,3	
<i>Triodia wiseana</i>	3	60 cm		



Site MRO11**Described by:** AL/MG **Date:** 28/07/22 **Type:** Quadrat 50 x 50 m**MGA Zone:** 50 S 568977 mE 7538414 mN**Habitat:** Gentle NW facing slope off low escarpment.**Soil:** Dark reddish brown (2.5YR 2.5/4) sandy clay loam.**Vegetation:** *Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Grevillea wickhamii* subsp. *hispidula*, *Acacia bivenosa* tall open shrubland over *Senna glutinosa* subsp. *pruinosa* scattered shrubs over *Ptilotus astrolasius* scattered low shrubs over *Triodia wiseana* hummock grassland.**Veg Condition:** Excellent.**Fire Age:** Very long unburnt.

Species	Cover (%)	Height	Specimen	Notes
<i>Abutilon lepidum</i>	0.1	75 cm		
<i>Abutilon otocarpum</i>	0.1	30 cm		
<i>Acacia adoxa</i> var. <i>adoxo</i>	0.1	40 cm		
<i>Acacia atkinsiana</i>	0.5	240 cm		
<i>Acacia bivenosa</i>	1	240 cm		
<i>Acacia elachantha</i>	0.5	250 cm	MRO11-07	
<i>Acacia pyrifolia</i> var. <i>pyrifolia</i>	0.1	260 cm		
<i>Acacia tenuissima</i>	0.1	130 cm		
<i>Afrohybanthus aurantiacus</i>	0.1	20 cm		
<i>Amphipogon sericeus</i>	0.1	50 cm		
<i>Aristida holathera</i> var. <i>holathera</i>	0.5	25 cm		
<i>Aristida latifolia</i>	0.1	120 cm		
<i>Bonamia pilbarensis</i>	0.1	2 cm		
<i>Capparis umbonata</i>	0.1	160 cm	MRO11-09	
<i>Corchorus</i> sp.	0.1	25 cm	MRO11-05	Inadequate material.
<i>Corymbia hamersleyana</i>	0.5	500 cm		
<i>Cymbopogon ambiguus</i>	0.1	60 cm		
<i>Dampiera candidans</i>	0.1	60 cm		
<i>Dysphania rhadinostachya</i>	0.1	5 cm		
<i>Enneapogon lindleyanus</i>	0.1	70 cm		
<i>Enneapogon polyphyllus</i>	0.1	25 cm		
<i>Eriachne aristidea</i>	0.1	20 cm		
<i>Eriachne mucronata</i>	0.1	40 cm		Typical form.
<i>Eriachne pulchella</i>	0.1	10 cm		
<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i>	2	650 cm		
<i>Eucalyptus xerothermica</i>	0.5	450 cm	MRO11-10	
<i>Eulalia aurea</i>	0.1	70 cm	MRO11-11	
<i>Euphorbia tannensis</i> subsp. <i>eremophila</i>	0.1	25 cm	MRO11-01	
<i>Gompholobium oreophilum</i>	0.1	75 cm		
<i>Goodenia cusackiana</i>	0.1	7 cm	MRO11-14	
<i>Goodenia microptera</i>	0.1	15 cm		
<i>Goodenia stobbsiana</i>	0.1	20 cm		
<i>Grevillea wickhamii</i> subsp. <i>hispidula</i>	1	260 cm	MRO11-06	
<i>Hakea lorea</i> subsp. <i>lorea</i>	0.1	50 cm		
<i>Hibiscus sturtii</i> var. <i>campylochlamys</i>	0.1	15 cm	MRO11-03	
<i>Indigofera monophylla</i>	0.1	70 cm		
<i>Jasminum didymum</i> subsp. <i>lineare</i>	0.1	130 cm		
<i>Maireana villosa</i>	0.1	20 cm	MRO11-04	
<i>Paraneurachne muelleri</i>	0.1	60 cm		
<i>Ptilotus astrolasius</i>	1	50 cm		
<i>Ptilotus calostachyus</i>	0.1	140 cm		
<i>Ptilotus exaltatus</i>	0.1	5 cm		
<i>Ptilotus helipteroides</i>	0.1	5 cm		
<i>Scaevola parvifolia</i> subsp. <i>parvifolia</i>	0.1	20 cm	MRO11-13	
<i>Schizachyrium fragile</i>	0.1	10 cm	MRO11-12	
<i>Senna artemisioides</i> subsp. <i>oligophylla</i>	0.1	75 cm	MRO11-02	
<i>Senna artemisioides</i> subsp. <i>oligophylla</i> x subsp.	0.1	150 cm	MRO11-08	

Species	Cover (%)	Height	Specimen	Notes
<i>helmsii</i>				
<i>Senna glutinosa</i> subsp. <i>glutinosa</i>	0.1	190 cm		
<i>Senna glutinosa</i> subsp. <i>pruinosa</i>	1	190 cm		
<i>Sida echinocarpa</i>	0.1	190 cm		
<i>Themeda triandra</i>	0.1	90 cm		
<i>Trachymene oleracea</i> subsp. <i>oleracea</i>	0.1	10 cm		
<i>Trigastrotheca molluginea</i>	0.1	10 cm		
<i>Triodia wiseana</i>	35	75 cm		
<i>Vincetoxicum lineare</i>	0.1	50 cm		



Site MRO12**Described by:** AL/MG **Date:** 28/07/22 **Type:** Quadrat 50 x 50 m**MGA Zone:** 50 S 567855 mE 7530767 mN**Habitat:** Clay plain with crabholes.**Soil:** Dark red (2.5YR 3/6) medium clay.**Vegetation:** *Astrebla lappacea*, (*Iseilema vaginiflorum*) closed tussock grassland with *Sida trichopoda*, *Wahlenbergia tumidifructa*, *Blumea tenella*, *Plantago cunninghamii*, *Rostellularia adscendens* var. *clementii* very open herbland.**Veg Condition:** Excellent.**Fire Age:** No sign of recent fire.

Species	Cover (%)	Height	Specimen	Notes
<i>Abutilon malvifolium</i>	0.1	10 cm	MRO12-09	
<i>Amaranthus cuspidifolius</i>	0.1	5 cm	MRO12-16	
<i>Astrebla lappacea</i>	71	45 cm	MRO12-02	Confirmed by M. Hislop.
<i>Blumea tenella</i>	0.5	20 cm	MRO12-04	
<i>Bulbine pendula</i>	0.1	20 cm	MRO12-07	
<i>Cullen graveolens</i>	0.1	10 cm		
<i>Dichanthium sericeum</i> subsp. <i>humilius</i>	0.1	25 cm	MRO12-18	
<i>Haloragis</i> sp.	0.1	10 cm	MRO12-21	Inadequate material; fruit immature.
<i>Hibiscus verdcourtii</i>	0.1	15 cm	MRO12-23	
<i>Ipomoea lonchophylla</i>	0.1	15 cm		
<i>Iseilema membranaceum</i>	0.1	20 cm	MRO12-19	
<i>Iseilema vaginiflorum</i>	0.5	15 cm	MRO12-05, 17	
<i>Lotus cruentus</i>	0.1	10 cm	MRO12-12	
<i>Nellica maderaspatensis</i>	0.1	20 cm	MRO12-15	
<i>Nicotiana obliqua</i>	0.1	20 cm	KTF127R=	
<i>Operculina aequisepala</i>	0.1	10 cm		
<i>Panicum laevinode</i>	0.1	25 cm	KTF127R=	
<i>Plantago cunninghamii</i>	0.5	15 cm	MRO12-10	
<i>Polymeria longifolia</i>	0.1	20 cm		
<i>Ptilotus gomphrenoides</i>	0.1	5 cm	MRO12-11	
<i>Rhynchosia minima</i>	0.1	10 cm		
<i>Rostellularia adscendens</i> var. <i>clementii</i>	0.5	10 cm	MRO12-24	
<i>Sida fibulifera</i>	0.1	10 cm	MRO12-06	Sens. lat. dkBot
<i>Sida trichopoda</i>	1	25 cm	MRO12-01	
<i>Sonchus oleraceus</i>	0.1	4 cm	MRO12-20	
<i>Stemodia kingii</i>	0.1	15 cm	ALop55=	
* <i>Vachellia farnesiana</i>	0.1	140 cm		
<i>Vigna</i> sp. Hamersley Clay (A.A. Mitchell PRP 113)	0.1	15 cm	MRO12-13, 14	
<i>Wahlenbergia tumidifructa</i>	0.1	15 cm	MRO12-03	



Site MRO13**Described by:** AL/MG **Date:** 29/07/22 **Type:** Quadrat 50 x 50 m**MGA Zone:** 50 S 567794 mE 7528142 mN**Habitat:** Clay plain.**Soil:** Dark reddish brown (2.5YR 2.5/4) light medium clay.**Vegetation:** *Acacia aptaneura*, (*A. pruinocarpa*) low open forest over *Senna glutinosa* subsp. *glutinosa* scattered tall shrubs over *Hibiscus burtonii*, *Ptilotus obovatus*, *Maireana villosa*, *Sida* sp. L (A.M. Ashby 4202) low open shrubland over *Triodia epactia* very open hummock grassland and *Enneapogon polyphyllus* scattered bunch grasses with *Ptilotus helipteroides* scattered herbs.**Veg Condition:** Very Good; **Cenchrus ciliaris*.**Fire Age:** No sign of recent fire.

Species	Cover (%)	Height	Specimen
<i>Abutilon lepidum</i>	0.1	20 cm	
<i>Abutilon macrum</i>	0.1	30 cm	MRO13-0
<i>Abutilon otocarpum</i>	0.1	25 cm	
<i>Acacia ancistrocarpa</i>	0.1	65 cm	
<i>Acacia aptaneura</i>	14	650 cm	MRO13-01
<i>Acacia pruinocarpa</i>	6	650 cm	
<i>Acacia tenuissima</i>	0.1	80 cm	
<i>Aristida latifolia</i>	0.1	35 cm	
<i>Aristida obscura</i>	0.1	25 cm	
<i>Calotis hispidula</i>	0.1	5 cm	MRO13-08
* <i>Cenchrus ciliaris</i>	0.1	35 cm	
<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	0.1	20 cm	
<i>Chrysopogon fallax</i>	0.1	110 cm	
<i>Digitaria brownii</i>	0.1	65 cm	
<i>Duperreya commixta</i>	0.1	160 cm	
<i>Dysphania kalpari</i>	0.1	10 cm	
<i>Dysphania rhadinostachya</i>	0.1	5 cm	
<i>Enneapogon polyphyllus</i>	0.5	25 cm	
<i>Eremophila cuneifolia</i>	0.1	75 cm	
<i>Eremophila forrestii</i> subsp. <i>forrestii</i>	0.1	110 cm	MRO13-05
<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	0.1	10 cm	
<i>Glycine canescens</i>	0.1	220 cm	MRO13-07
<i>Goodenia microptera</i>	0.1	20 cm	
<i>Goodenia muelleriana</i>	0.1	10 cm	
<i>Goodenia nuda</i>	0.1	35 cm	
<i>Hibiscus burtonii</i>	0.5	120 cm	
<i>Hibiscus sturtii</i> var. <i>grandiflorus</i>	0.1	20 cm	MRO13-04
<i>Hibiscus sturtii</i> var. <i>platyklamys</i>	0.1	110 cm	
<i>Indigofera monophylla</i>	0.1	60 cm	
<i>Lepidium phlebopetalum</i>	0.1	2 cm	MRO13-11
<i>Maireana villosa</i>	0.5	25 cm	MRO13-02
<i>Paraneurachne muelleri</i>	0.1	45 cm	
<i>Paspalidium clementii</i>	0.1	10 cm	
<i>Peripleura arida</i>	0.1	20 cm	MRO13-09
<i>Polygala glaucifolia</i>	0.1	2 cm	
<i>Portulaca oleracea</i>	0.1	2 cm	
<i>Psyrax suaveolens</i>	0.1	130 cm	MRO13-06
<i>Ptilotus calostachyus</i>	0.1	90 cm	
<i>Ptilotus exaltatus</i>	0.1	25 cm	
<i>Ptilotus gaudichaudii</i>	0.1	10 cm	MRO13-12
<i>Ptilotus helipteroides</i>	0.5	15 cm	
<i>Ptilotus obovatus</i> var. <i>obovatus</i>	0.5	95 cm	
<i>Ptilotus polystachyus</i>	0.1	20 cm	MRO13-10
<i>Rhynchosia minima</i>	0.1	20 cm	
<i>Senna artemisioides</i> subsp. <i>oligophylla</i>	0.1	25 cm	
<i>Senna glutinosa</i> subsp. <i>glutinosa</i>	1	310 cm	
<i>Senna glutinosa</i> subsp. <i>x luerssenii</i>	0.1	220 cm	

Species	Cover (%)	Height	Specimen
<i>Senna notabilis</i>	0.1	30 cm	
<i>Sida</i> sp. L (A.M. Ashby 4202)	0.5	20 cm	MRO13-03
<i>Solanum lasiophyllum</i>	0.1	35 cm	
<i>Solanum piceum</i>	0.1	70 cm	MGop09
<i>Sporobolus australasicus</i>	0.1	5 cm	
<i>Tragus australianus</i>	0.1	5 cm	KTF127R=
<i>Triodia epactia</i>	6	25 cm	
<i>Vincetoxicum lineare</i>	0.1	35 cm	

No photo.

Site MRO-R01

Described by: AL **Date:** 26/04/22 **Type:** Relevé 20 x 125 m
MGA Zone: 50 S 573330 mE 7553006 mN
Habitat: Shallow gully.
Rock Type: Ironstone.
Vegetation: *Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Aristida burbidgeae* very open tussock grassland.
Veg Condition: Excellent.
Fire Age: No sign of recent fire.

Species	Cover (%)	Height	Specimen	Notes
<i>Aristida burbidgeae</i>	2.5	55 cm	R01-04	
<i>Bulbostylis barbata</i>	0.1	20 cm	R01-10B	
<i>Cymbopogon ambiguus</i>	0.1	75 cm		
<i>Cyperus hesperius</i>	0.1	25 cm	R01-10A	
<i>Enneapogon lindleyanus</i>	0.1	60 cm	R01-07	
<i>Enneapogon polyphyllus</i>	0.1	30 cm	R01-09	
<i>Eriachne ciliata</i>	0.1	25 cm	R01-11	Confirmed by M. Hislop.
<i>Eriachne mucronata</i>	0.1	25 cm		Typical form.
<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i>	3	450 cm		
<i>Euphorbia trigonosperma</i>	0.1	20 cm	R01-08	
<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	0.1	15 cm		
<i>Ficus brachypoda</i>	0.1	400 cm	R01-01	
<i>Flueggea virosa</i> subsp. <i>melanthesoides</i>	0.1	180 cm	R01-02	
<i>Gomphrena cunninghamii</i>	0.1	15 cm	R01-03	
<i>Gossypium robinsonii</i>	0.1	170 cm		
<i>Jasminum didymum</i> subsp. <i>lineare</i>	0.1	150 cm		
<i>Themeda triandra</i>	0.1	40 cm	R01-05	
<i>Tinospora smilacina</i>	0.1	50 cm	R01-06	
<i>Triodia epactia</i>	0.1	30 cm	ALop02=	



Site MRO-R02**Described by:** MM **Date:** 06/06/22 **Type:** Relevé 25 x 100 m**MGA Zone:** 50 S 559403 mE 7588013 mN**Habitat:** Drainage area through plain.**Soil:** Dark reddish brown sandy clay loam.**Rock Type:** Fine ironstone gravel in patches.**Vegetation:** *Acacia macraneura*, (*A. citrinoviridis*, *Corymbia hamersleyana*) low open forest over *Triodia epactia* open hummock grassland.**Veg Condition:** Very Good.**Fire Age:** No sign of recent fire.

