Warrirda Road Native Vegetation Clearing Permit Support Document

Prepared for Mineral Resources Limited

ecological AUSTRALIA
A TETRA TECH COMPANY

1300 646 131
www.ecoaus.com.au

DOCUMENT TRACKING

Proposal Name	Warrirda Road Native Vegetation Clearing Permit Support Document
Project Number	23PER4904
Project Manager	Libby Payne
Prepared by	Aaron Caubo
Reviewed by	Libby Payne
Approved by	Jeremy Mitchell
Status	**Draft**
Version Number	**v12**
Last saved on	**17 May 2023**

This report should be cited as 'Eco Logical Australia 2023. *Warrirda Road Native Vegetation Clearing Permit Support Document*. Prepared for Mineral Resources Limited.'

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Limited with support from Mineral Resources Limited.

Template 2.8.1

Contents

List of Figures

List of Tables

Abbreviations

Abbreviation	Description
ASS	Acid Sulphate Soils
BAM Act	*Biosecurity and Agriculture Management Act 2007*
BC Act	*Biodiversity Conservation Act 2016*
DBCA	Department of Biodiversity Conservation and Attractions
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DER	Department of Environmental Regulation (now DWER)
DevWA	Development WA
DMIRS	Department of Mines, Industrial Regulation and Safety
DoE	Department of the Environment
DoW	Department of Water
DPIRD	Department of Primary Industries and Regional Development
DWER	Department of Water and Environmental Regulation (previously DER)
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Area
MNES	Matters of National Environmental Significance
MRWA	Main Road Western Australia
NVCP	Native Vegetation Clearing Permit
PEC	Priority Ecological Community

Abbreviation	Description
TDS	Total Dissolved Solids
TEC	Threatened Ecological Community
WAOL	Western Australian Organism List
WA	Western Australia

1. Introduction

Mineral Resources Limited (MinRes) is expanding its iron ore mining operations within the western Pilbara region. To facilitate the transport of ore to port, Main Roads (WA) (MRWA) require construction upgrades to Warrirda Road. MRWA has appointed MinRes as its contractor to undertake these construction works. A Native Vegetation Clearing Permit (NVCP) covering the existing road reserve has been acquired by MRWA for this purpose (CP 9534/1). Further detailed design of the proposed works has identified a requirement for some additional land adjoining the MRWA road reserve to support a temporary bypass track, construction laydown and access areas, cut and fill requirements and additional slope battering. The proposed additional disturbance areas (the Proposal) are contained within lots held by the Western Australian Land Authority, trading as Development WA (DevWA).

The Proposal requires clearing of up to 14.4 ha of native vegetation in several discontinuous locations on the northern side of Warrirda Road, referred to throughout the rest of the document as the Proposal Area (Figure 1-1).

This document has been prepared to support a native vegetation clearing permit application covering six parcels of land held by DevWA. DevWA has granted authorisation to access land for clearing purposes and MinRes will be the permit holder. The specific parcels of land subject to this application are:

- Lot 557 on Deposited Plan 74894, Certificate of Title 2882/149
- Lot 558 on Deposited Plan 71346, Certificate of Title 2779/354
- Lot 561 on Deposited Plan 71346, Certificate of Title 2779/356
- Lot 565 on Deposited Plan 71346, Certificate of Title 2779/359
- Lot 575 on Deposited Plan 71345, Certificate of Title 2779/364
- Lot 605 on Deposited Plan 402524, Certificate of Title 4022/822

The Letter of Authority from DevWA and the Certificates of Title are provided within Appendix A. This permit application will be assessed by the Department of Water and Environmental Regulation (DWER).

This document includes the following information:

- An overview of the existing environmental conditions of the site.
- An evaluation of potential impacts of vegetation clearing.
- An evaluation of the proposed clearing against the ten clearing principles listed under Schedule 5 of the EP Act.
- Detailed description and assessment of impacts to flora and fauna species as well as vegetation communities which are listed under the *Biodiversity Conservation Act 2016* (BC Act) and are associated with the Proposal.
- Detailed description of mitigation measures.
- Environmental approval and management requirements.

1.1. Proposal Description

The Proposal involves clearing of up to 14.4 ha of native vegetation to support the construction of a road (Figure 1-1). The expansion will include:

- Creation of cutbacks and batter slopes
- Temporary bypass roads and laydown areas
- Temporary access to facilitate construction
- Water management structures, such as culverts.

1.2. Location and Ownership

The 14.4 ha Proposal Area is located within the Ashburton North Strategic Industrial Area Structure Plan area, approximately 16 km south of Onslow within the Shire of Ashburton. The land parcels and current owner are outlined in Table 1-1.

Proof of ownership documentation and '*Authority to access and clear native vegetation*' letters, where relevant, have been provided in Appendix A.

Table 1-1: Proposal Area Lot Numbers and File Notation Areas

Deposit Number	Lot Number	Current Landowner
71345	575	Owned by DevelopmentWA
71346	558	
	561	
	565	
74894	557	
402524	605	

Figure 1-1: The Proposal Area, Including Regional Location

Proposal Area

N

0 1 2 4

Kilometres

Datum/Projection:
GDA 1994 MGA Zone 50

23PER4904-ED Date: 5/05/2023

eco logical AUSTRALIA
A TETRA TECH COMPANY

2. Environmental Context

2.1. Site Context

2.1.1. Bioregion and Climate

The Proposal Area is located within the Carnarvon Interim Biogeographical Regionalisation for Australia (IBRA) bioregion and the Cape Range IBRA subregion (DAWE 2022). The subregion is characterised by limestone ranges and extensive areas of red dune fields, coastal beach dunes and mudflats. The area has an arid, semi-desert to subtropical climate, with variable summer and winter rainfall and cyclonic activity can be significant in the subregion (Kendrick and Mau 2001).

2.1.2. Soils and Geology

The land systems of WA have been mapped at a scale of 1:250,000 (DPIRD 2021), three of which occur within the Proposal Area (Table 2-1).

Table 2-1: Land System in Proposal Area

Land System	Description	Total Extent within the Proposal Area (ha)	Total Extent in Carnarvon Bioregion (ha)
Dune Land System	Dune fields supporting soft spinifex and minor hard spinifex grasslands.	1.8	37,448
Littoral Land System	Bare coastal mudflats (unvegetated), samphire flats, sandy islands, coastal dunes, and beaches, supporting samphire low shrublands, sparse acacia shrublands and mangrove forests.	2.7	156,748
Onslow Land System	Undulating sandplains, dunes and level clay plains supporting soft spinifex grasslands and minor tussock grasslands.	9.9	56,711

The surface geology of Western Australia has been mapped into various geological units at a scale of 1:500,000 (DMIRS 2020). The Proposal Area occurs within the K-WN-sf unit of the Winning group as defined by DMIRS (2020). Lithologically, this unit is defined as 'shale, siltstone; marl, and basal sandstone; commonly glauconitic; radiolarian siltstone in central parts' and is widespread across the bioregion.

2.1.3. Hydrology and Hydrogeology

The Proposal Area occurs within the Ashburton River and Coastal sub-catchments of the Ashburton River Basin (DWER 2018). Quick Mud Creek is the only watercourse which intersects with the Proposal Area and flows into the coastal tidal flats to the north of the Proposal Area. Quick Mud Creek is an ephemeral and supra-tidal watercourse, with water-flows only present from exceptionally large tides associated with tidal storm surges as well as rainfall runoff. The Proposal Area also intersects with several tidal flats (mudflats and claypans), the largest of which occurs at the eastern end of the Proposal Area, all of which empty out into a large estuarine wetland to the north.

The Proposal Area occurs within the Birdrong Sandstone regional aquifer (DoW 2007). The aquifer is 20 to 30 m thick and ranges between 200 m and 1000 mAHD (Australian Height Datum). The water within the aquifer is mainly brackish but around the Proposal Area it becomes highly saline

(exceeding 12, 000 mg/L Total Dissolved Solids [TDS]) due to its close association with the nearby estuarine wetland and the rarity of recharge rainfall events.

2.1.4. Pre-European Vegetation

Pre-European vegetation within WA has been mapped by Beard at various scales in 1976 (Beard 1976). The Commonwealth of Australia's stated national target and objectives for biodiversity conservation is the retention of 30% or more of the pre-European extent of each community to preserve Australia's biological diversity (Commonwealth of Australia 2001).

The Proposal Area occurs across three sub-associations, all of which have more than 90% of the pre-European extent remaining. A brief description of these units and relative abundance within the Proposal Area and the State is provided in Table 2-2.

Table 2-2: Beard Vegetation Sub Associations

Sub Association	Description	Area in the Proposal Area (ha)	Pre-European Extent (ha) *	Current Extent (ha) *	Percentage Remaining (%) *
Short bunch-grass savanna/ Grass Steppe	*Eragrostis* sp. tussock grassland and Triodia sp. hummock grassland / *Triodia pungens* open hummock grassland	0.9	806,985	802,647	99.5
Shrub Steppe	*Acacia* sp. tall, isolated shrubs over *Triodia basedowii* open hummock grassland	10.8	147,810	147,794	100.0
Tidal mudflats	*NA*	2.2	171,574	170,791	99.5
Samphire	*Tecticornia* sp. low open samphire shrubland	0.5	438,799	435,592	99.3

*BASED ON ALL OF WESTERN AUSTRALIA (GOWA 2019)

2.1.5. Environmentally Sensitive Areas

Environmentally Sensitive Areas (ESAs) are defined in the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005* under s 51b of the EP Act. ESAs include areas declared as World Heritage, included on the Register for National Estate, defined wetlands, Bush Forever sites, vegetation containing rare (Threatened) flora and or Threatened Ecological Communities (TEC). No part of the Proposal Area lies within an ESA, with the closest ESA being Cane River (Mount Minnie and Nanutarra), 5 km south-east of the Proposal Area.

2.2. Technical Studies

A detailed and targeted (conservation significant species) flora and vegetation as well as a basic fauna survey was conducted by Spectrum Ecology & Spatial (Spectrum) in May 2021 to support an NVCP application submitted by Main Roads Western Australia (MRWA) in late 2021 (CPS 9534/1, Spectrum 2021). While these surveys covered the majority of the Proposal Area, additional surveys were conducted on the north side of Warrirda Road to achieve full coverage. These additional surveys consisted of a targeted Threatened and Priority flora survey and a vegetation survey, both of which were conducted by Spectrum in December 2022 (Spectrum 2023a & b).

The 2023 survey reports combines the findings from the 2021 and 2022 surveys and provided a consolidated dataset for the total area surveyed (Figure 2-1). The total survey effort within and around the Proposal Area is presented in Figure 2-1, the full technical reports are provided in Appendix B and the survey results are summarised in Section 2.2.1 and Section 2.2.2, respectively.

All surveys were conducted in accordance with the EPA *Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessments* (EPA 2016) and *Technical Guidance: Terrestrial vertebrate surveys for Environmental Impact Assessments* (EPA 2020).

Figure 2-1: Survey Effort

Proposal Area

Survey Boundary

N

0 0.5 1 2

Kilometres

Datum/Projection:
GDA 1994 MGA Zone 50

23PER4904-ED Date: 5/05/2023

ecological AUSTRALIA
A TETRA TECH COMPANY

2.2.1. Flora and Vegetation Values

2.2.1.1. Flora

A total of 145 flora individuals representing 36 families and 97 genera were recorded within the survey area (Spectrum 2021). No Threatened flora species as listed under s 178 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) or Part 2 of the *Biodiversity Conservation Act 2016* (BC Act) were recorded within the Proposal Area.

A total of nine conservation significant flora species were identified from the desktop assessment as possibly occurring within the Proposal Area (Spectrum 2021). Of these species two were recorded or thought to have a moderate to high likelihood of occurrence, namely *Eremophila forrestii* subsp. *viridis* (P3) and *Triumfetta echinata* (P3).

2.2.1.1.1. *Eremophila forrestii* subsp. *viridis* (P3)

During the 2023 survey 591 *Eremophila forrestii subsp. viridis'* were recorded – 573 within the regional survey sites and 18 within the survey area (Spectrum 2023a). All vegetation communities within the survey area were extensively traversed; however, individuals were only recorded within the D1 vegetation community (refer to Section 2.2.1.3). Thus, all other vegetation types present within the survey area were considered to be unsuitable for *Eremophila forrestii subsp. viridis* and are unlikely to support their occurrence (Spectrum 2023c).

One of the 18 individuals recorded within the survey area also occurred within the Proposal Area. This individual represents 0.7% of the individuals recorded during the survey and approximately 0.01% of the local population which has currently been quantified (Figure 2-1). It is noted that whilst this individual occurs within the Proposal Area, it also occurs within a previously approved Hastings NVCP (CPS 9818/1) area, currently held by Yangibana Pty Ltd, which overlaps the Proposal Area. It is assumed that the removal of this individual has already been accounted for under the aforementioned permit, as presented in Figure 2-2.

Based on this assumption, the Proposal will not result in the loss of any known *Eremophila forrestii* subsp. *viridis* individuals. Furthermore, the Proposal is also unlikely to impact any unrecorded individuals as the species has only been recorded within the D1 vegetation community, and all occurrences of this community within the survey area have been extensively traversed, resulting in a high level of confidence that this species is not present within these areas. As such, the Proposal is not expected to contribute to the cumulative impact of the species.

2.2.1.1.2. *Triumfetta echinata* (P3)

Triumfetta echinata was not recorded within the Proposal Area during the 2023 survey, despite the entire survey area being extensively traversed. Approximately 137 individuals were recorded within 600 m of the eastern end of the Proposal Area between 2017 and 2021 (Spectrum 2021) (Figure 2-1). All these individuals were recorded within red sand and sand dune habitat types, which corresponds with the D1 dune habitat vegetation community recorded within the survey area (Spectrum 2021). To this effect the species was considered by Spectrum (2021) as having a high likelihood of occurrence within the D1 vegetation community within the Proposal Area. However, due to the absence of any *Triumfetta echinata* records within any of the D1 vegetation communities within the Proposal Area, despite it being extensively traversed, MinRes anticipates a reduced potential for the species to occur within the Proposal Area itself. Although the survey was undertaken at a sub-optimal time, *Triumfetta*

echinata was still found and recorded in D1 habitat in the survey area – i.e. it is reasonable to expect it should have also been found within similar habitat within the Proposal Area. Given *Triumfetta echinata* has only been found in the D1 vegetation type no other vegetation types within the survey area are expected to support the occurrence of the species.

The Proposal will not directly impact any known *Triumfetta echinata* individuals within or in proximity (<500 m) to the Proposal Area. Furthermore, it is not expected to impact any unrecorded individuals as:

- The only suitable vegetation community within the Proposal Area, i.e. D1, was extensively traversed and no individuals were found
- If they were to occur, the limited extent of D1 habitat type within the Proposal Area (i.e. 2 ha or 13.9% of the total Proposal Area [Table 2-3]) would limit the potential number of individuals occurring.

In addition, *Triumfetta echinata* is known from multiple locations in three IBRA regions and is not considered regionally restricted (WAH 2023 cited in Spectrum 2023).

As such, the Proposal is not expected to significantly impact or otherwise contribute to the cumulative impact on the species on a local or regional basis.

2.2.1.2. Introduced Flora

Nine of the 145 vascular flora species recorded within the Proposal Area were identified as being introduced (weed) species (Spectrum 2021). Two of the species (Mesquite [*Neltuma pallida* [ex-*Prosopis pallida*]] and Athel tree [*Tamarix aphylla*]) are listed as a Declared Pest, Prohibited under Section (s) 12 of the *Biosecurity and Agriculture Management Act 2007* (BAM Act). *Tamarix aphylla* is also considered to be a Weed of national Significance. All other introduced species recorded are listed on the Western Australian Organism List (WAOL) Database as being s 11 (permitted) species under the BAM Act. This indicates that no specific management of the species is required.

2.2.1.3. Vegetation Communities

Eight vegetation communities were recorded in the 2021 survey of which seven were identified within the Proposal Area (Spectrum 2023b) (Figure 2-3). Two additional areas, totalling 4.1 ha, were added to the survey area in 2023 and the vegetation mapping and condition for these areas were determined using aerial imagery and extrapolation of on-ground data (Spectrum 2023d). This extrapolation was considered by Spectrum accurate and suitable for the purposes of this application as both areas were adjacent to previously mapped areas and vegetation types in the area are very uniform and thus easy to identify from aerial imagery.

A section at the northern end of the survey area was mapped as the C2 vegetation community (+/- *Tecticornia auriculata* low isolated shrubs*) by Spectrum (2023a) (Figure 2-3: Map 1 of 15). However, on reviewing the aerial imagery this area appears to be naturally devoid of vegetation. To confirm the state of vegetation in this area MinRes undertook an assessment using data collected from satellite and drone imagery as well as an on-site inspection. The assessment found that the area was devoid of native vegetation (Oliver. G, [MinRes] pers. comm, 6 April 2023). Despite the assessment supporting the conclusion that this area is devoid of native vegetation, it has been mapped as the C2 vegetation community, as part of a conservative approach this northern portion has been included within the Proposal Area as some Proposal activities will occur here.

A detailed description and the relative abundance of the vegetation communities within the survey area and the Proposal Area is presented in Table 2-3. None of the vegetation communities recorded within the Proposal Area were identified as, or associated with, any Threatened or Priority Ecological Communities (TECs or PECs) (Spectrum 2021). No vegetation communities have been identified of other conservation significance, such as Groundwater Dependent Ecosystems (GDEs).

Table 2-3: Vegetation Communities within the Proposal Area

Vegetation Name	Vegetation Description (NVIS)	Extent within Proposal Area (ha [%])	Extent within Survey Area (ha [%])
Claypans 1 (C1)	*Tecticornia auriculata* or *Tecticornia indica* subsp. *leiostachya* low open shrubland over *Eragrostis pergracilis* and/or *Cenchrus ciliaris* low sparse grassland.	1.0 (6.9)	15.6 (3.0)
Claypans 2 (C2)	+/- *Tecticornia auriculata* low isolated shrubs*	1.3 (9.0)	26.4 (5.0)
Dunes 1 (D1)	+/- *Grevillea stenobotrya* tall sparse shrubland over *Scaevola sericophylla*, +/- *Acacia stellaticeps* mid sparse shrubland over *Triodia epactia* open hummock grassland.	2.0 (13.9)	126.7 (24.1)
Drainage Line (DL1)	+/-*Eucalyptus camaldulensis* subsp. *refulgens* low isolated trees over *Acacia tetragonophylla* and **Vachellia farnesiana* tall open shrubland over **Cenchrus ciliaris* sparse tussock grassland.	NA	2.1 (0.4)
Plains 1a (P1a)	+/- *Acacia tetragonophylla* tall, isolated shrubs over *Triodia epactia* open hummock grassland	3.3 (22.9)	192.2 (36.5)
Plains 1b (P1b)	*Cenchrus ciliaris* low open tussock grassland, with +/- *Triodia epactia* sparse hummock grassland	5.9 (41.0)	79.8 (15.2)
Plains 2 (P2)	*Acacia synchronicia, Acacia tetragonophylla* and *Vachellia farnesiana* tall sparse shrubland over *Scaevola spinescens* and *Sesbania cannabina* mid sparse shrubland over *Diplachne fusca* subsp. *fusca, Eulalia aurea* and *Cenchrus ciliaris* sparse tussock grassland.	0.7 (4.9)	11.8 (2.2)
Plains 3 (P3)	*Prosopis pallida* tall closed shrubland over *Cenchrus ciliaris* open tussock grassland.	0.1 (0.7)	1.9(0.4)
Cleared	Cleared with no vegetation	<0.1 (0.7)	69.7 (13.2)
Total		**14.4(100.0)**	**526.2 (100.0)**

*IT IS NOTED THAT APPROXIMATELY 0.5 HA OF THE C2 VEGETATION COMMUNITY (APPROXIMATELY 38.5% WITHIN THE PROPOSAL AREA) IS NATURALLY DEVOID OF VEGETATION.

Vegetation condition within the Proposal Area and the survey area was classified based on EPA technical guidance (EPA 2016) and ranged from Very Good to Completely Degraded (Spectrum 2023b) (Table 2-4, Figure 2-4).

Table 2-4: Vegetation Condition within the Proposal Area

Condition	Disturbance Details	Extent within Proposal Area (ha [%])	Extent within Survey Area (ha [%]))
Very Good	Scattered weeds, low levels of grazing within area of undisturbed native vegetation.	3.5 (24.3)	215.9(41.0)
Good	Moderate weed cover within undisturbed native vegetation	4.4 (30.6)	110.6 (21.0)

Condition	Disturbance Details	Extent within Proposal Area (ha [%])	Extent within Survey Area (ha [%]))
Poor	Vegetation along roadside or large areas that may have been cleared, dominated by weeds, but maintains the natural vegetation structure.	6.3 (43.8)	109.4 (20.8)
Degraded	Areas which have previously been cleared that have regenerated with very few native species along roadsides and areas dominated by weeds with no native species present.	0.1 (0.7)	19.7 (3.7)
Completely Degraded	Includes parkland cleared and developed areas, including roads and roadsides with no vegetation present.	<0.1 (0.6)	69.7 (13.2)
Total	**NA**	**14.4 (100)**	**526.2 (100.0)**

Figure 2-2: Conservation Significant Flora within the Proposal Area

Proposal Area

Conservation Significant Flora – approved to clear under CPS 9818/1

Conservation Significant Flora - Spectrum (2022)

Eremophila forrestii subsp. *viridis*

Historical Records

Eremophila forrestii subsp. *viridis* - Hastings (2021)

Triumfetta echinata - GHD (2017)

Triumfetta echinata - Spectrum Ecology (2021)

0 0.5 1 2

Kilometres

Datum/Projection:
GDA 1994 MGA Zone 50

23PER4904-ED Date: 8/05/2023

N

eco logical AUSTRALIA
A TETRA TECH COMPANY

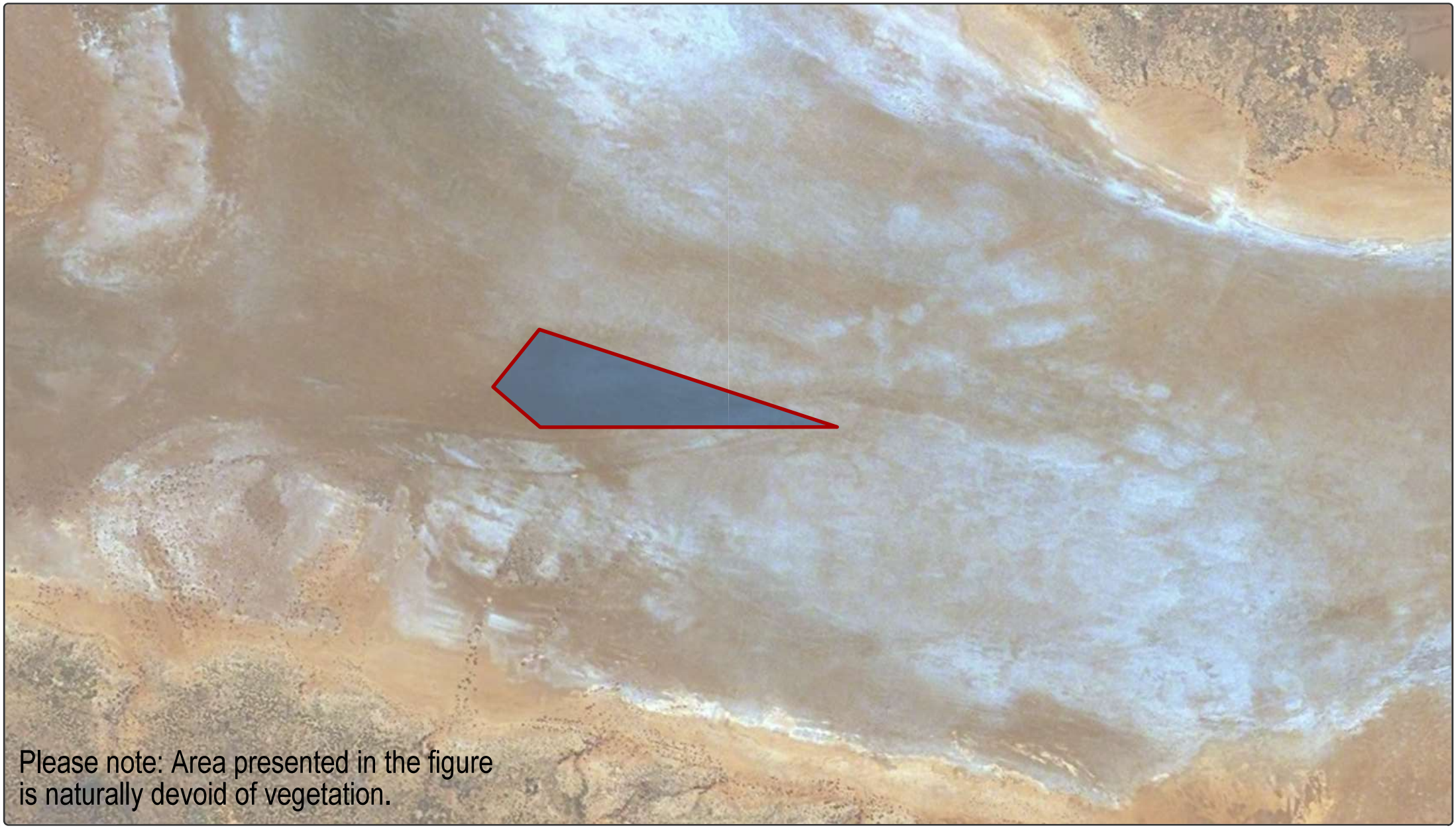


Figure 2-3: Vegetation Communities within the Proposal Area (Map 1 of 13)

Proposal Area

Vegetation Community

C2

0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

eco logical AUSTRALIA
A TETRA TECH COMPANY

Figure 2-3: Vegetation Communities within the Proposal Area (Map 2 of 13)

Proposal Area

Vegetation Community

P1b

0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

eco logical AUSTRALIA
A TETRA TECH COMPANY

Figure 2-3: Vegetation Communities within the Proposal Area (Map 3 of 13)

Proposal Area

Vegetation Community

- C1
- P1a
- P1b

0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

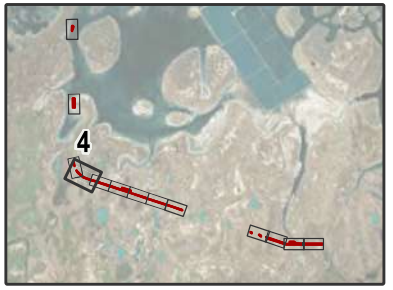
eco logical AUSTRALIA
A TETRA TECH COMPANY

Figure 2-3: Vegetation Communities within the Proposal Area (Map 4 of 13)

Proposal Area

Vegetation Community

- C1
- P1a
- P1b



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

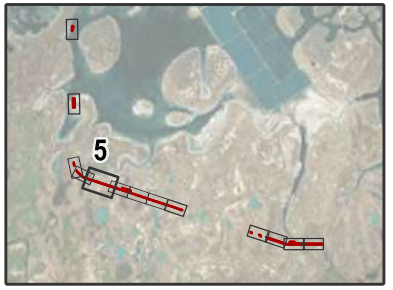
eco logical AUSTRALIA
A TETRA TECH COMPANY

Figure 2-3: Vegetation Communities within the Proposal Area (Map 5 of 13)

Proposal Area

Vegetation Community

- C1
- C2
- D1
- P1a



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

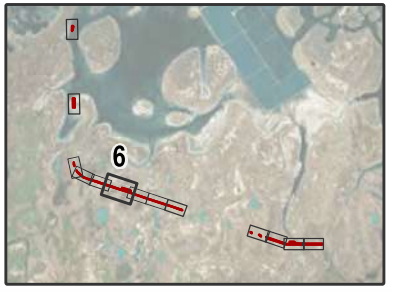
ecological AUSTRALIA
A TETRA TECH COMPANY

Figure 2-3: Vegetation Communities within the Proposal Area (Map 6 of 13)

Proposal Area

Vegetation Community

- C1
- C2
- P1a



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

ecological AUSTRALIA
A TETRA TECH COMPANY

Figure 2-3: Vegetation Communities within the Proposal Area (Map 7 of 13)

Proposal Area

Vegetation Community

- C1
- C2
- P1a

0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

eco logical AUSTRALIA
A TETRA TECH COMPANY

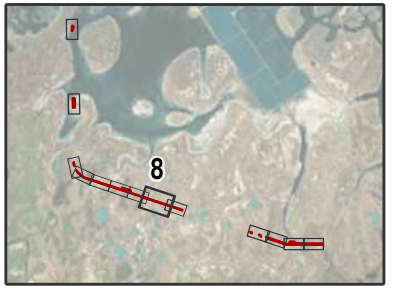
Figure 2-3: Vegetation Communities within the Proposal Area (Map 8 of 13)

Proposal Area

Vegetation Community

C2

P1a



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

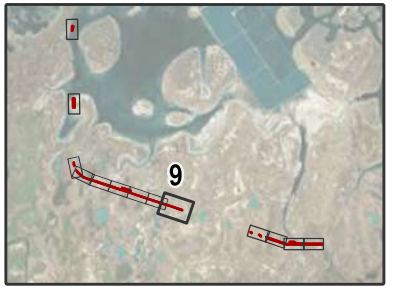
eco logical AUSTRALIA
A TETRA TECH COMPANY

Figure 2-3: Vegetation Communities within the Proposal Area (Map 9 of 13)

Proposal Area

Vegetation Community

- Cleared
- P1a
- P1b
- P3



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

ecological AUSTRALIA
A TETRA TECH COMPANY

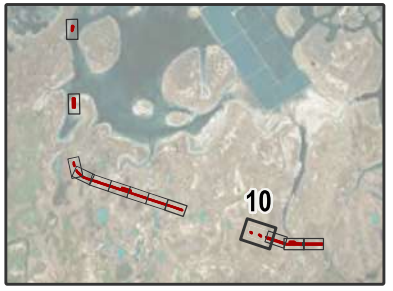
Figure 2-3: Vegetation Communities within the Proposal Area (Map 10 of 13)

Proposal Area

Vegetation Community

C1

D1



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

eco logical AUSTRALIA
A TETRA TECH COMPANY

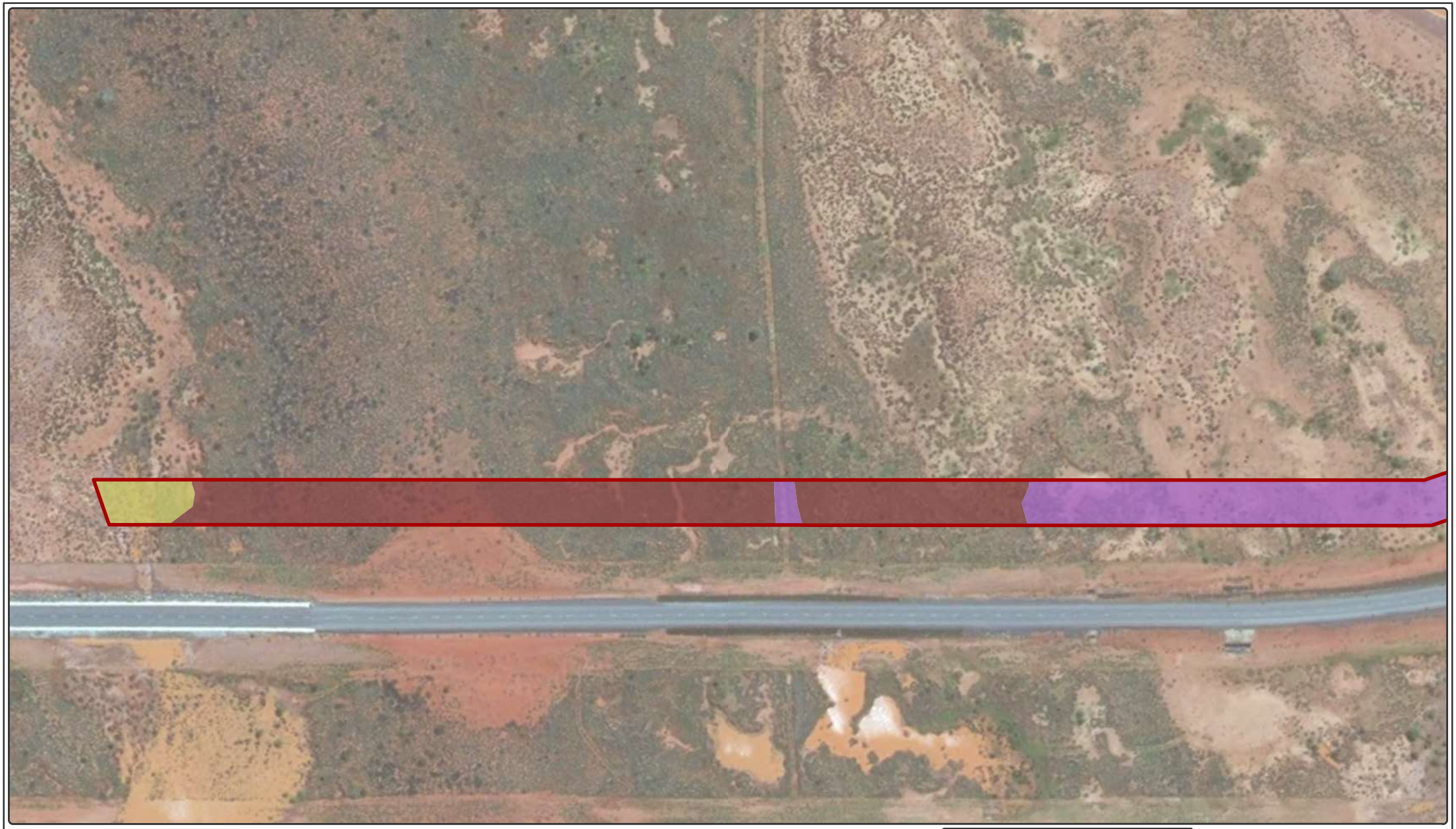
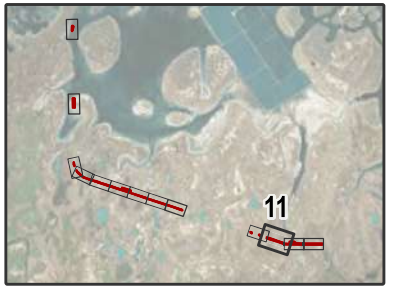