Species	Cover (%)	Height	Specimen
<i>Acacia ancistrocarpa</i>	0.1	210 cm	
<i>Acacia atkinsiana</i>	0.1	400 cm	
<i>Acacia citrinoviridis</i>	10	600 cm	
<i>Acacia macraneura</i>	35	600 cm	MRO-R02-03
<i>Acacia trachycarpa</i>	0.1	70 cm	
<i>Arivela viscosa</i>	0.1	90 cm	
<i>Bonamia erecta</i>	0.1	40 cm	
<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	0.1	30 cm	
<i>Chrysopogon fallax</i>	0.1	40 cm	
<i>Corymbia hamersleyana</i>	1.5	650 cm	
<i>Duperreya commixta</i>	0.1	250 cm	
<i>Eremophila latrobei</i> subsp. <i>filiformis</i>	0.1	110 cm	
<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	0.1	20 cm	
<i>Hibiscus sturtii</i> var. <i>grandiflorus</i>	0.1	40 cm	MRO-R02-01
<i>Indigofera monophylla</i>	0.1	30 cm	
<i>Ptilotus exaltatus</i>	0.1	40 cm	
<i>Senna artemisioides</i> subsp. <i>oligophylla</i>	0.1	130 cm	MRO-R02-02
<i>Sida</i> sp. L (A.M. Ashby 4202)	0.1	25 cm	
<i>Sida</i> sp. spiciform panicles (E. Leyland s.n. 14/8/90)	0.1	80 cm	
<i>Themeda triandra</i>	0.1	70 cm	
<i>Triodia epactia</i>	12	50 cm	
<i>Vincetoxicum lineare</i>	0.1	50 cm	



Site MRO-R03**Described by:** MM **Date:** 06/06/22 **Type:** Relevé 25 x 100 m**MGA Zone:** 50 S 559938 mE 7587522 mN**Habitat:** Broad drainage area through plain.**Soil:** Dark reddish brown sandy clay loam to clay loam.**Rock Type:** Very fine ironstone gravel.**Vegetation:** *Acacia citrinoviridis*, (*Corymbia hamersleyana*, *A. pruinocarpa*) low woodland.**Veg Condition:** Very Good.**Fire Age:** No sign of recent fire.

Species	Cover (%)	Height	Specimen
<i>Acacia citrinoviridis</i>	20	550 cm	
<i>Acacia pruinocarpa</i>	0.5	400 cm	
<i>Acacia pyrifolia</i> var. <i>pyrifolia</i>	0.1	140 cm	
<i>Acacia trachycarpa</i>	0.1	45 cm	
<i>Arivela viscosa</i>	0.1	70 cm	
<i>Bonamia erecta</i>	0.1	35 cm	
<i>Chrysopogon fallax</i>	0.1	30 cm	
<i>Corymbia hamersleyana</i>	1	750 cm	
<i>Duperreya commixta</i>	0.1	350 cm	
<i>Eremophila forrestii</i> subsp. <i>forrestii</i>	0.1	120 cm	
<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	0.1	20 cm	
<i>Goodenia forrestii</i>	0.1	25 cm	MRO-R03-01
<i>Gossypium australe</i>	0.1	30 cm	
<i>Indigofera monophylla</i>	0.1	30 cm	
<i>Paraneurachne muelleri</i>	0.1	40 cm	
<i>Ptilotus obovatus</i> var. <i>obovatus</i>	0.1	80 cm	
<i>Rhynchosia minima</i>	0.1	15 cm	
<i>Senna glutinosa</i> subsp. <i>glutinosa</i>	0.1	100 cm	
<i>Sida</i> sp. L (A.M. Ashby 4202)	0.1	25 cm	
<i>Sida</i> sp. spiciform panicles (E. Leyland s.n. 14/8/90)	0.1	70 cm	
<i>Triodia epactia</i>	0.1	12 cm	



Site MRO-R04

Described by: AL **Date:** 06/06/22 **Type:** Relevé 12.5 x 200 m
MGA Zone: 50 S 560325 mE 7586688 mN
Habitat: Gently sloping plain.
Soil: Sandy clay loam.
Vegetation: *Acacia* ? *incurvaneura* (*A. citrinoviridis*) low woodland over *Triodia epactia* open hummock grassland.
Veg Condition: Very Good.
Fire Age: No sign of recent fire.

Species	Cover (%)	Height	Specimen	Notes
<i>Acacia citrinoviridis</i>	3	500 cm		
<i>Acacia</i> ? <i>incurvaneura</i>	11	550 cm	MRO-R04-01	ISM.
<i>Acacia pruinocarpa</i>	0.1	410 cm		
<i>Bonamia erecta</i>	0.1	20 cm		
<i>Cheilanthes sieberi</i> subsp. <i>sieberi</i>	0.1	20 cm	MRO-R04-04	
<i>Corchorus tectus</i>	0.1	75 cm	MRO-R04-02	
<i>Duperreya commixta</i>	0.1	110 cm		
<i>Eremophila latrobei</i> subsp. <i>filiformis</i>	0.1	60 cm	ALop33=	
<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	0.1	15 cm		
<i>Grevillea wickhamii</i>	0.1	250 cm		Sterile.
<i>Hibiscus burtonii</i>	0.1	70 cm		
<i>Hibiscus coatesii</i>	0.1	110 cm	ALop31=	
<i>Indigofera monophylla</i>	0.1	50 cm		
<i>Maireana</i> ? <i>planifolia</i>	0.1	70 cm	MRO-R04-05	Inadequate material.
<i>Ptilotus calostachyus</i>	0.1	90 cm		
<i>Rhynchosia minima</i>	0.1	60 cm		
<i>Senna glutinosa</i> subsp. <i>glutinosa</i>	0.1	240 cm		
<i>Senna notabilis</i>	0.1	40 cm		
<i>Seringia nephrosperma</i>	0.1	55 cm		
<i>Sida</i> sp. L (A.M. Ashby 4202)	0.1	25 cm	MRO-R04-03	
<i>Solanum lasiophyllum</i>	0.1	20 cm		
<i>Triodia epactia</i>	11	70 cm		
<i>Vincetoxicum lineare</i>	0.1	60 cm		



Site MRO-R05**Described by:** AL **Date:** 29/07/22 **Type:** Relevé 12.5 x 200 m**MGA Zone:** 50 S 567131 mE 7529361 mN**Habitat:** Hardpan clay plain.**Soil:** Medium clay.**Vegetation:** *Sclerolaena bicornis* var. *bicornis* scattered low shrubs over *Sida fibulifera*, (*Calotis plumifera*, *Cullen graveolens*, *Bulbine pendula*, *Swainsona leeana*) very open herbland.**Veg Condition:** Very Good; signs of cattle, weeds.**Fire Age:** Very long unburnt.

Species	Cover	Height	Specimen
<i>Bulbine pendula</i>	0.5	15 cm	MRO12-07=
<i>Calocephalus knappii</i>	0.1	15 cm	MRO-R05-01
<i>Calotis plumulifera</i>	1	15 cm	MRO-R05-02
* <i>Cenchrus ciliaris</i>	0.1	40 cm	
<i>Cullen graveolens</i>	1	10 cm	
<i>Dactyloctenium radulans</i>	0.1	5 cm	
<i>Dichanthium sericeum</i> subsp. <i>humilius</i>	0.1	20 cm	KTF127R=
<i>Lepidium phlebopetalum</i>	0.1	5 cm	MRO13-11=
<i>Lotus cruentus</i>	0.1	5 cm	MRO12-12=
<i>Portulaca oleracea</i>	0.1	2 cm	
<i>Ptilotus gomphrenoides</i>	0.1	5 cm	KTF127R=
<i>Ptilotus polystachyus</i>	0.1	20 cm	
<i>Ptilotus roei</i>	0.1	5 cm	
<i>Salsola australis</i>	0.1	10 cm	
<i>Sclerolaena bicornis</i> var. <i>bicornis</i>	1	20 cm	ALop56=
<i>Senna hamersleyensis</i>	0.1	20 cm	MGop13=
<i>Sida fibulifera</i>	3	10 cm	
<i>Swainsona leeana</i>	0.5	5 cm	ALop=
<i>Trianthema triquetrum</i>	0.1	2 cm	
* <i>Vachellia farnesiana</i>	0.1	140 cm	



Site MRO-R06**Described by:** AL/MG **Date:** 28/07/22 **Type:** Relevé 20 x 125 m**MGA Zone:** 50 S 567717 mE 7530542 mN**Habitat:** Moderate drainage line.**Soil:** Clay loam.**Vegetation:** *Eucalyptus victrix* open woodland over **Vachellia farnesiana* tall open shrubland over *Dichanthium sericeum* subsp. *sericeum*, *Eriachne benthamii* very open tussock grassland.**Veg Condition:** Very Good; cattle tracks, scat. Low cover of **Cenchrus ciliaris*.**Fire Age:** Very long unburnt.

Species	Cover (%)	Height
<i>Alternanthera nodiflora</i>	0.1	20 cm
<i>Blumea tenella</i>	0.1	15 cm
<i>*Cenchrus ciliaris</i>	0.1	50 cm
<i>Chloris pectinata</i>	0.1	20 cm
<i>Chrysopogon fallax</i>	0.1	40 cm
<i>Dichanthium sericeum</i> subsp. <i>sericeum</i>	4	60 cm
<i>Eriachne benthamii</i>	3	35 cm
<i>Eucalyptus victrix</i>	6	1200 cm
<i>Euphorbia australis</i> var. <i>subtomentosa</i>	0.1	5
<i>Ipomoea muelleri</i>	0.1	10 cm
<i>Rhynchosia minima</i>	0.1	35
<i>Rostellularia adscendens</i> var. <i>clementii</i>	0.1	10 cm
<i>*Vachellia farnesiana</i>	2	210

No photo.

Manuwarra Red Dog Highway Stage 4 Biological Survey (Biota 2021)

Site	KTF27
Described by	RM/SY Date 23/4/2020
Type	Quadrat 50 x 50 m
Central Coord	50 551697 mE, 7597983 mN
Habitat	Undulating stony plain.
Soil	Dark reddish brown silty clay loam.
Rock Type	Scattered ironstone.
Vegetation	<i>Corymbia hamersleyana</i> scattered low trees over <i>Acacia atkinsiana</i> tall open shrubland over <i>A. ancistrocarpa</i> , <i>Hakea lorea</i> subsp. <i>lorea</i> scattered shrubs over <i>Acacia trachycarpa</i> scattered low shrubs over <i>Triodia wiseana</i> , (<i>T. epactia</i>) very open hummock grassland.
Veg Condition	Excellent.
Fire Age	Burnt 3-5 years ago.
Notes	U1 ^ <i>Corymbia hamersleyana</i> ^tree\6\bi;M1+ ^ <i>Acacia atkinsiana</i> ^shrub\4\r;M2 <i>Acacia ancistrocarpa</i> , <i>Hakea lorea</i> subsp. <i>lorea</i> ^shrub\3\bi;M3 <i>Acacia trachycarpa</i> ^shrub\2\bi;G1 ^ <i>Triodia wiseana</i> , <i>Triodia epactia</i> ^hummock grass\1\r.

Species	Cover (%)	Height (cm)	Specimen	Notes
<i>Acacia ancistrocarpa</i>	0.5	180		
<i>Acacia atkinsiana</i>	5	280	KTF27-07	
<i>Acacia maitlandii</i>	0.1	25		
<i>Acacia tenuissima</i>	0.1	50	KTF27-10	
<i>Acacia trachycarpa</i>	0.5	90		
<i>Aristida contorta</i>	0.1	30		
<i>Arivela viscosa</i>	0.1	20		
<i>Corchorus</i> sp.	0.1	20	KTF27-05	Inadequate material.
<i>Corymbia hamersleyana</i>	0.25	450		
<i>Dodonaea coriacea</i>	0.1	50	KTF27-02	
<i>Eriachne mucronata</i>	0.1	30	KTF27-04	Typical form. Erect hairs under sheaths.
<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	0.1	10		
<i>Goodenia microptera</i>	0.1	5		
<i>Grevillea wickhamii</i>	0.1	50	Sterile.	
<i>Hakea lorea</i> subsp. <i>lorea</i>	0.25	170	KTF27-11	
<i>Hibiscus sturtii</i> var. <i>campylochlamys</i>	0.1	10	KTF27-06	
<i>Indigofera monophylla</i>	0.1	10		
<i>Polygala glaucifolia</i>	0.1	2	KTF16-09=	
<i>Ptilotus calostachyus</i>	0.1	20		
<i>Ptilotus exaltatus</i>	0.1	10		
<i>Ptilotus obovatus</i> var. <i>obovatus</i>	0.1	30	KTF27-08	
<i>Senna glutinosa</i> subsp. <i>glutinosa</i>	0.1	170		
<i>Senna notabilis</i>	0.1	5		
<i>Seringia nephrosperma</i>	0.1	60	KTF27-01	
<i>Sida fibulifera</i>	0.1	7		
<i>Tephrosia</i> sp. Bungaroo Creek (M.E. Trudgen 11601)	0.1	20	KTF27-03	
<i>Triodia epactia</i>	0.5	40		
<i>Triodia wiseana</i>	5	40	KTF27-09	



Site KTF43
Described by RM/SY **Date** 25/4/2020
Type Quadrat 50 x 50 m
Central Coord 50 560946 mE, 7587008 mN
Habitat Plain.
Soil Dark reddish brown silty clay loam.
Rock Type Ironstone.
Vegetation *Acacia pruinocarpa* scattered low trees over *A. dictyophleba*, (*A. ancistrocarpa*) tall open shrubland over *Triodia epactia* hummock grassland.
Veg Condition Excellent.
Fire Age No sign of recent fire.
Notes U1 ^*Acacia pruinocarpa*^\tree\6\bi;M1 ^*Acacia dictyophleba*,*Acacia ancistrocarpa*^\shrub\4\r;G1+ ^*Triodia epactia*^\hummock grass\1\c.

Species	Cover (%)	Height (cm)	Specimen	Notes
<i>Abutilon lepidum</i>	0.1	5		
<i>Acacia ancistrocarpa</i>	1	280		
<i>Acacia dictyophleba</i>	2.5	350	KTF43-01	
<i>Acacia pruinocarpa</i>	1	300		
<i>Acacia tenuissima</i>	0.1	90		
<i>Acacia trachycarpa</i>	0.1	50		
<i>Eriachne aristidea</i>	0.1	10		
<i>Goodenia microptera</i>	0.1	5		
<i>Grevillea wickhamii</i>	0.1	5	Sterile.	
<i>Hakea chordophylla</i>	0.1	110		
<i>Hibiscus sturtii</i> var. <i>campylochlamys</i>	0.1	30	KTF43-05	
<i>Indigofera monophylla</i>	0.1	10		
<i>Maireana planifolia</i>	0.1	50	KTF43-02	
<i>Ptilotus calostachyus</i>	0.1	50		
<i>Ptilotus</i> sp.	0.1	5	KTF43-04	Inadequate material; juvenile.
<i>Senna notabilis</i>	0.1	20		
<i>Trianthema glossostigmum</i>	0.1	5		
<i>Triodia epactia</i>	18	40	KTF43-03	



Site KTF46
Described by BRMMG **Date** 24/4/2020
Type Quadrat 72 x 35 m
Central Coord 50 551094 mE, 7599169 mN
Habitat Very shallow, broad flowline and flood banks.
Soil Dusky red (10R 3/4) sandy loam.
Vegetation *Corymbia hamersleyana* low woodland over *Acacia tumida* var. *pilbarensis*, (*Grevillea wickhamii* subsp. *hispidula*, *A. atkinsiana*) tall shrubland over *Indigofera monophylla* scattered low shrubs over *Triodia epactia* open hummock grassland over *Themeda triandra*, (*Eulalia aurea*) very open tussock grassland.
Veg Condition Excellent.
Fire Age No sign of recent fire.
Notes U1 ^*Corymbia hamersleyana*\^tree\6\i;M1+ ^*Acacia tumida* var. *pilbarensis*,*Grevillea wickhamii* subsp. *hispidula*,*Acacia atkinsiana*\^shrub\4\i;M2 *Indigofera monophylla*\shrub\1\bi;G1 *Themeda triandra*,*Eulalia aurea*\tussock grass\2\r;G2 ^*Triodia epactia*\^hummock grass\1\i.

Species	Cover (%)	Height (cm)	Specimen	Notes
<i>Acacia atkinsiana</i>	1	240		
<i>Acacia maitlandii</i>	0.1	110		
<i>Acacia tenuissima</i>	0.1	45	KTF32-13=	
<i>Acacia trachycarpa</i>	0.1	70		
<i>Acacia tumida</i> var. <i>pilbarensis</i>	15	450		A lot of the <i>A. tumida</i> has died off.
<i>Afrohybanthus aurantiacus</i>	0.1	30		
<i>Aristida contorta</i>	0.1	30		
<i>Aristida holathera</i> var. <i>holathera</i>	1	30		
<i>Aristida inaequiglumis</i>	0.1	110	KTF46-02	
<i>Arivela viscosa</i>	0.1	50		
<i>Bonamia erecta</i>	0.1	20		
<i>Bonamia pannosa</i>	0.1	5	KTF46-06	
<i>Corchorus tectus</i>	0.1	30	KTF32-01=	
<i>Corymbia hamersleyana</i>	12	800		
<i>Cucumis variabilis</i>	0.1	45		
<i>Cynodon convergens</i>	0.1	30	KTF33-14=	
<i>Dampiera candidans</i>	0.1	45		
<i>Digitaria brownii</i>	0.1	40	KTF46-15	
<i>Duperreya commixta</i>	0.1	70		
<i>Enneapogon polyphyllus</i>	0.1	25	KTF46-07	
<i>Eragrostis cumingii</i>	0.1	20	KTF46-13	
<i>Eriachne aristidea</i>	0.1	30		
<i>Eriachne mucronata</i>	0.1	40	KTF46-10	Typical form. Erect hairs under sheaths.
<i>Eriachne pulchella</i>	0.1	15		
<i>Eulalia aurea</i>	0.5	70		
<i>Euphorbia australis</i> var. <i>subtomentosa</i>	0.1	3	KTF46-11	
<i>Euphorbia biconvexa</i>	0.1	30	KTF46-04	
<i>Evolvulus alsinoides</i> var. <i>decumbens</i>	0.1	30	KTF33-13=	
<i>Evolvulus alsinoides</i> var. <i>villosicalyx</i>	0.1	20		
<i>Gomphrena cunninghamii</i>	0.1	20		
<i>Goodenia microptera</i>	0.1	30		
<i>Grevillea wickhamii</i> subsp. <i>hispidula</i>	1	500	KTF46-09	
<i>Haloragis</i> sp.	0.1	15	KTF46-14	Inadequate material.
<i>Hibiscus sturtii</i> var. <i>campylochlamys</i>	0.1	30	KTF46-03,8	
<i>Indigofera monophylla</i>	1	70		
<i>Isotropis atropurpurea</i>	0.1	40		
<i>Paraneurachne muelleri</i>	0.1	40		
<i>Polymeria ambigua</i>	0.1	15	KTF33-15=	
<i>Ptilotus calostachyus</i>	0.1	50		

Species	Cover (%)	Height (cm)	Specimen	Notes
<i>Ptilotus exaltatus</i>	0.1	5		
<i>Ptilotus fusiformis</i>	0.1	40		
<i>Rhynchosia minima</i>	0.1	20		
<i>Senna notabilis</i>	0.1	3		
<i>Seringia nephrosperma</i>	0.1	70	KTF18-03=	
<i>Sida</i> sp. L (A.M. Ashby 4202) PN	0.1	20	KTF46-16	
<i>Solanum diversiflorum</i>	0.1	3		
<i>Sporobolus australasicus</i>	0.1	30		
<i>Streptoglossa bubakii</i>	0.1	8	KTF01-21=	
<i>Tephrosia</i> sp. Bungaroo Creek (M.E. Trudgen 11601)	0.1	15	KTF46-05	
<i>Themeda triandra</i>	4	80		
<i>Trichodesma zeylanicum</i> var. <i>zeylanicum</i>	0.1	30		
<i>Triodia epactia</i>	12	60	KTF46-01	
<i>Triumfetta chaetocarpa</i>	0.1	15	KTF46-12	
<i>Waltheria indica</i>	0.1	3		



Appendix 10

Locations of Significant Flora



Species	Status	UTM Zone	Easting	Northing	No. Individuals / Density
<i>Euphorbia inappendiculata</i> var. <i>queenlandica</i>	P2	50S	568065	7530439	Not recorded.
<i>Astrebla lappacea</i>	P3	50S	567871	7530735	71%
<i>Dolichocarpa</i> sp. Hamersley Station (A.A. Mitchell PRP 1479)	P3	50S	540085	7603523	0.1%
<i>Glycine falcata</i>	P3	50S	568896	7532076	N=200. Outside survey area.
<i>Streptoglossa</i> sp. Cracking clays (S. van Leeuwen et al. PBS 7353)	P3	50S	567685	7530116	N=5
<i>Streptoglossa</i> sp. Cracking clays (S. van Leeuwen et al. PBS 7353)	P3	50S	567674	7530111	Not recorded.
<i>Swainsona thompsoniana</i>	P3	50S	567871	7530735	0.1%
<i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431)	P3	50S	567808	7530172	N=25.
<i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431)	P3	50S	568259	7531070	N=200.
<i>Triodia basitricha</i>	P3	50S	571285	7553060	5%
<i>Triodia basitricha</i>	P3	50S	570275	7552605	Not recorded.
<i>Triodia basitricha</i>	P3	50S	570165	7552732	7%
<i>Triodia basitricha</i>	P3	50S	572140	7551578	4%

Appendix 11

Locations of Weeds



Species	UTM Zone	Easting	Northing	No. Individuals / Density
* <i>Cenchrus ciliaris</i>	50S	562680	7572218	N=1000.
* <i>Cenchrus ciliaris</i>	50S	562779	7571585	N=1.
* <i>Cenchrus ciliaris</i>	50S	571142	7553066	N=3.
* <i>Cenchrus ciliaris</i>	50S	567806	7528109	0.1%
* <i>Cenchrus ciliaris</i>	50S	567761	7530494	0.1%
* <i>Cenchrus ciliaris</i>	50S	570259	7553241	N=5.
* <i>Cenchrus ciliaris</i>	50S	567153	7529316	0.1%
* <i>Cenchrus ciliaris</i>	50S	571285	7553060	0.1%
* <i>Cenchrus setiger</i>	50S	562413	7572730	N=300.
* <i>Cenchrus setiger</i>	50S	562421	7572670	N=100.
* <i>Malvastrum americanum</i>	50S	552725	7581484	N=10.
* <i>Sonchus oleraceus</i>	50S	567871	7530735	0.1%
* <i>Vachellia farnesiana</i>	50S	567761	7530494	0.1%
* <i>Vachellia farnesiana</i>	50S	567871	7530735	0.1%
* <i>Vachellia farnesiana</i>	50S	567153	7529316	0.1%
* <i>Vachellia farnesiana</i>	50S	540093	7603483	N=1.

Appendix 12

Potential Fauna Species List and Species Recorded During Current Survey



Amphibians

Family	Species	Common Name	Current Survey	Conservation Status		Database Searches			Previous Surveys									
				State	Federal	Nature Map	EPBC PMST	DBCA	PBS	(Biota 2012)	(Biota 2015)	(Biota 2009)	(Biota 2011)	(Biota 2008)	(Ecologia 2014b)	(Ecologia 2012)	(Biota 2021)	(Biota 2022)
Pelodyadidae	<i>Cyclorana australis</i>	Giant Frog																
Hylidae	<i>Cyclorana maini</i>	Main's Frog							.	.		.	.	.	.	.	.
Pelodyadidae	<i>Cyclorana occidentalis</i>	Western Water-holding Frog										.						
Hylidae	<i>Litoria rubella</i>	Little Red Tree Frog				.				.		.		.	.	.	.
Limnodynastidae	<i>Neobatrachus sutor</i>	Shoemaker Frog															.	
Limnodynastidae	<i>Notaden nichollsi</i>	Desert Spadefoot										.						
Limnodynastidae	<i>Platyplectrum spenceri</i>	Centralian Burrowing Frog										.						
Myobatrachidae	<i>Pseudophryne douglasi</i>	Gorge Toadlet				.						.				.	.
Myobatrachidae	<i>Uperoleia saxatilis</i> (1)	Pilbara Toadlet				.									.	.		

(1) - formerly included within *U. russelli*, some previous records listed as such

Reptiles

Family	Species	Common Name	Current Survey	Conservation Status		Database Searches			Previous Surveys										
				State	Federal	Nature Map	EPBC PMST	DBCA	PBS	(Biota 2012)	(Biota 2015)	(Biota 2009)	(Biota 2011)	(Biota 2008)	(Ecologia 2014b)	(Ecologia 2012)	(Biota 2021)	(Biota 2022)	
Cheluidae	<i>Chelodina steindachneri</i>	Flat-shelled Turtle				.						.						.	
Carphodactylidae	<i>Nephurus wheeleri</i>					.					.		.		.	.
Gekkonidae	<i>Underwoodisaurus seorsus</i> (1)	Pilbara Barking Gecko		P2		.		.							.	.
Diplodactylidae	<i>Crenadactylus pilbarensis</i> (2)	Pilbara Clawless Gecko				.						.				.			
Diplodactylidae	<i>Diplodactylus bilybara</i> (3)	Western Fat-tailed Gecko				.			.	.		.			.	.
Diplodactylidae	<i>Diplodactylus galaxias</i>	Northern Pilbara Beak-faced Gecko				.									.				
Diplodactylidae	<i>Diplodactylus mitchelli</i>					.			.										
Diplodactylidae	<i>Diplodactylus pulcher</i>										.		.					.	
Diplodactylidae	<i>Diplodactylus savagei</i>	Southern Pilbara Beak-faced Gecko				.			.			.	.		.	.
Diplodactylidae	<i>Lucasium stenodactylum</i>					.			.	.		.	.		.	.		.
Diplodactylidae	<i>Lucasium wombeyi</i>					.			.	.		.			.	.
Diplodactylidae	<i>Oedura fimbria</i> (4)	Western Marbled Velvet Gecko				.			.			.			.	.		.
Diplodactylidae	<i>Rhynchoedura ornata</i>	Western Beaked Gecko				.			.	.		.	.		.	.		.
Diplodactylidae	<i>Strophurus elderi</i>					.					.		.		.	.
Diplodactylidae	<i>Strophurus jeanae</i>										.				.				
Diplodactylidae	<i>Strophurus strophurus</i>					.										.			
Diplodactylidae	<i>Strophurus wellingtonae</i>					.			.	.		.			.	.
Gekkonidae	<i>Gehyra crypta</i> (5)																	.	
Gekkonidae	<i>Gehyra media</i> (6)																		

Family	Species	Common Name	Current Survey	Conservation Status		Database Searches			Previous Surveys									
				State	Federal	Nature Map	EPBC PMST	DBCA	PBS	(Biota 2012)	(Biota 2015)	(Biota 2009)	(Biota 2011)	(Biota 2008)	(Ecologia 2014b)	(Ecologia 2012)	(Biota 2021)	(Biota 2022)
Gekkonidae	<i>Gehyra micra</i> (6)																	
Gekkonidae	<i>Gehyra pilbara</i>					.						.				.		
Gekkonidae	<i>Gehyra punctata</i>					.			.			.	.	.	.	.	.
Gekkonidae	<i>Gehyra variegata</i>					.			.	.		.	.		.	.
Gekkonidae	<i>Heteronotia binoei</i>	Bynoe's Gecko				.			.	.		.	.	.	.	.
Gekkonidae	<i>Heteronotia spelea</i>	Desert Cave Gecko, Pilbara Cave Gecko				.						.				.		
Pygopodidae	<i>Delma butleri</i>					.					.	.				.
Pygopodidae	<i>Delma elegans</i>					.						.			.	.
Pygopodidae	<i>Delma nasuta</i>					.			.	.		.	.	.	.	.
Pygopodidae	<i>Delma pax</i>					.					.	.			.	.
Pygopodidae	<i>Delma tincta</i>					.			.	.		.	.	.	.	.
Pygopodidae	<i>Lialis burtonis</i>					.					.	.	.	.	.	.
Pygopodidae	<i>Pygopus nigriceps</i>					.					.	.	.	.	.	.
Agamidae	<i>Ctenophorus caudicinctus</i>	Ring-tailed Dragon	.			.			.	.	.	.	.	.	.	.	.	.
Agamidae	<i>Ctenophorus isolepis</i>	Crested Dragon, Military Dragon				.			.	.		.	.	.	.	.	.	.
Agamidae	<i>Ctenophorus reticulatus</i>	Western Netted Dragon				.			.	.		.	.		.
Agamidae	<i>Diporiphora amphiboluroides</i>	Mulga Dragon									.	.				.		
Agamidae	<i>Diporiphora valens</i>	Southern Pilbara Tree Dragon				.			.			.	.	.	.	.
Agamidae	<i>Gowidon longirostris</i>	Long-nosed Dragon				.			.	.		.	.	.	.	.	.
Agamidae	<i>Pogona minor</i>	Dwarf Bearded Dragon	.			.			.	.		.	.	.	.	.	.	.
Agamidae	<i>Tympanocryptis diabolicus</i> (7)	Hamersley Pebble-mimic Dragon				.			.						.	.
Agamidae	<i>Tympanocryptis fortescuensis</i> (7)	Fortescue Pebble-mimic Dragon				.			.						.	.
Scincidae	<i>Carlia munda</i>	Shaded-litter Rainbow Skink				.			.	.		.	.	.	.	.
Scincidae	<i>Carlia triacantha</i>	Desert Rainbow Skink				.					.				.	.
Scincidae	<i>Cryptoblepharus buchananii</i> (8)					.						.			.	.
Scincidae	<i>Cryptoblepharus ustulatus</i> (8)					.						.			.	.	.
Scincidae	<i>Ctenotus atlas</i>											.						
Scincidae	<i>Ctenotus duricola</i>					.					.	.	.	.	.	.
Scincidae	<i>Ctenotus grandis</i>					.					.	.	.	.	.	.
Scincidae	<i>Ctenotus hanloni</i>					.					.			.	.
Scincidae	<i>Ctenotus helenae</i>					.			.	.		.	.	.	.	.
Scincidae	<i>Ctenotus leonhardii</i>					.									.	.		