Figure 2-3: Vegetation Communities within the Proposal Area (Map 11 of 13)

Proposal Area

Vegetation Community

- C1
- D1
- P1b



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

eco logical AUSTRALIA
A TETRA TECH COMPANY

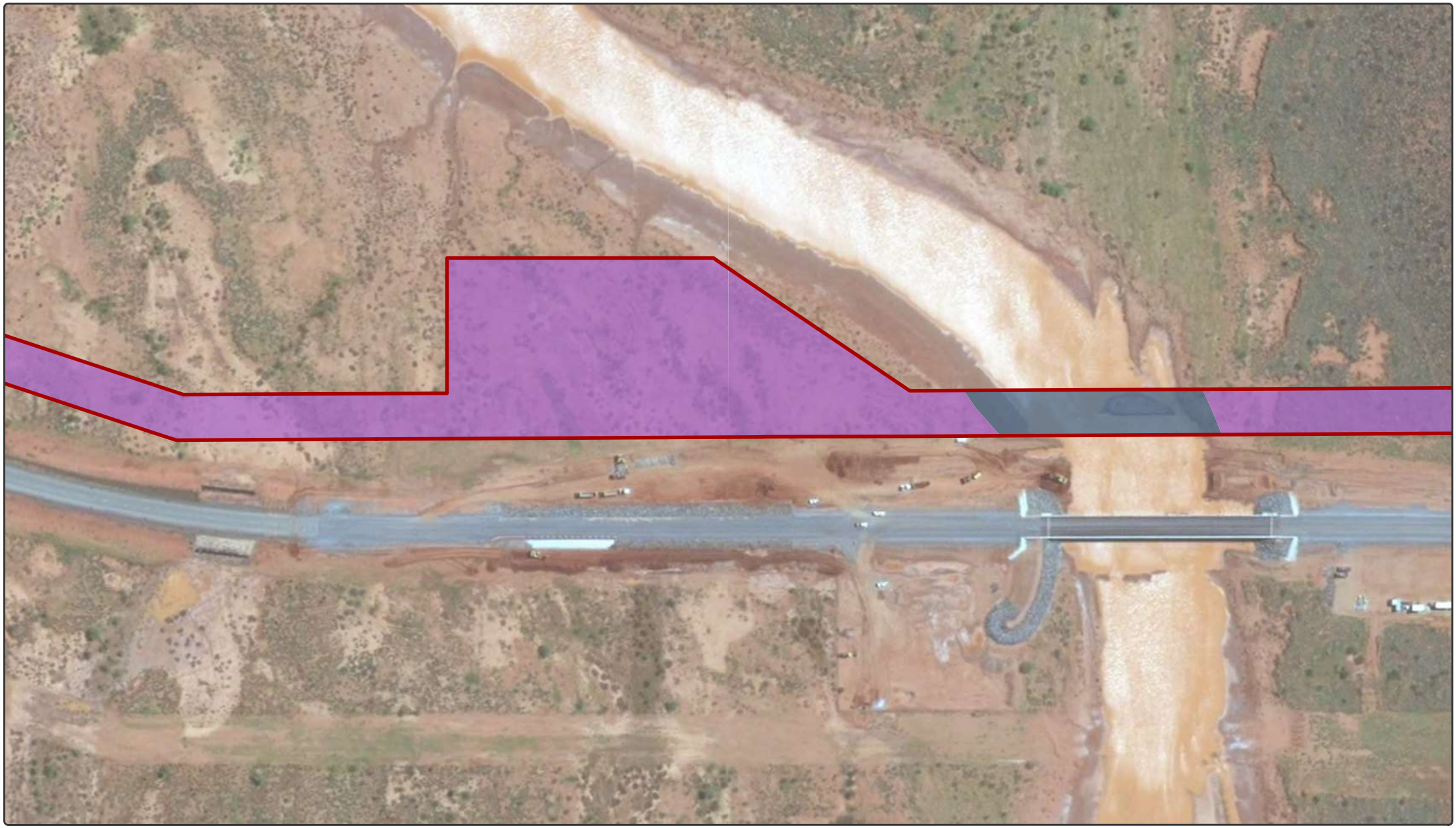


Figure 2-3: Vegetation Communities within the Proposal Area (Map 12 of 13)

Proposal Area

Vegetation Community

- C2
- D1
- P1b

0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

ecological AUSTRALIA
A TETRA TECH COMPANY

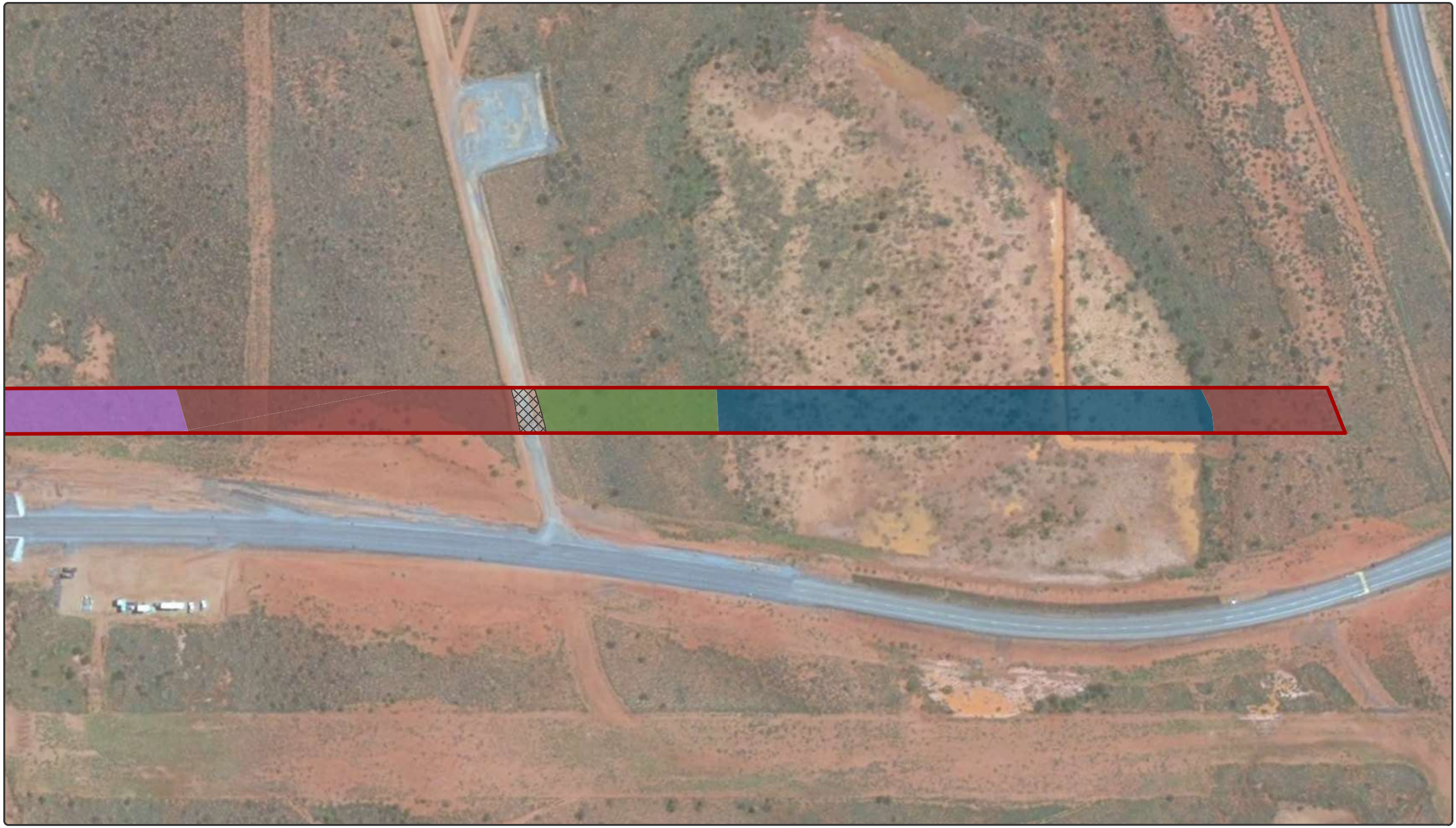
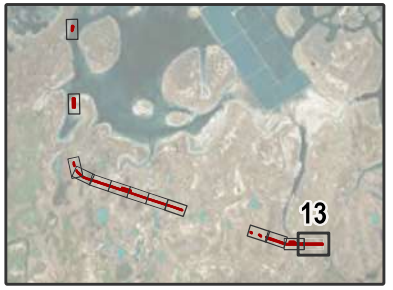


Figure 2-3: Vegetation Communities within the Proposal Area (Map 13 of 13)

Proposal Area

Vegetation Community

- Cleared
- D1
- P1a
- P1b
- P2



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

eco logical AUSTRALIA
A TETRA TECH COMPANY

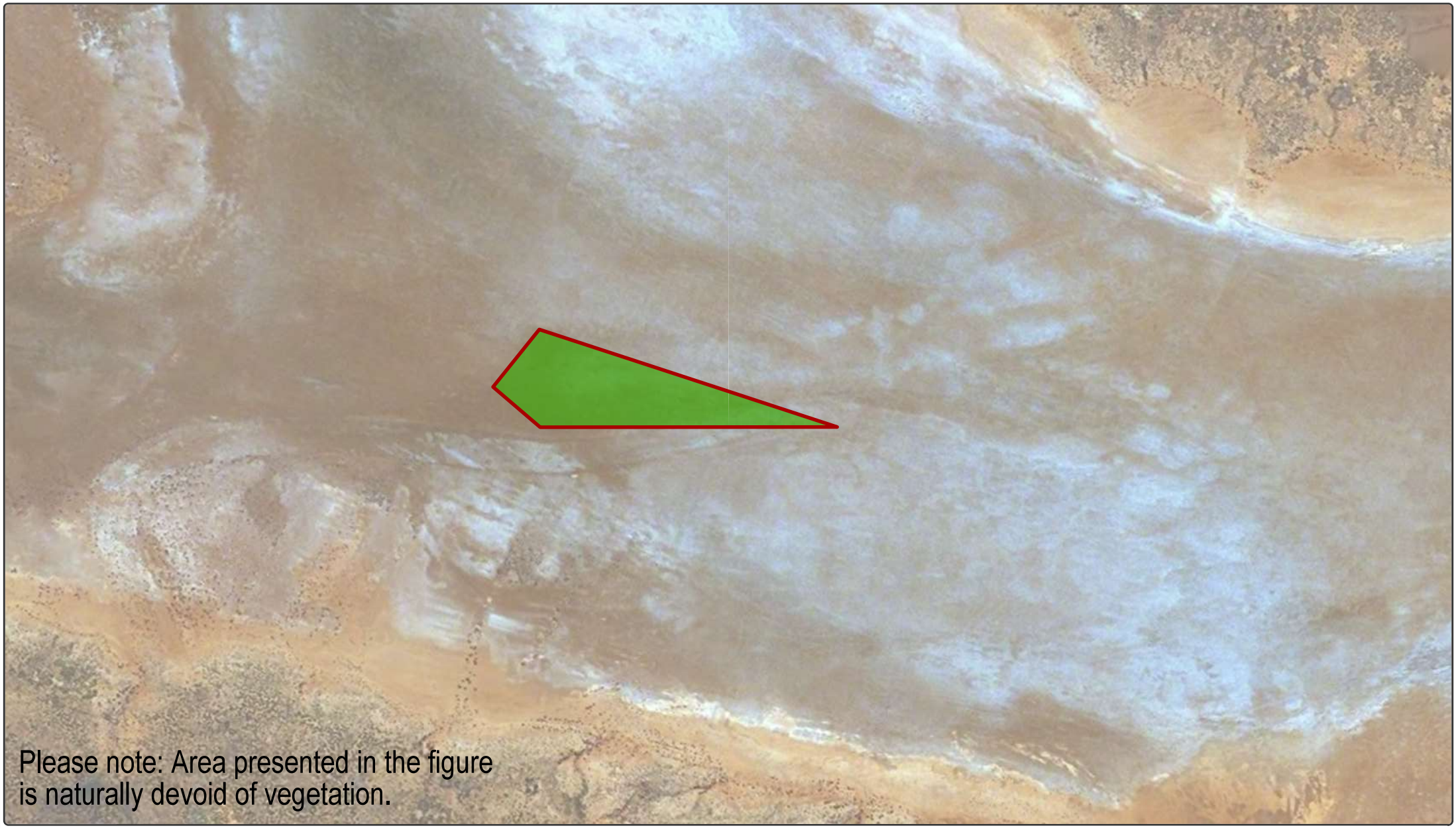
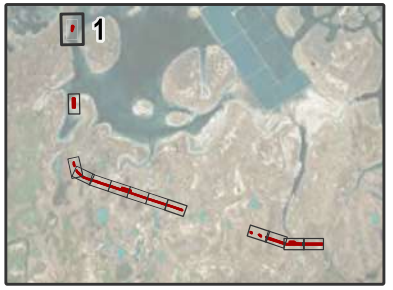


Figure 2-4: Vegetation Condition within the Proposal Area (Map 1 of 13)

Proposal Area

Vegetation Condition

Very Good



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

eco logical AUSTRALIA
A TETRA TECH COMPANY

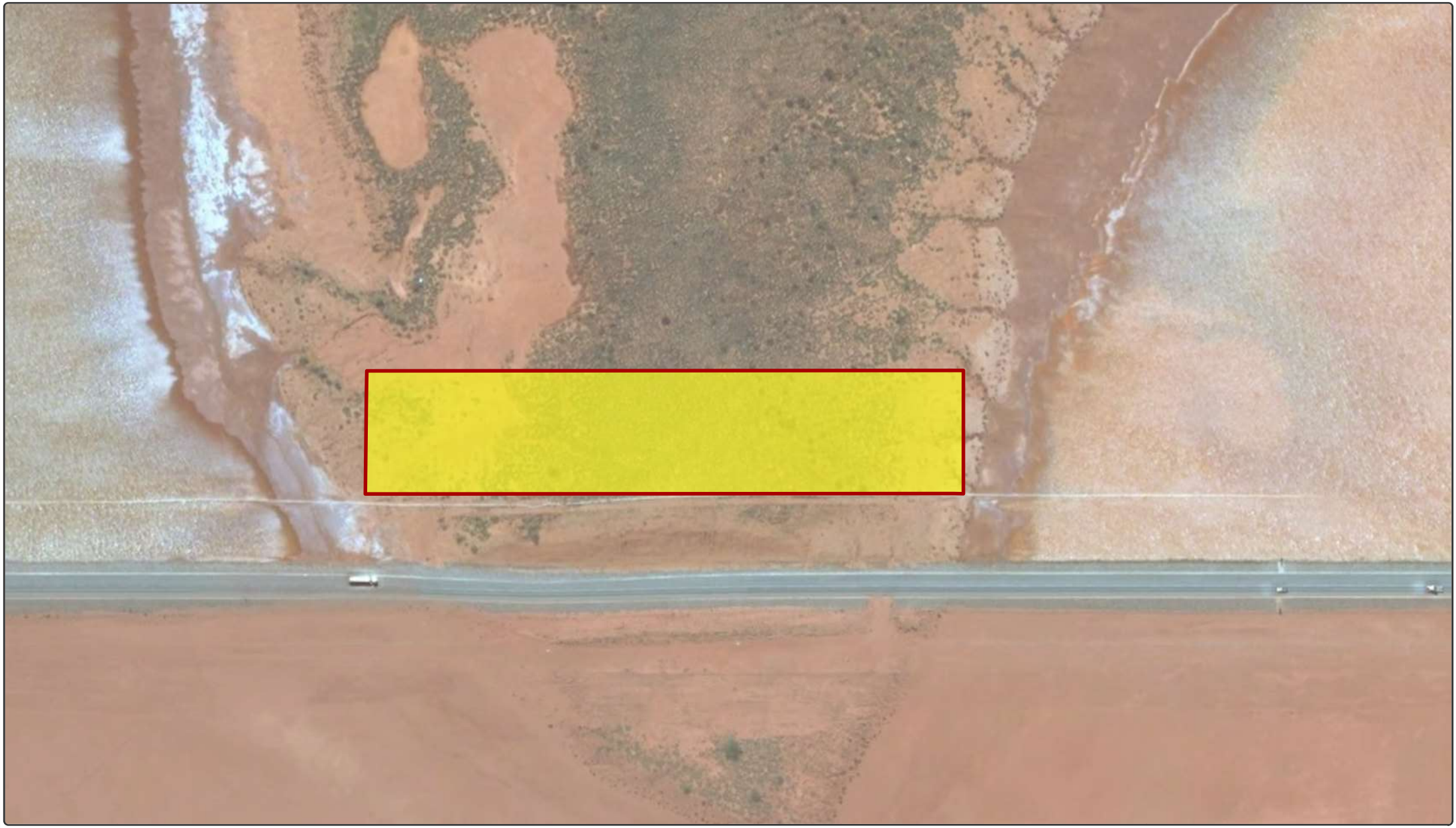


Figure 2-4: Vegetation Condition within the Proposal Area (Map 2 of 13)

Proposal Area

Vegetation Condition

Poor

0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

eco logical AUSTRALIA
A TETRA TECH COMPANY

Figure 2-4: Vegetation Condition within the Proposal Area (Map 3 of 13)

Proposal Area

Vegetation Condition

- Very Good
- Good
- Poor

0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

ecological AUSTRALIA
A TETRA TECH COMPANY

Figure 2-4: Vegetation Condition within the Proposal Area (Map 4 of 13)

Proposal Area

Vegetation Condition

- Very Good
- Good
- Poor

0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

ecological AUSTRALIA
A TETRA TECH COMPANY

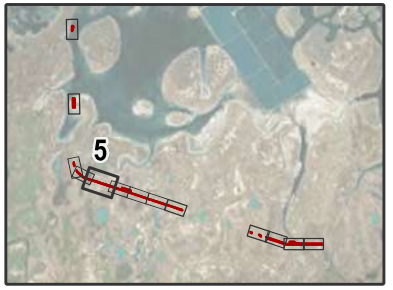
Figure 2-4: Vegetation Condition within the Proposal Area (Map 5 of 13)

Proposal Area

Vegetation Condition

Very Good

Good



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

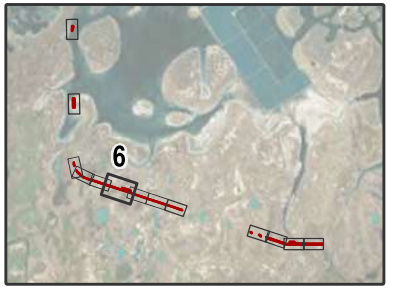
eco logical AUSTRALIA
A TETRA TECH COMPANY

Figure 2-4: Vegetation Condition within the Proposal Area (Map 6 of 13)

Proposal Area

Vegetation Condition

- Very Good
- Good



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

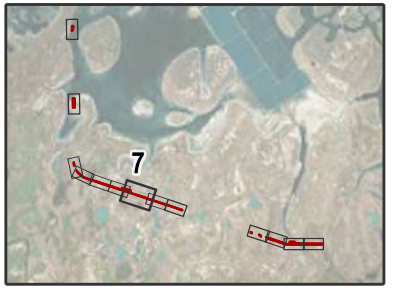
eco logical AUSTRALIA
A TETRA TECH COMPANY

Figure 2-4: Vegetation Condition within the Proposal Area (Map 7 of 13)

Proposal Area

Vegetation Condition

- Very Good
- Good



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

eco logical AUSTRALIA
A TETRA TECH COMPANY

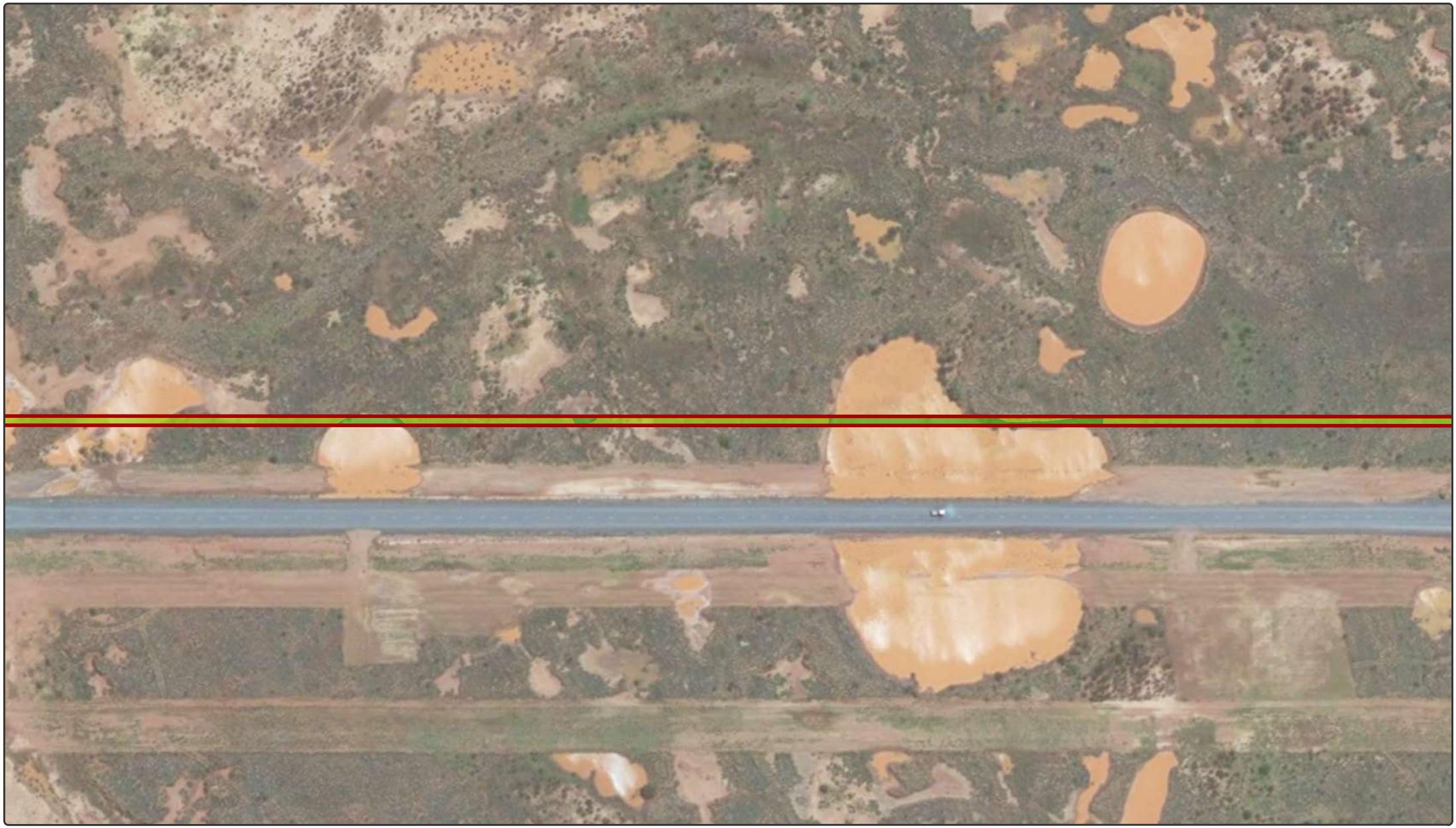
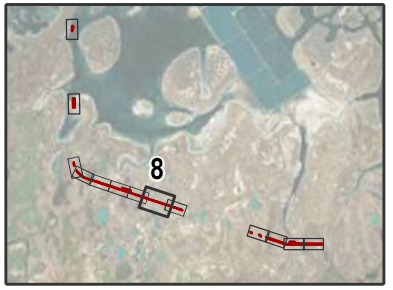


Figure 2-4: Vegetation Condition within the Proposal Area (Map 8 of 13)

Proposal Area

Vegetation Condition

- Very Good
- Good



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

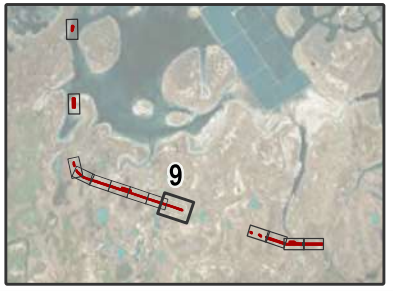
ecological AUSTRALIA
A TETRA TECH COMPANY

Figure 2-4: Vegetation Condition within the Proposal Area (Map 9 of 13)

Proposal Area

Vegetation Condition

- Good
- Degraded
- Completely Degraded



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

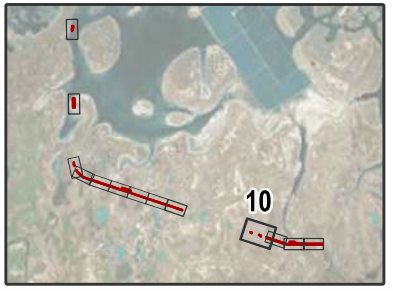
ecological AUSTRALIA
A TETRA TECH COMPANY

Figure 2-4: Vegetation Condition within the Proposal Area (Map 10 of 13)

Proposal Area

Vegetation Condition

- Very Good
- Good



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

eco logical AUSTRALIA
A TETRA TECH COMPANY

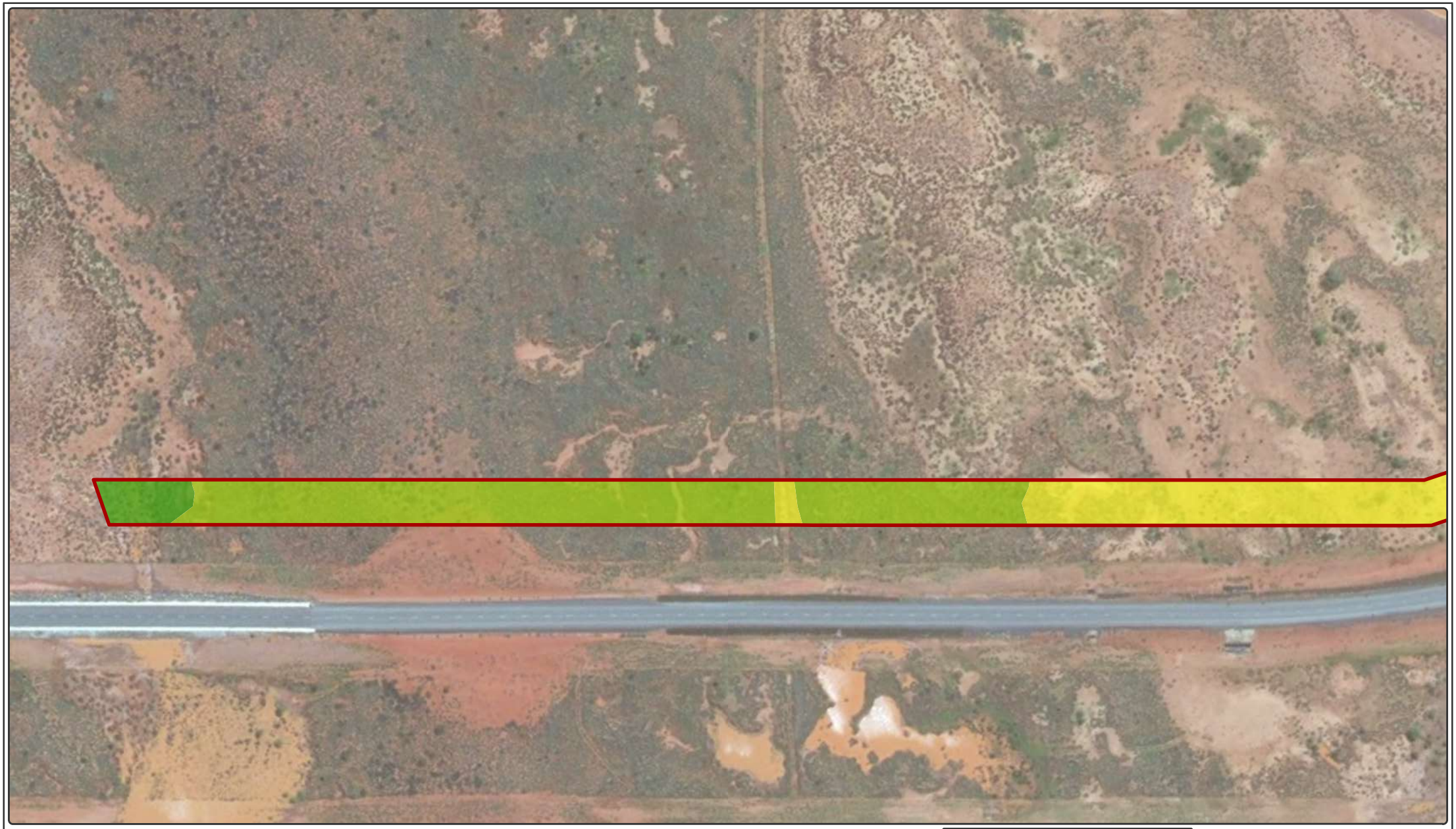
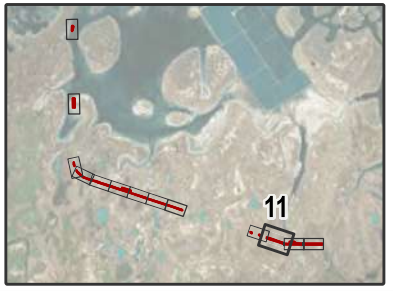


Figure 2-4: Vegetation Condition within the Proposal Area (Map 11 of 13)

Proposal Area

Vegetation Condition

- Very Good
- Good
- Poor



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

ecological AUSTRALIA
A TETRA TECH COMPANY

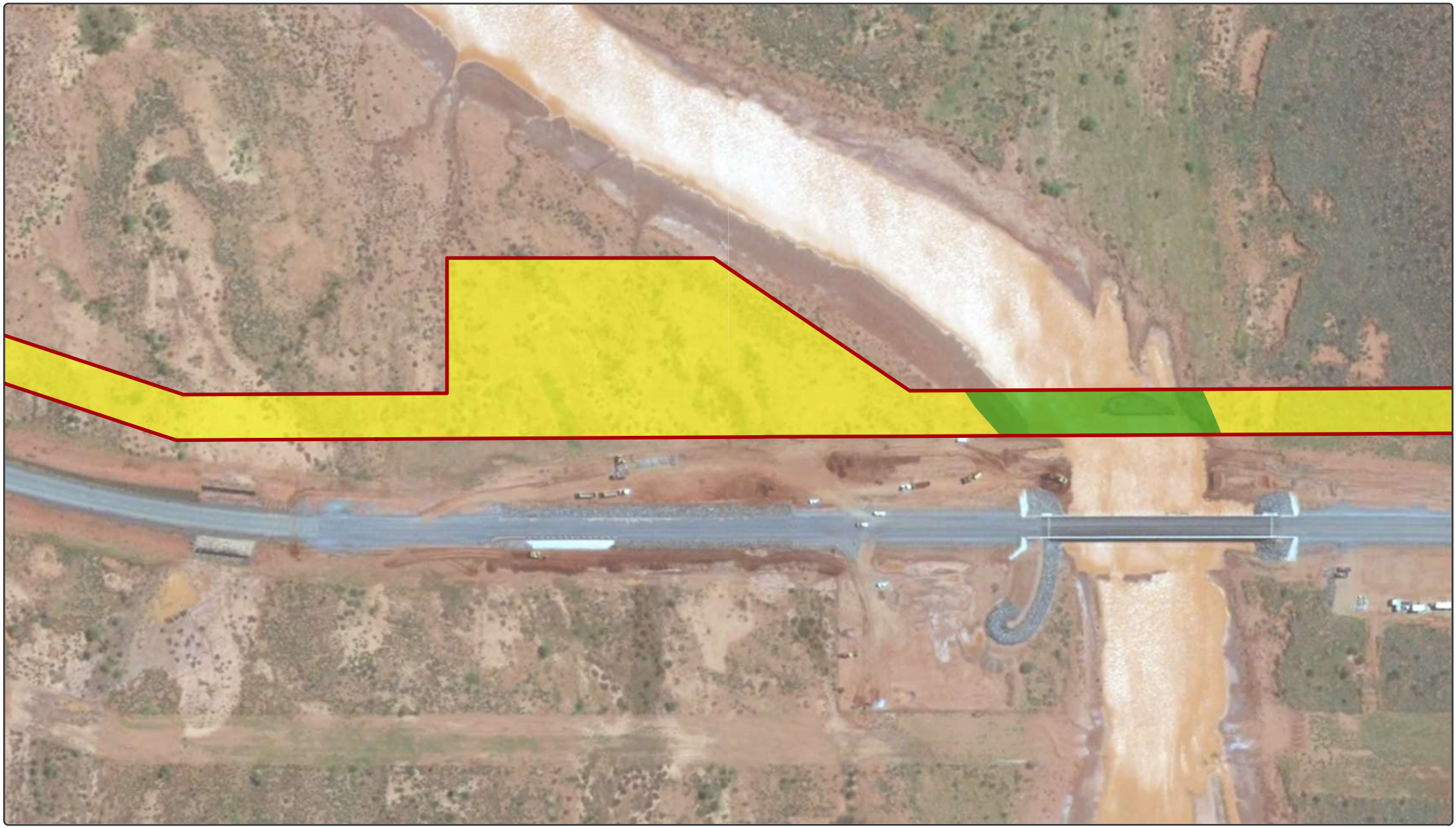
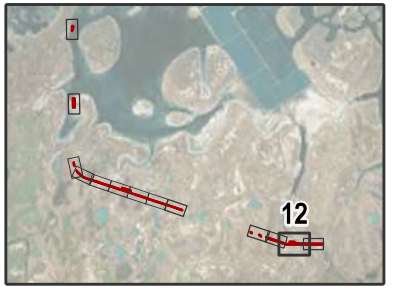


Figure 2-4: Vegetation Condition within the Proposal Area (Map 12 of 13)

Proposal Area

Vegetation Condition

- Very Good
- Poor



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

eco logical AUSTRALIA
A TETRA TECH COMPANY

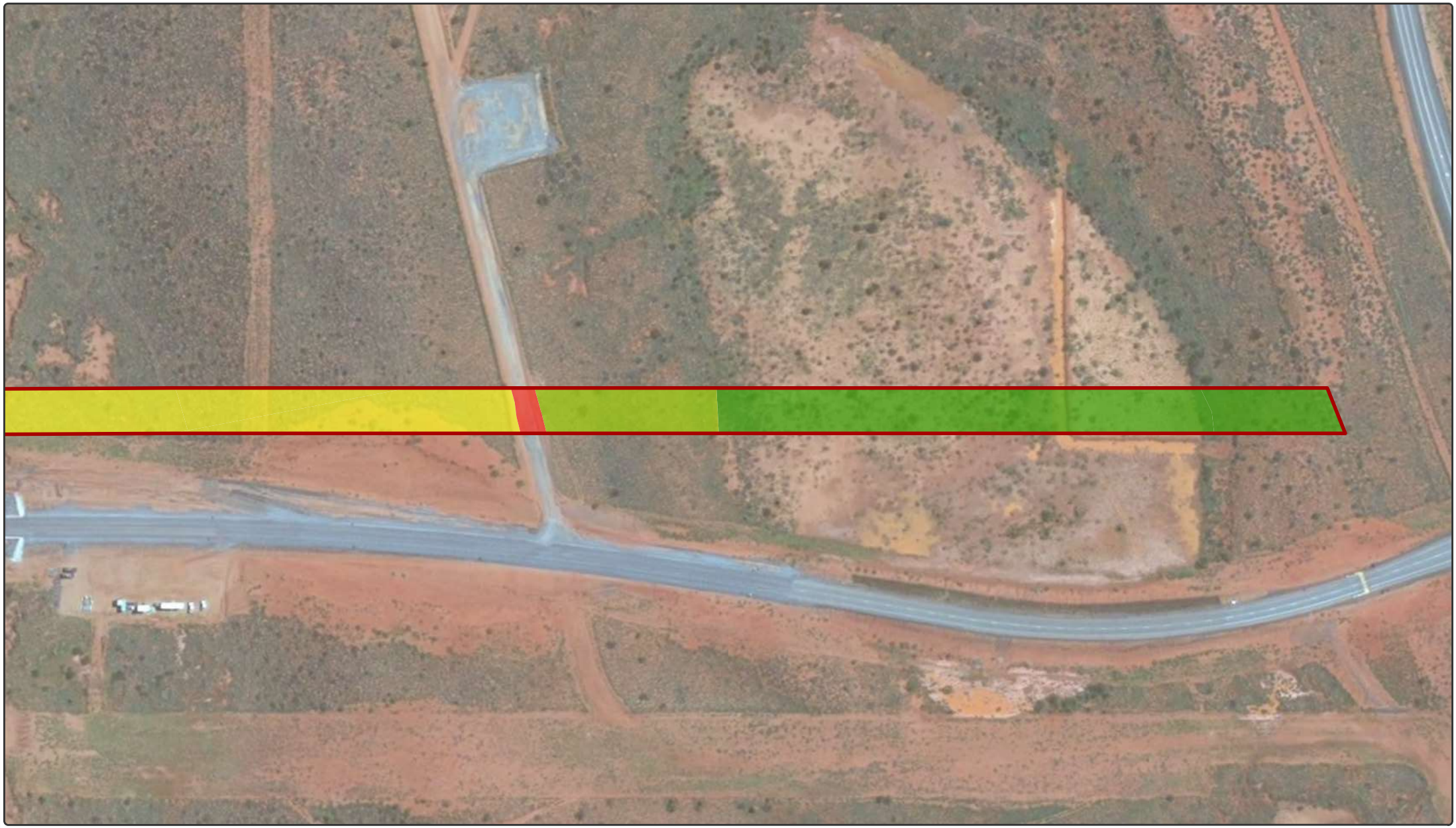
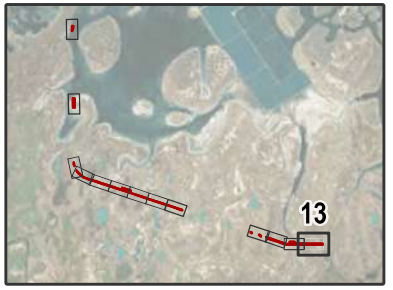


Figure 2-4: Vegetation Condition within the Proposal Area (Map 13 of 13)

Proposal Area

Vegetation Condition

- Very Good
- Good
- Poor
- Completely Degraded



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

eco logical AUSTRALIA
A TETRA TECH COMPANY

2.2.2. Fauna Values

2.2.2.1. Fauna Habitat

A basic fauna survey was undertaken in 2021 by Spectrum for the purposes of supporting the MRWA NVCP application. Fauna habitat was mapped based on the vegetation types identified in the detailed and targeted flora and vegetation survey (Spectrum 2023 a & b). These same vegetation types have been mapped within the Proposal Area, corresponding to the habitat types within the Proposal Area. The five vegetation types and their corresponding habitat types are described in Figure 2-5 and shown spatially in Figure 2-5.

Table 2-5: Habitat Types of The Proposal Area as Defined in Spectrum (2021)

Habitat Type	Extent within Proposal Area(ha)	% in Proposal Area	Extent in Survey Area (ha)	% of Survey Area
Sand Plains (SP)	9.9	68.8	285.8	54.3
Sand Dunes (SD)	2.0	13.9	126.6	24.1
Tidal Mudflats and Claypans (TM &C)*	1.3	9.0	26.4	5.0
Tecticornia Shrubland (TS)	1.0	6.9	15.6	3.0
Tall Mesquite Shrubland (MS)	0.1	0.7	1.9	0.4
Cleared	<0.1	0.7	69.6	13.3
Total	14.4	100.0	526.2	100.0

*IT IS NOTED THAT APPROXIMATELY 0.5 HA OF THE TM & C (APPROXIMATELY 38.5% WITHIN THE PROPOSAL AREA) HABITAT TYPE IS NATURALLY DEVOID OF VEGETATION

2.2.2.2. Terrestrial Fauna

The basic fauna survey was undertaken to support the MRWA NVCP assessment (MRWA 2021); however, the extension represented by the Proposal Area was not specifically surveyed for fauna. Given that vegetation and associated habitat types of the Proposal Area are consistent with those identified in the 2021 survey area and are contiguous, the same fauna species which are known to or are likely to occur are also expected to be consistent.

The survey identified a total of 44 vertebrate fauna species including one native mammal, four introduced species of mammals, 34 species of birds, and five reptile species. Two species of conservation significance were recorded as flying over the survey area – Gull-billed Tern (*Sterna macrotarsa*) and Little Tern (*Sterna albifrons*) (both species: EPBC Act – Migratory; BC Act – Migratory) (Spectrum 2021). An additional two significant fauna species were recorded previously, the Oriental Pratincole (*Glareola maldivarum*) and Caspian Tern (*Hydroprogne caspia*).

A likelihood of occurrence assessment has been undertaken based on results of the Spectrum (2021) assessment and database searches (Table 2-6). A total of 25 species were assessed during the Spectrum 2021 survey as having a High likelihood of occurrence in the 2021 survey area including one mammal and 24 birds. Most of these species will be transitory in nature, generally just flying over the Proposal Area, only the White-winged Black Turn (*Sterna leucoptera*) and Osprey (*Pandion haliaetus*) are likely to have any level of reliance on the habitat types present. Eleven species were assessed as having a Medium likelihood of occurrence, and 19 species were assessed as having a Low to Very Low likelihood of occurrence.

Table 2-6: Likelihood of Occurrence of Significant Species within the Proposal Area

Species	Conservation Status			Preferred Habitats	Previous Records	Post-survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Mammals						
Northern Quoll (*Dasyurus hallucatus*)	EN	EN	-	Critical denning habitats include rocky gorges, basalt hills, escarpments, mesas, boulder piles, caves and adjacent cliff faces. Foraging occurs in adjacent habitat with suitable cover and food resources (Spectrum 2021).	Five records, two of which occur within the Survey Area. The closest 'certain' records are from 64 km south-east of the Survey Area.	**Low:** There is no suitable rocky habitat within the Survey Area. Records from within the Survey Area are uncertain.
Shark Bay Bandicoot (*Perameles bougainville)*	EN	VU	-	Considered extinct on mainland Australia outside of feral-free fenced areas. Was thought to occur in dense scrub, low heath and hummock grasslands (Friend 2008 cited in Spectrum 2021).	Two undated records and low spatial accuracy. Inaccurate records.	**Very low:** The species is regionally extinct.
Ghost Bat (*Macroderma gigas*)	VU	VU	-	Use a range of structures including caves, rock piles and abandoned mines for transient and feeding roosts. Foraging can occur up to 2 km from roosting sites. Maternity roosts require caves with specific warm, dark and humid microclimates (Armstrong and Anstee 2000 cited in Spectrum 2021).	PMST record only – species or species habitat may occur in the area.	**Low:** Suitable roosting structures do not occur within 2 km of the Survey Area.
Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* (Pilbara form))	VU	VU	-	Dissected rocky escarpments with suitable roost caves with high humidity and stable temperatures. Forages in a variety of habitats, particularly along water bodies and riparian vegetation (Armstrong 2001; Cramer et al. 2016 cited in Spectrum Ecology 2021).	PMST record only – species or species habitat likely occur in the area.	**Low:** Suitable rocky caves and foraging habitat do not occur within the Survey Area.
North-western Free-tailed Bat (*Mormopterus cobourgianus*)	-	-	P1	Found in coastal areas from Exmouth to Broome, as well as the Northern Territory and Queensland. Roosts in small spouts and dead branches of mangroves. Foraging occurs in mangroves, vine thickets and waterways (Churchill 2009; Burbidge, Harrison and Woinarski 2014 cited in Spectrum Ecology 2021).	Two DBCA records from Thevenard Island. Recorded by Biota in mangrove habitat approximately 2.5 km north of the Survey Area (Biota Environmental Sciences 2010 cited in Spectrum Ecology 2021).	**Low**: Suitable roosting and foraging habitat does not occur within the Survey Area.

Species	Conservation Status			Preferred Habitats	Previous Records	Post-survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Northern Short-tailed Mouse (*Leggadina lakedownensis*)	-	-	P4	Occur on a variety of habitats from spinifex and tussock grasslands, samphire shrublands, sedgelands and open woodland. Most are recorded from seasonally inundated sandy or cracking clay (Kutt and Kemp 2005; Moro and Kutt 2008 cited in Spectrum Ecology 2021).	Over 300 records in the vicinity of the Survey Area. Many of the records are from Thevenard and Serrurier Islands. Those associated with the Wheatstone project have a low degree of certainty and accuracy.	**High**: The Survey Area contains spinifex and tussock grasslands over sandy clay that may support the species.
Western Pebble-mound Mouse (*Pseudomys chapmani*)	-	-	P4	Found on gentle slopes of rocky ranges with pebbled soil, hard spinifex, and scattered shrubs. The habitat is patchy but widespread (Start 2008 cited in Spectrum Ecology 2021).	Five records in the vicinity of the Survey Area, four of which have low spatial accuracy. One record is within 300 m of the Survey Area. An inactive mound was recorded by Biota south east of the Survey Area (Biota Environmental Sciences 2010 cited in Spectrum Ecology 2021).	**Low:** Suitable rocky slopes do not occur within the Survey Area.
Birds						
Bar-tailed Godwit (Northern Siberian) (*Limosa lapponica menzebieri*)	CR	CR	-	Inhabit coastal areas, particularly tidal flats. Some species may also inhabit mangroves, ocean beaches and rocky shorelines (Menkhorst et al. 2019 cited in Spectrum Ecology 2021).	Four records – two from 1901, two undated.	**Low:** Suitable foraging habitat is present within the Survey Area however there are few species records in the vicinity of the Survey Area.
Curlew Sandpiper (*Calidris ferruginea*)	CR & MI	CR	-	Most abundant on tidal flats but also occurs on brackish and fresh inland wetlands	Five records from coastal flats or islands.	**High**: Suitable foraging habitat is present in the tidal flats (that extend into the Proposal Area). The species has been recorded in the vicinity of the Survey Area.
Eastern Curlew (*Numenius madagascariensis*)	CR & MI	MI	-	Inhabit coastal areas, particularly tidal flats. Some species may also inhabit mangroves, ocean beaches and rocky shorelines (Menkhorst et al. 2019 cited in Spectrum Ecology 2021).	26 records from coastal flats and islands in the vicinity of the Survey Area.	**High**: Suitable foraging habitat is present in the tidal flats. The species have been frequently recorded in the vicinity of the Survey Area.
Great Knot (*Calidris tenuirostris*)	CR & MI	MI	-		Six records. One, from 2008, is within the Survey Area with an accuracy of 25 km.	
Night Parrot (*Pezoporus occidentalis*)	EN	CR	-	Roosting sites located in Triodia grasslands where it shelters in Triodia hummocks. Foraging sites are in treeless non-Triodia open grasslands and herb fields.	Single record from 1967.	**Low:** Suitable habitat does not occur within the Survey Area; the single record is over fifty years old.

Species	Conservation Status			Preferred Habitats	Previous Records	Post-survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Lesser Sand Plover (*Charadrius mongolus*)	EN & MI	EN	-	Inhabit coastal areas, particularly tidal flats. Some species may also inhabit mangroves, ocean beaches and rocky shorelines (Menkhorst et al. 2019 cited in Spectrum Ecology 2021).	19 records from coastal areas and islands in the vicinity of the Survey Area. One record from 2008 is within the Survey Area.	**High**: Suitable foraging habitat is present in the tidal flats (that extend into the Proposal Area). The species have been frequently recorded in the vicinity of the Survey Area.
Australian Painted Snipe (*Rostratula australis*)	EN	EN	-	Shallow terrestrial freshwater wetlands, lakes, and swamps, typically with low, dense fringing vegetation. Favours sites with shallow water and exposed mud (Menkhorst et al. 2019 cited in Spectrum Ecology 2021).	PMST record only – species or species habitat may occur within the area.	**Low:** Suitable habitat does not occur in the Survey Area and the species has not been recorded in proximity of the Survey Area.
Southern Giant Petrel (*Macronectes giganteus*)	EN	EN	-	Seabird, migrates to tropical waters in winter.	PMST record only – species or species habitat may occur within the area.	**Low:** Seabird, suitable habitat does not occur within the Survey Area; species has not been recorded in proximity to the Survey Area.
Red Knot (*Calidris canutus*)	EN & MI	MI	-	Inhabit coastal areas, particularly tidal flats. Some species may also inhabit mangroves, ocean beaches and rocky shorelines (Menkhorst et al. 2019 cited in Spectrum Ecology 2021).	Recorded three times in the 1980's.	**Medium:** Suitable foraging habitat is present within the Survey Area however there are few species records in the vicinity of the Survey Area.
Fairy Tern (*Sternula nereis nereis*)	VU	VU	-	Coastal – most species forage over water with depth and proximity to shore varying between species. Nesting occurs on sandbars, spits, and rocky islands. Roosting on ocean beaches, rock platforms and man-made structures.	All records are from coastal margins or islands.	**Medium:** Records returned in the database searches are all from islands and coastal margins.
Grey Falcon *(Falco hypoleucos)*	VU	VU	-	Triodia grassland, Acacia shrubland, and lightly timbered arid woodland.	Recorded flying over in the area by (GHD, 2011); did not report which sites it was recorded from.	**Medium**: Suitable nesting habitat is not present in the Survey Area however the species may forage over the Survey Area
Greater Sand Plover (*Charadrius leschenaultia*)	VU & MI	MI	-	Inhabit coastal areas, particularly tidal flats. Some species may also inhabit mangroves, ocean beaches and rocky shorelines (Menkhorst et al. 2019 cited in Spectrum Ecology 2021).	91 records from coastal areas and islands in the vicinity of the Survey Area. One record from 2008 is within the Survey Area.	**High**: Suitable foraging habitat is present in the tidal flats (that extend into the Proposal Area). The species have been frequently recorded in the vicinity of the Survey Area.

Species	Conservation Status			Preferred Habitats	Previous Records	Post-survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Grey-tailed Tattler (*Tringa brevipes*)	MI	MI	P4	Inhabit coastal areas, particularly tidal flats. Some species may also inhabit mangroves, ocean beaches and rocky shorelines (Menkhorst et al. 2019 cited in Spectrum Ecology 2021).	71 records, mostly from coastal areas and islands. One record from 2008 is from within the Survey Area.	**High**: Suitable foraging habitat is present in the tidal flats (that extend into the Proposal Area). The species is frequently recorded in the vicinity of the Survey Area.
Fork-tailed swift *(Apus pacificus)*	MI	MI	-	Highly nomadic and rarely land spending much of their time foraging in large flocks high above the canopy; associated with storm fronts (DAWE 2020 cited in Spectrum Ecology 2021).	Ten records in the vicinity of the Survey Area of which three are within less than 1 km.	**High:** Always a possibility as the species is associated with storm fronts.
Pacific Golden Plover (*Pluvialis fulva*)	MI	MI	-	Inhabit coastal areas, particularly tidal flats. Some species may also inhabit mangroves, ocean beaches and rocky shorelines (Menkhorst et al. 2019 cited in Spectrum Ecology 2021).	Five records, all from offshore islands.	**Medium:** Suitable foraging habitat is present within the Survey Area however there are few species records in the vicinity of the Survey Area, all of which are from islands.
Grey Plover (*Pluvialis squatarola*)	MI	MI	-		21 records from coastal areas and islands in the vicinity of the Survey Area.	**High**: Suitable foraging habitat is present in the tidal flats (that extend into the Proposal Area). The species have been frequently recorded in the vicinity of the Survey Area.
Whimbrel (*Numenius phaeopus*	MI	MI	-		Forty records from coastal areas and islands in the vicinity of the Survey Area. One record from 2008 is within the Survey Area.	
Bar-tailed Godwit (*Limosa lapponica*)	MI	MI	-		88 records on of which from 2008 is within the Survey Area. The remaining records are from coastal areas and islands.	
Ruddy Turnstone (*Arenaria interpres*)	MI	MI	-		78 records, mostly associated with coastal margins and islands. One record from 2008 is within the Survey.	
Sanderling (*Calidris alba*)	MI	MI	-		64 records, mostly associated with coastal margins and islands. One record from 2008 is within the Survey.	**High**: Suitable foraging habitat is present in the tidal flats (that extend into the Proposal Area). The species has been recorded in the vicinity of the Survey Area.

Species	Conservation Status			Preferred Habitats	Previous Records	Post-survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Terek Sandpiper (*Xenus cinereus*)	MI	MI	-		Three records, all of which are on offshore islands.	**Medium:** Suitable foraging habitat is present within the Survey Area however there are few species records in the vicinity of the Survey Area, all of which are from offshore islands.
Marsh Sandpiper (*Tringa stagnatilis*)	MI	MI	-		One coastal record 34 km west of the Survey Area.	**Medium:** Suitable foraging habitat is present within the Survey Area however there is only one species record in the vicinity of the Survey Area
Oriental Plover (*Charadrius veredus*)	MI	MI	-	Found on thinly vegetated grasslands and plains e.g. those that have been recently burnt or intensively grazed (Menkhorst et al. 2019 cited in Spectrum Ecology 2021).	Three records, one of which is within 100 m of the Survey Area.	**Medium:** Both species have been recorded in proximity to the Survey Area in the last 20 years.
Little Curlew (*Numenius minutus*)					Recorded twice, 12 and 14 km northeast of the Survey Area.	
Black-tailed Godwit (*Limosa limosa*)	MI	MI	-	Shallow inland wetlands.	Three records. Two, from 1978 and 1978 are 8 km from the Survey Area. One from 2007 is from Serrurier Island.	**Low:** Records in proximity to the Survey Area are from over 40 years ago. Suitable habitat may be present when claypans are inundated.
Pectoral Sandpiper (*Calidris melanotos*)					Three records from a 2015 survey, all from within 100 m of the Survey Area.	**High:** Suitable habitat is likely to be present when tidal mudflats claypans are inundated; the species have been recorded in the vicinity of the Survey Area.
Wood Sandpiper (*Tringa glareola*)					Single record from 2008 is within the Survey Area.	
Sharp-tailed Sandpiper (*Calidris acuminata*)	MI	MI	-	A variety of habitats including saline inland wetlands, damp grasslands and tidal flats	13 records, mostly associated with coastal margins and islands. One record from 2008 is within the Survey Area with an accuracy of 25 km.	**High**: Suitable foraging habitat is present in the tidal flats (that extend into the Proposal Area). The species has been recorded in the vicinity of the Survey Area.
Red-necked Stint (*Calidris ruficollis*)	MI	MI	-	Most abundant on tidal flats but also occurs on brackish and fresh inland wetlands	63 records, mostly associated with coastal margins and islands. One record from 2008 is within the Survey.	**High**: Suitable foraging habitat is present in the tidal flats (that extend into the Proposal Area). The species has been frequently recorded in the vicinity of the Survey Area.

Species	Conservation Status			Preferred Habitats	Previous Records	Post-survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Common Sandpiper (*Actitis hypoleucos*)	MI	MI	-	Narrow, steep shorelines, mangrove lined creeks and steep sided sewage ponds and dams	Sixty records in the vicinity of the Survey Area. One record falls within the Survey Area, the remaining records are from coastal areas, islands, and waterways.	**Medium** Suitable foraging habitat does not occur within the Survey Area however the species was recorded in 2008.
Common Greenshank (*Tringa nebularia*)	MI	MI	-	Coastal to freshwater habitats with mud flats or still shallow water	33 records; one from of which from 2008 is within the Survey Area. Four records from 2015 are within 100 m of the Survey Area.	**High**: Suitable foraging habitat is present in the tidal flats and claypans. The species has been frequently recorded in the vicinity of the Survey Area.
Oriental Pratincole (*Glareola maldivarum*)	MI	MI	-	Open country associated with water such as plains, tidal flats, beaches, and wetlands.	Four records of which three are within the Survey Area (previous surveys).	**Recorded:** Likely forages over the claypans and tidal mudflats.
Gull-billed Tern (*Gelochelidon nilotica*)	MI	MI	-	Common on coastlines with tidal flats; also found in freshwater swamps, brackish and salt lakes, beaches, floodwaters, and sewage farms. Breeds on large ephemeral lakes, marshes, and wetlands. Forages over water and grassy plains	13 records, mostly associated with coastal margins and islands. One record from 2008 is within the Survey Area.	**Recorded:** Likely forages over the claypans and tidal mudflats.
Caspian Tern (*Hydroprogne caspia*)	MI	MI	-	Coastal – most species forage over water with depth and proximity to shore varying between species. Nesting occurs on sandbars, spits, and rocky islands. Roosting on ocean beaches, rock platforms and man-made structures.	Over 100 records six of which were within the Survey Area. Recorded inside the Survey Area are from 2008 and within 100 m of the Survey Area in 2015.	**Recorded:** Use of the Survey Area is likely to be limited to flying over.
Crested Tern (*Thalasseus bergii*)	MI	MI	-		47 records in the vicinity of the Survey Area. Most records are coastal or on islands.	**High:** Frequently recorded nearby; use of the Survey Area likely to be limited to flying over.
Little Tern (*Sterna albifrons*)	MI	MI	-		34 records, mostly from coastal areas and islands. One record from 2008 is from within the Survey Area.	**Recorded:** Use of the Survey Area is likely to be limited to flying over.
Roseate Tern (*Sterna dougallii*)	MI	MI	-		36 records, mostly associated with coastal margins and islands. One record from 2008 is within the Survey Area with an accuracy of 25 km.	**High:** Frequently recorded nearby; use of the Survey Area likely to be limited to flying over.

Species	Conservation Status			Preferred Habitats	Previous Records	Post-survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Common Tern (*Sterna hirundo*)	MI	MI	-		Forty records of which one from 2008 is within the Survey Area with an accuracy of 25 km. The remaining records are coastal or on islands.	
Bridled Tern (*Onychoprion anaethetus)*	MI	MI	-	Seabird breeding on rocky islands and foraging far offshore.	All records are on islands.	**Low:** Seabird, suitable habitat does not occur within the Survey Area, all records are from islands.
White-winged Black Tern (*Sterna leucoptera*)	MI	MI	-	Found on fresh to saline wetlands.	Ten records, one of which is 1 km from the Survey Area. The remaining records are primarily from islands.	**High:** May forage in the claypans and tidal mudflats.
Wilson's Storm-petrel (*Oceanites oceanicus*)	MI	MI	-	Seabird, migrates to tropical waters in winter.	Single record 15 km northeast of the Survey Area.	**Low:** Seabird, suitable habitat does not occur within the Survey Area.
Wedge-tailed Shearwater (*Ardenna pacifica*)	MI	MI	-	Seabird, breeding occurs on islands.	Recorded 296 times, the majority of which are from islands.	**Low:** Seabird, suitable habitat does not occur within the Survey Area.
Brown Booby (*Sula leucogaster*)	MI	MI	-		Four records, all on islands.	**Low:** Seabird, suitable habitat does not occur within the Survey Area
Glossy Ibis (*Plegadis falcinellus*)	MI	MI	-	Found near shallow fresh and estuarine waters or dry grasslands. Roosts in trees near water.	Two records 4 and 5 km west of the Survey Area.	**Medium:** Suitable habitat is unlikely to occur in the Survey Area however the species has been recorded in proximity.
Osprey ***(Pandion haliaetus)***	MI	MI	-	Coastal and terrestrial wetlands of tropical and temperate Australia and offshore islands, occasionally ranging inland along rivers.	Over 160 records in the vicinity of the Survey Area. One record from 2008 is within the Survey Area.	**High**: Suitable nesting habitat is not present in the Survey Area however the species may forage over the Survey Area.
Barn Swallow (*Hirundo rustica*)	MI	MI	-	Open country with low vegetation, farmlands and meadows (DoE 2020).	10 records 15 km from the Survey Area.	**High:** Suitable habitat occurs on the sandy plains (which occurs in the Proposal Area), several records in proximity to the Survey Area.
Yellow Wagtail (*Motacilla flava*)	MI	MI	-	Common migrant, found in open, muddy, grassy, or moist areas, sewage treatment areas and bare ground such as sports fields.	PMST record only – species or species habitat may occur within the area	**Low:** Suitable habitat does not occur within the Survey Area and there are no nearby records.

Species	Conservation Status			Preferred Habitats	Previous Records	Post-survey Likelihood of Occurrence
	EPBC Act	BC Act	DBCA			
Grey Wagtail (*Motacilla cinerea*)	MI	MI	-	Scarce visitor to Australia, preference for wet habitats – beaches and rock pools, fast flowing rocky waterways and waterfalls.	PMST record only – species or species habitat may occur within the area	**Low:** Suitable habitat does not occur within the Survey Area and there are no nearby records.
Peregrine Falcon *(Falco peregrinus)*	-	OS	-	Occur across much of Australia inhabiting cliffs, coastal habitats, rivers, wooded water courses and lakes. Require secure nesting sites preferring cliffs, riverine gorges, and open woodland near water (Birdlife Australia 2012 cited in Spectrum Ecology 2021).	Five records between 500 m and 5 km from the Survey Area.	**High**: Suitable nesting habitat is not present in the Survey Area. Nearby records are likely foraging birds.
Letter-winged Kite (*Elanus scriptus*)	-	-	P4	Found in arid and semi-arid Australia occupying open country and grasslands. The species booms following high rodent populations with individuals found in coastal areas during dry spells following a boom (Menkhorst et al. 2019 cited in Spectrum Ecology 2021).	Single record from 1979.	**Low:** The Survey Area is not in the species preferred habitat; the single record is from over 40 years ago.
Reptiles						
Olive Python (*Liasis olivaceus barroni*)	VU	VU	-	Inhabits gorges, gullies, stony ranges, rock piles and along watercourses. Often associated with permanent and temporary water bodies though is not restricted to them. Habitat requirements are likely to vary throughout the year (DSEWPAC 2011 cited in Spectrum Ecology 2021).	Single record with low certainty 5 km from the Survey Area.	**Low:** Suitable habitat does not occur within the Survey Area.
Maryan's Keeled Slider (*Lerista planiventralis maryani*)	-	-	P4	Found in loose sand and soil associated with coastal consolidated dunes and low shrubland (Cogger 2018 cited in Spectrum Ecology 2021).	Two DBCA records in the vicinity of the Survey Area, both with low spatial accuracy.	**Medium:** The species may be found in the sand dunes but tends to be associated with coastal dunes.