Family	Species	Common Name	Current Survey	Conservation Status		Database Searches			Previous Surveys									
				State	Federal	Nature Map	EPBC PMST	DBCA	PBS	(Biota 2012)	(Biota 2015)	(Biota 2009)	(Biota 2011)	(Biota 2008)	(Ecologia 2014b)	(Ecologia 2012)	(Biota 2021)	(Biota 2022)
Scincidae	<i>Ctenotus pantherinus</i>	Leopard Ctenotus				.			.	.		.	.	.	.	.	.
Scincidae	<i>Ctenotus robustus</i>					.			.			.		.	.	.	.
Scincidae	<i>Ctenotus rubicundus</i>					.				.		.	.			.
Scincidae	<i>Ctenotus rutilans</i>					.			.		.	.	.		.	.
Scincidae	<i>Ctenotus saxatilis</i>	Rock Ctenotus				.			.	.	.	.	.	.		.
Scincidae	<i>Ctenotus schomburgkii</i>					.			.			.	.	.		.
Scincidae	<i>Ctenotus serventyi</i>					.										.		
Scincidae	<i>Ctenotus severus</i>					.												
Scincidae	<i>Ctenotus uber</i>			P2				.		.					.			
Scincidae	<i>Cyclodomorphus melanops</i>	Slender Blue-tongue				.			.	.		.	.	.	.	.	.	.
Scincidae	<i>Egernia cygnitos</i> (9)	Western Pilbara Spiny-tailed Skink				.								.	.			
Scincidae	<i>Egernia formosa</i>					.				.	.	.				.
Scincidae	<i>Eremiascincus richardsonii</i>	Broad-banded Sand Swimmer				.				.		.				.
Scincidae	<i>Lerista flammicauda</i>								.			.			.			
Scincidae	<i>Lerista jacksoni</i>					.							.			.		
Scincidae	<i>Lerista muelleri</i>					.				.		.				.
Scincidae	<i>Lerista timida</i>					.								.				
Scincidae	<i>Lerista zietzi</i>					.										.		
Scincidae	<i>Menetia greyii</i>					.			.	.		.	.	.	.	.	.
Scincidae	<i>Menetia surda</i>					.			.	.		.				.
Scincidae	<i>Morethia ruficauda</i>					.			.	.		.		.	.	.	.	.
Scincidae	<i>Notoscincus butleri</i>			P4		.		.								.		
Scincidae	<i>Notoscincus ornatus</i>					.				.		.			.
Scincidae	<i>Proablepharus reginae</i>					.				.		.	.		.
Scincidae	<i>Tiliqua multifasciata</i>	Central Blue-tongue				.			.	.		.		.	.	.	.
Scincidae	<i>Tiliqua occipitalis</i>	Western Bluetongue				.												
Varanidae	<i>Varanus acanthurus</i>	Spiny-tailed Monitor				.			.	.	.	.	.	.	.	.	.
Varanidae	<i>Varanus brevicauda</i>	Short-tailed Pygmy Monitor				.			.	.		.		.	.	.	.
Varanidae	<i>Varanus bushi</i>	Pilbara Mulga Monitor				.			.	.			.		.	.	.
Varanidae	<i>Varanus caudolineatus</i>					.				.		.			.
Varanidae	<i>Varanus eremius</i>	Pygmy Desert Monitor				.			.	.		.		.	.	.	.
Varanidae	<i>Varanus giganteus</i>	Perentie				.												
Varanidae	<i>Varanus gilleni</i>	Pygmy Mulga Monitor				.				.			.					

Family	Species	Common Name	Current Survey	Conservation Status		Database Searches			Previous Surveys									
				State	Federal	Nature Map	EPBC PMST	DBCA	PBS	(Biota 2012)	(Biota 2015)	(Biota 2009)	(Biota 2011)	(Biota 2008)	(Ecologia 2014b)	(Ecologia 2012)	(Biota 2021)	(Biota 2022)
Varanidae	<i>Varanus gouldii</i>	Bungarra or Sand Monitor	•			•				•	•		•					
Varanidae	<i>Varanus hamersleyensis</i> (10)	Pilbara Rock Monitor, Northern Pilbara Rock Goanna				•										•		
Varanidae	<i>Varanus panoptes</i>	Yellow-spotted Monitor				•				•			•		•	•		
Varanidae	<i>Varanus tristis</i>	Racehorse Monitor				•				•	•	•	•		•	•		
Typhlopidae	<i>Aniliios ammodytes</i>								•	•		•				•		
Typhlopidae	<i>Aniliios ganei</i>			P1				•							•	•		
Typhlopidae	<i>Aniliios grypus</i>								•	•		•	•		•	•		
Typhlopidae	<i>Aniliios hamatus</i>								•	•		•						
Typhlopidae	<i>Aniliios pilbarensis</i>									•						•		
Typhlopidae	<i>Aniliios waitii</i>											•						
Boidae	<i>Antaresia perthensis</i>	Pygmy Python				•						•				•		
Boidae	<i>Antaresia stimsoni</i>	Stimson's Python				•						•			•	•	•	
Boidae	<i>Aspidites melanocephalus</i>	Black-headed Python				•						•				•		
Boidae	<i>Liasis olivaceus barroni</i>	Pilbara Olive Python		VU	VU	•	•	•				•				•		
Elapidae	<i>Acanthophis pyrrhus</i>	Desert Death Adder				•												
Elapidae	<i>Acanthophis wellsi</i>	Pilbara Death Adder				•					•		•		•	•		
Elapidae	<i>Brachyuropis approximans</i>	North-western Shovel-nosed Snake				•					•		•		•	•		
Elapidae	<i>Demansia psammophis</i>	Yellow-faced Whipsnake				•					•		•	•	•	•	•	
Elapidae	<i>Demansia rufescens</i>	Rufous Whipsnake				•					•		•		•	•		
Elapidae	<i>Furina ornata</i>	Moon Snake				•						•	•		•	•		
Elapidae	<i>Parasuta monachus</i>					•					•		•	•	•	•	•	
Elapidae	<i>Pseudechis australis</i>	Mulga Snake	•			•					•		•	•	•	•	•	
Elapidae	<i>Pseudonaja mengdeni</i> (11)	Western Brown Snake				•							•	•	•	•		
Elapidae	<i>Pseudonaja modesta</i>	Ringed Brown Snake				•					•		•	•	•	•		
Elapidae	<i>Suta fasciata</i>	Rosen's Snake				•						•	•	•	•	•		
Elapidae	<i>Suta punctata</i>	Spotted Snake				•					•		•	•	•	•		
Elapidae	<i>Vermicella snelli</i>					•						•			•	•		

- (1) - previously included within *U. milii*, some previous records listed as such
(2) - previously included within *C. ocellatus*, previous records listed as such
(3) - previously included within *D. conspicillatus*, previous records listed as such
(4) - previously included within *O. marmorata*, some previous records listed as such
(5) - previously included within *G. variegata*, many previous records of *G. variegata* likely attributable to this taxon
(6) - previously included within *G. punctata*, many previous records of *G. punctata* likely attributable to these taxa
(7) - previously included within *T. cephalus*, previous records of *T. cephalus* attributable to one or both of these taxa
(8) - previously included within *C. plagiocephalus*, previous records of *C. plagiocephalus* attributable to one or both of these taxa
(9) - previously included within *E. depressa*, some previous records listed as such
(10) - previously included within *V. pilbarensis*, previous records listed as such
(11) - previously included within *P. nuchalis*, some previous records listed as such

Removed *Cyclodomorphus maximus* (Kimberley plateau endemic) and *Parasuta nigriceps* (south-west species)

Ground-dwelling Mammals

Family	Species	Common Name	Current Survey	Conservation Status		Database Searches			Previous Surveys									
				State	Federal	Nature Map	EPBC PMST	DBCA	PBS	(Biota 2012)	(Biota 2015)	(Biota 2009)	(Biota 2011)	(Biota 2008)	(Ecologia 2014b)	(Ecologia 2012)	(Biota 2021)	(Biota 2022)
Tachyglossidae	<i>Tachyglossus aculeatus</i>	Short-beaked Echidna				•				•								
Dasyuridae	<i>Dasykaluta rosamondae</i>	Little Red Kaluta				•			•	•		•	•	•	•	•		
Dasyuridae	<i>Dasyurus hallucatus</i>	Northern Quoll	•	EN	EN	•	•	•		•								
Dasyuridae	<i>Ningauia timealeyi</i>	Pilbara Ningauia				•				•		•	•	•	•	•		
Dasyuridae	<i>Planigale ingrami</i>	Long-tailed Planigale				•				•			•					
Dasyuridae	<i>Planigale maculata</i>	Common Planigale				•									•			
Dasyuridae	<i>Planigale</i> spp. (1)	undescribed planigale spp.				•			•	•			•					
Dasyuridae	<i>Pseudantechinus woolleyae</i>	Woolley's Pseudantechinus				•			•							•		
Dasyuridae	<i>Sminthopsis longicaudata</i>	Long-tailed Dunnart			P4	•		•	•									
Dasyuridae	<i>Sminthopsis macroura</i>	Stripe-faced Dunnart				•			•	•		•	•	•	•	•		
Dasyuridae	<i>Sminthopsis youngsoni</i>									•								
Thylacomyidae	<i>Macrotis lagotis</i>	Bilby		VU	VU	•	•	•										
Phalangeridae	<i>Trichosurus vulpecula</i>	Brushtail Possum				•												
Macropodidae	<i>Lagorchestes conspicillatus leichardti</i>	Spectacled Hare-wallaby			P4	•		•										
Macropodidae	<i>Osphranter robustus</i>	Euro, Biggada				•					•	•		•	•	•		•
Macropodidae	<i>Osphranter rufus</i>	Red Kangaroo, Marlu				•				•		•	•	•	•	•		•
Macropodidae	<i>Petrogale rothschildi</i>	Rothschild's Rock-wallaby				•											•	
Muridae	<i>Leggadina lakedownensis</i>	Northern Short-tailed Mouse			P4	•		•	•						•			
Muridae	<i>Mus musculus</i> *	House Mouse				•	•			•			•	•	•	•		
Muridae	<i>Pseudomys chapmani</i>	Western Pebble-mound Mouse	•		P4	•		•		•	•	•	•	•	•	•	•	•
Muridae	<i>Pseudomys delicatulus</i>	Delicate Mouse				•									•			
Muridae	<i>Pseudomys desertor</i>	Desert Mouse				•			•	•			•	•	•	•		
Muridae	<i>Pseudomys hermannsburgensis</i>	Sandy Inland Mouse				•			•	•		•	•	•	•	•		
Muridae	<i>Rattus rattus</i> *	Black Rat					•											
Muridae	<i>Zyomys argurus</i>	Common Rock-rat				•				•	•	•			•	•		
Leporidae	<i>Oryctolagus cuniculus</i> *	Rabbit					•											
Pteropodidae	<i>Pteropus alecto</i>	Black Flying-fox				•									•			
Canidae	<i>Canis familiaris dingo</i>	Dingo								•			•	•	•		•	•
Canidae	<i>Vulpes Vulpes</i> *	Red Fox					•											
Felidae	<i>Felis catus</i> *	Cat				•	•							•	•	•	•	•
Equidae	<i>Equus asinus</i> *	Donkey					•						•					
Equidae	<i>Equus caballus</i> *	Horse					•									•		
Camelidae	<i>Camelus dromedaries</i> *	Camel					•											
Bovidae	<i>Bos taurus</i> *	European Cattle				•								•	•	•	•	•

(1) - Planigales in Pilbara currently considered to comprise two undescribed species, previously listed as *P. ingrami* and *P. maculata*.

* - denotes introduced species.

Bats

Family	Species	Common Name	Current Survey	Conservation Status		Database Searches			Previous Surveys									
				State	Federal	Nature Map	EPBC PMST	DBCA	PBS	(Biota 2012)	(Biota 2015)	(Biota 2009)	(Biota 2011)	(Biota 2008)	(Ecologia 2014b)	(Ecologia 2012)	(Biota 2021)	(Biota 2022)
Hipposideridae	<i>Rhinonictis aurantia</i>	Pilbara Leaf-nosed Bat	•	VU	VU	•	•	•			•					•	•	•
Megadermatidae	<i>Macroderma gigas</i>	Ghost Bat	•	VU	VU	•	•	•	•							•	•	•
Emballonuridae	<i>Saccolaimus flaviventris</i>	Yellow-bellied Sheath-tailed Bat	•			•			•					•	•	•		•
Emballonuridae	<i>Taphozous georgianus</i>	Common Sheath-tailed Bat	•			•			•				•	•	•	•	•	•
Emballonuridae	<i>Taphozous hilli</i>	Hill's Sheath-tail-bat				•										•		
Molossinae	<i>Austronomus australis</i>	White-striped Free-tailed Bat	•						•				•				•	•
Molossidae	<i>Chaerephon jobensis</i>	Greater Northern Freetail-bat	•			•			•				•		•	•	•	•
Molossidae	<i>Ozimops lumsdenae</i>	Northern Free-tailed Bat	•						•								•	•
Vespertilionidae	<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	•			•			•			•	•	•	•	•	•	•
Vespertilionidae	<i>Nyctophilus daedalus</i>	Pallid Long-eared Bat	•														•	•
Vespertilionidae	<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat				•							•			•	•	
Vespertilionidae	<i>Scotorepens greyii</i>	Little Broad-nosed Bat	•			•			•				•	•	•	•	•	•
Vespertilionidae	<i>Vespadelus finlaysoni</i>	Finlayson's Cave Bat	•			•			•			•	•	•	•	•	•	•

Birds

Family	Species name	Common name	Current Survey	Conservation Status		Database Searches			Previous Surveys									
				State	Federal	Nature Map	EPBC PMST	DBCA	PBS	(Biota 2012)	(Biota 2015)	(Biota 2009)	(Biota 2011)	(Biota 2008)	(Ecologia 2014b)	(Ecologia 2012)	(Biota 2021)	(Biota 2022)
Casuariidae	<i>Dromaius novaehollandiae</i>	Emu				•							•	•	•	•		
Phasianidae	<i>Coturnix pectoralis</i>	Stubble Quail			M	•										•		
Phasianidae	<i>Coturnix ypsilophora</i>	Brown Quail				•				•						•		
Anatidae	<i>Dendrocygna eytoni</i>	Plumed Whistling Duck				•										•	•	
Anatidae	<i>Chenonetta jubata</i>	Maned Duck				•										•	•	
Anatidae	<i>Anas superciliosa</i>	Pacific Black Duck				•										•	•	
Anatidae	<i>Anas gracilis</i>	Grey Teal				•										•	•	
Podargidae	<i>Podargus strigoides</i>	Tawny Frogmouth				•										•		
Caprimulgidae	<i>Eurostopodus argus</i>	Spotted Nightjar			M	•									•	•		•
Aegothelidae	<i>Aegotheles cristatus</i>	Australian Owlet-nightjar				•				•					•	•		
Apodidae	<i>Apus pacificus</i>	Pacific Swift		MI	M/MI	•	•	•								•		
Otididae	<i>Ardeotis australis</i>	Australian Bustard				•				•				•	•	•		
Centropodidae	<i>Centropus phasianinus</i>	Pheasant Coucal				•										•		
Cuculidae	<i>Chrysococcyx basalus</i>	Horsfield's Bronze Cuckoo				•				•		•	•	•		•		•
Cuculidae	<i>Chrysococcyx osculans</i>	Black-eared Cuckoo			M	•			•									
Cuculidae	<i>Cacomantis pallidus</i>	Pallid Cuckoo			M	•			•	•		•	•	•		•	•	•
Columbidae	<i>Columba livia</i>	Rock Dove					•											
Columbidae	<i>Phaps chalcoptera</i>	Common Bronzewing				•			•			•	•	•	•	•	•	•

Family	Species name	Common name	Current Survey	Conservation Status		Database Searches			Previous Surveys									
				State	Federal	Nature Map	EPBC PMST	DBCA	PBS	(Biota 2012)	(Biota 2015)	(Biota 2009)	(Biota 2011)	(Biota 2008)	(Ecologia 2014b)	(Ecologia 2012)	(Biota 2021)	(Biota 2022)
Columbidae	<i>Ocyphaps lophotes</i>	Crested Pigeon	•			•				•		•	•	•	•	•	•	•
Columbidae	<i>Geophaps plumifera</i>	Spinifex Pigeon	•			•				•		•	•	•	•	•	•	
Columbidae	<i>Geopelia cuneata</i>	Diamond Dove	•			•			•	•		•	•	•	•	•	•	•
Columbidae	<i>Geopelia placida</i>	Peaceful Dove				•						•	•	•	•	•	•	
Rallidae	<i>Gallirallus philippensis</i>	Buff-banded Rail				•												
Rallidae	<i>Porzana fluminea</i>	Australian Crane				•										•		
Rallidae	<i>Porzana tabuensis</i>	Spotless Crane			M	•												
Turnicidae	<i>Turnix velox</i>	Little Buttonquail	•			•			•	•			•		•	•	•	
Burhinidae	<i>Burhinus grallarius</i>	Bush Stone-curlew				•									•	•		•
Recurvirostridae	<i>Himantopus leucocephalus</i>	Pied Stilt			M	•												
Charadriidae	<i>Vanellus tricolor</i>	Banded Lapwing				•									•	•		
Charadriidae	<i>Euseyornis melanops</i>	Black-fronted Dotterel														•	•	
Phalacrocoracidae	<i>Microcarbo melanoleucos</i>	Little Pied Cormorant				•												
Phalacrocoracidae	<i>Phalacrocorax varius</i>	Australian Pied Cormorant				•												
Threskiornithidae	<i>Threskiornis spinicollis</i>	Straw-necked Ibis			M	•						•					•	
Ardeidae	<i>Nycticorax caledonicus</i>	Nankeen Night Heron			M	•												
Ardeidae	<i>Bubulcus coromandus</i>	Eastern Cattle Egret			M		•											
Ardeidae	<i>Ardea pacifica</i>	White-necked Heron				•									•	•	•	•
Ardeidae	<i>Ardea alba</i>	Great Egret			M	•	•											
Ardeidae	<i>Egretta novaehollandiae</i>	White-faced Heron				•										•	•	
Pelecanidae	<i>Pelecanus conspicillatus</i>	Australian Pelican			M	•												
Accipitridae	<i>Elanus axillaris</i>	Black-shouldered Kite	•			•				•		•		•	•	•		
Accipitridae	<i>Lophoictinia isura</i>	Square-tailed Kite				•												
Accipitridae	<i>Hamirostra melanosternon</i>	Black-breasted Buzzard				•				•							•	
Accipitridae	<i>Hieraaetus morphnoides</i>	Little Eagle										•		•		•	•	
Accipitridae	<i>Aquila audax</i>	Wedge-tailed Eagle	•			•				•		•	•	•	•	•	•	
Accipitridae	<i>Accipiter fasciatus</i>	Brown Goshawk			M	•									•	•	•	
Accipitridae	<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk				•						•			•	•		
Accipitridae	<i>Circus assimilis</i>	Spotted Harrier				•				•			•		•	•	•	•
Accipitridae	<i>Milvus migrans</i>	Black Kite										•			•		•	
Accipitridae	<i>Haliastur sphenurus</i>	Whistling Kite			M	•				•			•	•	•	•	•	
Accipitridae	<i>Haliaeetus leucogaster</i>	White-bellied Sea Eagle			M		•											
Strigidae	<i>Ninox connivens</i>	Barking Owl											•			•	•	
Strigidae	<i>Ninox boobook</i>	Australian Boobook			M										•			
Halcyonidae	<i>Dacelo leachii</i>	Blue-winged Kookaburra				•				•		•	•	•	•	•	•	
Halcyonidae	<i>Todiramphus sanctus</i>	Sacred Kingfisher			M	•				•						•	•	
Halcyonidae	<i>Todiramphus pyrrhopygius</i>	Red-backed Kingfisher				•				•			•	•	•	•	•	

Family	Species name	Common name	Current Survey	Conservation Status		Database Searches			Previous Surveys									
				State	Federal	Nature Map	EPBC PMST	DBCA	PBS	(Biota 2012)	(Biota 2015)	(Biota 2009)	(Biota 2011)	(Biota 2008)	(Ecologia 2014b)	(Ecologia 2012)	(Biota 2021)	(Biota 2022)
Meropidae	<i>Merops ornatus</i>	Rainbow Bee-eater	•		M	•	•			•	•		•	•	•	•	•	•
Falconidae	<i>Falco cenchroides</i>	Nankeen Kestrel	•		M	•				•			•	•	•	•	•	
Falconidae	<i>Falco longipennis</i>	Australian Hobby				•			•	•					•		•	
Falconidae	<i>Falco berigora</i>	Brown Falcon	•			•			•	•		•		•	•	•	•	
Falconidae	<i>Falco hypoleucos</i>	Grey Falcon		VU		•											•	
Falconidae	<i>Falco peregrinus</i>	Peregrine Falcon		OS		•		•		•				•		•		
Psittacidae	<i>Nymphicus hollandicus</i>	Cockatiel				•			•	•			•	•	•	•	•	
Psittacidae	<i>Eolophus roseicapilla</i>	Galah	•			•				•		•	•	•	•	•	•	•
Psittacidae	<i>Cacatua sanguinea</i>	Little Corella	•			•				•		•	•	•	•	•	•	•
Psittacidae	<i>Psephotellus varius</i>	Mulga Parrot								•		•						
Psittacidae	<i>Barnardius zonarius</i>	Australian Ringneck	•			•				•		•	•	•	•	•	•	•
Psittacidae	<i>Pezoporus occidentalis</i>	Night Parrot		CR	EN		•											
Psittacidae	<i>Neopsephotus bourkii</i>	Bourke's Parrot				•										•		
Psittacidae	<i>Melopsittacus undulatus</i>	Budgerigar	•			•			•	•			•	•	•	•	•	•
Ptilonorhynchidae	<i>Chlamydera guttata</i>	Western Bowerbird	•			•						•		•	•	•	•	•
Climacteridae	<i>Climacteris melanurus</i>	Black-tailed Treecreeper															•	
Maluridae	<i>Malurus assimilis</i>	Purple-backed Fairywren	•			•				•		•	•	•	•	•	•	•
Maluridae	<i>Malurus leucopterus</i>	White-winged Fairywren	•			•				•		•	•	•	•	•	•	•
Maluridae	<i>Stipiturus ruficeps</i>	Rufous-crowned Emu-wren				•				•				•		•		
Maluridae	<i>Amytornis striatus</i>	Striated Grasswren				•		•		•		•			•	•		
Meliphagidae	<i>Epthianura tricolor</i>	Crimson Chat	•			•				•			•	•	•	•	•	•
Meliphagidae	<i>Conopophila whitei</i>	Grey Honeyeater				•							•	•	•			
Meliphagidae	<i>Certhionyx variegatus</i>	Pied Honeyeater				•				•					•	•		
Meliphagidae	<i>Sugomel niger</i>	Black Honeyeater								•			•		•	•	•	
Meliphagidae	<i>Lichmera indistincta</i>	Brown Honeyeater				•				•		•	•	•	•	•	•	•
Meliphagidae	<i>Melithreptus gularis</i>	Black-chinned Honeyeater				•				•		•		•	•	•		
Meliphagidae	<i>Purnella albifrons</i>	White-fronted Honeyeater								•							•	
Meliphagidae	<i>Gavicalis virescens</i>	Singing Honeyeater	•			•			•	•		•	•	•	•	•	•	•
Meliphagidae	<i>Ptilotula keartlandi</i>	Grey-headed Honeyeater	•			•				•		•	•	•	•	•	•	•
Meliphagidae	<i>Ptilotula penicillata</i>	White-plumed Honeyeater	•							•			•	•	•	•	•	•
Meliphagidae	<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater				•			•	•		•	•	•	•	•	•	•
Meliphagidae	<i>Manorina flavigula</i>	Yellow-throated Miner	•			•				•		•	•	•	•	•	•	•
Pardalotidae	<i>Pardalotus rubricatus</i>	Red-browed Pardalote				•				•		•	•	•	•	•	•	
Pardalotidae	<i>Pardalotus striatus</i>	Striated Pardalote				•				•			•	•	•	•	•	
Acanthizidae	<i>Smicromnis brevirostris</i>	Weebill				•			•	•		•	•	•	•	•	•	
Acanthizidae	<i>Gerygone fusca</i>	Western Gerygone				•			•			•	•	•	•	•	•	
Acanthizidae	<i>Acanthiza apicalis</i>	Inland Thornbill				•						•	•	•	•	•	•	

Family	Species name	Common name	Current Survey	Conservation Status		Database Searches			Previous Surveys									
				State	Federal	Nature Map	EPBC PMST	DBCA	PBS	(Biota 2012)	(Biota 2015)	(Biota 2009)	(Biota 2011)	(Biota 2008)	(Ecologia 2014b)	(Ecologia 2012)	(Biota 2021)	(Biota 2022)
Acanthizidae	<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill	•			•				•		•	•	•	•	•	•	
Acanthizidae	<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill				•												
Acanthizidae	<i>Acanthiza robustirostris</i>	Slaty-backed Thornbill				•							•			•		
Pomatostomidae	<i>Pomatostomus temporalis</i>	Grey-crowned Babbler	•			•			•	•		•	•	•	•	•	•	•
Pomatostomidae	<i>Pomatostomus superciliosus</i>	White-browed Babbler								•								
Artamidae	<i>Artamus leucorhynchus</i>	White-breasted Woodswallow								•								
Artamidae	<i>Artamus personatus</i>	Masked Woodswallow				•			•	•			•		•	•	•	•
Artamidae	<i>Artamus superciliosus</i>	White-browed Woodswallow				•												
Artamidae	<i>Artamus cinereus</i>	Black-faced Woodswallow	•			•			•	•		•	•	•	•	•	•	•
Artamidae	<i>Artamus minor</i>	Little Woodswallow				•				•		•	•	•	•	•		
Cracticidae	<i>Gymnorhina tibicen</i>	Australian Magpie				•			•			•	•	•	•	•		•
Cracticidae	<i>Cracticus torquatus</i>	Grey Butcherbird				•			•	•		•	•	•	•	•	•	•
Cracticidae	<i>Cracticus nigrogularis</i>	Pied Butcherbird	•			•				•		•	•	•	•	•	•	•
Campephagidae	<i>Coracina maxima</i>	Ground Cuckooshrike				•								•	•	•		
Campephagidae	<i>Coracina novaehollandiae</i>	Black-faced Cuckooshrike	•		M	•				•		•	•	•	•	•	•	•
Campephagidae	<i>Lalage tricolor</i>	White-winged Triller				•				•			•	•	•	•	•	
Neosittidae	<i>Daphoenositta chrysoptera</i>	Varied Sittella				•							•		•			
Pachycephalidae	<i>Oreoica gutturalis</i>	Crested Bellbird	•			•			•	•		•	•	•	•	•	•	•
Pachycephalidae	<i>Pachycephala rufiventris</i>	Rufous Whistler	•			•			•	•		•	•	•	•	•	•	•
Pachycephalidae	<i>Colluricincla harmonica</i>	Grey Shrikethrush	•			•			•	•		•	•	•	•	•	•	•
Dicruridae	<i>Rhipidura leucophrys</i>	Willie Wagtail	•			•			•	•		•	•	•	•	•	•	•
Rhipiduridae	<i>Rhipidura albiscapa</i>	Grey Fantail											•	•				
Dicruridae	<i>Grallina cyanoleuca</i>	Magpie-lark	•		M	•			•	•		•	•	•	•	•	•	•
Corvidae	<i>Corvus orru</i>	Torresian Crow				•				•		•	•	•	•	•	•	•
Corvidae	<i>Corvus bennetti</i>	Little Crow	•			•				•		•	•	•	•	•	•	•
Petroicidae	<i>Melanodryas cucullata</i>	Hooded Robin				•			•			•	•	•	•	•		
Petroicidae	<i>Microeca fascinans</i>	Jacky Winter											•	•				
Petroicidae	<i>Petroica goodenovii</i>	Red-capped Robin				•						•	•	•	•	•		
Alaudidae	<i>Mirafra javanica</i>	Horsfield's Bush Lark				•								•	•	•	•	
Hirundinidae	<i>Hirundo neoxena</i>	Welcome Swallow	•		M	•									•			
Hirundinidae	<i>Petrochelidon ariel</i>	Fairy Martin				•							•	•		•	•	
Hirundinidae	<i>Petrochelidon nigricans</i>	Tree Martin			M	•									•	•	•	
Sylviidae	<i>Acrocephalus australis</i>	Australian Reed Warbler				•												
Sylviidae	<i>Poodytes carteri</i>	Spinifexbird				•				•					•	•	•	•
Megaluridae	<i>Cincloramphus cruralis</i>	Brown Songlark	•							•			•	•	•	•	•	

Family	Species name	Common name	Current Survey	Conservation Status		Database Searches			Previous Surveys									
				State	Federal	Nature Map	EPBC PMST	DBCA	PBS	(Biota 2012)	(Biota 2015)	(Biota 2009)	(Biota 2011)	(Biota 2008)	(Ecologia 2014b)	(Ecologia 2012)	(Biota 2021)	(Biota 2022)
Megaluridae	<i>Cincloramphus mathewsi</i>	Rufous Songlark	•							•					•	•	•	•
Dicaeidae	<i>Dicaeum hirundinaceum</i>	Mistletoebird				•						•	•		•	•		
Estrilidae	<i>Emblema pictum</i>	Painted Finch				•				•		•	•	•	•	•	•	•
Estrilidae	<i>Neochmia ruficauda</i>	Star Finch				•			•					•			•	
Estrilidae	<i>Taeniopygia guttata</i>	Zebra Finch	•			•			•	•		•	•	•	•	•	•	•
Motacillidae	<i>Anthus australis</i>	Australian Pipit			M	•								•	•	•		

Appendix 13

Likelihood of Occurrence of Significant Fauna



Species Name	Common Name	Conservation Status		Database Searches		Previous Surveys							Records within 18 km of Survey Area	Preferred Habitat	Pre-survey Likelihood of Occurrence	Habitat Available in Survey Area?	Post-survey Likelihood of Occurrence	
		BC Act	EPBC Act	NatureMap	EPBC PMST	DBCA Pilbara Biological Survey	Biota (2012)	Biota (2015)	Biota (2009)	Biota (2011)	Biota (2008c)	Ecologia (2014b)						Ecologia (2012)
<i>Dasyurus hallucatus</i>	Northern Quoll	EN	EN	•	•		•							152 NatureMap records, the nearest being 2 km from the survey area; the most recent record from 2018.	In the Pilbara region, primarily rocky areas and major drainage lines.	Likely to occur	Yes; rocky areas may be used for denning and foraging habitat, and creek lines may be used for dispersal through the landscape.	Recorded in the survey area.
<i>Sminthopsis longicaudata</i>	Long-tailed Dunnart	P4	–	•		•								Two NatureMap records from 2011, which are 4 km from the survey area.	Arid and rugged, rocky scree areas, including scree slopes, boulder and stony plateaus and adjacent stony plains with shrubs over spinifex hummock grassland.	Likely to occur	Yes; stony plains.	May occur; some suitable habitat present, but limited in extent within study area.
<i>Macrotis lagotis</i>	Bilby	VU	VU	•	•									Two records from 1970 and 1984, both 14.5 km from the closest survey area boundary. GPS locations from older records are often inaccurate as they have been positioned generally in the inland Pilbara area; these GPS records were only to 1 decimal place and therefore considered unreliable.	Acacia shrubland, open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas.	Unlikely to occur; some suitable habitat present, but recorded infrequently and over 35 years ago.	Marginal; some sandy areas and open patches of Acacia shrubland, including <i>A. trachycarpa</i> , which is known to support root-dwelling larvae similar to <i>A. monticola</i> .	Unlikely to occur; some suitable habitat present, but recorded infrequently and over 35 years ago.
<i>Lagorchestes conspicillatus leichardti</i>	Spectacled Hare-wallaby	P4	–	•										One record from 1966, near to Mt Sheila, 0.8 km from the closest survey area boundary.	Sandy habitats with spinifex or low shrubbery.	Unlikely to occur; some suitable habitat present but recorded infrequently and over 40 years ago.	Marginal; some areas of low spinifex but usually rocky rather than sandy.	Unlikely to occur; some suitable habitat present but recorded infrequently and over 40 years ago.
<i>Leggadina lakedownensis</i>	Northern Short-tailed Mouse	P4	–	•		•							•	Nine records from 2005, 2006 and 2014; the closest record to the survey area boundary is 5.6 km away.	Spinifex and tussock grasslands, primarily on cracking clays or sandy soils.	Likely to occur	Yes; clay plains.	May occur; suitable habitat present (0.02%) of study area and records of the species in close proximity to the survey area (within 10 km), but infrequently recorded.
<i>Pseudomys chapmani</i>	Western Pebble-mound Mouse	P4	–	•			•	•	•	•			•	Four records from 1992, one from 1995 and one from 2014; the closest was 10.2 km from the survey area boundary.	Stony plains and hills with hummock grasslands.	Likely to occur	Yes; stony plains and low rises.	Recorded in the survey area.
<i>Rhinioncteris aurantia</i>	Pilbara Leaf-nosed Bat	VU	VU	•	•			•					•	Nineteen records, with the most recent from 2019 and the nearest 1 km from the closest survey area boundary.	Forages over a broad range of habitats. Roosting is reliant on sites in caves or mine adits with stable, very hot (28-	Likely to occur	Yes, secondary only (foraging); no suitable caves for roosting.	Recorded in the survey area.