Source: Spectrum Ecology 2021

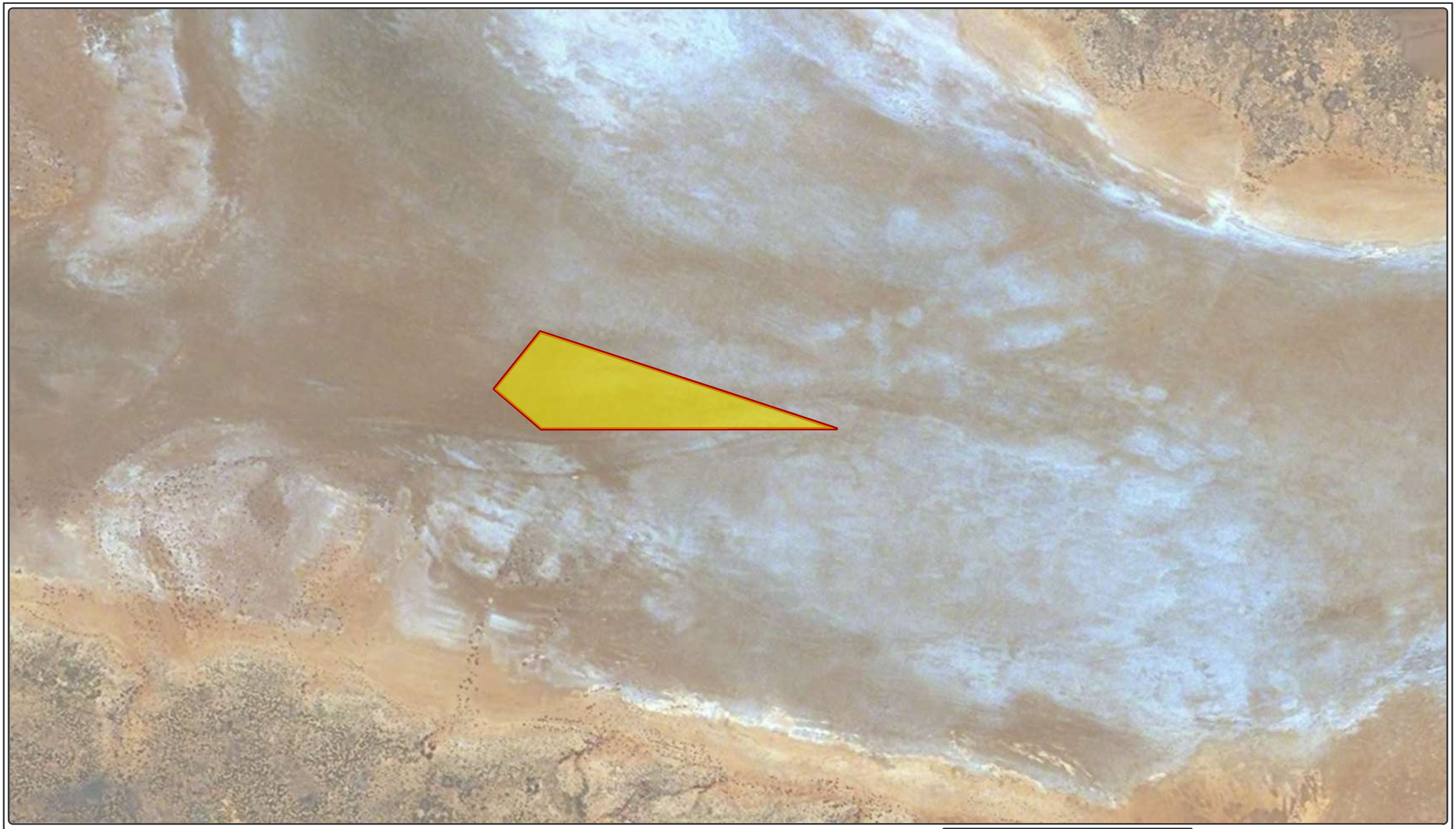


Figure 2-5: Fauna Habitat within the Proposal Area (Map 1 of 13)

Proposal Area

Fauna Habitat

TM&C

0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

ecological AUSTRALIA
A TETRA TECH COMPANY

Figure 2-5: Fauna Habitat within the Proposal Area (Map 2 of 13)

Proposal Area

Fauna Habitat

SP

0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

eco logical AUSTRALIA
A TETRA TECH COMPANY

Figure 2-5: Fauna Habitat within the Proposal Area (Map 3 of 13)

Proposal Area

Fauna Habitat

SP

TS

0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

eco logical AUSTRALIA
A TETRA TECH COMPANY

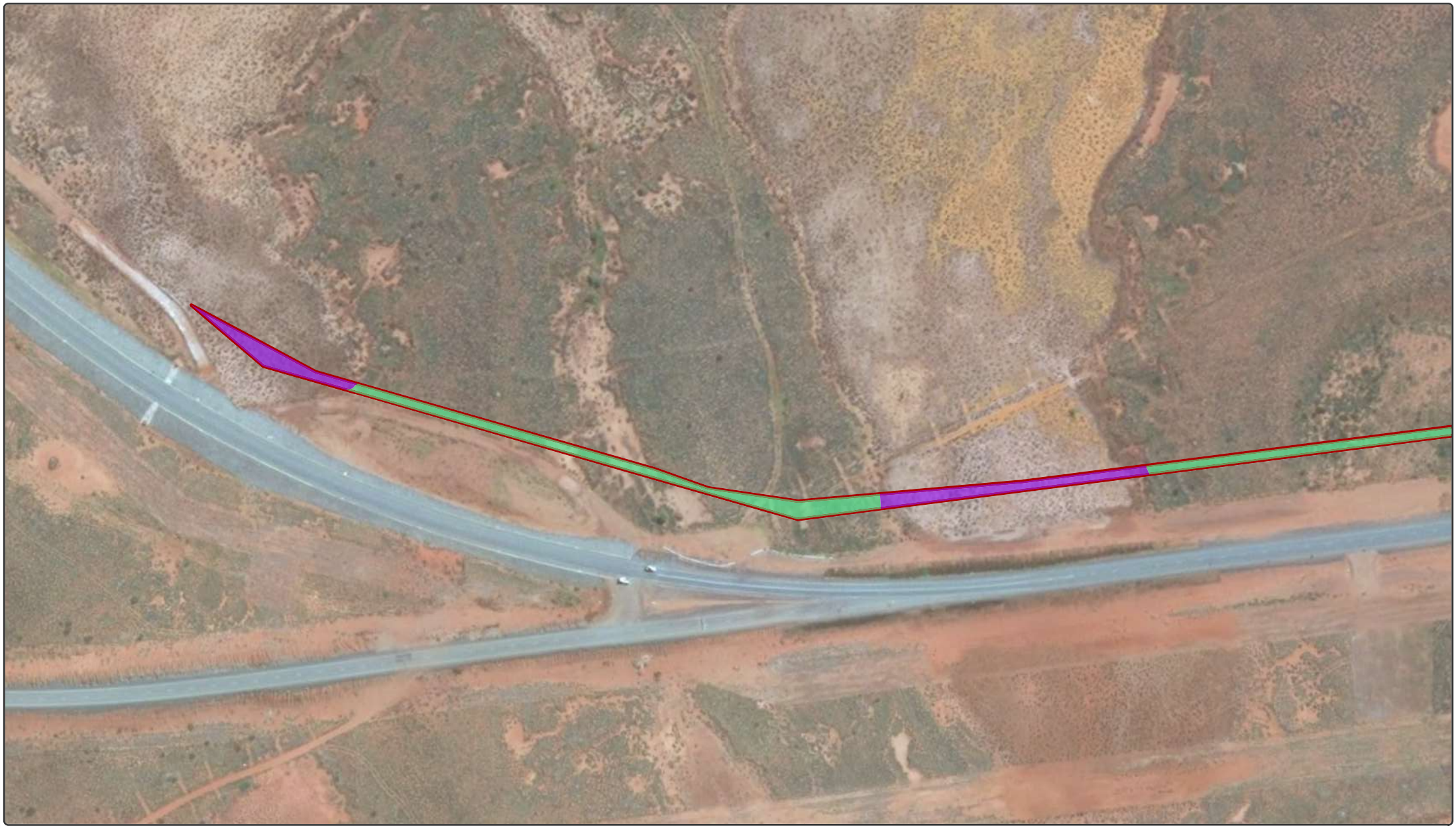


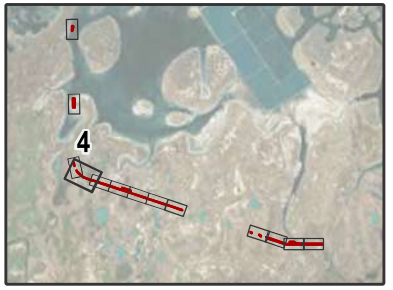
Figure 2-5: Fauna Habitat within the Proposal Area (Map 4 of 13)

Proposal Area

Fauna Habitat

SP

TS



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

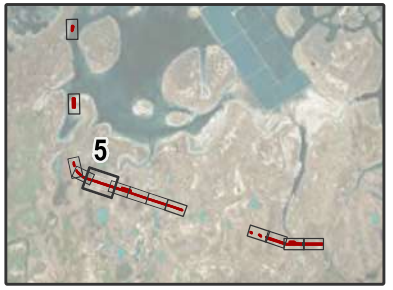
eco logical AUSTRALIA
A TETRA TECH COMPANY

Figure 2-5: Fauna Habitat within the Proposal Area (Map 5 of 13)

Proposal Area

Fauna Habitat

- SD
- SP
- TM&C
- TS



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

ecological AUSTRALIA
A TETRA TECH COMPANY

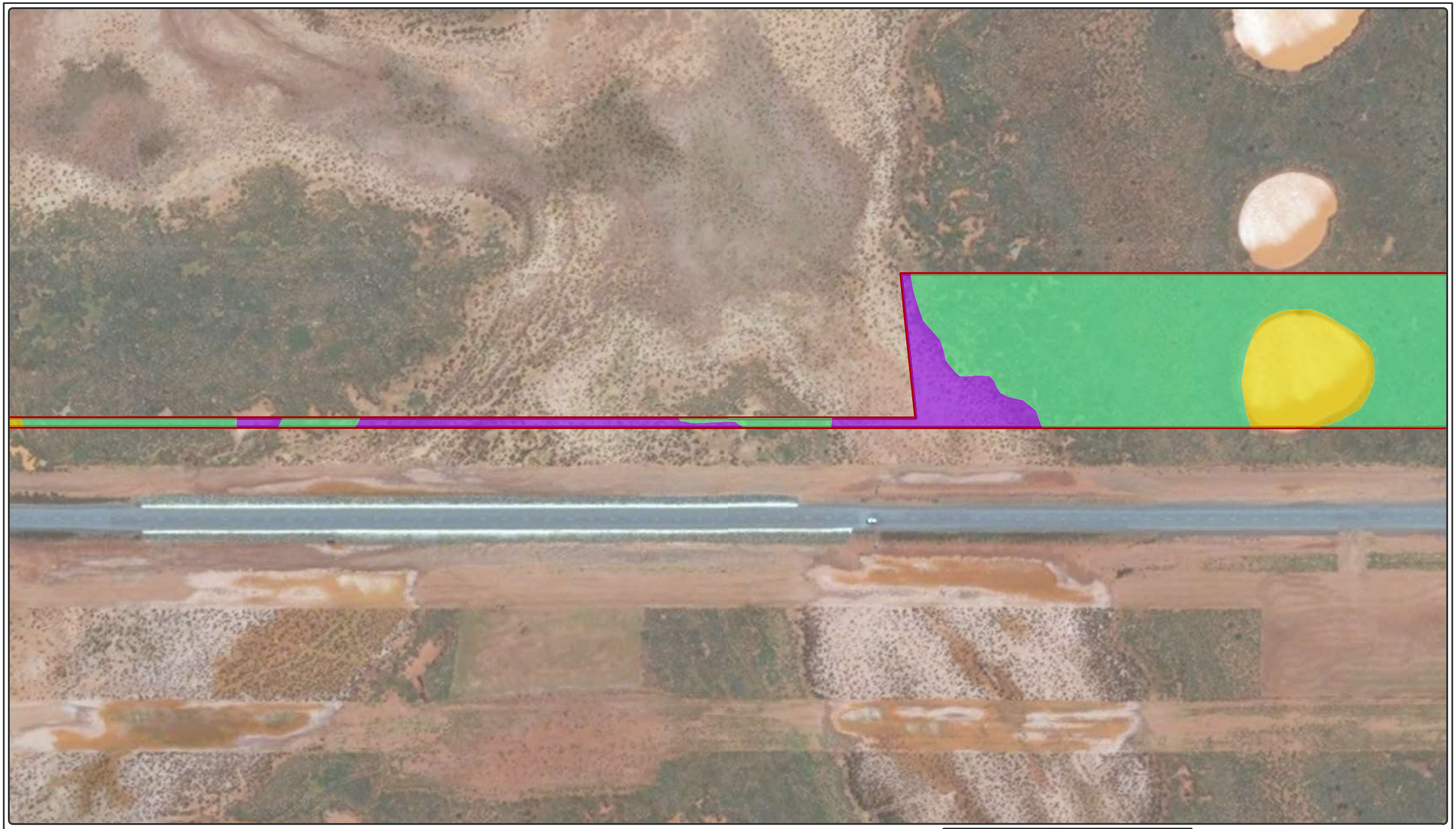
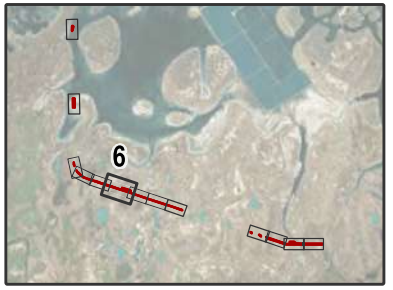


Figure 2-5: Fauna Habitat within the Proposal Area (Map 6 of 13)

Proposal Area

Fauna Habitat

- SP
- TM&C
- TS



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

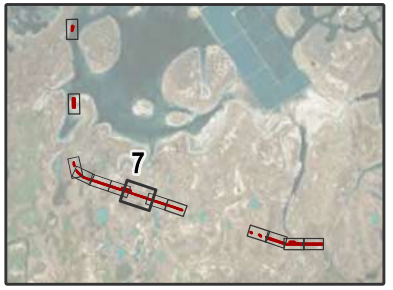
ecological AUSTRALIA
A TETRA TECH COMPANY

Figure 2-5: Fauna Habitat within the Proposal Area (Map 7 of 13)

Proposal Area

Fauna Habitat

- SP
- TM&C
- TS



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

ecological AUSTRALIA
A TETRA TECH COMPANY

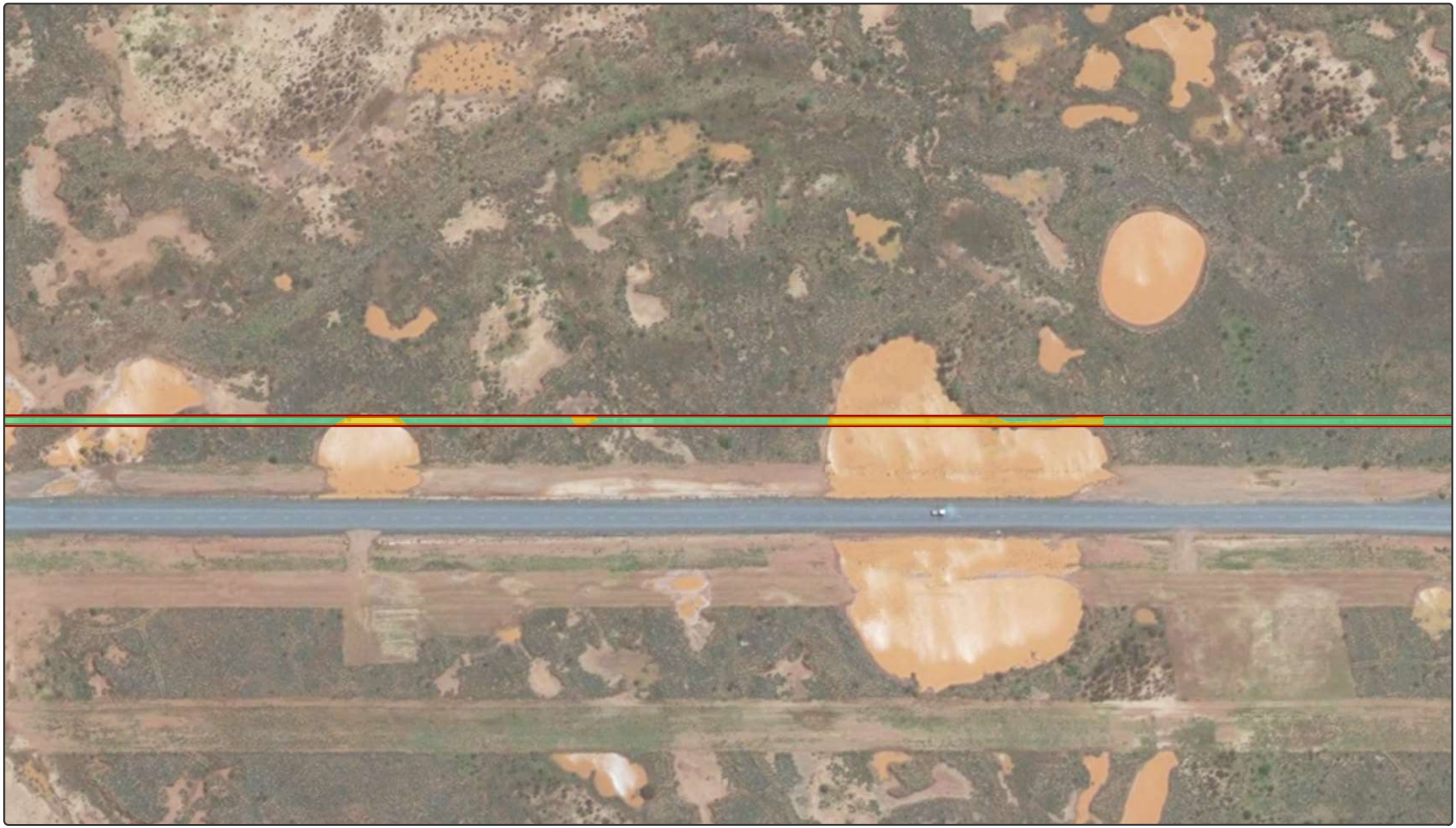


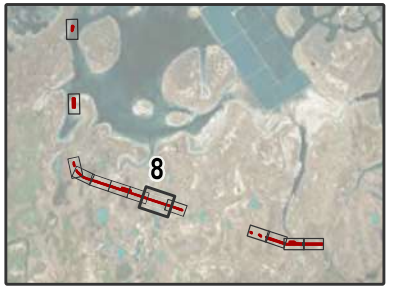
Figure 2-5: Fauna Habitat within the Proposal Area (Map 8 of 13)

Proposal Area

Fauna Habitat

SP

TM&C



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

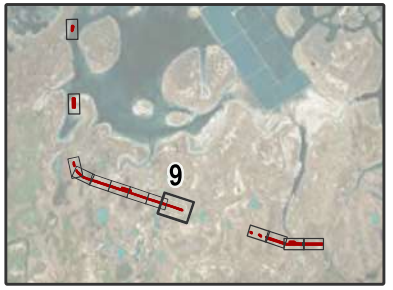
eco logical AUSTRALIA
A TETRA TECH COMPANY

Figure 2-5: Fauna Habitat within the Proposal Area (Map 9 of 13)

Proposal Area

Fauna Habitat

- Cleared
- MS
- SP



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

eco logical AUSTRALIA
A TETRA TECH COMPANY

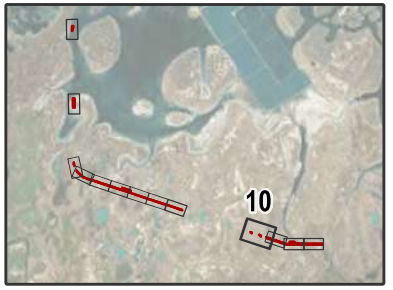
Figure 2-5: Fauna Habitat within the Proposal Area (Map 10 of 13)

Proposal Area

Fauna Habitat

SD

TS



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

eco logical AUSTRALIA
A TETRA TECH COMPANY

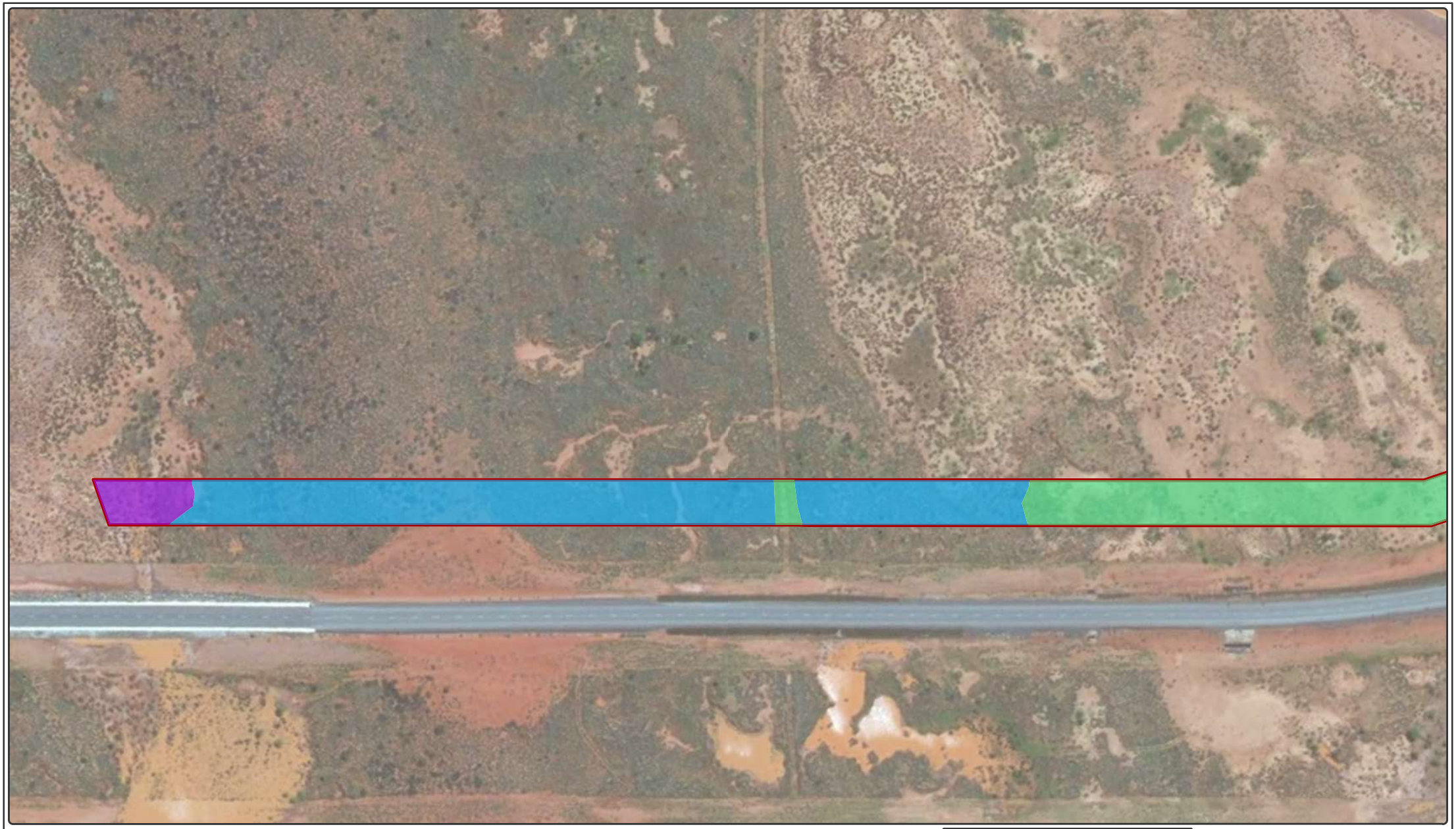
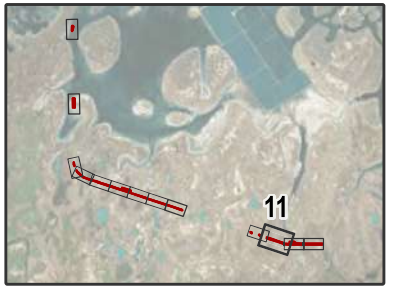


Figure 2-5: Fauna Habitat within the Proposal Area (Map 11 of 13)

Proposal Area

Fauna Habitat

- SD
- SP
- TS



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

ecological AUSTRALIA
A TETRA TECH COMPANY

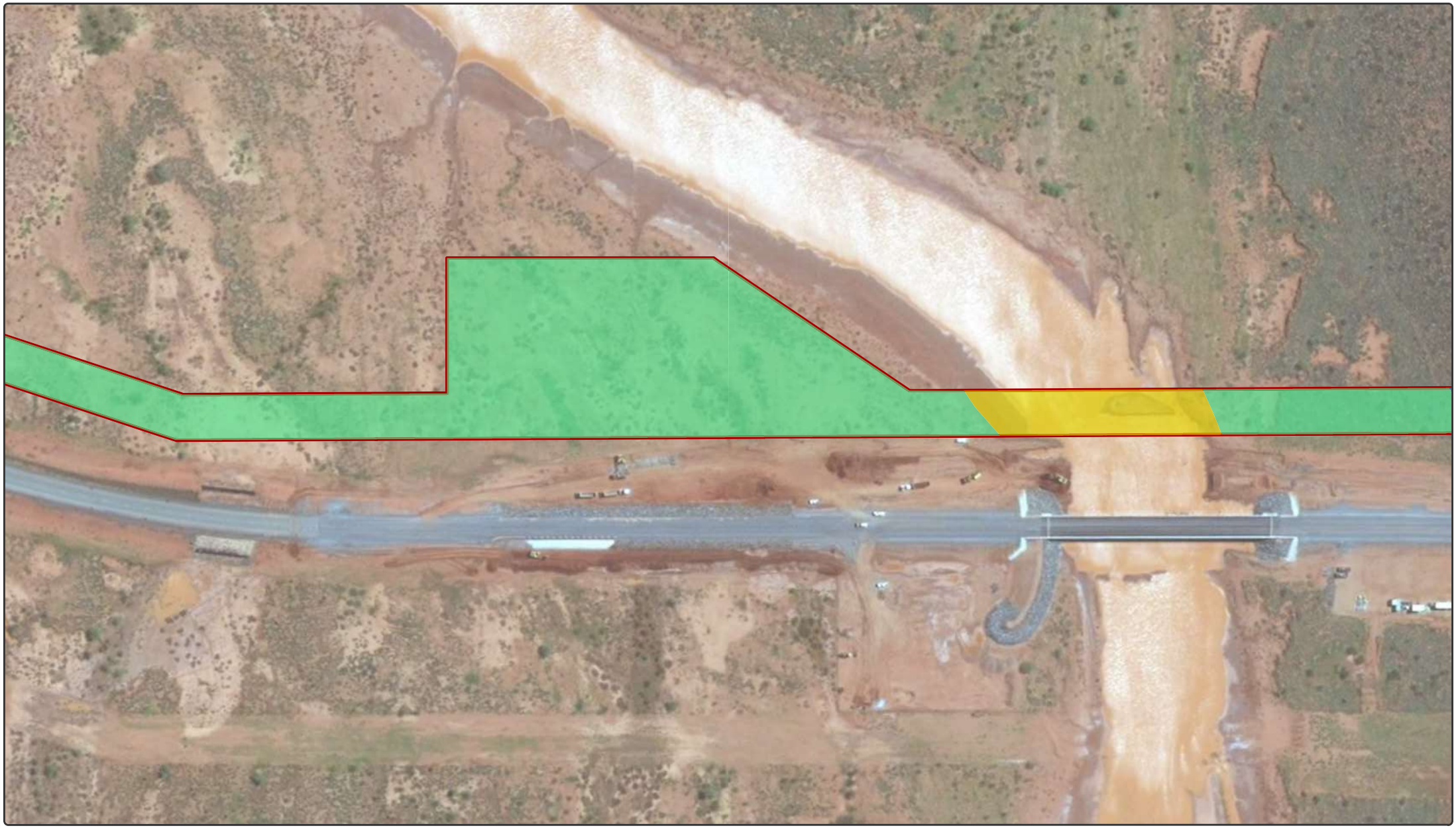
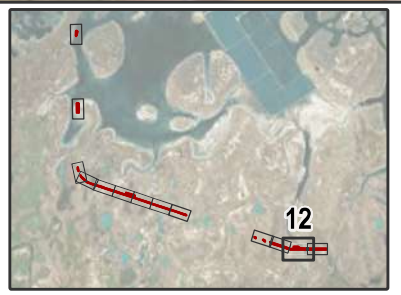


Figure 2-5: Fauna Habitat within the Proposal Area (Map 12 of 13)

Proposal Area

Fauna Habitat

- SD
- SP
- TM&C



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

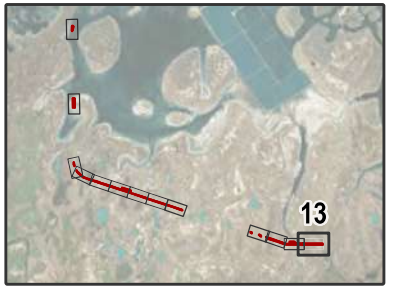
ecological AUSTRALIA
A TETRA TECH COMPANY

Figure 2-5: Fauna Habitat within the Proposal Area (Map 13 of 13)

Proposal Area

Fauna Habitat

- Cleared
- SD
- SP



0 25 50 100

Metres

Datum/Projection:
GDA 1994 MGA Zone 50
23PER4904-ED Date: 5/05/2023

N

eco logical AUSTRALIA
A TETRA TECH COMPANY

3. Application of Mitigation Hierarchy

In accordance with *A guide to the assessment of applications to clear native vegetation* (DER 2014), the impact mitigation sequence has been considered to ensure the environmental impact from the proposed clearing for the Proposal are avoided or minimised as far as practicable.

3.1. Avoidance

During the Proposal design process and the MRWA NVCP assessment, significant changes to the size of the road's disturbance envelope were made to avoid as many *Eremophila forrestii* subsp. *viridis* (P3) and *Triumfetta echinata* (P3) as practicable.

3.2. Mitigation

The following measures to mitigate the impacts of proposed clearing:

- The installation of appropriate surface water drainage infrastructure, to minimise any impacts to local natural hydrological regimes.
- Clearing will be conducted progressively to allow any fauna species currently residing within the Proposal Area to relocate to adjacent vegetation.
- A Construction Environmental Management Plan (CEMP) has been prepared to manage the potential environmental impacts associated with clearing and construction within the adjoining MRWA road reserve. The CEMP was submitted in support of the NVCP application. The clearing permit (CP 9534/1) was granted on 9 November 2022. The CEMP has been revised to incorporate commitments made during the assessment process and permit conditions. The plan will be revised again to include the clearing and construction associated with this Proposal and to incorporate any additional clearing permit conditions. There are no new environmental risks associated with the Proposal, relative to those considered for the MRWA NVCP. The CEMP addresses the management of potential impacts on the environment from the Proposal including:
    - Acid sulfate soils
    - Dust
    - Erosion and sedimentation
    - Noise and Vibrations
    - Storage and disposal of waste and hazardous materials
    - Invasive species.

4. Assessment Against the Ten Principles of Clearing Native Vegetation

Clearing of native vegetation is an offence unless a clearing permit is obtained, in accordance with s 51C of the EP Act, or unless:

- An exemption applies; or
- The proposed clearing was referred to DWER which determined that a permit is not required because the clearing is exempt, or the clearing satisfies all the permit criteria.

The clearing permit process supports a risk-based approach to assessing native vegetation clearing proposals by establishing a pathway to assess very low impact clearing activities that may not require a permit. It is expected that the likely impact from the clearing associated with the Proposal will be very low. This is due to the relatively small amount (i.e. in a regional context, proportional to total remaining vegetation) of vegetation which would be required to be cleared (i.e. up to 14.4 ha, including 0.5 ha of C2/ tidal mud flat that is naturally devoid of vegetation) with the clearing occurring next to an active road and as such the existing environmental quality of the area would be reduced.

An assessment of the proposed clearing against the ten principles for clearing native vegetation has been undertaken (Table 4-1).

Table 4-1: EP Act NVCP Clearing Principles

NVCP Clearing Principles	Response to criteria
Principle a – native vegetation should not be cleared if it comprises a high level of biological diversity	Seven vegetation communities occur within the Proposal Area, none of which are restricted to the Proposal Area (Figure 2-1) and are common throughout the Cape Range subregion (Spectrum 2021). None of these vegetation communities resemble any known Threatened or Priority Ecological Communities. Approximately 62.5% of the vegetation within the Proposal Area has been assessed as in in Good to Very Good condition (Spectrum 2023a). Within these vegetation communities, 145 vascular flora species were recorded within the survey area, of which none were identified as Threatened pursuant to the EPBC or BC Act. A total of 591 individuals of the DBCA listed Priority 3 species *Eremophila forrestii* subsp. *viridis* were recorded, with 573 occurring in the regional survey sites and 18 within the survey area (Spectrum 2023a). Of the 18 plants recorded in the survey area, one individual occurs within the Proposal Area. Whilst this individual is present within the Proposal Area, the section in which it occurs, comprises a portion of the Hastings NVCP (CPS 9818/1). Removal of this individual has already been accounted for under the aforementioned permit, therefore the Proposal will not result in the loss of any known *Eremophila forrestii* subsp. *viridis* individuals. It is also unlikely to impact any unrecorded individuals as the species has only been recorded within the D1 vegetation community and all instances of this community within the survey area have been extensively traversed. A second DBCA listed Priority 3 species, *Triumfetta echinata* is considered to have a moderate likelihood of occurring within the Proposal Area. This is due to the presence of suitable habitat (Sand Dunes) and 137 records occurring within 600 m of the Proposal Area (Figure 2-2,Spectrum 2021). Searches in the Proposal Area, however, did not find any individuals, despite individuals being found with the survey area in suitable habitat. Furthermore, the species is known from multiple locations across Western Australia and has been previously recorded on red sand and sand dune habitats across the Carnarvon, Gascoyne and Pilbara IBRA regions and is therefore not regionally restricted (Spectrum 2023a). *Triumfetta echinata* is unlikely to be impacted by additional clearing within the Proposal Area as no individuals were recorded, it is locally common, and not regionally restricted (Spectrum 2023a). The native vegetation present within the Proposal Area is broadly representative of the vegetation of the wider Cape Range subregion. The seven vegetation communities are not known to possess a high diversity of vascular flora species, with only one Priority 3 species being recorded and one with a moderate likelihood of occurring within the Proposal Area. Due to the widespread nature and thus the relative commonality of the Proposal Area's vegetation communities within the survey area and the wider Cape range subregion, as well as the minimal number of conservation significant species supported by these vegetation communities, they are not considered to possess a high level of floral biodiversity. Refer to Principle (b) below for background on fauna diversity – the fauna assemblage recorded, or likely to occur, within the Proposal Area is not expected to be an atypical representation of fauna diversity relative to other areas in the region.

NVCP Clearing Principles	Response to criteria
	Conclusion Due to the relatively moderate level of biological diversity and regionally widespread and good representation of the vegetation communities and supporting habitat for significant species in the Proposal Area**, the Proposal is not considered to be at variance with this Principle.**
Principle b – Native vegetation should not be cleared if it comprises the whole, or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia	Five fauna habitat types occur within the Proposal Area, all of which are widespread within the survey area and the Cape Range subregion. A total of 44 vertebrate fauna species including one native mammal, four introduced species of mammals, 34 species of birds, and five species of reptiles were recorded in the MRWA survey area (Spectrum 2021). Of these, 25 species were considered to have a high likelihood of occurrence. Two species had been recorded within the survey area in 2021, including the Oriental Pratincole and Caspian Tern, and an additional two species were recorded in the 2021 survey, the Gull-billed Tern, and Little Tern (Spectrum 2021). Although not recorded, the Northern Short-tailed Mouse (P4) is likely to occur within the sand plains habitat of the Proposal Area, as this habitat incorporates suitable sandy clay and spinifex that may support the species (Spectrum 2021). The suitable habitat type is common within the survey area, as such, while the clearing of native vegetation within the Proposal Area has the potential to impact this species, any potential impact is expected to be negligible. A total of 17 migratory shore bird species were recorded or assessed as having a high likelihood of occurrence as they have been frequently observed in close proximity to the survey area. The Tidal Mudflats and Claypans provides foraging habitat for shorebirds that feed on aquatic invertebrates. Migratory shorebirds likely forage within that habitat type while in Australia (from spring to autumn). It is noted however that the habitat is widespread in the region and these species are largely aerial and not restricted to the survey area. **Conclusion** Although the Northern Short-tailed Mouse (P4) is likely to occur, any potential impact is expected to be negligible due to the presence of suitable habitat outside the Proposal Area. Furthermore, due to the nature of the Migratory species that are likely to utilise and/or fly over the Proposal Area and habitat being well represented locally and regionally, **the Proposal is therefore not considered to be at variance with this Principle**.
Principle c – Native vegetation should not be cleared if it includes or is necessary for the continued existence of rare flora	No flora species listed as Threatened under the EPBC Act or the BC Act have been recorded within the Proposal Area. As aforementioned, one individual *Eremophila forrestii* subsp. *viridis* (Priority 3) was recorded within the Proposal Area. However, this portion of the Proposal Area overlaps with the Hastings NVCP (CPS 9818). It is assumed that this individual will have been removed in accordance with NVCP CPS 9818. As such the Proposal will not result in the loss of any *Eremophila forrestii* subsp. *viridis* nor contribute to the cumulative loss of the species. An additional Priority 3 species, *Triumfetta echinata* is considered to have a moderate likelihood of occurring within the Proposal Area. This is due to the presence of suitable habitat (Sand Dunes) and 137 records occurring within 600 m of the Proposal Area (Figure 2 2; Spectrum 2021). Searches in the Proposal Area, however, did not find any individuals, despite individuals being found with the survey area in suitable habitat. Furthermore, the species is known from multiple locations across Western Australia and has been previously recorded on red sand and sand dune habitats across the Carnarvon, Gascoyne and Pilbara IBRA regions and is therefore not regionally restricted

NVCP Clearing Principles	Response to criteria
	(Spectrum 2023a). *Triumfetta echinata* is unlikely to be impacted by additional clearing within the Proposal Area as no individuals were recorded, it is locally common, and not regionally restricted (Spectrum 2023a). **Conclusion** While *Eremophila forrestii* subsp. *viridis* was recorded within the Proposal Area, only 1 individual will be impacted which represents 0.05% of the local known population (assumed to remain intact after implementation of other NVCPs). Additionally, suitable habitat for this species is common at a local and regional scale. Furthermore, although suitable habitat is present in the Proposal Area, *Triumfetta echinata* is unlikely to be impacted by additional clearing within the Proposal Area as no individuals were recorded, it is locally common, and not regionally restricted. Therefore, **the Proposal is not considered to be at variance with this Principle.**
Principle d – Native vegetation should not be cleared if it comprises the whole, or part of, or is necessary for the maintenance of a threatened ecological community	The desktop assessment did not identify any TECs listed under the EPBC Act or the BC Act within the Proposal Area. This was confirmed during the field surveys as none of the vegetation communities' descriptions matched those of any TECs and therefore its concluded that none are present within the Proposal Area (Spectrum 2021 and 2023b). **Conclusion** Due to the absence of any known TECs within the Proposal Area, **the Proposal is not considered to be at variance with this Principle.**
Principle e - Native vegetation should not be cleared if it is significant as remnant vegetation in an area that has been extensively cleared.	The Proposal Area intersects with three vegetation sub associations, as mapped by Beard (1976); 'Short bunch grass savanna/Grass steppe' (589), 'Shrub Steppe' (670), 'Tidal mudflats' (127) and 'Samphire' (676) (Table 2-2). The current extent of 'Short bunch grass savanna/Grass steppe' vegetation sub-association 589 is 806,985 ha which is 99.5% of its pre-European extent. The Proposal will result in the clearing of an additional 0.9 ha, resulting in negligible change (i.e. approximately 99.5% of the pre-European extent will remain within the State). The 'Shrub steppe' vegetation sub-association 670 currently occupies 147,794 ha, which is approximately 10.8 ha less than its pre-European extent. The Proposal will result in the clearing of an additional 13.3ha, resulting in a negligible reduction in the pre-European extent remaining within the State (i.e. >99.9% will remain intact). The current extent of 'Tidal Mudflats' vegetation sub-association 127 is 171,574 ha, or 99.5% of its pre-European extent. The Proposal will result in the clearing of an additional 2.2 ha, a negligible change (i.e. approximately 99.5% of the pre-European extent will remain within the State). The current extent of 'Samphire' vegetation sub-association 676 is 438,799 ha, or 99.3% of its pre-European extent. The Proposal will result in the clearing of an additional 0.5 ha, a negligible change (i.e. approximately 99.3% of the pre-European extent will remain within the State).