Species Name	Common Name	Conservation Status		Database Searches		Previous Surveys							Records within 18 km of Survey Area	Preferred Habitat	Pre-survey Likelihood of Occurrence	Habitat Available in Survey Area?	Post-survey Likelihood of Occurrence	
		BC Act	EPBC Act	NatureMap	EPBC PMST	DBCA Pilbara Biological Survey	Biota (2012)	Biota (2015)	Biota (2009)	Biota (2011)	Biota (2008c)	Ecologia (2014b)						Ecologia (2012)
														32°C) and very humid (96-100%) microclimates.				
<i>Macroderma gigas</i>	Ghost Bat	VU	VU	•	•	•							•	Thirteen records in NatureMap mostly from the last 10 years with the most recent record from 2019. The nearest record was 2.1 km from the closest survey area boundary.	Forages over a broad range of habitats; distribution is influenced by the availability of suitable caves and mines for roost sites.	Likely to occur	Yes, secondary only (foraging); no suitable caves for roosting.	Recorded in the survey area.
<i>Pezoporus occidentalis</i>	Night Parrot	CR	EN		•									No recent records within 40 km of the survey area.	Old growth spinifex, often in association with samphire.	Unlikely to occur; habitat only marginal and no previous records from the locality.	Marginal.	Unlikely to occur; habitat only marginal and no recent records from the locality.
<i>Apus pacificus</i>	Pacific Swift	MI	M/MI	•	•								•	Two records from 2011 and one from 2010, the nearest being 5.9 km away.	Thought to be exclusively aerial.	Likely to occur.	Yes.	Likely to occur.
<i>Falco hypoleucos</i>	Grey Falcon	VU	VU	•										Two records from 2012, the nearest being 1.6 km from the closest survey area boundary.	Varied; lightly treed inland areas, sand ridges, gibber deserts, pastoral land, timbered watercourses.	Likely to occur.	Yes.	Likely to occur.
<i>Falco peregrinus</i>	Peregrine Falcon	OS	-	•			•						•	Seven NatureMap records, the most recent from 2017 and the nearest 1.1 km away.	Varied; cliffs, gorges, timbered watercourses, plains, wetlands, open woodlands, buildings.	Likely to occur.	Yes.	Likely to occur.
<i>Liasis olivaceus barroni</i>	Pilbara Olive Python	VU	VU	•	•	•			•				•	14 records with the most recent recorded in 2017. Two records within 1.5 km of the nearest survey area boundary.	Rocky areas within the Pilbara, showing preference for rocky gorges containing water in streams and rock pools.	Likely to occur.	Yes.	Likely to occur.
<i>Underwoodisaurus seorsus</i>	Pilbara Barking Gecko	P2	-	•									•	One record from 2014, 10.4 km from the closest survey area boundary.	Occurs in rocky areas with spinifex and scattered trees.	Likely to occur.	Yes.	Likely to occur.
<i>Notoscincus butleri</i>	Western Striped Snake-eyed Skink	-	-	•									•	One record from 2002 and five from 2011, the closest being 1.1 km from the survey area boundary.	Found in rocky areas near creek and river margins dominated by spinifex.	Likely to occur.	Yes.	Likely to occur.

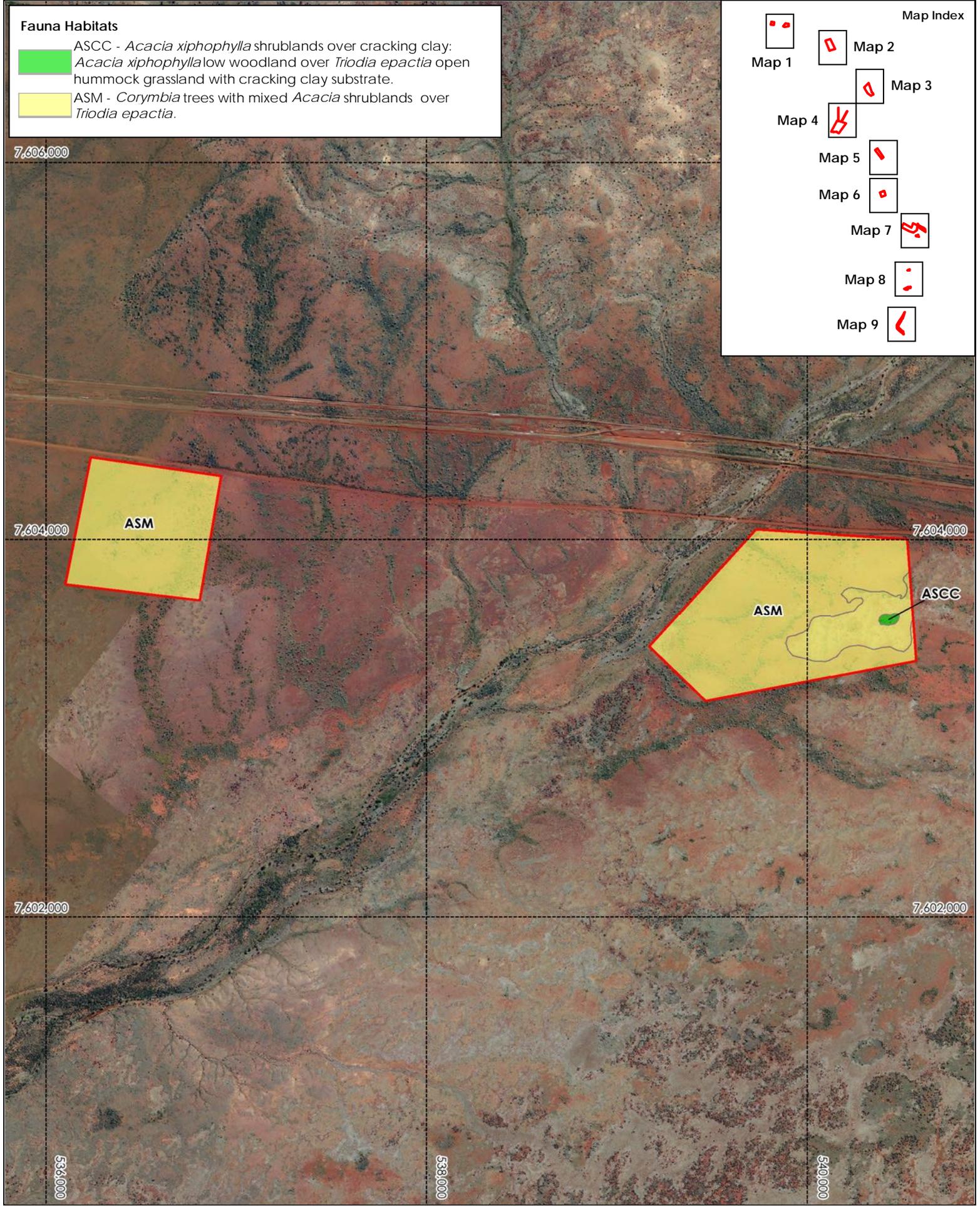
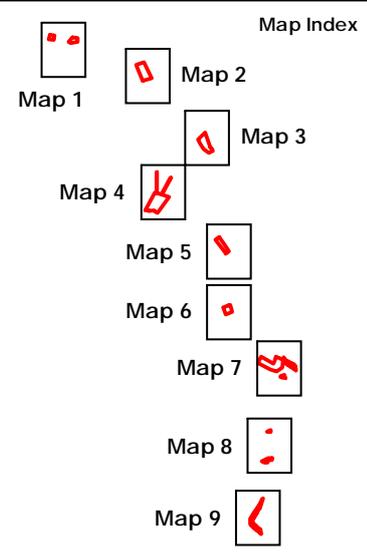
Appendix 14

Mapping of Fauna Habitats and Significant Fauna Records



Fauna Habitats

- ASCC - *Acacia xiphophylla* shrublands over cracking clay:
Acacia xiphophylla low woodland over *Triodia epactia* open hummock grassland with cracking clay substrate.
- ASM - *Corymbia* trees with mixed *Acacia* shrublands over *Triodia epactia*.



Survey area



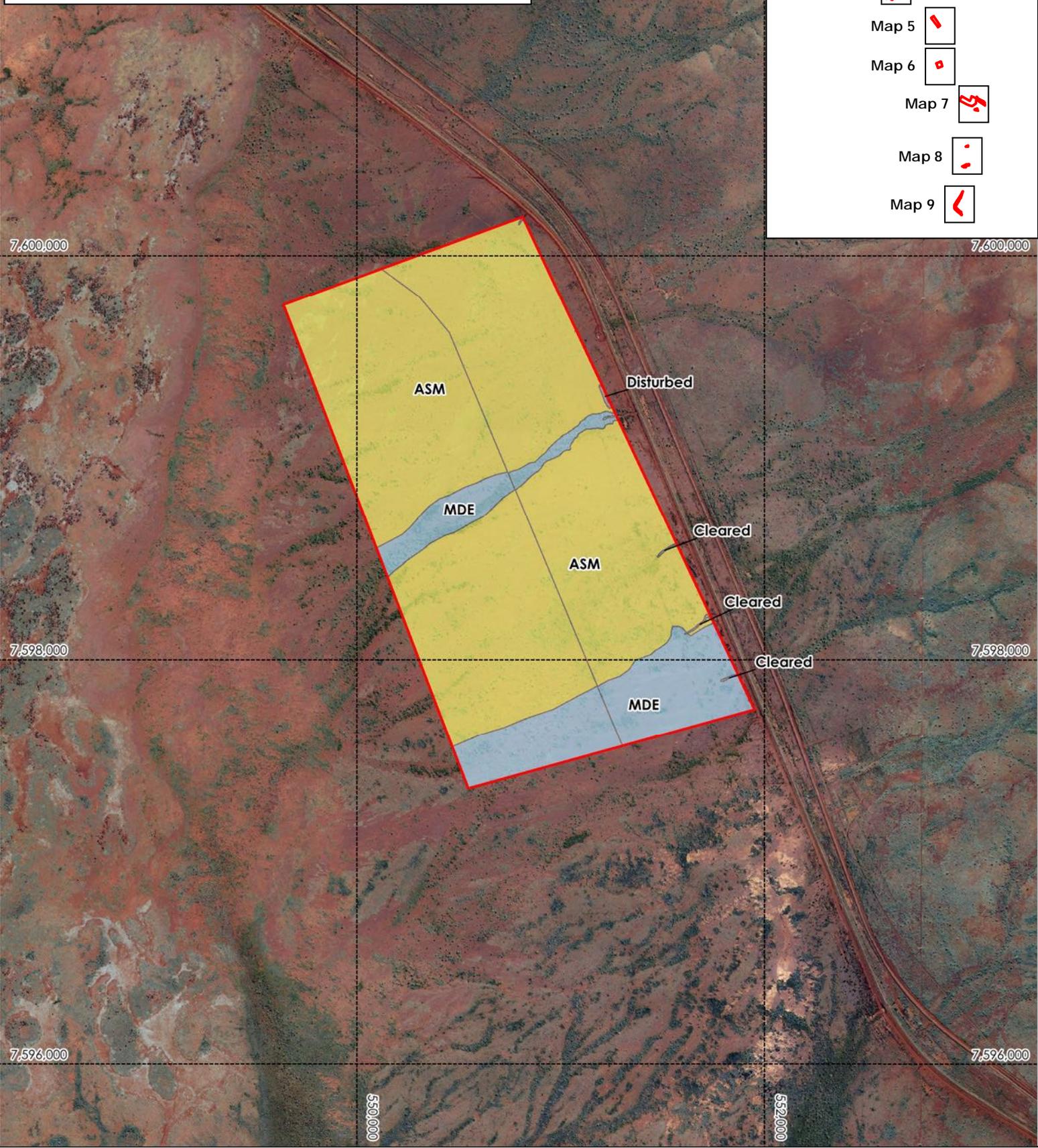
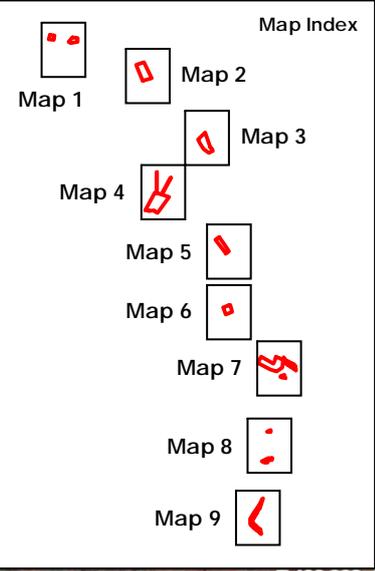
**Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Fauna Habitat Map 1**



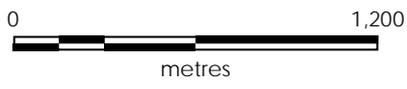
Fauna Habitats

ASM - *Corymbia* trees with mixed *Acacia* shrublands over *Triodia epactia*.

MDE - *Eucalyptus* fringed major drainage lines and associated tributaries: Open | *Eucalyptus victrix* / *E. camaldulensis*.



Survey area



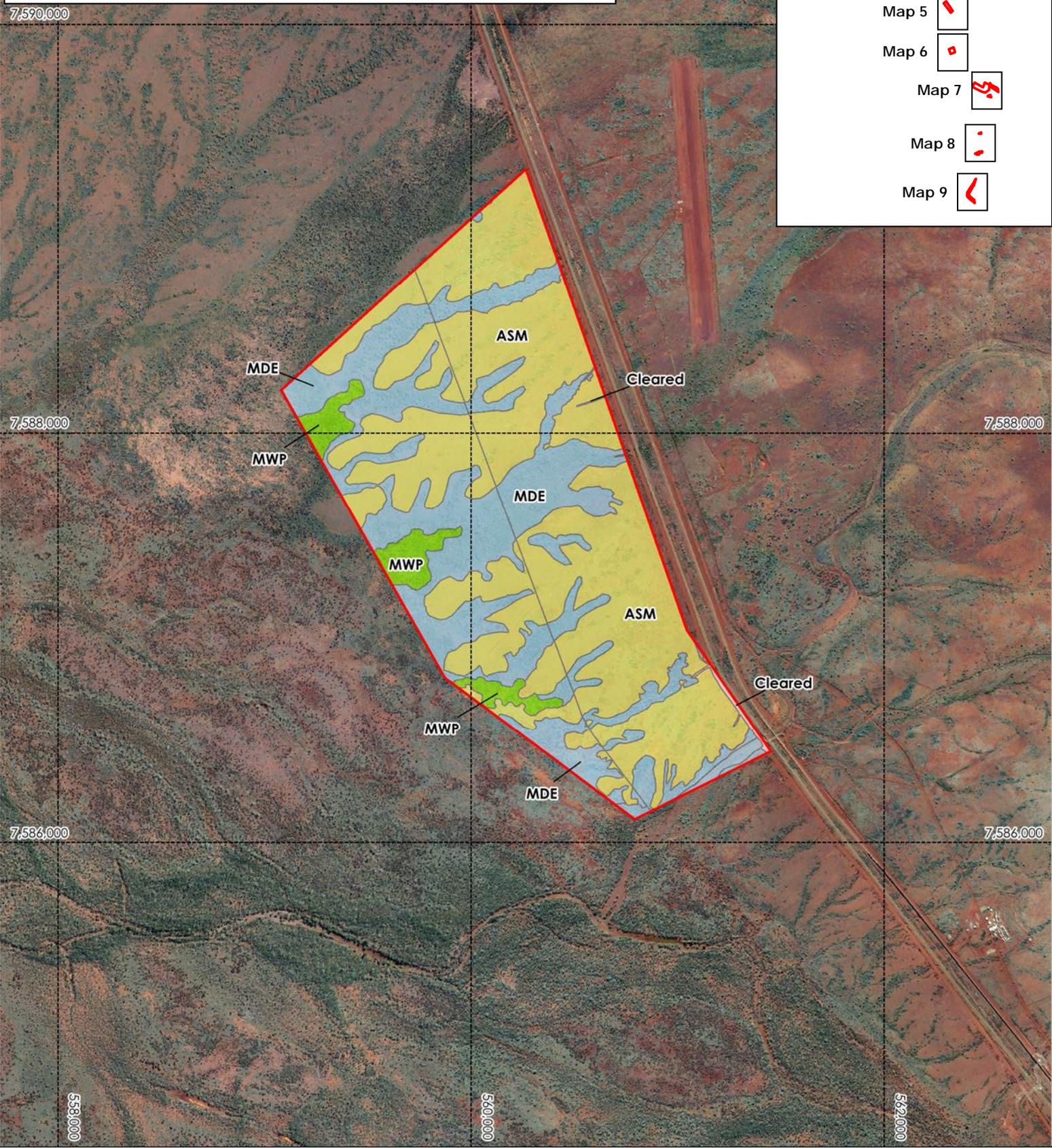
**Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Fauna Habitat Map 2**



Fauna Habitats

- ASM - *Corymbia* trees with mixed *Acacia* shrublands over *Triodia epactia*.
- MDE - *Eucalyptus* fringed major drainage lines and associated tributaries: Open *Eucalyptus victrix*/*E. camaldulensis*.
- MWP - Mulga woodland plain: *Acacia aneura* open woodland plains over scattered shrubs over *Triodia* spp. open hummock grassland.

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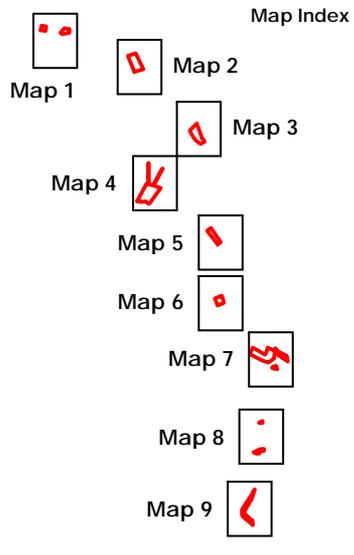


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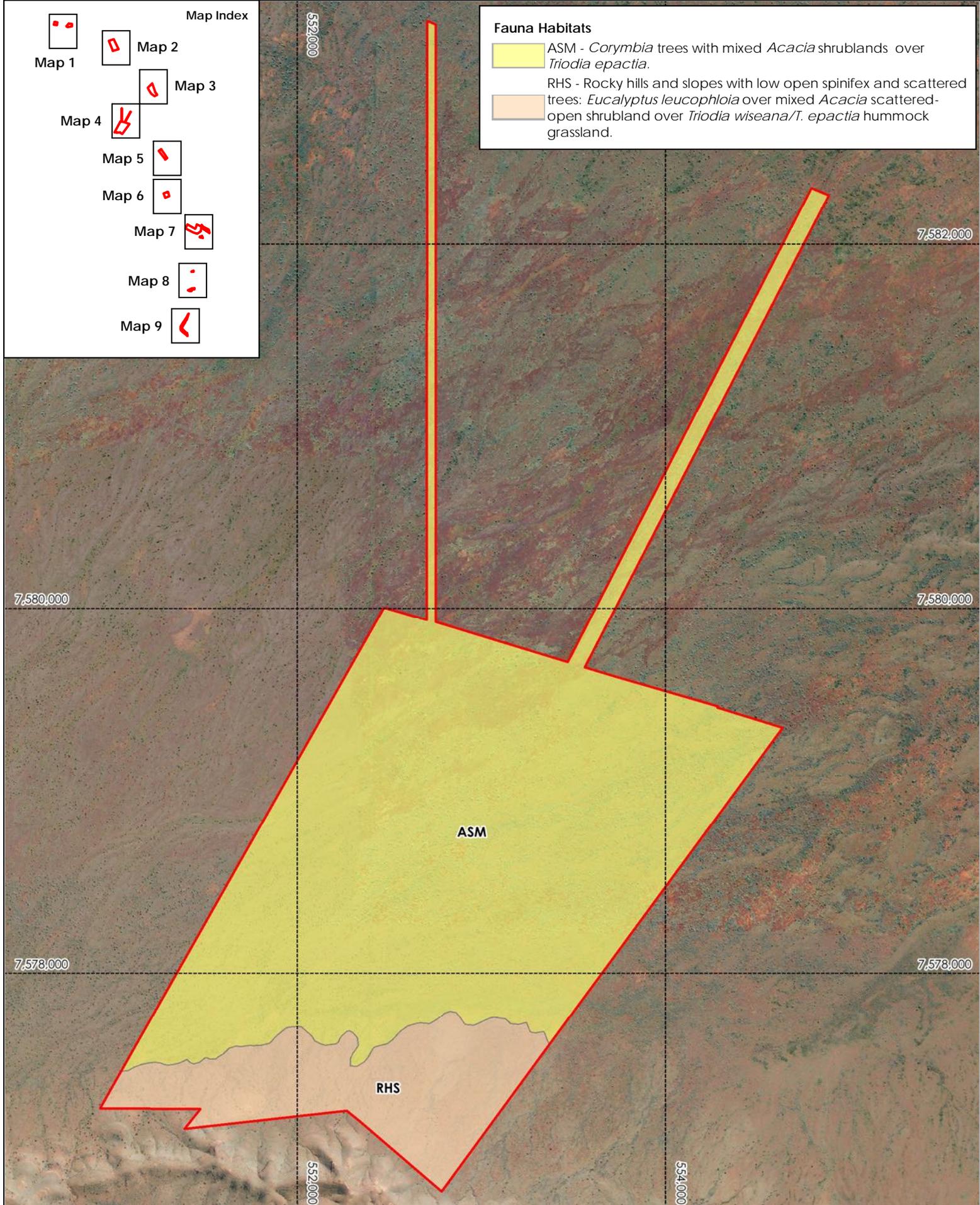
**Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Fauna Habitat Map 3**



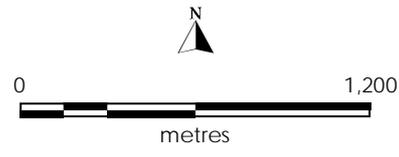


Fauna Habitats

-  ASM - *Corymbia* trees with mixed *Acacia* shrublands over *Triodia epactia*.
-  RHS - Rocky hills and slopes with low open spinifex and scattered trees: *Eucalyptus leucophloia* over mixed *Acacia* scattered-open shrubland over *Triodia wiseana*/*T. epactia* hummock grassland.



 Survey area



**Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Fauna Habitat Map 4**

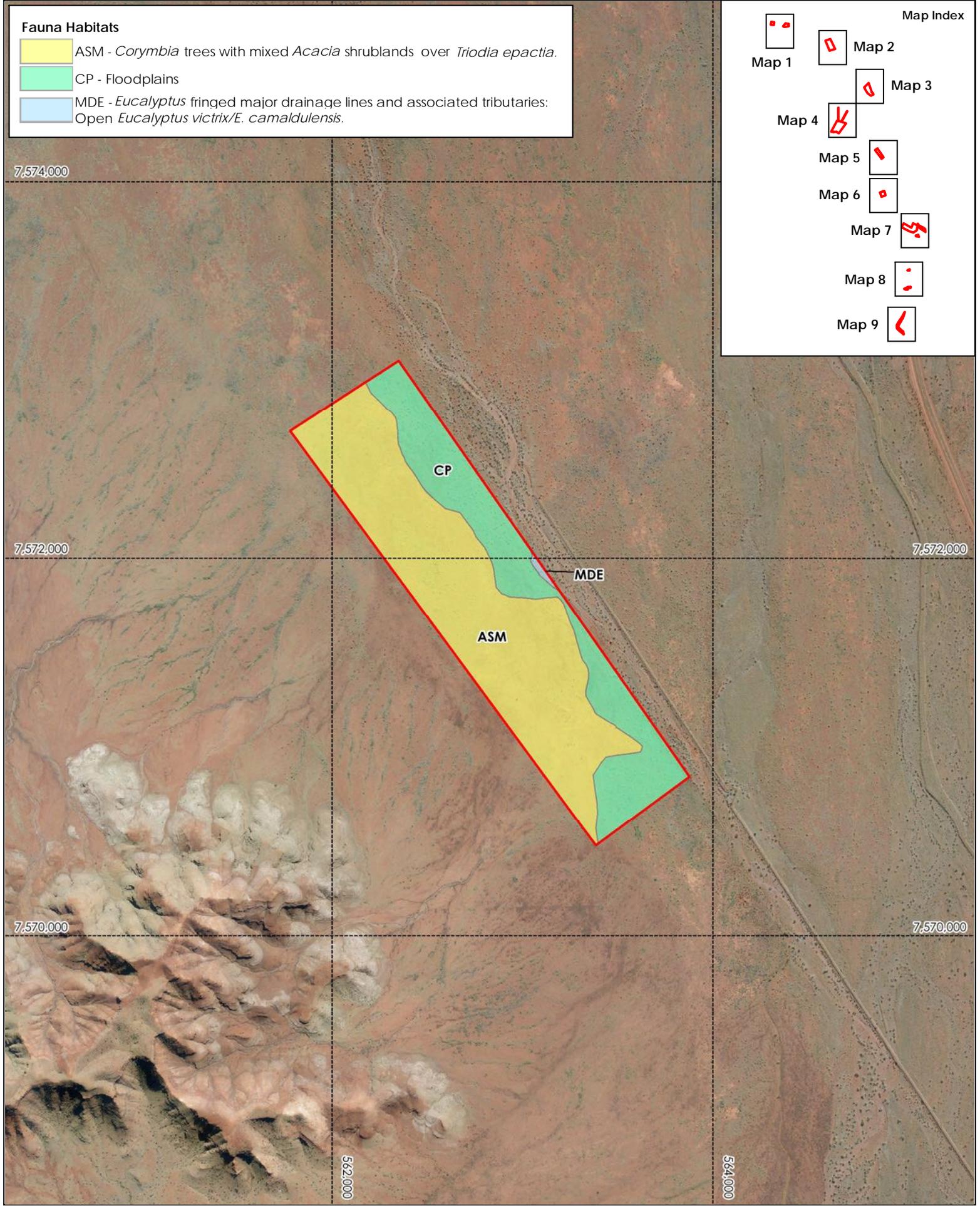


Fauna Habitats

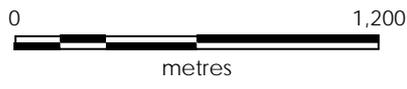
- ASM - *Corymbia* trees with mixed *Acacia* shrublands over *Triodia epactia*.
- CP - Floodplains
- MDE - *Eucalyptus* fringed major drainage lines and associated tributaries: Open *Eucalyptus victrix*/*E. camaldulensis*.

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Survey area

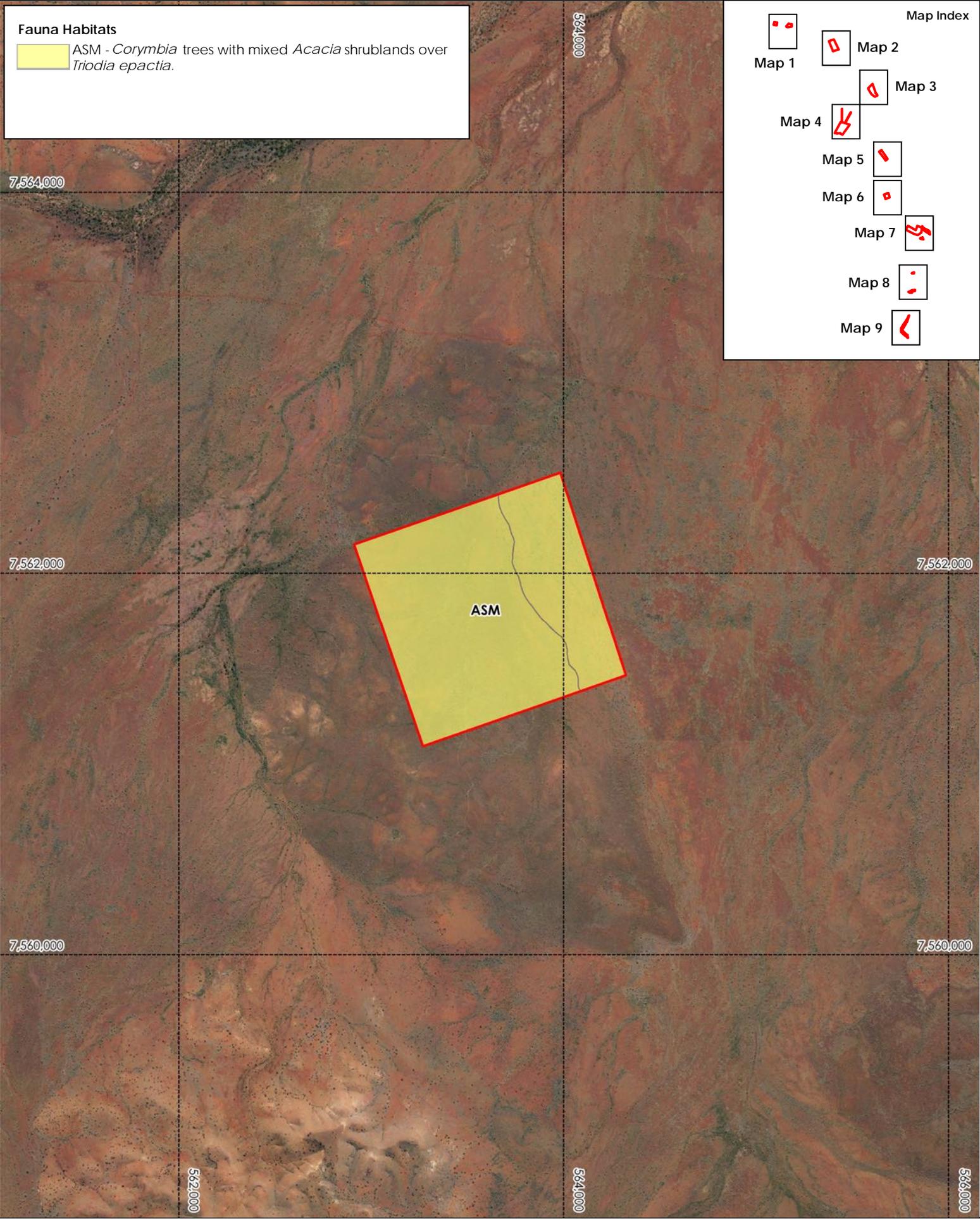
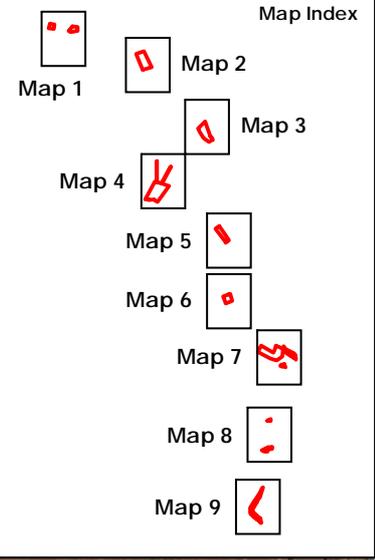


**Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Fauna Habitat Map 5**



Fauna Habitats

ASM - *Corymbia* trees with mixed *Acacia* shrublands over *Triodia epactia*.