NVCP Clearing Principles	Response to criteria
	The Western Australian Government is committed to the *National Objectives and Targets for Biodiversity Conservation* (Commonwealth of Australia 2001) to prevent the clearing of any ecological communities with a current extent of 30% or less of that present prior to European settlement. **Conclusion** No vegetation sub-association is expected to have its current extent reduced to less than 30% of the pre-European extent due to implementation of the Proposal. **As such, the Proposal is not considered to be at variance to this Principle.**
Principle f – Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland	The Proposal Area does not contain any RAMSAR or Nationally Important wetlands. The Proposal Area intersects with the - Quick Mud Creek - and several tidal mudflats and claypan areas (Figure 1-1). The C1 and C2 vegetation communities are associated with these areas. As a result of the implementation of the Proposal, approximately 1.0 ha of C1 and 1.3 ha (0.5 ha of which has been identified as naturally devoid of native vegetation) of the C2 claypan vegetation communities will be cleared. This amount is considered negligible as it represents a loss of less than 10% for both vegetation communities within the survey area (Table 2-3). These vegetation communities are also known to be widespread in the Cape Range Subregion (Spectrum 2021). Within the Proposal Area, Quick Mud Creek is an ephemeral and supra-tidal watercourse, with water flows only present from exceptionally large tides associated with tidal storm surges as well as rainfall runoff. The decision to construct a bridge over the creek was made because it provides the lowest risk of the creeks hydrological regimes being substantially altered. To facilitate the bridges construction Main Roads Western Australia has obtained a Bed and Banks Permit (PMB 207347(1)) under which any operations along creek will operate. The relatively narrow and linear nature of the Proposal also means that potential disturbance and fragmentation of the potential watercourse buffer areas/riparian zones within the Proposal Area will be kept to a minimum. Surface water management measures will be implemented to ensure that the Proposal does not have any indirect downstream impacts on native vegetation and to ensure that local hydrological regimes are maintained. Given the small scale of the Proposal any impacts are expected to be minor and able to be mitigated through standard management practices. **Conclusion** Although the Proposal involves some clearing of vegetation associated with watercourse/wetland features, given its small scale and only very localised and limited hydrological impacts, **it is considered not likely to be at variance with this Principle.**
Principle g - Native vegetation should not be cleared if the clearing of vegetation is likely to cause appreciable land degradation	The Proposal Area consists of two dominant soil types - sandy dune systems and clay/sandy clay mudflats and claypans, both of which are generally nutrient poor. Thus, the likelihood of appreciable land degradation occurring as a result of the Proposal varies with the soil system present. **Acidity** There is a moderate to high risk of Acid Sulfate Soils (ASS) being present in the mudflats and claypans within the Proposal Area, while the ASS risk associated with the low-lying sandy areas of the Proposal Area is low to moderate. There is no ASS risk associated with the other

NVCP Clearing Principles	Response to criteria
	sandy areas within the Proposal Area. If ASS is disturbed during construction, then there is a potential for it to spread into the surrounding area and increase the local soil acidity. ASS surveys have been conducted, and road construction methods require the laying of geofabric over mud flats before importing materials for the road base. No excavation of mud and claypans surfaces is proposed. Any soil excavated from bridge footings will be treated at existing MinRes facilities at either Yarri or the Port of Ashburton. Geofabric will be pre-laid prior to material loading for any areas of temporary access constructed over mud flats and removed at the completion of works. Remediation actions for any disturbed ASS include rapid reburial and movement to an ASS pad and treatment with lime. Details of these management actions will be outlined in the CEMP. **Erosion** The areas with high clay content (mudflats and claypans) are less susceptible to erosion due to the cohesiveness of the soil particles and their occurrence in areas of generally flat topography. The areas with mainly sandy soils are more suspectable to water and wind erosion especially during large storm events. This is due to lower levels of cohesiveness between particles and their occurrence on sloped areas (i.e. dunes) within the Proposal Area. Any impacts as a result of wind and water erosion, especially on sandy soils, will be minimised as far as practicable through the implementation of appropriate management actions including the use of silt fences during construction, batter slope protections (where required) such as concrete canvasing, and construction of diversion drains and culverts. **Salinity** Soil salinity is unlikely to be significantly increased as a result of the Proposal. This is due to the low likelihood of sodic material being present in the site. In the unlikely event that the soil salinity increases the impact is not expected to be significant as many of the flora species present within the Proposal Area are saline resistant. This is due to the proximity of the Proposal Area to the estuarine mudflats and the high salinity present in the local groundwater aquifer. **Waterlogging** The implementation of the Proposal is unlikely to result in waterlogging. The dunes and areas of high elevation consist of sandy soils which have a high level of internal drainage through the soil's high porosity. The lower lying areas are more suspectable to waterlogging due to the low level of porosity found in clay rich soils; however, these areas are generally connected with the clay pans and tidal flats to the north (Figure 1-1), which allows for drainage of water away from the low-lying areas. **Conclusion** Through the implementation of appropriate management actions, the Proposal is not expected to cause an appreciable degradation to the land within the Proposal Area. **As such, the Proposal is not considered to be at variance to this Principle.**

NVCP Clearing Principles	Response to criteria
Principle h – Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area	The desktop assessment indicated that no conservation areas occur within or immediately adjacent to the Proposal Area. The closest conservation area to the Proposal Area is the Cane River (Mount Minnie and Nanutarra) Conservation Park (LR3046/473) which is located approximately 5 km to the southeast. Additionally, none of the land around the Proposal Area serves as an ecological link to the Cane River Conservation Park. **Conclusion** Due to the distance to the nearest conservation area and that none of the vegetation within the Proposal Area acts as an ecological linkage to a conservation area, **the Proposal is not considered to be at variance with this Principle.**
Principle i – Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water	The risk that the surface water quality will deteriorate due to the clearing of vegetation is considered low. Erosion control measures will be implemented to minimise the amount of sediment entering Quick Mud Creek as well as the mudflats and claypans. The natural flows of these features will be maintained through the construction of appropriate drainage infrastructure. All chemicals and hydrocarbons which will be utilised during the clearing and the construction of the Proposal will be appropriately stored, in accordance with AS 1940, and kept away from all drainage lines. **Conclusion** Through the implementation of these measures **the Proposal is not considered to be at variance with this Principle.**
Principle j – Native vegetation should not be cleared if the clearing of vegetation is likely to cause, or exacerbate, the incident of flooding	The Proposal Area occurs within a semi-arid zone, with an average rainfall of approximately 304 mm per year. The area does experience large rainfall events associated with tropical storms and cyclonic events which can result in flash flooding. Suitably sized culverts and water diversion channels will be installed within the Proposal Area to direct surface water flows into natural drainage lines and thus maintain the area's natural hydrological regimes. **Conclusion** Given the proposed hydrological management to be implemented, the **Proposal is not considered to be at variance with this Principle.**

5. Matters of National Environmental Significance

The EPBC Act provides a legal framework for the protection of MNES. The EPBC Act requires that all actions that will or may have a significant impact on an MNES must be referred to the Minister for the Environment via the Department of Climate Change, Energy, the Environment and Water (DCCEEW). Protected Matters under the EPBC Act include:

- World heritage properties
- National heritage places
- Wetlands of international importance (Ramsar wetlands)
- Listed threatened species and ecological communities
- Migratory species protected under international agreements
- Commonwealth marine areas
- A water resource, in relation to coal seam gas activities and large coal mining activities
- The Great Barrier Reef Marine Park
- Nuclear Actions including uranium mining.

In addition, protected matters include the environment where actions proposed will affect Commonwealth land or the Proposals are being undertaken by a Commonwealth agency.

An assessment to determine if any of the potential impacts would result in a significant residual impact to any of the 26 MNES species recorded or likely to occur within the Proposal Area. The result of the assessment indicated that the clearing within the Proposal Area would not have a significant impact on any of these species. As such the action was not referred to DCCEEW for assessment under the EPBC Act. The basis for this assessment and conclusion that referral is not required has been provided in Sections 5.1 to 5.3.

5.1. Potential Impacts on Listed MNES species

The Proposal will result in the clearing of no more than 1.3 ha potential of migratory bird foraging habitat.

5.2. Assessment of the Significance of Potential Impacts

The following sections provide assessments on the significance of the potential impacts as a result of the implementation of the Proposal against the specific significant impact criteria.

5.2.1. Migratory Shorebirds

The Proposal will result in the clearing of up to 1.3 ha of migratory shorebird foraging habitat within the Proposal Area. This represents 4.9% of the foraging habitat within the survey area. The mudflats and claypans that represent important habitat for these species that are present within the Proposal Area are connected to much larger areas of similar habitat types to the north of the Proposal Area and within the wider Cape Range subregion (Spectrum 2021), as such, the Proposal Area is expected to comprise only a small fraction of available local and regional foraging habitat.

The desktop assessment identified 24 migratory shorebird species that have the potential to occur within the Proposal Area (Spectrum 2021):

- One species was recorded
- 16 species have a high likelihood of occurring
- Seven species have a moderate likelihood of occurring.

A full list of the species is provided in Section 0. The species with a low likelihood of occurrence have not been included in this assessment.

5.2.1.1. Migratory Shorebirds Important Habitat

The important habitat of a migratory shorebird species is a key term which needs to be defined for an accurate significant impact assessment to be conducted. The important migratory shorebird habitat is defined by the *Industry guidelines for avoiding and mitigating impact on EPBC Act listed migratory shorebird species* (DoE 2017) as being the same as the criteria used to define Ramsar Conservation Wetlands. These criteria are:

- Internationally important:
  - Regularly supports 1% of the individuals in a population of one species or subspecies of waterbird; or
  - A total abundance of at least 20,000 waterbirds.

- Nationally important:
  - 0.1% of the flyaway population of a single species of migratory shorebird; or
  - 2,000 migratory shorebirds; or
  - 15 migratory shorebird species.

The mudflats and claypan habitat types present within the Proposal Area form a part of a larger wetland to the north of the Proposal Area, which may be considered as nationally important given that more than 15 migratory shorebird species have been historically recorded. Additionally, the Proposal Area occurs within the Onslow Shorebird Area as classified in the Birdlife Directory (Weller *et al.* 2020).

5.2.1.2. Significant Impact Criteria – Migratory Shorebirds

An assessment on the significance of the Proposals impact on these migratory shorebird species is presented in Table 5-1. This assessment is conducted using the criteria and definitions presented in *Significant Impact Guidelines* (DoE 2013) and *Industry guidelines for avoiding and mitigating impact on EPBC Act listed migratory shorebird species* (DoE 2017).

Table 5-1: Assessment of significant impact criteria for migratory shorebirds

Significant impact criteria	Assessment of impacts to the migratory shorebirds
Potential to substantially modify (including by fragmenting, altering fire regimes, nutrient cycles, or hydrological cycles), destroy or isolate an area of important habitat for a migratory species	The mudflats and claypan habitat types provide potential foraging habitat for a number of migratory shorebirds. Mudflats and claypan habitat within the Proposal Area represent less than 5.0% of these habitat types' total extent within the survey area, which in itself only represents a small portion of their extent within the Cape Range subregion (Spectrum 2021). Furthermore, the proposed clearing is small in scale and is an extension to an existing road so does not represent a new or significant impact. The largely aerial nature of the migratory shorebird species utilising these habitat types also means that any potential further habitat fragmentation is unlikely to significantly impact any of these species. Additionally, the natural hydrological flows from the Proposal Area into the surrounding environment will be maintained through the construction of

Significant impact criteria	Assessment of impacts to the migratory shorebirds
	surface water management structures, thus avoiding any downstream indirect impacts as a result of the Proposal. Thus, the **Proposal is unlikely to substantially modify, destroy or isolate the important habitat of the wider wetland.**
Potential to result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species	Nine introduced flora species, including two Declared Pests, Prohibited species. (*Prosopis pallida* and *Tamarix aphylla*) and ten introduced fauna species were recorded within the survey area (Spectrum 2021). None of the introduced flora species are recognised as posing a threat to any migratory bird species or their important habitats. Two of the introduced fauna species, namely Cats and Red Foxes, are recognised as posing a threat to migratory birds through increasing levels of predation (DoE 2017). The Proposal has the potential to introduce additional or increase the current population of invasive flora and fauna species within the Proposal Area. However, management measures, such as hygiene and appropriate waste management will be implemented to reduce the likelihood of this occuring. Further details of these measures are provided in the CEMP. Through the implementation of these measures **the Proposal is unlikely to result in the introduction or spread of an invasive species that is harmful to migratory bird species, becoming established in an area of important habitat.**
Potential to seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	The mudflats and claypan habitats within the Proposal Area can provide some foraging opportunities for migratory bird species. However, only 1.3 ha of these habitat types will be impacted by the Proposal, which represents less than 5.0% within the survey area. These habitats are also widespread within the Cape Range Subregion. It is also noted that the habitat that will be cleared provides limited foraging opportunities for the majority of migratory shorebirds identified as potentially occurring in the Proposal Area and is unlikely to be used as breeding or resting (Spectrum 2021). Due to the small area which will be impacted and connection to the existing road, **the Proposal is unlikely to seriously disrupt the lifecycle of an ecologically significant proportion of the population of a migratory species.**

5.2.2. Other Migratory Birds

The desktop assessment identified ten other migratory bird species that have the potential to occur within the Proposal Area, three of which were recorded within the survey area and the remaining seven have a high likelihood of occurring within the Proposal Area (Spectrum 2021). A full list of the species is provided in Section 0. Eight of these species only fly over the Proposal Area and are not reliant on the habitat within it. As these species will not be impacted by the Proposal, the assessment will only be conducted on the Osprey and White-winged Black Tern which have been identified as having the potential to forage within mudflats and claypan habitats (Spectrum 2021). It is noted that neither species have been observed utilising the habitat within the Proposal Area.

The Proposal will result in the clearing of up to 1.3 ha of potential foraging habitat for the Osprey and the White-winged Black Tern within the Proposal Area. This represents 4.9% of the foraging habitat within the consolidated survey area.

5.2.2.1. Other Migratory Birds Important Habitat

The definition of an important habitat for the Osprey which will be used in the assessment is:

'*Bays, estuaries, along tidal stretches of large coastal rivers, mangrove swamps, coral and rock reefs, terrestrial wetlands and coastal lands of tropical and temperate Australia and offshore islands. They feed primarily in the sea or nearby estuarine waters and nest in trees (often dead or with dead tops), rocky coastlines and on artificial structures such as telecommunication towers. Ospreys are generally found on or near the coast but also range inland along large rivers, mainly in northern Australia* (DoE 2015).

The important habitat of the White-winged Black Tern is not specifically defined; however, the assessment of this species will use the definition provided in *Significant Impact Guidelines* (DoE 2013) which states:

- Habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species; and/or
- Habitat that is of critical importance to the species at particular life-cycle stages; and/or
- Habitat utilised by a migratory species which is at the limit of the species range; and/or
- Habitat within an area where the species is declining.

5.2.2.2. Significant Impact Criteria – Other Migratory Species

An assessment of the significance of impacts of the Proposal on these migratory species is presented in Table 5-2. This assessment is conducted using the criteria and definitions presented in the *Significant Impact Guidelines* (DoE 2013). The assessment for the Osprey will also draw on information from the Draft *Referral guideline for 14 birds listed as migratory species under the EPBC Act* (DoE 2015).

Table 5-2: Assessment of significant impact criteria for other migratory birds

Significant impact criteria	Assessment of impacts to the White-winged Black Tern	Assessment of impacts to the Osprey
Potential to substantially modify (including by fragmenting, altering fire regimes, nutrient cycles, or	White-winged Black Terns have been frequently recorded within the Proposal Area and may forage within the mudflats and claypans habitat types. The suitable	Ospreys have been recorded in the vicinity of the Proposal Area since 2008. While the habitat meets the definition of important habitat for the species as described in the

Significant impact criteria	Assessment of impacts to the White-winged Black Tern	Assessment of impacts to the Osprey
hydrological cycles), destroy or isolate an area of important habitat for a migratory species	habitat types within the Proposal Area only cover 1.3 ha, which is 4.9% of what has been recorded within the survey area. Which represents a small portion of the extent within the Cape Range Subregion. The highly mobile nature of the species also means that the impact of any fragmentation is likely to be minimal. Mitigation measures will be implemented to ensure that natural hydrological flows are maintained through the Proposal Area and that erosion is minimised to maintain the natural nutrient cycles of the environment. Thus, the **Proposal is unlikely to substantially modify, destroy or isolate the important habitat for the White-winged Back Tern.**	*Draft Referral Guidelines for 14 birds listed as migratory* (DoE 2015), the Osprey is only likely to use the mudflats and claypan habitat types for limited foraging, as these areas are unlikely to support a large population of prey fish species. The small size of the area, which is proposed to be impacted, 1.3 ha, location adjacent to an existing road and the highly mobile and aerial nature of the species means it is unlikely that the habitat will be so impacted or fragmented as to be classified as a substantial modification. Mitigation measures will be implemented to ensure that the natural hydrological flows are maintained through the Proposal Area and that erosion is minimised to maintain the natural nutrient cycles of the environment. Thus, the **Proposal is unlikely to substantially modify, destroy or isolate the important habitat for the Osprey.**
Potential to result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the Migratory species	None of the invasive flora species recorded within the Proposal Area (Section 2.2.1.2) are considered to pose a threat to the White-winged Black Tern. While there is limited research conducted on the potential impact of feral fauna on the species it is assumed that they are predated on by Red Foxes and feral Cats, like other migratory bird species. Both of which were recorded within the Proposal Area. To reduce the risk of the current invasive species population growing or additional invasive species being introduced as a result of the Proposal, mitigation measures will be implemented. These will include but will not be limited to hygiene and appropriate waste management. Further details of which are provided in the CEMP. Through the implementation of these measures, **the Proposal is unlikely to result in the introduction or spread of an invasive species that is harmful to the White-winged Black Tern, becoming established in an area of important habitat.**	None of the invasive species recorded within the Proposal Area (Sections 2.2.1.2 & 0) are considered to pose a threat to the Osprey or its important habitat (DoE, 2015). Mitigation measures will be implemented, the details of which are provided in the CEMP, to ensure that no new invasive species will be introduced as a result of the Proposal. This includes hygiene management and appropriate waste management. Through the implementation of these measures, **the Proposal is unlikely to result in the introduction or spread of an invasive species that is harmful to Osprey becoming established in an area of important habitat.**

Significant impact criteria	Assessment of impacts to the White-winged Black Tern	Assessment of impacts to the Osprey
Potential to seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species	The mudflats and the claypan habitat within the Proposal Area may provide some foraging and potential roosting opportunities regionally for the White-winged Black Tern. The amount of habitat which will be cleared as a result of the Proposal is 1.3 ha. Impacting on such a small area is unlikely to result in a serious disruption of the lifecycle of an ecologically significant proportion of the species. Additionally, these habitat types are widespread within the Cape Range subregion and approximately 25.6 ha will remain within the survey area. Thus, **the Proposal is unlikely to seriously disrupt the lifecycle of an ecologically significant proportion of the population of the White-wing Black Tern species.**	The mudflats and claypan habitats present within the Proposal Area provide some foraging opportunities for the Osprey. However, due to the small area these habitat types cover within the Proposal Area, they are unlikely to support a large fish population on which an ecologically significant proportion of the Ospreys population would be reliant. Additionally, none of the habitat types within the Proposal Area supports any large tree or telecommunication towers which the species may use for roosting, resting, or breeding (DoE, 2015). Thus, **the Proposal is unlikely to seriously disrupt the lifecycle of an ecologically significant proportion of the population of the Osprey species.**

5.3. Summary of Residual Impacts on MNES

Management of the environmental impacts associated with the clearing of native vegetation within the Proposal Area has been assessed against the mitigation hierarchy (Section 3). The Proposal Area was optimised during the planning process to avoid clearing of potential important migratory bird habitat as far as practicable. In addition, mitigation measures have been developed within the Proposals CEMP to reduce the likelihood of any potential environmental impacts.

The primary environmental impacts associated with the Proposal will be the direct loss of fauna habitat within the Proposal Area, namely:

- Clearing of 1.3 ha of Migratory Shorebird foraging habitat
- Clearing of 1.3 ha of Osprey foraging habitat
- Clearing of 1.3 ha of White-winged Black Tern foraging habitat.

All the impacts of the Proposal on these MNES species have been appropriately mitigated or managed. Since there are no significant residual impacts, it is expected that the Proposal will not be required to be referred to DCCEEW.

6. References

Beard, J. S., 1976. *Vegetation survey of Western Australia, Western Australia 1:1 000 000 vegetation series, Sheet 5, Pilbara*.

Commonwealth of Australia, 2001. *National Objectives and Targets for Biodiversity Conservation*. Department of Environment and Heritage, Canberra.

Department of Agriculture, Water, and the Environment (DAWE), 2022. *Australia's bioregions (IBRA)*. Available from: https://www.environment.gov.au/land/nrs/science/ibra. Accessed April 2022.

Department of Environment Regulation (DER), 2014. *A Guide to the Assessment of Applications to Clear Native Vegetation*. Government of Western Australia, Perth, Western Australia.

Department of Climate Change, Energy, the Environment and Water (DCCEEW), 2023. *Species Profile and Threats Database:* Chlidonias leucopterus — White-winged Tern, White-winged Black Tern.

Department of the Environment (DoE), 2013. *Matters of National Environmental Significance: Significant Impact Guidelines 1.1*. Australian Government, Canberra.

Department of the Environment (DoE), 2015. *Referral guideline for 14 birds listed as migratory species under the* Environment Protection Biodiversity Conservation Act. Australian Government, Canberra.

Department of the Environment (DoE), 2017. *EPBC Act Policy Statement 3.21—Industry guidelines for avoiding, assessing, and mitigating impacts on EPBC Act listed migratory shorebird species*. Australian Government, Canberra.

Department of Mines Industry Regulation and Safety (DMIRS), 2020. *1:500 000 State interpreted bedrock geology of Western Australia, 2020*.

Department of Primary Industries and Regional Development (DPIRD), 2021. *Soil Landscape Mapping - Best Available (DPIRD-027)*. Available from: https://nationalmap.gov.au/.

Department of Water (DoW), 2007. *Carnarvon Artesian Basin – Water Management Plan*. Department of Water, Perth Western Australia.

Department of Water and Environmental Regulation (DWER), 2018. *Hydrographic Catchments – Sub Catchments (DWER-030) Data*. Available from https://catalogue.data.wa.gov.au/dataset/hydrographic-catchments-subcatchments

Department of Water and Environmental Regulation (DWER), 2022. *Clearing Permit Decision Report.*

Environmental Protection Authority (EPA), 2016. *EPA Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment*. EPA.

Environmental Protection Authority (EPA), 2020. *Technical Guidance: Terrestrial vertebrate fauna Surveys for environmental impact assessment*. Perth, Western Australia.

Government of Western Australia (GoWA), 2019. *2018 Statewide Vegetation Statistics Incorporating the CAR Reserve Analysis (Full Report)*. Current as of March 2019. WA Department of Biodiversity, Conservation and Attractions, Perth, https://catalogue.data.wa.gov.au/dataset/dbca-statewide-vegetation-statistics.

Kendrick, P. and Mau, R, 2001. 'Carnarvon 1 (CAR1 - Cape Range subregion)', in *A Biodiversity Audit of Western Australia's 53 Biogeographic Subregions in 2002*. Department of Conservation and Land Management, pp. 69–86.

Spectrum Ecology & Spatial (Spectrum), 2021. *Warrirda Road Detailed & Targeted Flora & Basic Fauna Assessment*. Unpublished report prepared for Main Roads Western Australia.

Spectrum Ecology & Spatial (Spectrum), 2023a. *Warrirda Road Targeted Flora Assessment*. Prepared for Mineral Resources Limited

Spectrum Ecology & Spatial (Spectrum), 2023b. *Warrirda Road Vegetation Mapping Extension Memo*. Prepared for Mineral Resources Limited.

Spectrum Ecology & Spatial (Spectrum), 2023c. *Warrirda Road Priority Flora Likelihood of Occurrence Assessment*. Memo prepared for Mineral Resources Limited.

Spectrum Ecology & Spatial (Spectrum), 2023d. *Warrirda Road Vegetation Mapping Extension Memo*. Prepared for Mineral Resources Limited.

Weller, D., Kidd, L., Lee, C., Klose, S., Jaensch, R. and Driessen, J., 2020. *Directory of Important Habitat for Migratory Shorebirds in Australia*. Prepared for Australian Government Department of Agriculture, Water and the Environment by BirdLife Australia, Melbourne.

Appendix A : Proof of Ownership Documentation

Appendix B : Technical Studies

WARRIRDA ROAD
TARGETED FLORA ASSESSMENT
PREPARED FOR: MINERAL RESOURCES

Spectrum
ECOLOGY & SPATIAL

© Spectrum Ecology Pty Ltd
ABN 68 615 115 243
PO Box 314 Leederville
Western Australia 6902
Ph: (08) 9317 8233
Email: info@spectrumecology.com.au

Report Details			
Project Description:	Warrirda Road Targeted Flora Assessment		
Prepared For:	Mineral Resources		
Project ID:	2249		
Version History	Author	Reviewer	Date of Issue
V1	Christopher Shaw	Melissa Hay	31-01-2023
V2	Christopher Shaw	Melissa Hay	01-02-2023

TABLE OF CONTENTS

TABLES

MAPS

FIGURES

APPENDICES

EXECUTIVE SUMMARY

Mineral Resources Limited (MinRes) on behalf of Main Roads Western Australia (MRWA) required additional survey work on the north side of Warrirda Road (Disturbance Footprint) to accommodate additional disturbance required to construct a private haul road from their west Pilbara iron ore projects to the Port of Ashburton. The Disturbance Footprint is located approximately 16 km south of Onslow, Western Australia, and covers approximately 47 ha.

The project objective was to undertake a targeted flora survey for any Threatened or Priority flora within the Disturbance Footprint and a regional targeted survey for *Eremophila forrestii* subsp. *viridis* (Priority 3) and *Triumfetta echinata* (Priority 3) in analogous habitat. Eight Regional Survey Sites that represented analogous habitat for *Eremophila forrestii* subsp. *viridis* and *Triumfetta echinata* were selected in areas that had not previously been traversed.

The assessment was undertaken from the 5 to 7 December 2022 by two botanists. The survey was undertaken outside the ideal timing for the Eremaean Botanical Province (March–June). However, it was possible to identify *Eremophila forrestii* subsp. *viridis*, *Triumfetta echinata*, and six of the seven other significant flora taxa identified in the desktop assessment. A total of 49 km of targeted flora traverses were undertaken at a maximum spacing of 50 m through the Disturbance Footprint and all potential habitat for Priority flora within the Regional Survey Sites.

No Threatened flora species were reported from within the Disturbance Footprint or wider region during the desktop assessment. One Priority flora taxon, *Eremophila forrestii* subsp. *viridis*, has previously been recorded in the Disturbance Footprint. A total of eight further Priority flora taxa were also identified, *Triumfetta echinata* was considered to have a 'High' likelihood of occurrence. The remaining seven taxa were assigned a 'Low' likelihood of occurrence.

No Threatened flora taxa were recorded during the field assessment. One Priority flora taxon, *Eremophila forrestii* subsp. *viridis* (P3), was recorded in both the Disturbance Footprint and Regional Survey Sites. A total of 591 *Eremophila forrestii* subsp. *viridis* plants were recorded, 18 were within the Disturbance Footprint and 573 were in the Regional Survey Sites. Three plants of *Triumfetta echinata* were recorded within a Regional Survey Site, none were found in the Disturbance Footprint. *Triumfetta echinata* plants were small and appeared stressed which is likely due to sampling at the end of the dry season. No other significant flora taxa were recorded during the field assessment. Neither *Eremophila forrestii* subsp. *viridis* or *Triumfetta echinata* are considered locally or regionally restricted and it is unlikely that either species will be impacted by additional clearing within the Disturbance Footprint.

1. INTRODUCTION

1.1. Project Background

Mineral Resources Limited (MinRes) on behalf of Main Roads Western Australia (MRWA) required additional survey work on the north side of Warrirda Road (Disturbance Footprint) to accommodate additional disturbance required to construct a private haul road from their west Pilbara iron ore projects to the Port of Ashburton (Map 1.1). Spectrum Ecology & Spatial (Spectrum) undertook the original flora and fauna surveys to support the NVCP application (CPS 9354/1) in 2021 which has since been granted (9/11/2022). The Disturbance Footprint is located approximately 16 km south of Onslow, Western Australia, and covers 47 ha.

1.2. Project Scope

The project objective was to undertake a targeted flora survey for any Threatened or Priority flora within the Disturbance Footprint and a regional targeted survey for *Eremophila forrestii* subsp. *viridis* and *Triumfetta echinata* in analogous habitat.

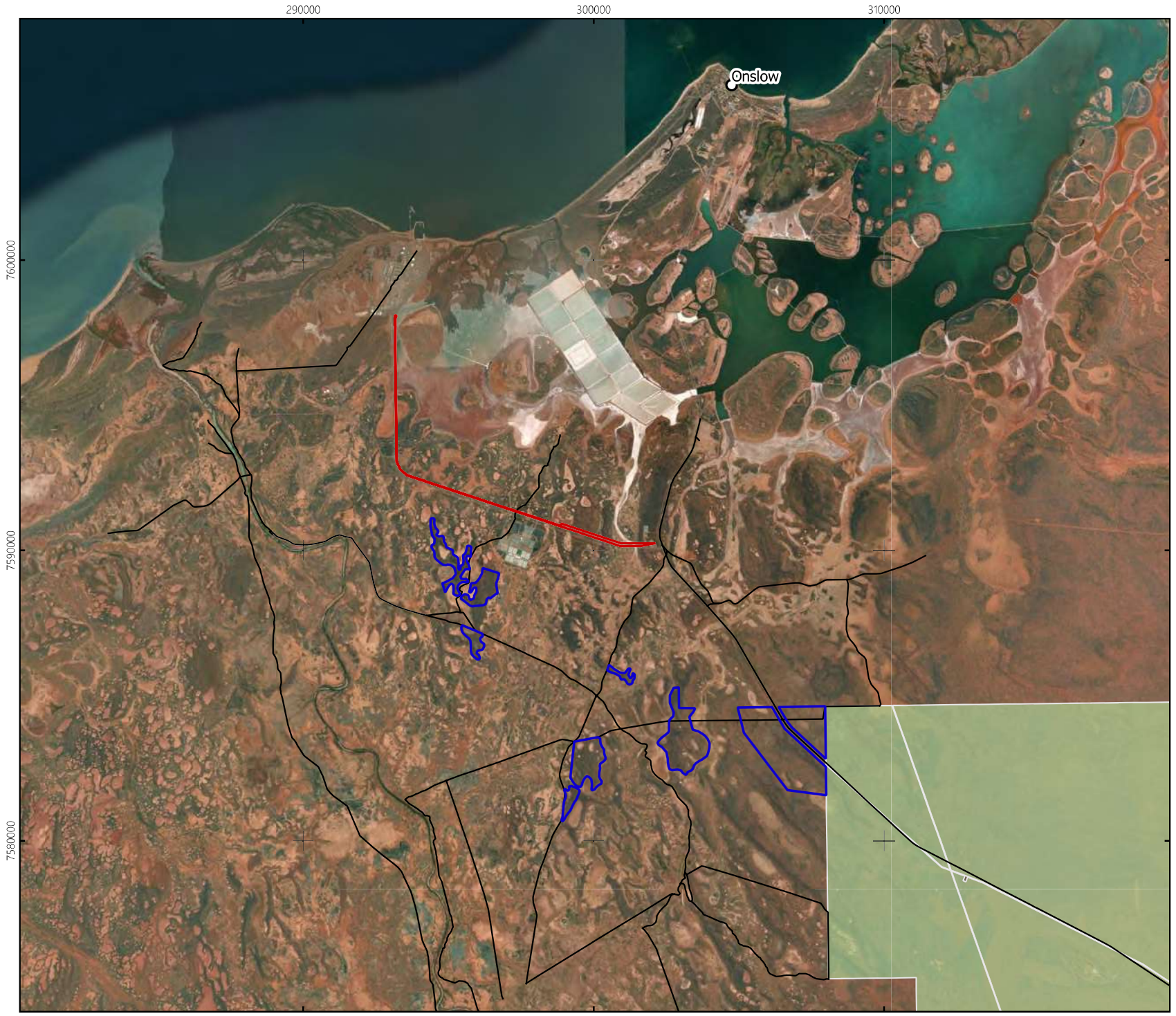
1.3. Legislation & Guidelines

Flora in Western Australia are protected by various legislation, including:

- *Biodiversity Conservation Act 2016* (BC Act);
- *Environmental Protection Act 1986* (EP Act); and
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The survey was compliant with survey guidelines, as outlined in:

- EPA Environmental Factor Guideline: Flora and Vegetation (Environmental Protection Authority, 2016a);
- EPA Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (Environmental Protection Authority, 2016c);
- DBCA Threatened and Priority Flora Report Form – Field Manual (Department of Biodiversity Conservation and Attractions, 2017); and
- National Vegetation Information System (NVIS) Australian Vegetation Attribute Manual (ESCAVI, 2003).



Legend

- Cities & Towns

Survey Area

- Disturbance Footprint
- Regional Survey Sites
- Roads & Tracks
- Conservation Estates

N

0 2 4 6 km

Scale 1:180,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Ecology + Spatial

Author: CS

Date: 12-01-2023

Location of the Survey Area

Warrirda Road Targeted Flora Survey

MAP

Prepared for
Mineral Resources

1.1

2. METHODS

2.1. Desktop Assessment

A desktop review of relevant and available biological data sources of the Desktop Study Area was undertaken prior to the field survey, to assess the flora likely to occur across the Disturbance Footprint. The Desktop Study Area includes a buffer of approximately 40 km surrounding the Disturbance Footprint, or as listed in Table 2.1, and displayed on Map 1.1.

2.1.1. Biological Database Searches

The following databases were searched and incorporated into the desktop assessment (Table 2.1).

Table 2.1: Summary of Database Searches

Data Source	Custodian	Details	Buffer
Mineral Resources Shapefiles	Mineral Resources	Date: 21/11/2022	80 km
Main Roads Database	Main Roads	Date: 07/04/2021	50 km
Naturemap	Department of Biodiversity Conservation and Attraction (DBCA)	Date: 07/04/2021	40 km
Commonwealth Protected Matters Search Tool (PMST)	Department of the Environment and Energy (DoEE)	Date: 08/04/21	40 km
DBCA Threatened & Priority Flora Databases (TPFL / WA Herbarium)	DBCA	Date: 17/03/21	40 km
Index of Biodiversity Surveys and Assessments (IBSA) Database	Department of Water and Environmental Regulation (DWER)	Date: 08/04/21	40 km

2.1.2. Literature Review

Previously conducted assessments within the desktop Study Area were reviewed for significant flora. Reports were incorporated if they were provided by MinRes, or if they were publicly available. The 12 reports incorporated into the desktop assessment are listed in Table 2.2.

Table 2.2: Previously Conducted Biological Assessments

Report	Reference	Location from Current Project	Survey Summary
Onslow Material Pits Environmental Impact Assessment and Environmental Management Plan	GHD (2011)	Several Disturbance Footprints along Onslow Road – one is adjacent to this Disturbance Footprint, another six are within 50 km from this Disturbance Footprint.	Priority 3 species *Triumfetta echinata* was recorded less than 300 m from Disturbance Footprint. Priority 3 species *Eremophila forrestii* subsp. *viridis* was recorded approximately 49 km from Disturbance Footprint.
Level 1 Flora and Vegetation Survey of the Ashburton North Gas Pipeline (ANGP) Project Area	Mattiske Consulting (2014)	Less than 100 m from current Disturbance Footprint.	Two Priority 3 species, *Eremophila forrestii* subsp. *viridis* and *Triumfetta echinata*, were recorded.

Report	Reference	Location from Current Project	Survey Summary
Targeted Flora Survey - Onslow Utilities Infrastructure Upgrade Project	GHD (2017)	Partially overlaps current Disturbance Footprint.	Two Priority 3 species, *Eremophila forrestii* subsp. *viridis* and *Triumfetta echinata*, were recorded.
Flora and Vegetation Survey and Terrestrial Fauna Survey for the Proposed Pilbara Regional Waste Management Facility. Prepared for Talis Consultants.	Phoenix Environmental Sciences (2017)	Approximately 15 km southeast.	Two Priority 3 species, *Abutilon* sp. Pritzelianum (S. van Leeuwen 5095) and *Triumfetta echinata*, were recorded.
Detailed Flora and Vegetation Survey for the Pilbara Regional Waste Management Facility. Prepared for Talis Consultants.	Phoenix Environmental Sciences (2018)	Approximately 15 km southeast.	Unconfirmed records of Priority 3 *Abutilon* sp. Pritzelianum (S. van Leeuwen 5095). Definitive confirmation of plant identity was not possible and inferred from previous survey.
Onslow Road Phase 2 Reconnaissance Survey	Main Roads (2018)	Partially overlaps current Disturbance Footprint.	Site inspection targeted significant species. 5903 individuals of *Abutilon* sp. Onslow (F. Smith s.n. 10/9/61) were recorded 8 km from the Disturbance Footprint.
Detailed Flora and Vegetation Assessment Onslow Rare Earths Plant. Unpublished report prepared for Hastings Technology Metals, Perth, WA.	RPS (2020)	Overlaps with current Disturbance Footprint.	Priority 3 species *Eremophila forrestii* subsp. *viridis* was recorded from three locations.
Pilbara Ports Authority - Port of Ashburton - Eastern Port Precinct - Additional Clearing Areas Flora Survey	Vicki Long & Associates (2020)	Approximately 3 km north.	Priority 3 species *Abutilon* sp. Pritzelianum (S. van Leeuwen 5095) was recorded.
Ashburton Infrastructure Project. Flora and Vegetation Assessment. Report. Prepared for Mineral Resources Limited.	360 Environmental (2021)	Approximately 1 km east.	Priority 3 species *Eremophila forrestii* subsp. *viridis* was recorded from seven locations.
Targeted Er*emophila forrestii* subsp. *viridis* (P3) Survey at Onslow. Memo report prepared for Hastings Technology Metals Limited.	Eco Logical Australia (2021)	Overlaps with current Disturbance Footprint.	Priority 3 species *Eremophila forrestii* subsp. *viridis* was recorded from multiple locations in the local area.
Warrirda Road Detailed & Targeted Flora & Basic Fauna Assessment	Spectrum Ecology (2022)	Shares border with current Disturbance Footprint.	Two Priority 3 species, *Eremophila forrestii* subsp. *viridis* and *Triumfetta echinata*, were recorded.
Eremophila forrestii subsp. *viridis* Targeted Flora Survey	Anders Environmental Consulting (2022)	Overlaps current Disturbance Footprint.	A targeted survey for *Eremophila forrestii* subsp. *viridis* undertaken within an impact and regional Survey Area.

2.1.3. Likelihood of Occurrence of Significant Flora

The following information was collated for each significant flora taxon identified during the desktop assessment:

- Conservation status (EPBC Act, BC Act, DBCA listing);
- Description of species and flowering period (flora only);
- Description of habitat requirements;
- Description of previous records; and
- Distance of record to the Project.

A likelihood of occurrence assessment was then conducted using the criteria listed in Table 2.3. This included assessing the distance of the record from the Project (historical database records considered not accurate were excluded if required) and presence of appropriate habitats within the Disturbance Footprint (using geology, vegetation mapping, and/or aerial imagery).

Table 2.3: Likelihood of Occurrence Criteria

Likelihood	Flora & Vegetation
Recorded	Species or vegetation community accurately recorded within the Disturbance Footprint during the literature review.
High	Species or vegetation community recorded within 20 km near the Disturbance Footprint, and suitable habitat does, or is likely, to occur.
Medium	Species or vegetation community recorded outside the Disturbance Footprint but within 20 km and suitable habitat may occur.
Low	Species or vegetation community rarely or not recorded within 20 km of the Disturbance Footprint and suitable habitat is not likely to occur within the Disturbance Footprint.

2.2. Survey Timing

The assessment was undertaken over three days from the 5 to the 7 of December 2022. Monthly climate data was sourced from the nearest Bureau of Meteorology (BOM) station with complete data (Onslow Airport #5017), located approximately 13 km north of the Disturbance Footprint (Bureau of Meteorology, 2022). Additionally, the median monthly rainfall recorded from 1886 to 2012 at the closed Onslow (#5016) BOM station was included. Rainfall recorded 12 months prior to the survey and median monthly rainfall is presented in Figure 2.1.

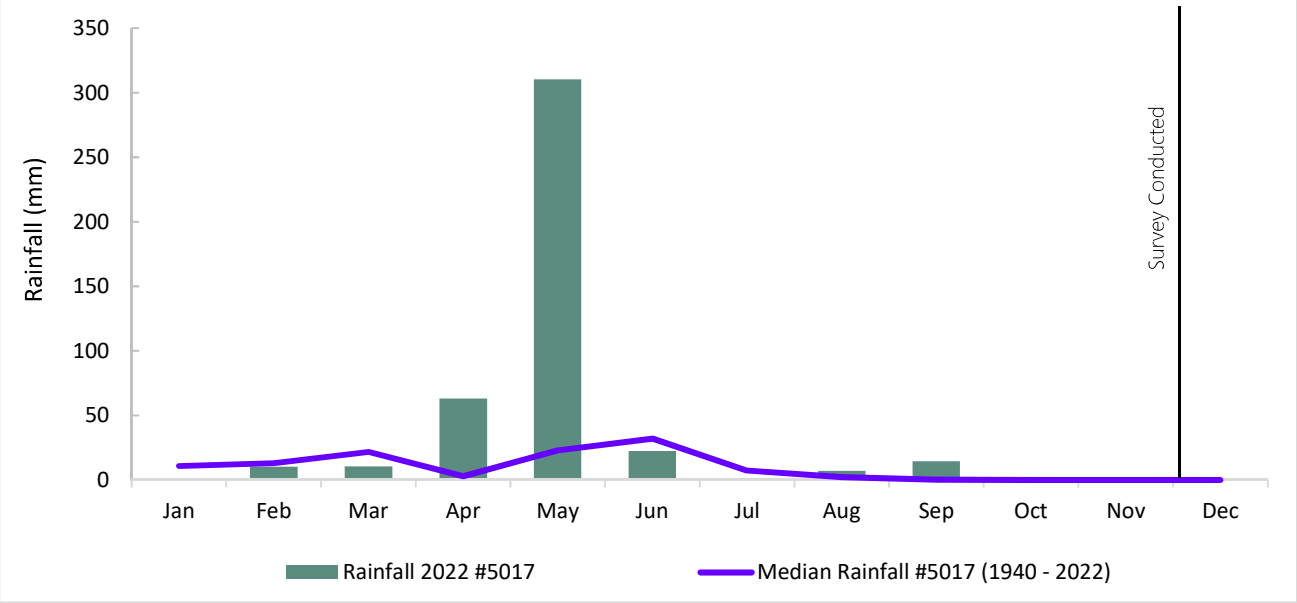


Figure 2.1: Mean Temperature & Rainfall for the 12 Months Preceding the Survey

The following rainfall was recorded at Onslow Airport (#5017) prior to the survey:

- The 12 months preceding the field survey (January to December 2022) recorded 438.6 mm of rainfall, 159.2 mm higher than the sum of the long-term annual median of 279.4 mm; and
- The three-months preceding the field survey (September – November 2022) recorded 14.4 mm of rainfall, 14.2 mm higher than the sum of the long-term annual median for the same three months (0.2 mm).

2.2.1. Flora Detectability

The targeted survey was undertaken from the 5 to 7 December 2022 over six person days. The ideal timing for undertaking a flora survey in the Eremaean Botanical Province is six to eight weeks following summer rainfall (March to May). The field survey therefore occurred in less optimal conditions for plant growth and flowering times for the region, however as the assessment was a targeted survey, appropriate survey timing is associated with being able to detect and identify the target species. Table 2.4 lists the significant flora target species, their longevity, flowering period, identifiability, and detectability during the current survey.

Of the nine target species, one was an annual that may not have been present due to the survey timing. One target plant species, *Triumfetta echinata*, with a 'High' likelihood of occurrence was assigned a 'Possible' likelihood of detectability in the survey. *Triumfetta echinata* requires flowering or fruiting material to be identified accurately.

Table 2.4: Target Species Flowering & Detectability

Status	Taxon	Longevity & Lifeform	Flowering Period	ID from Vegetative Material	Highest Likelihood of Occurrence	Detectability in Survey
P1	*Abutilon* sp. Onslow (F. Smith s.n. 10/9/61)	Perennial shrub	August to October	No	Low	Yes
P1	*Isotropis forrestii*	Perennial shrub	April to September or December	Yes	Low	Yes
P3	*Myriocephalus scalpellus*	Perennial herb	-	No	Low	Possible
P3	*Abutilon* sp. Pritzelianum (S. van Leeuwen 5095)	Perennial shrub	-	No	Low	Yes
P3	*Carpobrotus* sp. Thevenard Island (M. White 050)	Perennial herb	August	-	Low	Possible
P3	*Eleocharis papillosa*	Annual Herb	November	-	Low	No
P3	*Eremophila forrestii* subsp. *viridis*	Perennial shrub	August	Yes	Recorded	Yes
P3	*Stackhousia clementii*	Perennial shrub	-	Yes	Low	Yes
P3	*Triumfetta echinata*	Perennial shrub	August	No	High	Possible

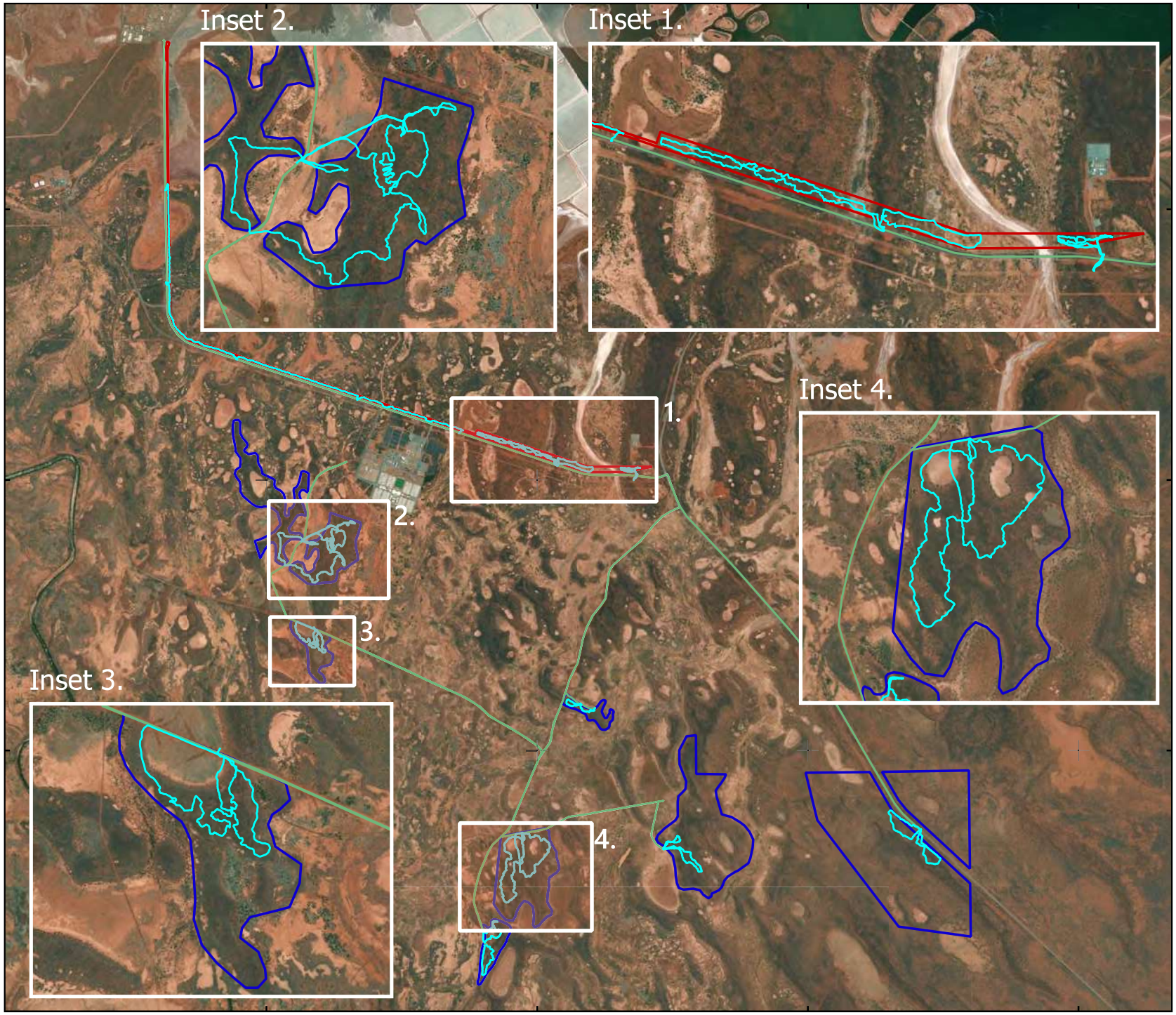
2.3. Field Methods & Sampling Effort

A targeted significant flora survey was undertaken within the Survey Area (Map 1.1). The survey was competed by two botanists over a three-day period. There were 49.4 km of targeted traverses sampled during the assessment (Map 2.1). The targeted flora survey was undertaken across two areas, the Development Envelope and Regional Survey Sites.

Traverses were spaced approximately 50 m apart with the width surveyed <25 m. Traverses undertaken in regional areas targeted habitat for *Eremophila forrestii* subsp. *viridis* and *Triumfetta echinata*, when target species were encountered closer transects (<50 m) were walked if necessary to accurately map the number of individuals.

All targeted species were recorded at an individual plant level where possible/practical (i.e. a GPS co-ordinate for each plant). Where individual GPS co-ordinates were not practical, an estimation of individual plants and size (i.e. 20 × 20 m) of the discrete group of plants was recorded. When the target species were encountered sufficient information was collected to be compliant with the requirements of the Threatened and Priority flora report form, and included:

- Observation date;
- Observer, role, organisation;
- Description of location, land tenure;
- GPS coordinates;
- Abundance count and count method;
- Reproductive state (of collected specimens);
- Condition of population;
- Habitat information;
- Vegetation classification; and
- Condition of habitat, fire history etc.



Legend

- Traverses
- Vehicle Tracks

Survey Area

- Disturbance Footprint
- Regional Survey Sites

N

0 1 2 3 km

Scale 1:98,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Geology + Spatial

Author: CS

Date: 12-01-2023

Sampling Effort

Warrirda Road Targeted Flora Survey

MAP

Prepared for
Mineral Resources

2.1

2.4. Reporting & Data Analysis

2.4.1. Flora Nomenclature, Taxonomy & Lodgement

Flora nomenclature used in this report is consistent with the Western Australian Herbarium's plant census, provided on FloraBase (Western Australian Herbarium, 2023) and is current at the time of report preparation.

Specimens were identified using the appropriate taxonomic keys and where required, relevant taxonomic experts at the Western Australian Herbarium were consulted. Specimens were vouchered with the Western Australian Herbarium as per guidance; when they represent new populations of Threatened or Priority flora, new occurrences of TECs or PECs, individuals that have atypical characteristics, or bioregional range extensions.

2.4.2. Significant Flora Definitions

Significant flora can include (Environmental Protection Authority, 2016b):

- Being identified as Threatened: Critically Endangered, Endangered, or Vulnerable (state listed Biodiversity conservation - BC Act and/or nationally listed Environment Protection and Biodiversity Conservation - EPBC Act);
- Locally endemic or associated with a restricted habitat type (e.g. surface water or groundwater dependent ecosystems);
- New species or anomalous features that indicate a potential new species;
- Representative of the range of a species (particularly, at the extremes of range, recently discovered range extensions, or isolated outliers of the main range);
- Unusual species, including restricted subspecies, varieties or naturally occurring hybrids; or
- Relictual status, being representative of taxonomic groups that no longer occur widely in the broader landscape.

2.5. Data for the Index of Biodiversity Surveys for Assessment (IBSA)

The EPA has given instruction that all biological surveys collecting data on biodiversity will submit the report and associated raw data to IBSA as an IBSA data package. All survey data collected at the Disturbance Footprint and Regional Survey Sites has been provided electronically to comply with IBSA and MinRes data standards.

2.6. Project Team & Licences

Spectrum personnel involved with this assessment are listed in Table 2.5, along with their role and years of experience.

Table 2.5: Project Team & Licences

Staff	Qualification	Role	Project Tasks	Years of Experience	Flora Licence
Dr Christopher Shaw	Phd	Senior Botanist	Project management, field survey, data management, reporting	7 years	FB62000241
Steven Spragg	BSc	Botanist	Field survey	2 years	FB62000501
Melissa Hay	Bsc (Hons)	Principal Botanist	Review	16 years	n/a

2.7. Limitations & Constraints

Survey specific limitations and constraints for the flora assessment at the Survey Area (Disturbance Footprint and Regional Survey Sites) are discussed in Table 2.6.

Table 2.6: Survey Limitations & Constraints

Limitation	Constraint	Comment
Availability of the contextual information at a regional and local scale.	No	Database searches from the previous Spectrum Ecology (2022) survey were used in addition to updated shapefiles provided by MinRes. These resources were adequate to guide field survey design and effort. There were multiple assessments conducted within and in the vicinity of the Survey Area and have been included in the desktop assessment.
Competency/experience of the consultant carrying out the survey including experience in bioregion surveyed.	No	Senior Botanist Christopher Shaw has suitable knowledge and experience conducting botanical surveys in the Carnarvon and Pilbara region of Western Australia.
Timing/weather/season/cycle.	Possible	The field survey timing was considered somewhat appropriate for a targeted flora survey at the Survey Area. Eight of the nine significant flora taxa were detectable or possible to detect at the time of the survey. Habitat for *Eleocharis papillosa*, that was undetectable at the time of the survey, was not present within the Survey Area. The two significant flora taxa with a 'High' or 'Recorded' likelihood of occurrence in the Survey Area were detectable at the time of the survey. *Triumfetta echinata* at previous known locations appeared to be in poor health after the dry conditions leading up to the survey and was only identifiable with remnant fruit.
Disturbances (e.g., fire, flood, accidental human intervention) which affected results of survey.	No	No disturbances were recorded at the Survey Area that affected the results of the flora assessment.
Remoteness and/or access problems.	No	There were no access restrictions at the Survey Area.
Survey effort and extent.	No	The targeted flora assessment was conducted along 49 km of traverses at a spacing of approximately 50 m through the Disturbance Footprint and identified potential habitat for Priority flora at the Regional Survey Sites. Sections of the Disturbance Footprint that were not traversed contained no vegetation.
Proportion of flora recorded and/or collected, any identification issues.	No	At least one specimen per population was collected for confirmation. *Triumfetta echinata* could only be identified with if it had fruiting material, one Malvaceae species could not be identified to the species level as it had no fruit or flowering material. Plants were identified by the Senior Botanist Christopher Shaw and confirmed by Senior Botanist/Taxonomist Raimond Orifici who has botanical and taxonomic experience throughout Western Australia and is particularly experienced around the Onslow area.

3. RESULTS & DISCUSSION – FLORA

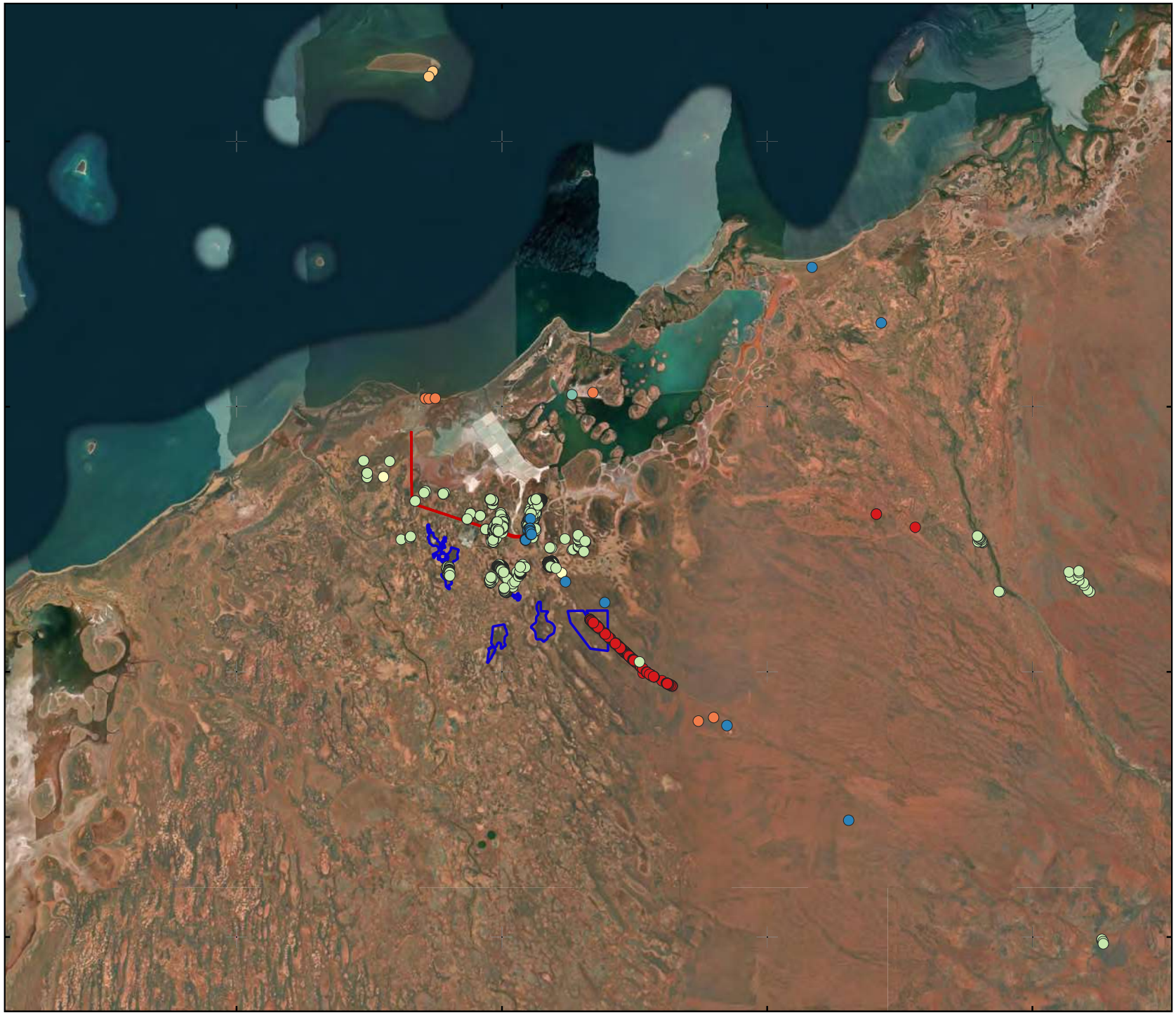
3.1. Desktop Assessment

No Threatened flora species were reported from within the Disturbance Footprint during the desktop assessment (Appendix B).

One Priority flora taxon has previously been recorded in the Disturbance Footprint. A total of eight further Priority flora taxa were also identified, one of which are considered to have a 'High' likelihood of occurrence within the Disturbance Footprint (Table 3.1). The remaining seven taxa have been assigned a 'Low' likelihood of occurrence. All significant flora returned from database searches and a detailed desktop assessment are presented in Appendix B.

Table 3.1: Desktop Significant Flora – Recorded, High & Medium Likelihood of Occurrence

Likelihood	Status	Taxa	Longevity	Flowering Period
Recorded	Priority 3	*Eremophila forrestii* subsp. *viridis*	Perennial	August
High	Priority 3	*Triumfetta echinata*	Perennial	August
Low	Priority 1	*Abutilon* sp. Onslow (F. Smith s.n. 10/9/61)	Perennial	August to October
		Isotropis forrestii	Perennial	April to Sept or Dec.
		Myriocephalus scalpellus	Perennial	-
	Priority 3	*Abutilon* sp. Pritzelianum (S. van Leeuwen 5095)	Perennial	-
		Eleocharis papillosa	Annual	November
		Stackhousia clementii	Perennial	-
		Carpobrotus sp. Thevenard Island (M. White 050)	Perennial	August



Legend

Survey Area

- Disturbance Footprint
- Regional Survey Sites

Significant Flora

- P1 - Abutilon sp. Onslow (F. Smith s.n. 10/9/61)
- P3 - Abutilon sp. Pritzelianum (S. van Leeuwen 5095)
- P3 - Carpobrotus sp. Thevenard Island (M. White 050)
- P3 - Eleocharis papillosa
- P3 - Eremophila forrestii subsp. viridis
- P3 - Stackhousia clementii
- P3 - Triumfetta echinata

N

0 5 10 15 km

Scale 1:400,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

Author: CS

Date: 17-01-2023

Desktop Assessment - Significant Flora

Warrirda Road Targeted Flora Survey

MAP

Prepared for
Mineral Resources

3.1

3.2. Significant Flora

No Threatened flora taxa were recorded during the desktop or field assessment or were considered likely to occur in the Disturbance Footprint. One Priority flora taxon, *Eremophila forrestii* subsp. *viridis* (P3), was recorded within both the Disturbance Footprint and Regional Survey Sites (Table 3.2, Map 3.2). One Priority flora taxon, *Triumfetta echinata* (P3), was only recorded within the Regional Survey Site. No other significant flora taxa (as listed in section 2.4.2) were recorded during the field assessment. Coordinates of all significant flora taxa have been provided electronically with this report.

Eremophila forrestii subsp. *viridis* was widespread across the swales and footslopes of the red sand dunes, and 591 individuals were recorded during the assessment. Of these, 18 individuals were recorded within the Disturbance Footprint, and 573 individuals were recorded across the Regional Survey Sites (Table 3.2; Map 3.2). All new records of *Eremophila forrestii* subsp. *viridis* within the Disturbance Footprint were part of known populations (records separated <500 m). Four new populations of *Eremophila forrestii* subsp. *viridis* were identified at Regional Survey Sites.

Eremophila forrestii subsp. *viridis* has previously been recorded within the Disturbance Footprint and from 25 locations in the local area (within 12 km for the Disturbance Footprint). It appears to be widespread across the sand dune and sandy areas in vicinity of the Disturbance Footprint. *Eremophila forrestii* subsp. *viridis* is known form a further five locations within 80 km of the Disturbance Footprint. The species has been recorded on sandy and rocky habitats across six Interim Biogeographic Regionalisation for Australia (IBRA) regions (Carnarvon, Pilbara, Little Sandy Desert, Great Sandy Desert, Great Victoria Desert, Central Ranges) and is therefore not regionally restricted (Chinnock, 2007).

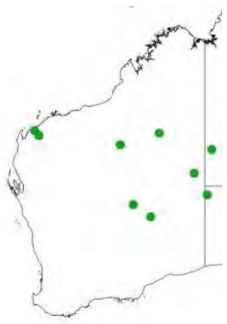
Eremophila forrestii subsp. *viridis* is unlikely to be impacted by additional clearing within the Disturbance Footprint as it is locally common and not regionally restricted. Furthermore, the number of individuals of *Eremophila forrestii* subsp. *viridis* recorded in the Disturbance Footprint was approximately 30 times lower than in the Regional Survey Sites in the current survey.

Three individuals of *Triumfetta echinata* were recorded at one location on a dune crest at a Regional Survey Site (Table 3.2; Map 3.2), which represents a new population. *Triumfetta echinata* plants were small and appeared stressed which is likely due to sampling at the end of the dry season.