Survey area



**Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Fauna Habitat Map 6**

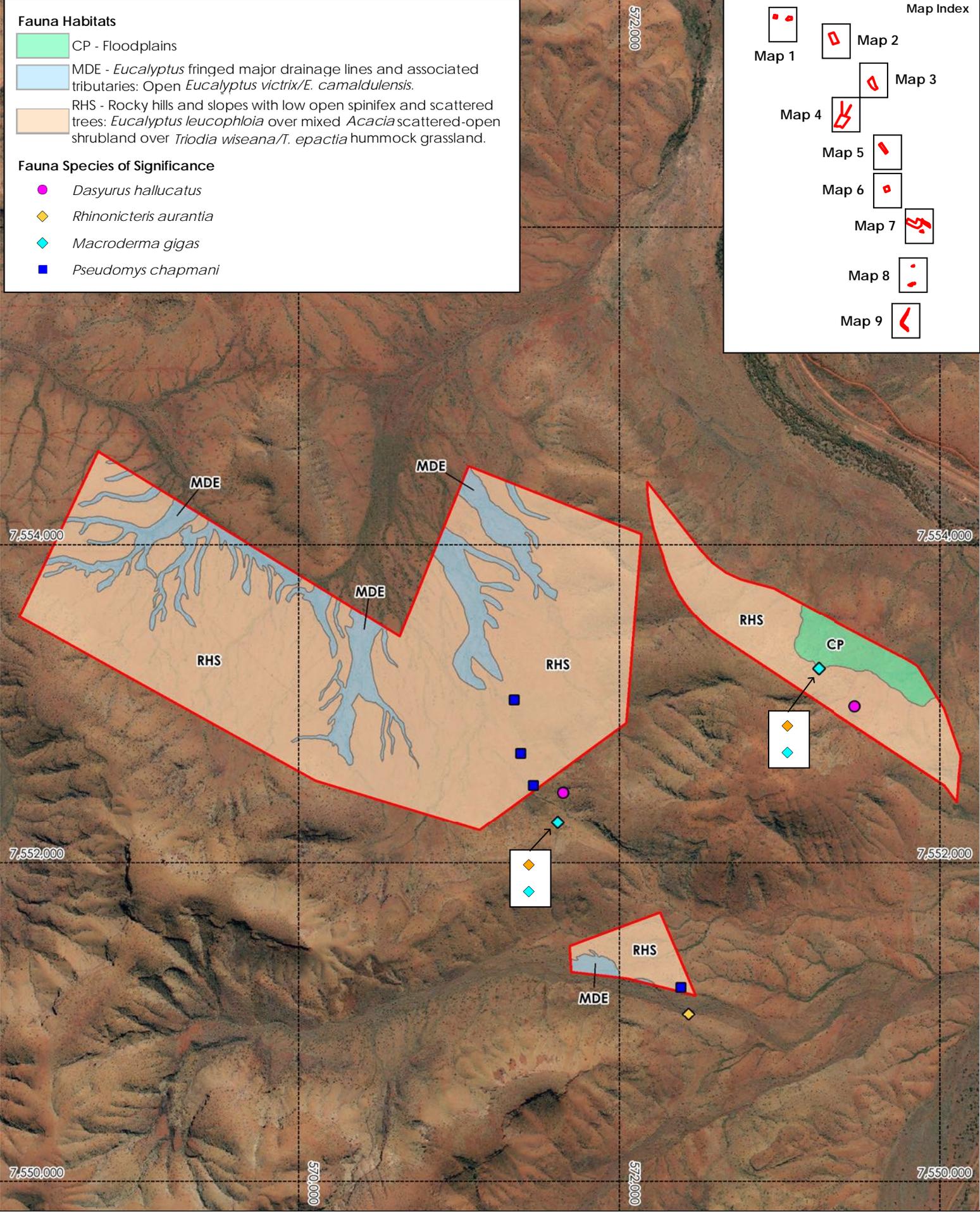
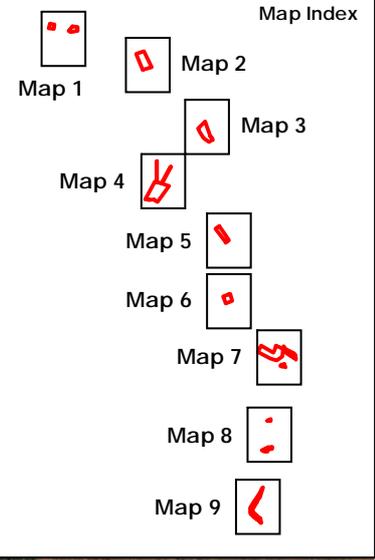


Fauna Habitats

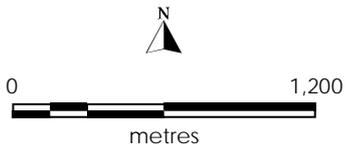
- CP - Floodplains
- MDE - *Eucalyptus* fringed major drainage lines and associated tributaries: Open *Eucalyptus victrix*/*E. camaldulensis*.
- RHS - Rocky hills and slopes with low open spinifex and scattered trees: *Eucalyptus leucophloia* over mixed *Acacia* scattered-open shrubland over *Triodia wiseana*/*T. epactia* hummock grassland.

Fauna Species of Significance

- Dasyurus hallucatus*
- Rhinonictes aurantia*
- Macroderma gigas*
- Pseudomys chapmani*



Survey area



**Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Fauna Habitat Map 7**

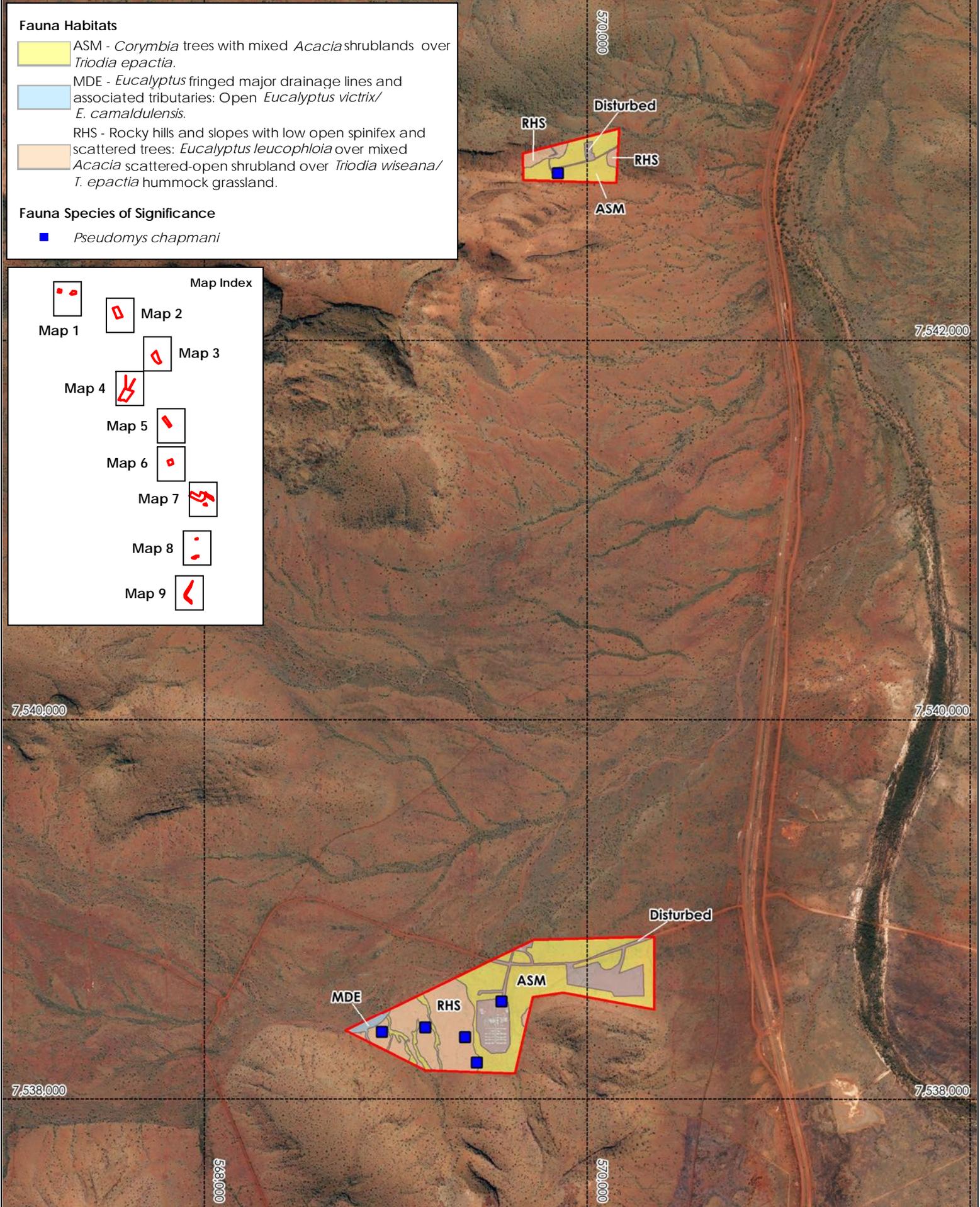
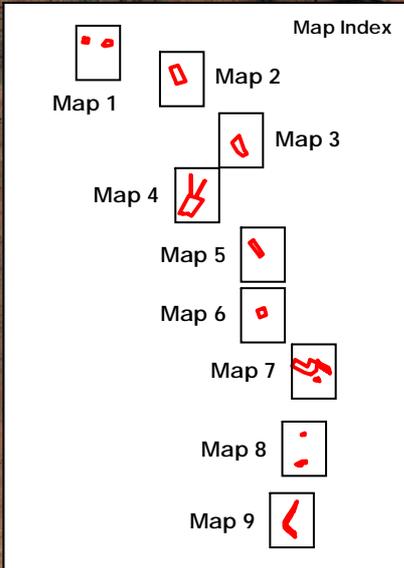


Fauna Habitats

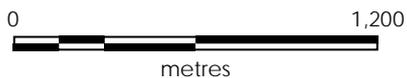
- ASM - *Corymbia* trees with mixed *Acacia* shrublands over *Triodia epactia*.
- MDE - *Eucalyptus* fringed major drainage lines and associated tributaries: Open *Eucalyptus victrix*/*E. camaldulensis*.
- RHS - Rocky hills and slopes with low open spinifex and scattered trees: *Eucalyptus leucophloia* over mixed *Acacia* scattered-open shrubland over *Triodia wiseana*/*T. epactia* hummock grassland.

Fauna Species of Significance

- Pseudomys chapmani*



Survey area



**Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Fauna Habitat Map 8**



Fauna Habitats

-  ASM - *Corymbia* trees with mixed *Acacia* shrublands over *Triodia epactia*.
-  GPCC - Grassland plains with cracking clay: *Themeda* grassland (TEC) in the south and in the north, *Astrebla* grasslands (PEC), both with cracking clay substrates.
-  MDE - *Eucalyptus* fringed major drainage lines and associated tributaries: Open *Eucalyptus victrix*/*E. camaldulensis*.
-  MWP - Mulga woodland plain: *Acacia aneura* open woodland plains over scattered shrubs over *Triodia* spp. open hummock grassland.
-  RHS - Rocky hills and slopes with low open spinifex and scattered trees: *Eucalyptus leucophloia* over mixed *Acacia* scattered-open shrubland over *Triodia wiseana*/*T. epactia* hummock grassland.

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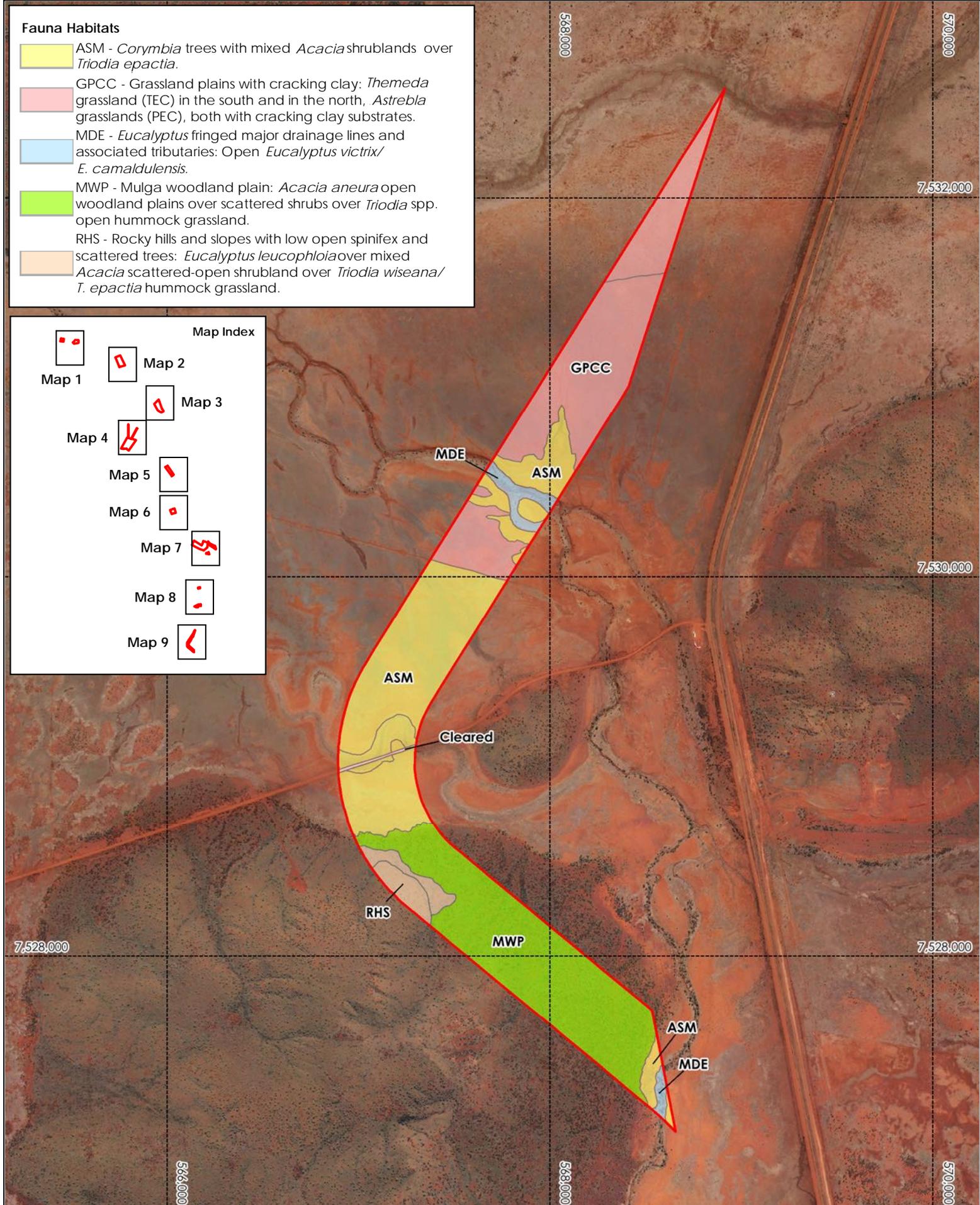
Map 5

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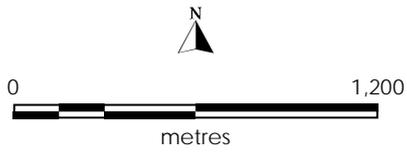
Map 7

Map 8

Map 9



 Survey area



**Manuwarra Red Dog Hwy Stage 4
Borrow Pits Biological Survey
Fauna Habitat Map 9**