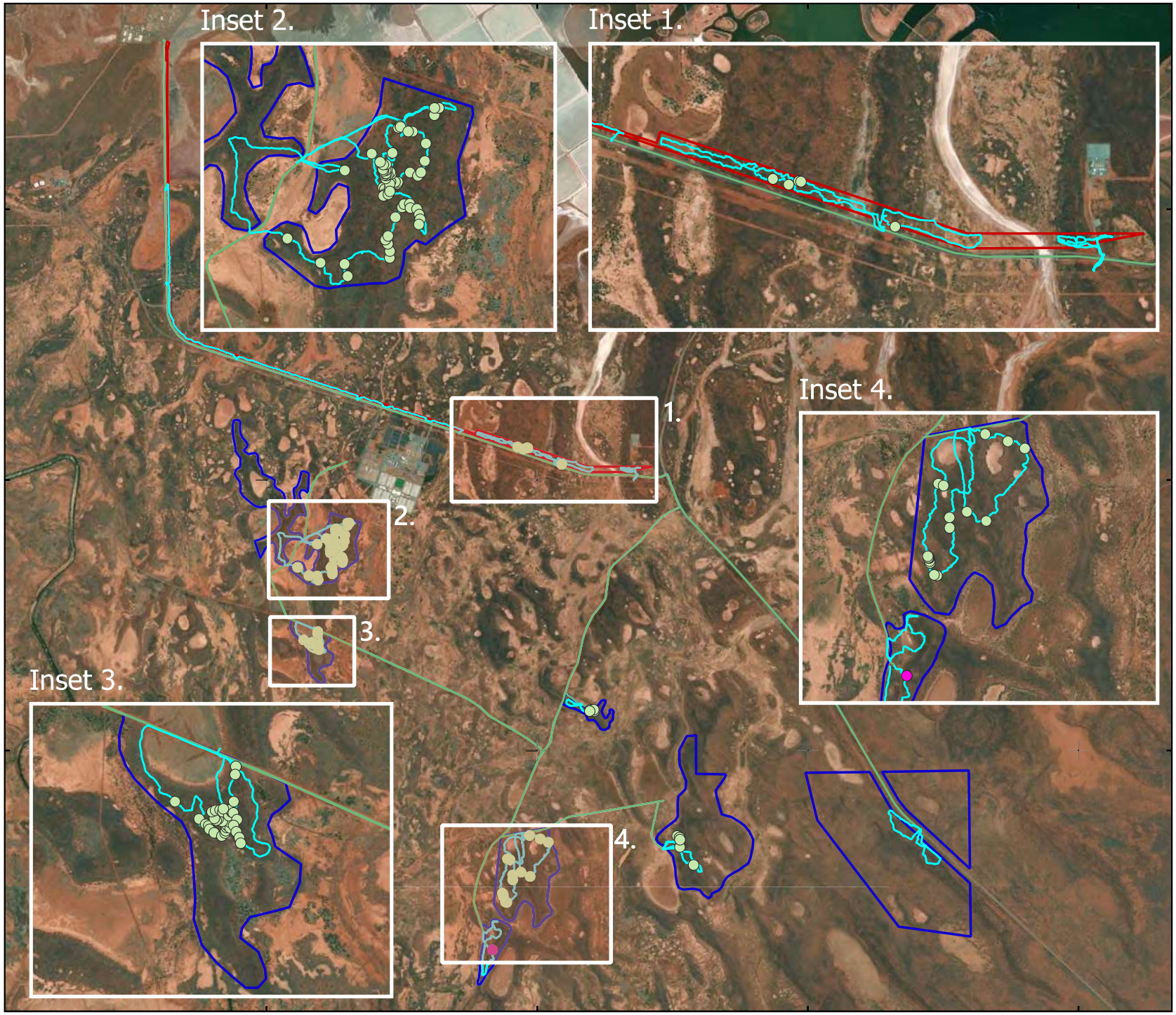
Triumfetta echinata is previously known from five locations in the vicinity of the Disturbance Footprint (within 8 km). *Triumfetta echinata* is known from a further four locations within 32 km of the Disturbance Footprint. These records were all found on red sand dunes. It is likely to be widespread across the sand dune and sandy areas in the vicinity of the Disturbance Footprint. *Triumfetta echinata* is known from multiple locations across Western Australia, and has been recorded on red sand and sand dune habitats across three IBRA regions (Carnarvon, Gascoyne, Pilbara) and is therefore not regionally restricted (Western Australian Herbarium, 2023).

Triumfetta echinata is unlikely to be impacted by additional clearing within the Disturbance Footprint as no individuals were recorded, it is locally common, and not regionally restricted.

Table 3.2: Significant Flora

Status	Taxon	Description of plants in Survey Area	Landforms in Survey Area	# of individuals	Map[1]	Local & Regional Distribution	Photograph
P3	*Eremophila forrestii* subsp. *viridis*	Many branching shrub to 1 m high. Sparsely hairy to glabrous, dark green foliage. Flowers pink.	Recorded on the swales and footslopes of red sand dunes.	Disturbance Footprint - 18 Regional Survey Sites - 573 **Total - 591**		**Local**: Known from 25 locations in the local area. **Regional**: Known from many scattered locations throughout Western Australia: Carnarvon, Pilbara, Little Sandy Desert, Great Sandy Desert, Great Victoria Desert, Central Ranges.	
P3	*Triumfetta echinata*	Prostrate shrub, to 0.3 m high, with yellow flowers and spiky, round fruits recorded.	Recorded on crests of red sand dunes.	Disturbance Footprint - 0 Regional Survey Sites - 3 **Total - 3**		**Local**: Known from five locations in the local area. **Regional**: Known from Carnarvon, Gascoyne, and Pilbara IBRA regions.	

[1]Images were downloaded from The Australasian Virtual Herbarium (Council of Heads of Australasian Herbaria, 2023).



Legend

- Traverses
- Vehicle Tracks

Survey Area

- Disturbance Footprint
- Regional Survey Sites

Significant Flora

- P3 - Eremophila forrestii subsp. viridis
- P3 - Triumfetta echinata

N

0 1 2 3 km

Scale 1:98,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Ecology + Spatial

Author: CS

Date: 17-01-2023

Significant Flora

Warrirda Road Targeted Flora Survey

MAP

Prepared for
Mineral Resources

3.2

4. CONCLUSION

No Threatened flora were recorded or considered likely to occur within the Disturbance Footprint, including the Disturbance Footprint. *Eremophila forrestii* subsp. *viridis* (P3) was recorded within the Disturbance Footprint (18 individuals) and Regional Survey Sites (573 individuals) across the swales and footslopes of the red sand dunes. *Eremophila forrestii* subsp. *viridis* is locally common and is not regionally restricted, it is unlikely that *Eremophila forrestii* subsp. *viridis* will be impacted by additional clearing in the Disturbance Footprint. Three individuals of *Triumfetta echinata* (P3) were recorded at one location on a dune crest at a Regional Survey Site. *Triumfetta echinata* has now been recorded at six locations in the local area and is not regionally restricted. It is unlikely that *Triumfetta echinata* will be impacted by additional clearing in the Disturbance Footprint as no individuals were recorded and it appears locally common.

5. REFERENCES

360 Environmental (2021) *Ashburton Infrastructure Project. Flora and Vegetation Assessment. Report. Prepared for Mineral Resources Limited.*

Anders Environmental Consulting (2022) *Eremophila forrestii subsp. viridis Targeted Flora Survey*.

Bureau of Meteorology (2022) *Climate Data Online*. Available at: http://www.bom.gov.au/climate/data/.

Chinnock, R.J. (2007) *Eremophila and allied genera. A Monograph of the Myoporaceae*. 1st edn. Kenthurst: Rosenberg Publishing Pty Ltd.

Council of Heads of Australasian Herbaria (2023) *The Australasian Virtual Herbarium*. Available at: https://avh.chah.org.au/ (Accessed: 13 January 2023).

Department of Biodiversity Conservation and Attractions (2017) 'Threatened and Priority Flora Report Form - Field Manual'. Department of Biodiversity, Conservation and Attractions.

Eco Logical Australia (2021) *Targeted Eremophila forrestii subsp. viridis (P3) Survey at Onslow. Memo report prepared for Hastings Technology Metals Limited.*

Environmental Protection Authority (2016a) 'EPA Environmental Factor Guideline: Flora and Vegetation'. Western Australia: EPA.

Environmental Protection Authority (2016b) 'EPA Environmental Factor Guideline: Flora and Vegetation'. Western Australia: EPA.

Environmental Protection Authority (2016c) 'EPA Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment'. Western Australia: EPA.

ESCAVI (2003) 'Australian Vegetation Attribute Manual: National Vegetation Information System, Version 6.0'. Canberra: Executive Steering Committee for Australian Vegetation information. Department of Environment and Heritage.

GHD (2011) *Onslow Material Pits Environmental Impact Assessment and Environmental Management Plan*. Unpublished report for Main Roads Western Australia.

GHD (2017) *Targeted Flora Survey - Onslow Utilities Infrastructure Upgrade Project - Horizon Power*.

Main Roads (2018) *Onslow Road Phase 2 Reconnaissance Survey*.

Mattiske Consulting (2014) *Level 1 flora and vegetation survey of the Ashburton North Gas Pipeline (ANGP) project area*.

Phoenix Environmental Sciences (2017) *Flora and vegetation survey and terrestrial fauna survey for the proposed Pilbara Regional Waste Management Facility. Prepared for Talis Consultants.*

Phoenix Environmental Sciences (2018) *Detailed flora and vegetation survey for the Pilbara Regional Waste Management Facility. Prepared for Talis Consultants.*

RPS (2020) *Detailed Flora and Vegetation Assessment Onslow Rare Earths Plant. Unpublished report prepared for Hastings Technology Metals, Perth, WA.*

Spectrum Ecology (2022) *Warrirda Road Detailed & Targeted Flora & Basic Fauna Assessment*.

Vicki Long & Associates (2020) *Pilbara Ports Authority - Port of Ashburton - Eastern Port Precinct - Additional Clearing Areas Flora Survey*.

Western Australian Herbarium (2023) *FloraBase—the Western Australian Flora. Department of Biodiversity, Conservation and Attractions*. Available at: https://florabase.dpaw.wa.gov.au/ (Accessed: 13 January 2023).

Appendix A: Conservation Codes

Appendix A1: Definitions of Conservation Categories under the EPBC Act

Category	Definition
Extinct	A native species is eligible to be included in the extinct category at a particular time if, at that time, there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild	A native species is eligible to be included in the extinct in the wild category at a particular time if, at that time: (a) it is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; or (b) it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered	A native species is eligible to be included in the critically endangered category at a particular time if, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	A native species is eligible to be included in the endangered category at a particular time if, at that time: (a) it is not critically endangered; and (b) it is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable	A native species is eligible to be included in the vulnerable category at a particular time if, at that time: (a) it is not critically endangered or endangered; and (b) it is facing a high risk of extinction in the wild in the medium term future, as determined in accordance with the prescribed criteria.
Conservation Dependent	A native species is eligible to be included in the conservation dependent category at a particular time if, at that time: (a) the species is the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered, or critically endangered; or (b) the following subparagraphs are satisfied: (i) the species is a species of fish; (ii) the species is the focus of a plan of management that provides for management actions necessary to stop the decline of, and support the recovery of, the species so that its chances of long term survival in nature are maximised; (iii) the plan of management is in force under a law of the Commonwealth or of a State or Territory; (iv) cessation of the plan of management would adversely affect the conservation status of the species.

Appendix A2: Definitions of Conservation Categories Under the BC Act

Code	Definition (BC Act)
Threatened Species (T) 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 that subset of 'Specially Protected Fauna' listed under schedules 1 to 3 of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for Threatened Fauna. **Threatened flora** is that subset of 'Rare Flora' listed under schedules 1 to 3 of the Wildlife Conservation (Rare Flora) Notice 2018 for Threatened Flora. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.	
Critically Endangered (CR)	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. Published under **schedule 1** of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for critically endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for critically endangered flora.
Endangered (EN)	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. Published under **schedule 2** of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for endangered fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for endangered flora.
Vulnerable (VU)	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. Published under **schedule 3** of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for vulnerable fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for vulnerable flora.

Code	Definition (BC Act)
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.	
Extinct species (EX)	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). Published as presumed extinct under **schedule 4** of the Wildlife Conservation (Specially Protected Fauna) Notice 2018 for extinct fauna or the Wildlife Conservation (Rare Flora) Notice 2018 for extinct flora.
Extinct in the wild species (EW)	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 threatened fauna or threatened flora species listed as extinct in the wild. If listing of a species as extinct in the wild occurs, then a schedule will be added to the applicable notice.
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.	
Migratory species (MI)	Fauna that periodically or occasionally visit Australia or an external Territory or the exclusive economic zone; or the species is subject of an international agreement that relates to the protection of migratory species and that binds the Commonwealth; and listing is otherwise in accordance with the ministerial guidelines (section 15 of the BC Act). Includes birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and fauna subject to the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), an environmental treaty under the United Nations Environment Program. Migratory species listed under the BC Act are a subset of the migratory animals, that are known to visit Western Australia, protected under the international agreements or treaties, excluding species that are listed as Threatened species. Published as migratory birds protected under an international agreement under **schedule 5** of the Wildlife Conservation (Specially Protected Fauna) Notice 2018.
Conservation Dependent (CD)	Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened, and listing is otherwise in accordance with the ministerial guidelines (section 14 of the BC Act). Published as conservation dependent fauna under **schedule 6** of the Wildlife Conservation (Specially Protected Fauna) Notice 2018
Other specially protected fauna (OS)	Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act). Published as other specially protected fauna under **schedule 7** of the Wildlife Conservation (Specially Protected Fauna) Notice 2018
Priority species (P) Possibly threatened species that do not meet survey criteria, 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 priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna or flora. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Assessment of Priority codes 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.	
Priority 1: Poorly-known species (P1)	Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

Code	Definition (BC Act)
Priority 2: Poorly-known species (P2)	Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
Priority 3: Poorly-known species (P3)	Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
Priority 4: Rare, Near Threatened and other species in need of monitoring (P4)	(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Appendix A3: Legal Status Definition of Listed Plants in Western Australia

Legal Status	Definition
Declared Pest, Prohibited – s12	Prohibited organisms are declared pests by virtue of section 22(1) and may only be imported and kept subject to permits.
Declared Pest – s22(2)	Declared pests must satisfy any applicable import requirements when imported and may be subject to control keeping requirements.
Permitted – s11	Permitted organisms must satisfy applicable import requirements and import permits (where required).
Permitted, Requires Permit – r73	Regulation 73 permitted organisms may be subject to restriction under legislation other than the BAM Act (2007).
Unlisted	Unlisted organisms are prohibited in WA.
Control Categories	**Definition**
C1 Exclusion	Organisms should be excluded from parts or all of WA.
C2 Eradication	Organisms should be eradicated from all or parts of WA.
C3 Management	Organisms should have some form of management applied that will alleviate the harmful impact of the organism, reduce the numbers or distribution of the organism or prevent or contain the spread of the organism.
Unassigned	Declared pest that are recognised as having a harmful impact under certain circumstances where their subsequent control requirements are determined by a plan or other legislative arrangements under the Act.
Keeping Categories	**Definition**
Prohibited keeping	Can only be kept under a permit for public display, education or scientific purposes.
Restricted keeping	Kept under a permit by private individuals due to a low risk of becoming a problem for the environment.
Exempt keeping	No permit or conditions are required for keeping. Organism may be subject to restrictions under the Wildlife Conservation Act (WCA, 1950).

Appendix B: Likelihood of Occurrence Assessment – Flora

Pre-survey Likelihood	Post-survey Likelihood	Status	Taxon	Longevity	Flowering time	Closest Record to Project (km)	Description	Habitat
Recorded	Recorded	P3	*Eremophila forrestii* subsp. *viridis*	Perennial	Aug.	0	Much-branched shrub, ca 1 m high. Flowers pink-cream.	Red sand dunes.
High	Medium	P3	*Triumfetta echinata*	Perennial	Aug.	0.1	Prostrate shrub, to 0.3 m high. Flowers yellow. Spiky, round seed pods approximately 2–3 cm in diameter.	Red sandy soils. Sand dunes.
Low	Low	P3	*Abutilon* sp. Pritzelianum (S. van Leeuwen 5095)	Perennial	-	2.7	Tall grey spreading shrub with yellow flowers, growing up to 2 m tall.	Sandplain with orange brown sandy loam. Roadsides.
Low	Low	P3	*Eleocharis papillosa*	Annual	Nov.	3.5	Herb. Fl. Brown. Grows to around 10 centimetres (cm) in height.	Red clay over granite, open clay flats. Claypans.
Low	Low	P3	*Stackhousia clementii*	Perennial	-	11.1	Dense broom-like perennial, herb, to 0.45 m high. Fl. green/yellow/brown.	Skeletal soils. Sandstone hills.
Low	Low	P1	*Abutilon* sp. Onslow (F. Smith s.n. 10/9/61)	Perennial	Aug to Oct	7.7	Shrub, grows in a flat, spreading shape to about 10 cm in height and 100 cm in diameter. It has green-grey foliage, yellow flowers, and pinwheel like seed pods.	Flat, stony plain. Roadsides.
Low	Low	P3	*Carpobrotus* sp. Thevenard Island (M. White 050)	Perennial	Aug.	27.7	Prostrate, succulent perennial, herb, leaves sessile, triangular in cross-section, fruit turbinate. Fl. Cream.	Coarse white sand. Dune tops, disturbed areas.
Low	Low	P1	*Isotropis forrestii*	Perennial	Apr to Sep or Dec.	-	Erect shrub, 0.4-1.5 m high. Fl. yellow/orange & red.	Stony clay loam, sandy alluvium. Along drainage lines.
Low	Low	P1	*Myriocephalus scalpellus*	Perennial	-	-	Semi-erect herb, 0.03-0.08 m high.	Clay. Depression on flood plain.

MEMO

WARRIRDA ROAD VEGETATION MAPPING EXTENSION

PREPARED FOR: MINERAL RESOURCES

© Spectrum Ecology Pty Ltd
ABN 68 615 115 243
PO Box 314 Leederville
Western Australia 6902
Ph: (08) 9317 8233
Email: info@spectrumecology.com.au

Project ID: 2249	Warrirda Road Vegetation Mapping Extension
Prepared for:	Mineral Resources
Date of issue:	31-01-2023
Prepared by:	Christopher Shaw
Spectrum Review:	Melissa Hay

1. INTRODUCTION

1.1. Project Background

Mineral Resources Limited (MinRes) on behalf of Main Roads Western Australia (MRWA) required additional survey work on the north side of Warrirda Road (Disturbance Footprint) to accommodate additional disturbance required to construct a private haul road from their west Pilbara iron ore projects to the Port of Ashburton (Map 1). Spectrum Ecology & Spatial (Spectrum) undertook the original flora and fauna surveys to support the NVCP application (CPS 9354/1) in 2021 (Spectrum Ecology, 2022) which has since been granted (09/11/2022). The Disturbance Footprint is located approximately 16 km south of Onslow, Western Australia, and covers 46.7 ha. The Spectrum Ecology (2022) Survey Area occupied 372.2 ha, when the Disturbance Footprint is included the Survey Area and occupies 418.9 ha.

1.2. Project Scope

The project objective was to confirm that the vegetation types present within the Disturbance Footprint are consistent with those mapped previously by Spectrum (Spectrum Ecology, 2022).

1.3. Legislation & Guidelines

Flora in Western Australia are protected by various legislation, including:

- *Biodiversity Conservation Act 2016* (BC Act);
- *Environmental Protection Act 1986* (EP Act); and
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The survey was compliant with survey guidelines, as outlined in:

- EPA Environmental Factor Guideline: Flora and Vegetation (Environmental Protection Authority, 2016a);
- EPA Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (Environmental Protection Authority, 2016b);
- DBCA Threatened and Priority Flora Report Form – Field Manual (Department of Biodiversity Conservation and Attractions, 2017); and
- National Vegetation Information System (NVIS) Australian Vegetation Attribute Manual (ESCAVI, 2003).

Legend

- Cities & Towns

Survey Area

- Disturbance Footprint
- Survey Area (Spectrum Ecology, 2022)
- Roads & Tracks
- Conservation Estates

N

0 2 4 6 km

Scale 1:180,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Ecology + Spatial

Author: CS

Date: 19-01-2023

Location of the Survey Area

Warrirda Road Targeted Flora Survey

MAP 1

Prepared for
Mineral Resources

2. METHODS

2.1. Field Methods & Sampling Effort

There were 18.1 km of traverses undertaken during the assessment to map the boundaries of the vegetation types. A traverse is an unmarked route along which data is collected. Traverses are useful for identifying the boundaries and characteristics of vegetation types, selecting sites for detailed survey, and targeting significant flora or vegetation. Information recorded along a traverse is similar to relevés, with the addition of noting vegetation changes and relationships between vegetation and substrate. Vegetation types were compared to the descriptions provided in Spectrum Ecology (2022) and assigned a unit when they matched.

2.1.1. Vegetation Condition

Vegetation condition was recorded in the same way as the vegetation types throughout the Disturbance Footprint. The vegetation condition was mapped at the same scale as the vegetation mapping. Vegetation condition ratings follow the scale recommended for the Eremaean Botanical Province (Environmental Protection Authority, 2016b).

Table 1: Vegetation & Condition Scale – Eremaean Botanical Province

Condition	Disturbance Criteria
Excellent	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Very Good	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	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 obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
Degraded	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 multiple weed species present including very aggressive species.
Completely Degraded	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.

2.2. Project Team

Spectrum personnel involved with this assessment are listed in Table 2, along with their role and years of experience.

Table 2: Project Team & Licences

Staff	Qualification	Role	Project Tasks	Years of Experience	Flora Licence
Dr Christopher Shaw	Phd	Senior Botanist	Project management, field survey, data management, reporting	7 years	FB62000241
Steven Spragg	BSc	Botanist	Field survey	2 years	FB62000501
Melissa Hay	Bsc (Hons)	Principal Botanist	Review	16 years	n/a

2.3. Survey Timing

The assessment was undertaken over three days from the 5 to the 7 of December 2022. Monthly climate data was sourced from the nearest Bureau of Meteorology (BOM) station with complete data (Onslow Airport #5017), located approximately 13 km north of the Disturbance Footprint (Bureau of Meteorology, 2022). Additionally, the median monthly rainfall recorded from 1886 to 2012 at the closed Onslow (#5016) BOM station was included. Rainfall recorded 12 months prior to the survey and median monthly rainfall is presented in Figure 2.1.

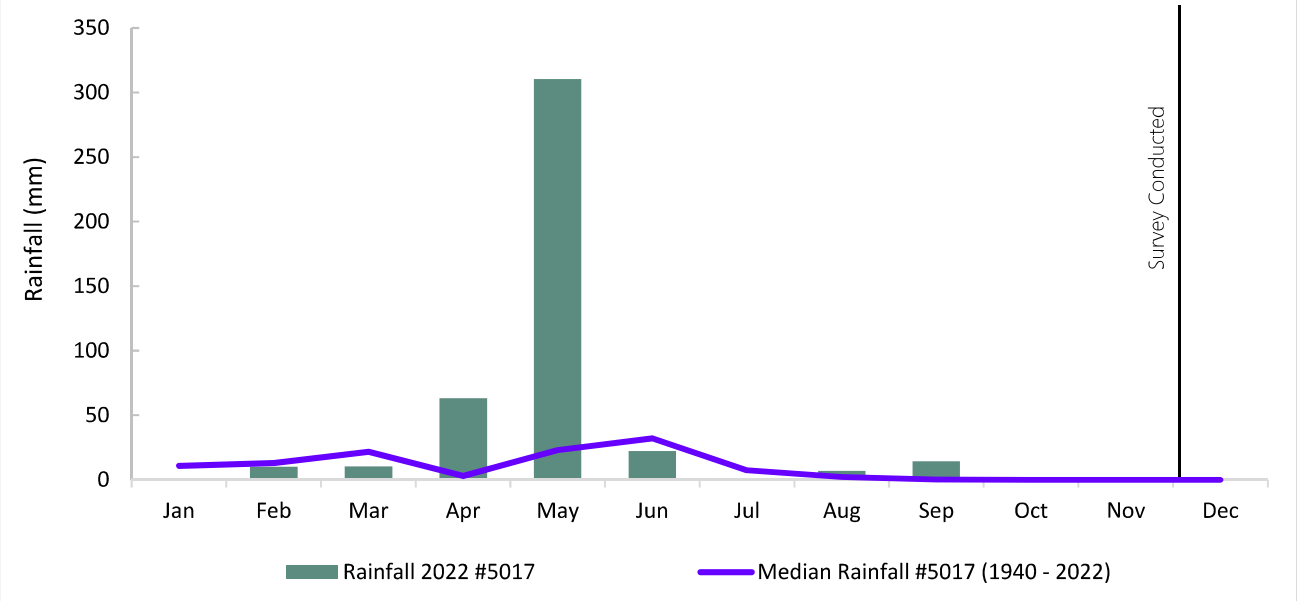


Figure 2.1: Mean Temperature & Rainfall for the 12 Months Preceding the Survey

The following rainfall was recorded at Onslow Airport (#5017) prior to the survey:

- The 12 months preceding the field survey (January to December 2022) recorded 438.6 mm of rainfall, 159.2 mm higher than the sum of the long-term annual median of 279.4 mm; and
- The three-months preceding the field survey (September – November 2022) recorded 14.4 mm of rainfall, 14.2 mm higher than the sum of the long-term annual median for the same three months (0.2 mm).

3. RESULTS & DISCUSSION

3.1. Vegetation Types

A total of eight vegetation types were described from the Spectrum Ecology (2022) Survey Area (Table 3). Seven vegetation types were recorded and extended into the Disturbance Footprint (Table 3) and are displayed on Map 2 to Map 12. No new vegetation types were recorded in the Disturbance Footprint during the current assessment.

The dune (D1) vegetation type was the most common and covered 19.2 ha (41.1%) of the Disturbance Footprint. The dune (D1) vegetation type covered 96.3 ha or 16.6% over the entire Survey Area when the Disturbance Footprint was included.

The P1a and P1b plains vegetation types covered 4.9 ha (10.5%) and 9.9 ha (21.2%) of the Disturbance Footprint, respectively. The P1a vegetation type covered 113.2 ha (26.9%) and P1b covered 67.9 ha (16.0%) when the Disturbance Footprint was included in the Survey Area. The P2 and P3 vegetation types were uncommon in the Survey Area and covered 13.6 ha (3.2%) and 3.2 ha (1.3%) when the Disturbance Footprint was included, respectively.

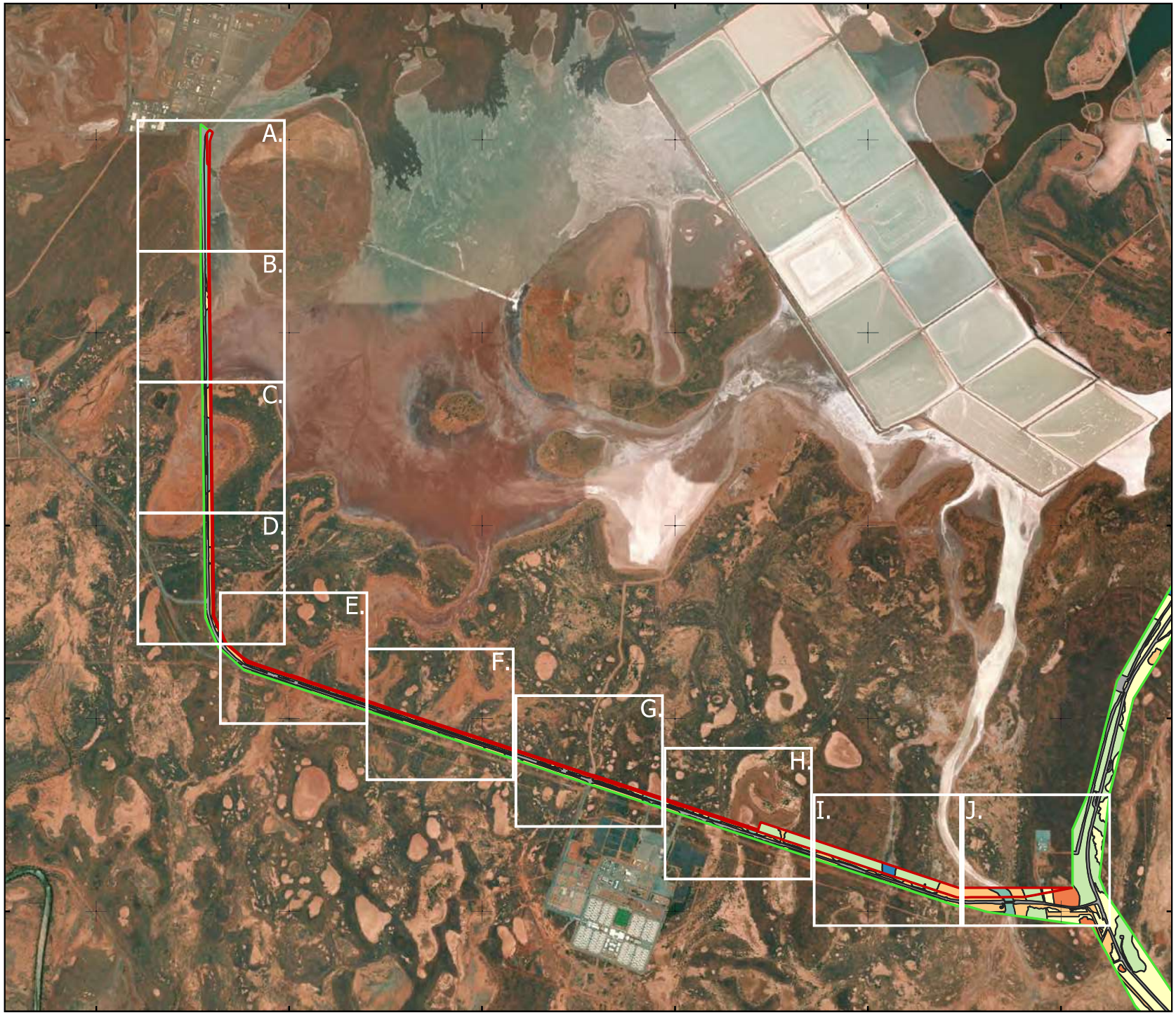
The C1 and C2 plains vegetation types covered 3.4 ha (7.6%) and 7.4 ha (15.8%) of the Disturbance Footprint, respectively. The C1 vegetation type covered 18.8 ha (4.5%) and C2 covered 33.9 ha (8.1%) when the Disturbance Footprint was included in the Survey Area.

The drainage lines (DL1) were not recorded in the Disturbance Footprint. Cleared vegetation was recorded covering 0.2 ha (0.4%) of the Disturbance Footprint and 69.8 ha (16.6%) of the total Survey Area with the Disturbance Footprint included.

Table 3: Vegetation Types

Code	Vegetation Description (NVIS)	Landform & Condition	Area ha & %		Representative Photo
			Disturbance Footprint	Total	
Claypans					
C1	*Tecticornia auriculata* or *Tecticornia indica* subsp. *leiostachya* low open shrubland over *Eragrostis pergracilis* and/or **Cenchrus ciliaris* low sparse tussock grassland.	Drainage plain, salt pans on clay soils.	3.4 ha 7.3%	18.8 ha 4.5%	
C2	+/-*Tecticornia auriculata* low isolated shrubs.	Bare clay pans, tidal mud flats.	7.4 ha 15.8%	33.9 ha 8.1%	
Dunes					
D1	+/-*Grevillea stenobotrya* tall sparse shrubland over *Scaevola sericophylla*, +/-*Acacia stellaticeps* mid sparse shrubland over *Triodia epactia* open hummock grassland.	Sand dunes, swales, low rises.	19.2 ha 41.1%	96.3 ha 16.6%	
Drainage Line					
DL1	+/-*Eucalyptus camaldulensis* subsp. *refulgens* low isolated trees over *Acacia tetragonophylla* and **Vachellia farnesiana* tall open shrubland over **Cenchrus ciliaris* sparse tussock grassland.	Drainage line. Degraded condition. Mostly no native species present.	-	2.1 ha 0.5%	

Code	Vegetation Description (NVIS)	Landform & Condition	Area ha & %		Representative Photo
			Disturbance Footprint	Total	
Plains					
P1a	*+/-Acacia tetragonophylla* tall isolated shrubs over *Triodia epactia* open hummock grassland.	Flat plains on sand/sandy clay/ clay soils.	4.9 ha 10.5%	113.2 ha 26.9%	
P1b	**Cenchrus ciliaris* low open tussock grassland, with *+/-Triodia epactia* sparse hummock grassland.	Flat plains / Floodplains on sandy clay soils. Structurally separated from P1a due to dominance of **Cenchrus ciliaris*.	9.9 ha 21.2%	67.9 ha 16.0%	
P2	*Acacia synchronicia*, *Acacia tetragonophylla* and **Vachellia farnesiana* tall sparse shrubland over *Scaevola spinescens* and *Sesbania cannabina* mid sparse shrubland over *Diplachne fusca* subsp. *fusca*, *Eulalia aurea*, and **Cenchrus ciliaris* sparse tussock grassland.	Minor depressions on clay to sandy clay soils.	0.4 ha 0.9%	13.6 ha 3.2%	
P3	**Prosopis pallida* tall closed shrubland over **Cenchrus ciliaris* open tussock grassland.	Unnatural depression on sandy clay soils. Degraded condition. Mostly no native species present.	1.3 ha 2.8%	3.2 ha 1.3%	
Other					
-	Cleared (no vegetation)	N/A	0.2 ha 0.4%	69.8 ha 16.6%	-



Legend

- Disturbance Footprint
- Survey Area (Spectrum Ecology, 2022)

Vegetation Unit

- C1
- C2
- D1
- P1a
- P1b
- P2
- P3
- Cleared

N

0 1 2 km

Scale 1:55,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Ecology + Spatial

Author: CS

Date: 19-01-2023

Vegetation Types - Overview

Warrirda Road Vegetation Extension

MAP 2

Prepared for
Mineral Resources

Legend

- Disturbance Footprint
- Survey Area (Spectrum Ecology, 2022)

Flora Survey Sites (Spectrum Ecology, 2022)

- Quadrat
- Releve

Vegetation Unit

- C1
- C2
- D1
- P1a
- P1b
- P2
- P3
- Cleared

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Author: CS

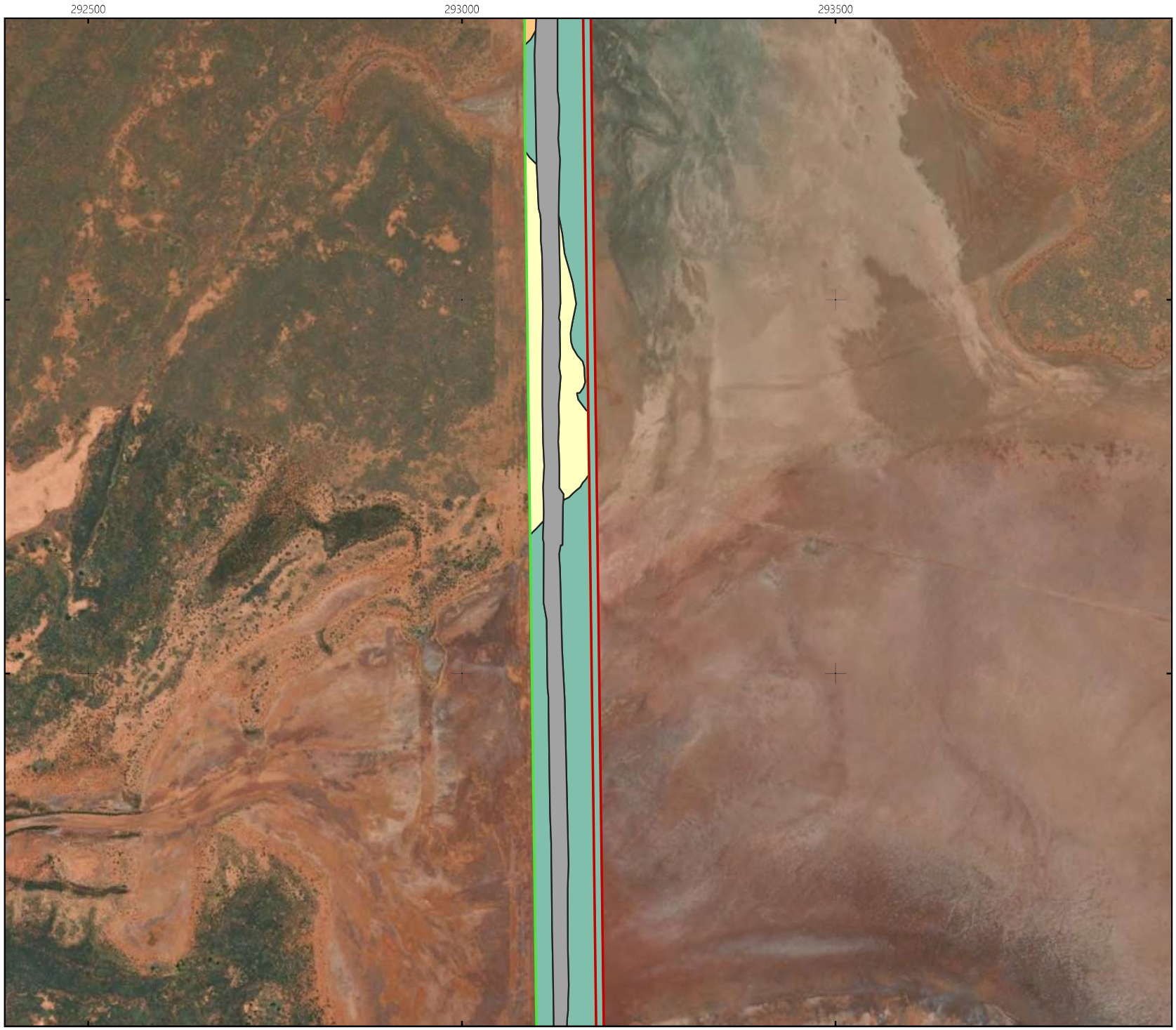
Date: 20-01-2023

Vegetation Types - Map A

Warrirda Road Vegetation Extension

MAP 3

Prepared for
Mineral Resources



Legend

- Disturbance Footprint
- Survey Area (Spectrum Ecology, 2022)

Flora Survey Sites (Spectrum Ecology, 2022)

- Quadrat
- Releve

Vegetation Unit

- C1
- C2
- D1
- P1a
- P1b
- P2
- P3
- Cleared

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Ecology + Spatial

Author: CS

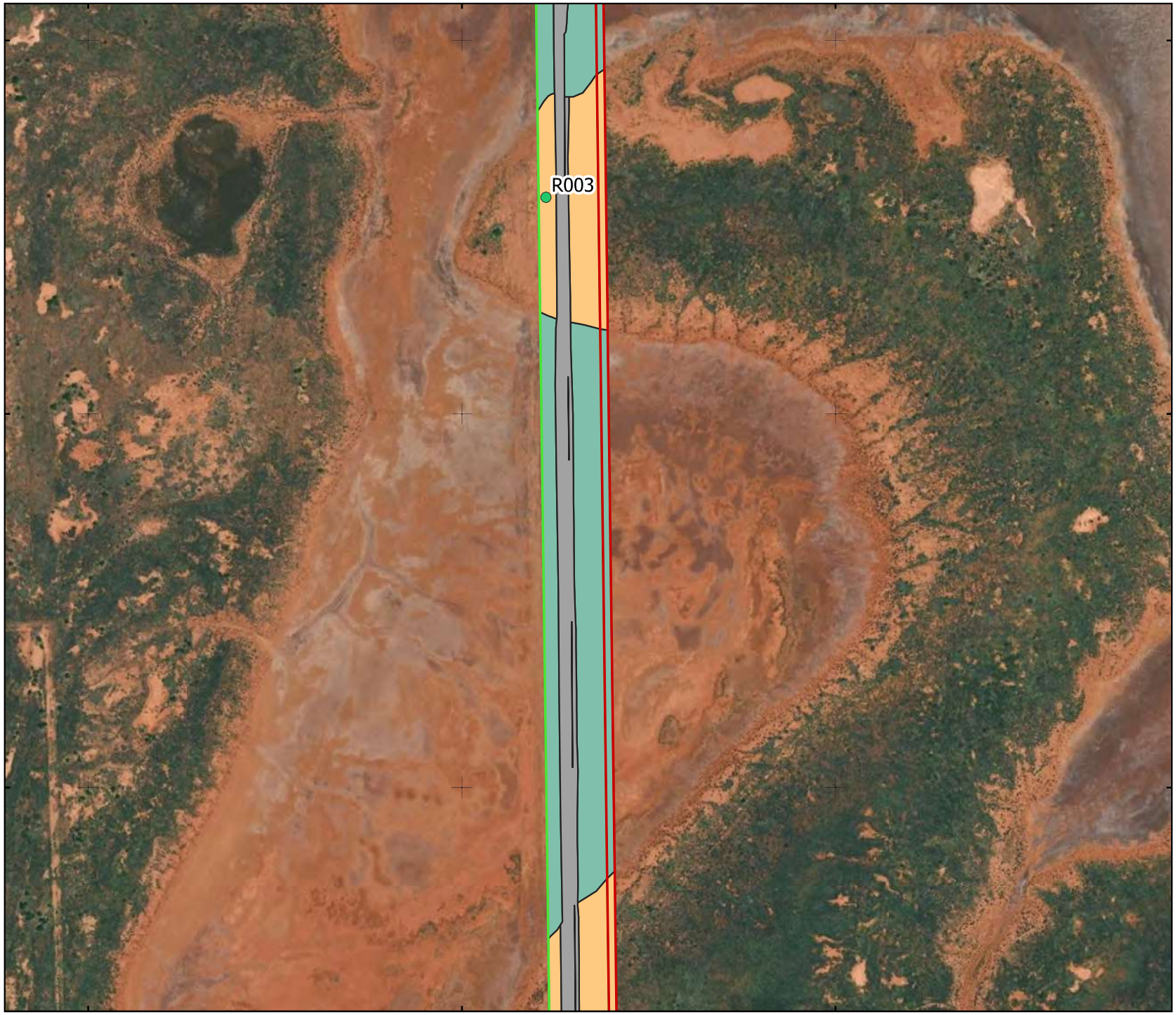
Date: 20-01-2023

Vegetation Types - Map B

Warrirda Road Vegetation Extension

MAP 4

Prepared for
Mineral Resources



Legend

- Disturbance Footprint
- Survey Area (Spectrum Ecology, 2022)

Flora Survey Sites (Spectrum Ecology, 2022)

- Quadrat
- Releve

Vegetation Unit

- C1
- C2
- D1
- P1a
- P1b
- P2
- P3
- Cleared

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Ecology + Spatial

Author: CS

Date: 20-01-2023

Vegetation Types - Map C

Warrirda Road Vegetation Extension

MAP 5

Prepared for
Mineral Resources

Legend

- Disturbance Footprint
- Survey Area (Spectrum Ecology, 2022)

Flora Survey Sites (Spectrum Ecology, 2022)

- Quadrat
- Releve

Vegetation Unit

- C1
- C2
- D1
- P1a
- P1b
- P2
- P3
- Cleared

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Ecology + Spatial

Author: CS

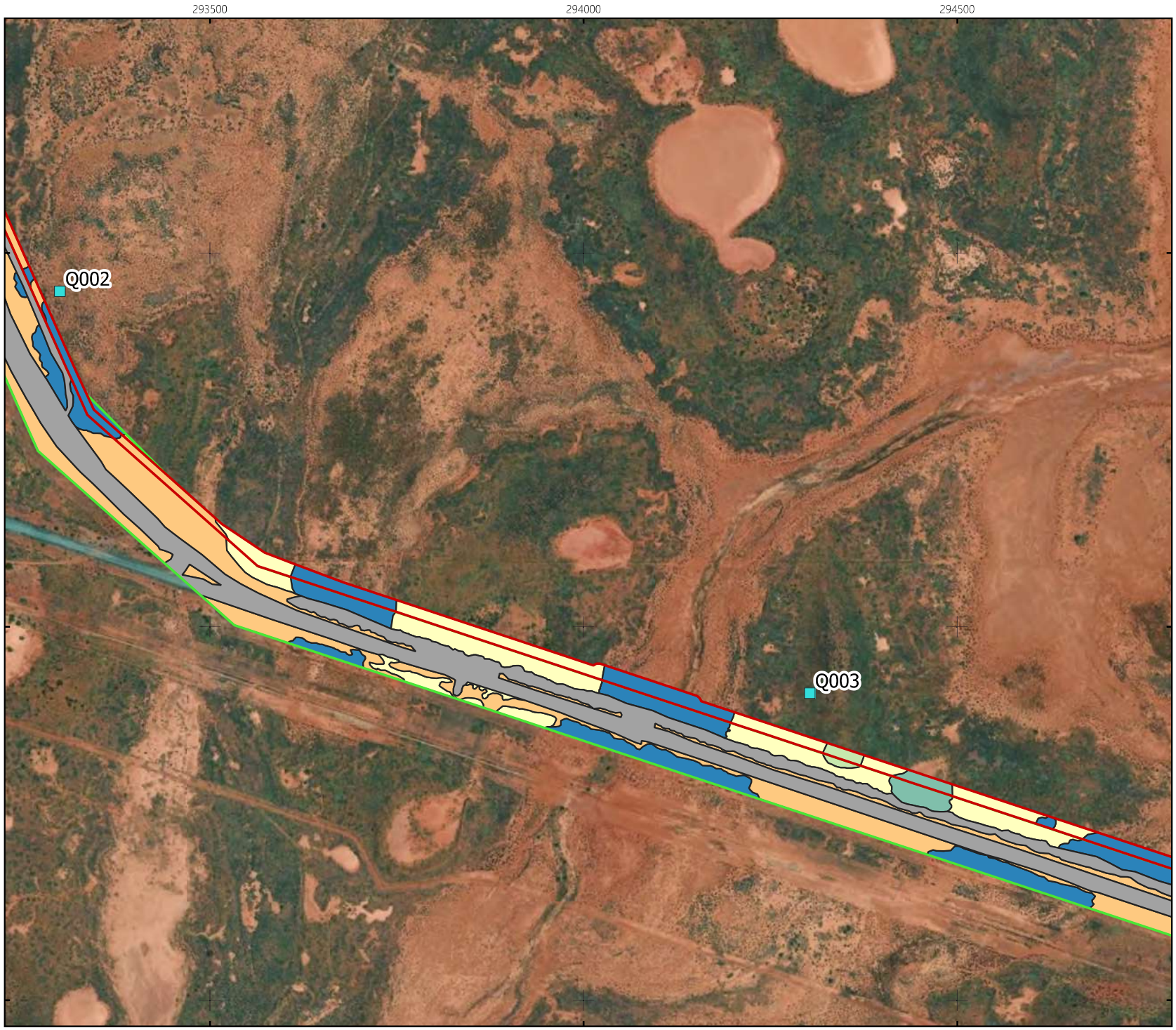
Date: 20-01-2023

Vegetation Types - Map D

Warrirda Road Vegetation Extension

MAP 6

Prepared for
Mineral Resources



Legend

- Disturbance Footprint
- Survey Area (Spectrum Ecology, 2022)

Flora Survey Sites (Spectrum Ecology, 2022)

- Quadrat
- Releve

Vegetation Unit

- C1
- C2
- D1
- P1a
- P1b
- P2
- P3
- Cleared

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Ecology + Spatial

Author: CS

Date: 19-01-2023

Vegetation Types - Map E

Warrirda Road Vegetation Extension

MAP 7

Prepared for
Mineral Resources

Legend

- Disturbance Footprint
- Survey Area (Spectrum Ecology, 2022)

Flora Survey Sites (Spectrum Ecology, 2022)

- Quadrat
- Releve

Vegetation Unit

- C1
- C2
- D1
- P1a
- P1b
- P2
- P3
- Cleared

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Ecology + Spatial

Author: CS

Date: 19-01-2023

Vegetation Types - Map F

Warrirda Road Vegetation Extension

MAP 8

Prepared for
Mineral Resources

Legend

- Disturbance Footprint
- Survey Area (Spectrum Ecology, 2022)

Flora Survey Sites (Spectrum Ecology, 2022)

- Quadrat
- Releve

Vegetation Unit

- C1
- C2
- D1
- P1a
- P1b
- P2
- P3
- Cleared

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Ecology + Spatial

Author: CS

Date: 19-01-2023

Vegetation Types - Map G

Warrirda Road Vegetation Extension

MAP 9

Prepared for
Mineral Resources

Legend

- Disturbance Footprint
- Survey Area (Spectrum Ecology, 2022)

Flora Survey Sites (Spectrum Ecology, 2022)

- Quadrat
- Releve

Vegetation Unit

- C1
- C2
- D1
- P1a
- P1b
- P2
- P3
- Cleared

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Ecology + Spatial

Author: CS

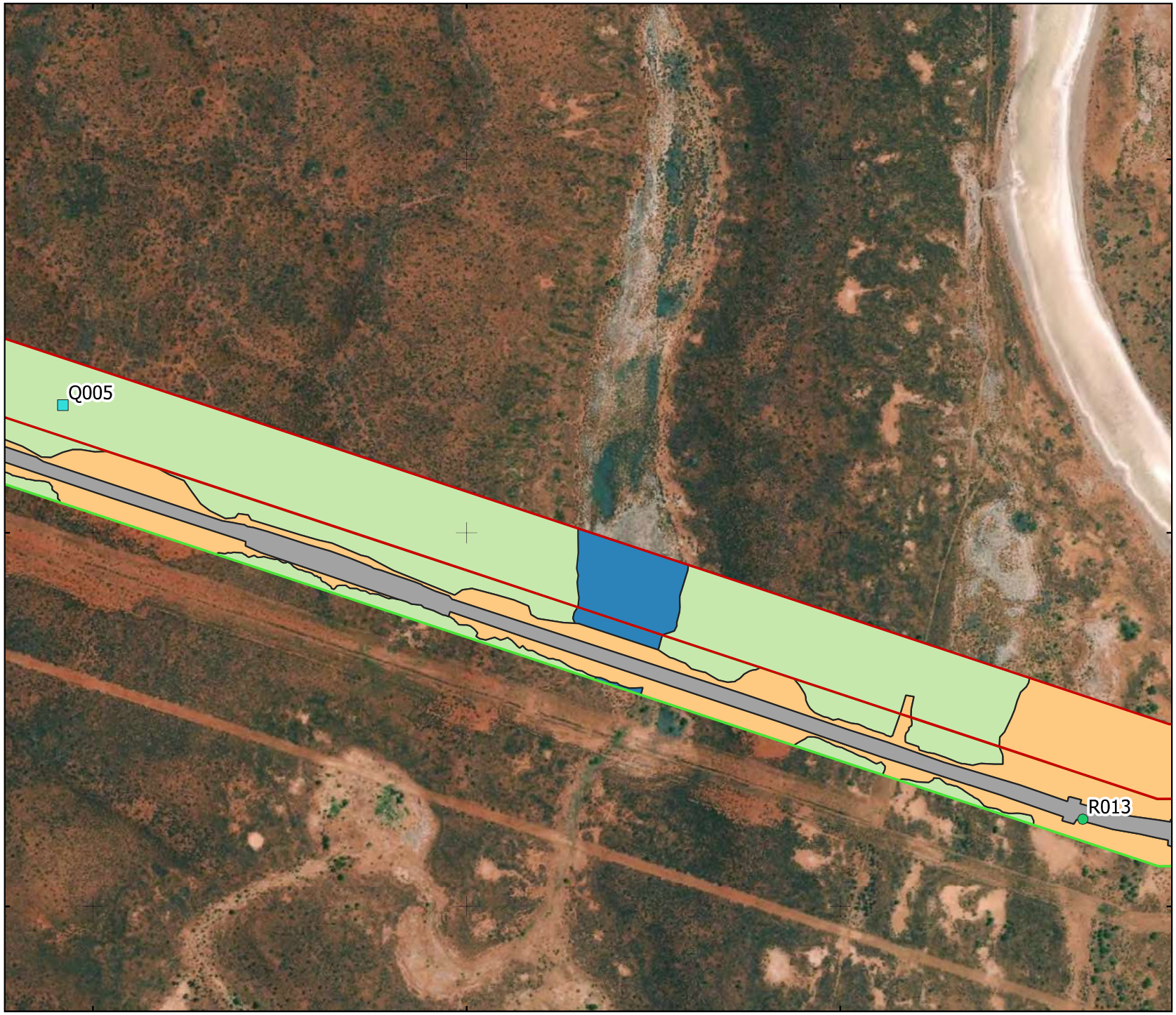
Date: 19-01-2023

Vegetation Types - Map H

Warrirda Road Vegetation Extension

MAP 10

Prepared for
Mineral Resources



Legend

- Disturbance Footprint
- Survey Area (Spectrum Ecology, 2022)

Flora Survey Sites (Spectrum Ecology, 2022)

- Quadrat
- Releve

Vegetation Unit

- C1
- C2
- D1
- P1a
- P1b
- P2
- P3
- Cleared

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Ecology + Spatial

Author: CS

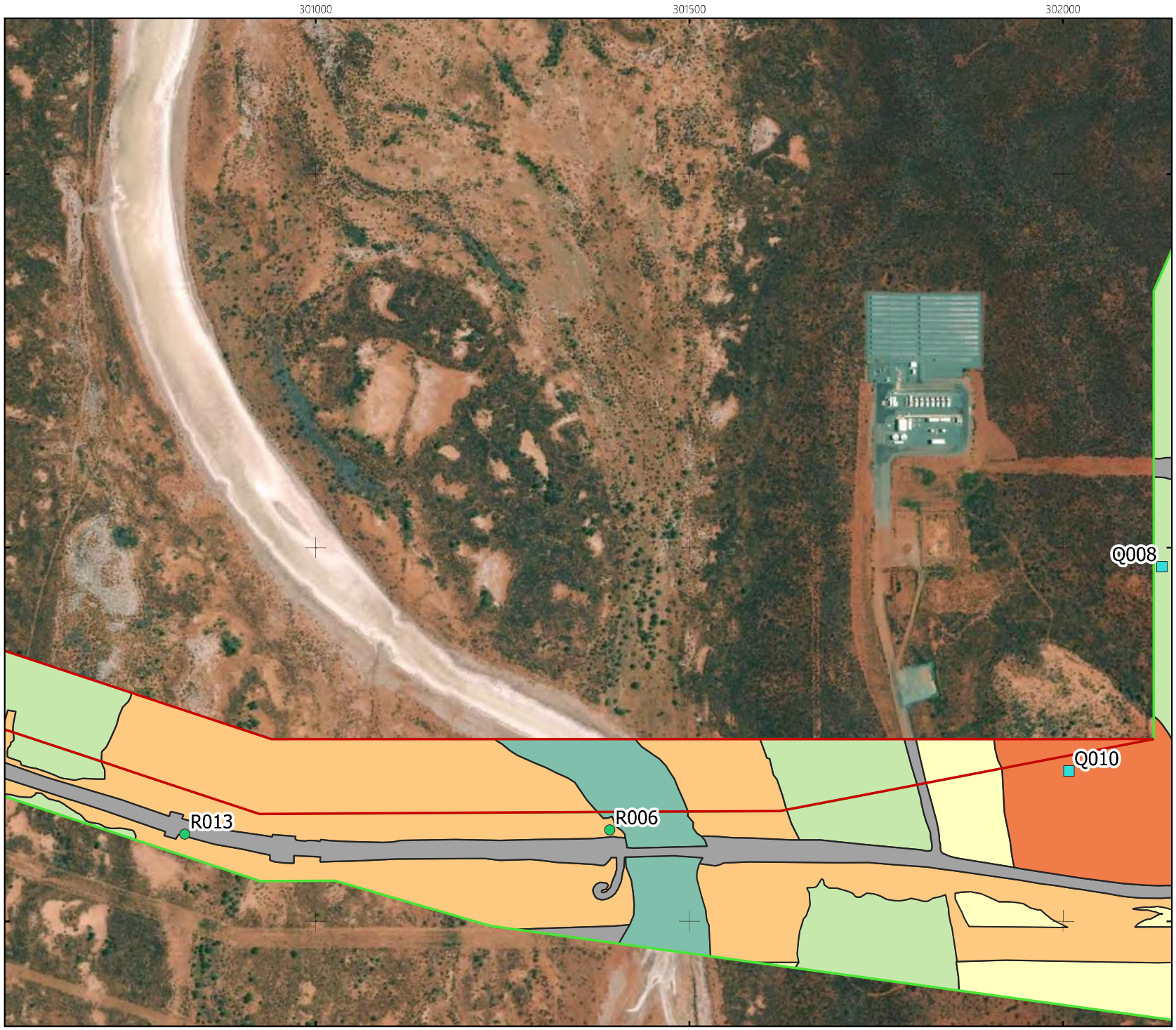
Date: 19-01-2023

Vegetation Types - Map I

Warrirda Road Vegetation Extension

MAP 11

Prepared for
Mineral Resources



Legend

- Disturbance Footprint
- Survey Area (Spectrum Ecology, 2022)

Flora Survey Sites (Spectrum Ecology, 2022)

- Quadrat
- Releve

Vegetation Unit

- C1
- C2
- D1
- P1a
- P1b
- P2
- P3
- Cleared

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Author: CS

Date: 20-01-2023

Vegetation Types - Map J

Warrirda Road Vegetation Extension

MAP 12

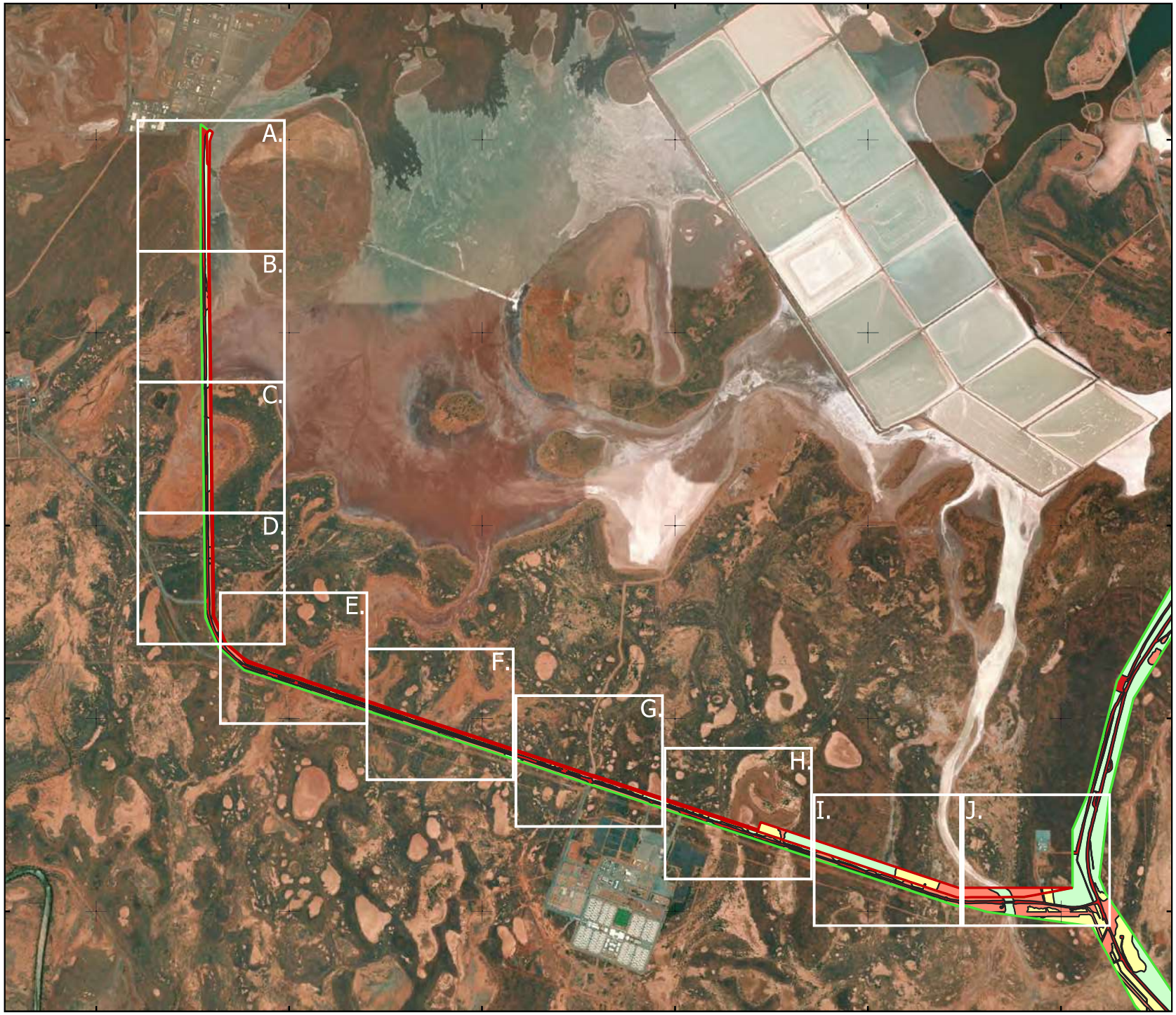
Prepared for
Mineral Resources

3.2. Vegetation Condition

The vegetation condition within the Disturbance Footprint ranged from Very Good (46.9%) to Completely Degraded (0.2%; Table 4). The vegetation condition within Survey Area was updated to include the Disturbance Footprint in Table 4, and condition ranged from Very Good (48.8%) to Completely Degraded (16.7%).

Table 4: Vegetation Condition

Condition	Area (ha) & %		Disturbance Detail in Survey Area
	Disturbance Footprint	Total	
Excellent	-	-	-
Very Good	21.9 ha 46.9%	204.4 ha 48.8%	Scattered weeds, low levels of grazing within areas of undisturbed native vegetation.
Good	12.0 ha 25.6%	59.7 ha 14.2%	Moderate weed cover within undisturbed native vegetation.
Poor	11.3 ha 24.2%	76.6 ha 18.3%	Vegetation along roadside or larger areas that may have been cleared, dominated by weeds, but maintains some natural vegetation structural components.
Degraded	1.4 ha 2.9%	8.3 ha 2.0%	Previously cleared areas that have regenerated with very few native species along roadsides and areas dominated by weeds with no native species present.
Completely Degraded	0.2 ha 0.2%	69.8 ha 16.7%	Includes the parkland cleared and developed areas, including roads and roadsides with no vegetation present. Mapped as 'Cleared' in vegetation mapping and vegetation condition for this project.



Legend

- Disturbance Footprint
- Survey Area (Spectrum Ecology, 2022)

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

N

0 1 2 km

Scale 1:55,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Ecology + Spatial

Author: CS

Date: 20-01-2023

Vegetation Condition - Overview

Warrirda Road Vegetation Extension

MAP 13

Prepared for
Mineral Resources

Legend

- Disturbance Footprint
- Survey Area (Spectrum Ecology, 2022)

Flora Survey Sites (Spectrum Ecology, 2022)

- Quadrat
- Releve

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Author: CS

Date: 20-01-2023

Vegetation Condition - Map A

Warrirda Road Vegetation Extension

MAP 14

Prepared for
Mineral Resources

Legend

- Disturbance Footprint
- Survey Area (Spectrum Ecology, 2022)

Flora Survey Sites (Spectrum Ecology, 2022)

- Quadrat
- Releve

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Author: CS

Date: 20-01-2023

Vegetation Condition - Map B

Warrirda Road Vegetation Extension

MAP 15

Prepared for
Mineral Resources

Legend

- Disturbance Footprint
- Survey Area (Spectrum Ecology, 2022)

Flora Survey Sites (Spectrum Ecology, 2022)

- Quadrat
- Releve

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Ecology + Spatial

Author: CS

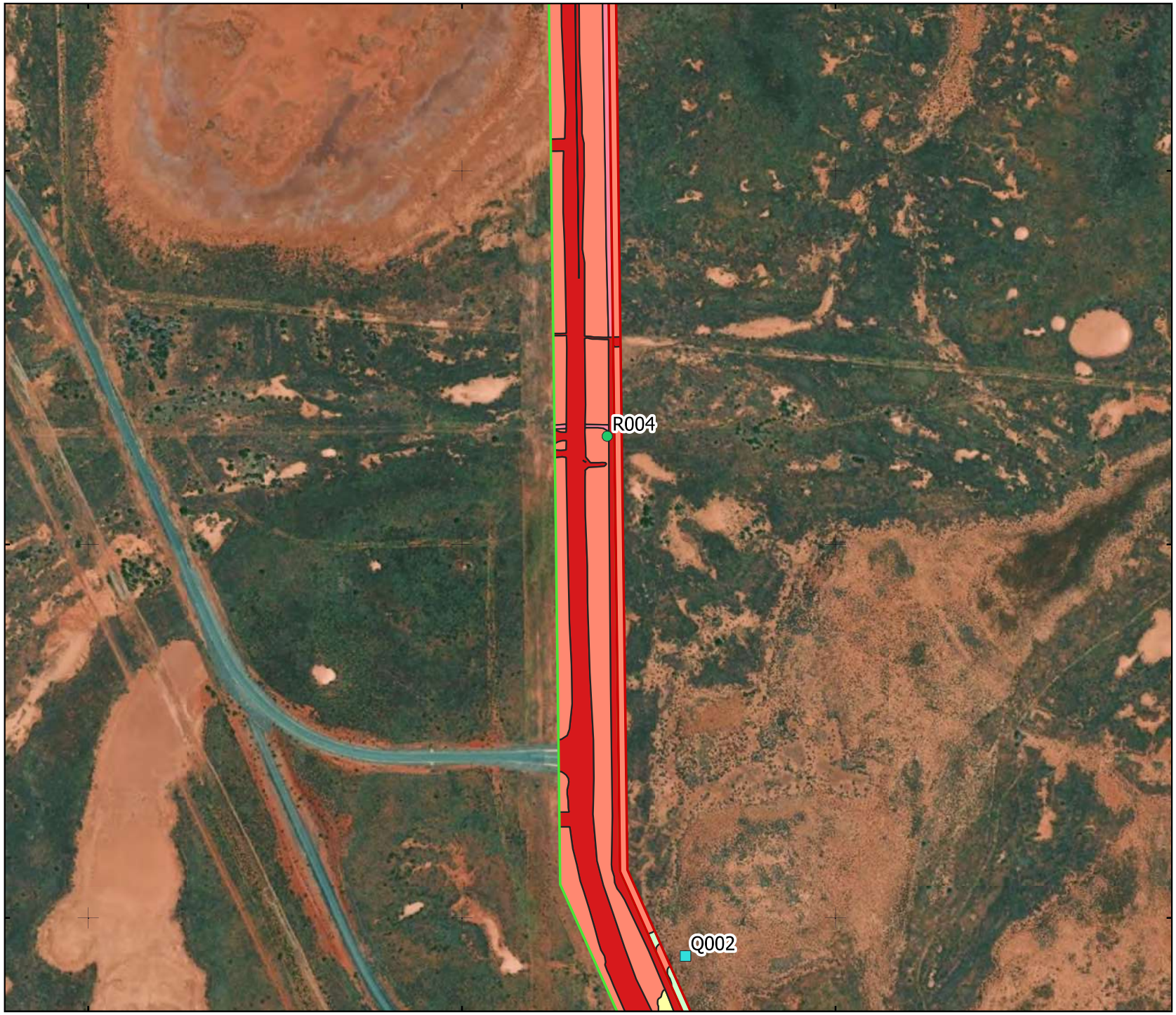
Date: 20-01-2023

Vegetation Condition - Map C

Warrirda Road Vegetation Extension

MAP 16

Prepared for
Mineral Resources



Legend

- Disturbance Footprint
- Survey Area (Spectrum Ecology, 2022)

Flora Survey Sites (Spectrum Ecology, 2022)

- Quadrat
- Releve

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Author: CS

Date: 20-01-2023

Vegetation Condition - Map D

Warrirda Road Vegetation Extension

MAP 17

Prepared for
Mineral Resources

Legend

- Disturbance Footprint
- Survey Area (Spectrum Ecology, 2022)

Flora Survey Sites (Spectrum Ecology, 2022)

- Quadrat
- Releve

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Ecology + Spatial

Author: CS

Date: 20-01-2023

Vegetation Condition - Map E

Warrirda Road Vegetation Extension

MAP 18

Prepared for
Mineral Resources

Legend

- Disturbance Footprint
- Survey Area (Spectrum Ecology, 2022)

Flora Survey Sites (Spectrum Ecology, 2022)

- Quadrat
- Releve

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Ecology + Spatial

Author: CS

Date: 20-01-2023

Vegetation Condition - Map F

Warrirda Road Vegetation Extension

MAP 19

Prepared for
Mineral Resources

Legend

- Disturbance Footprint
- Survey Area (Spectrum Ecology, 2022)

Flora Survey Sites (Spectrum Ecology, 2022)

- Quadrat
- Releve

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Ecology + Spatial

Author: CS

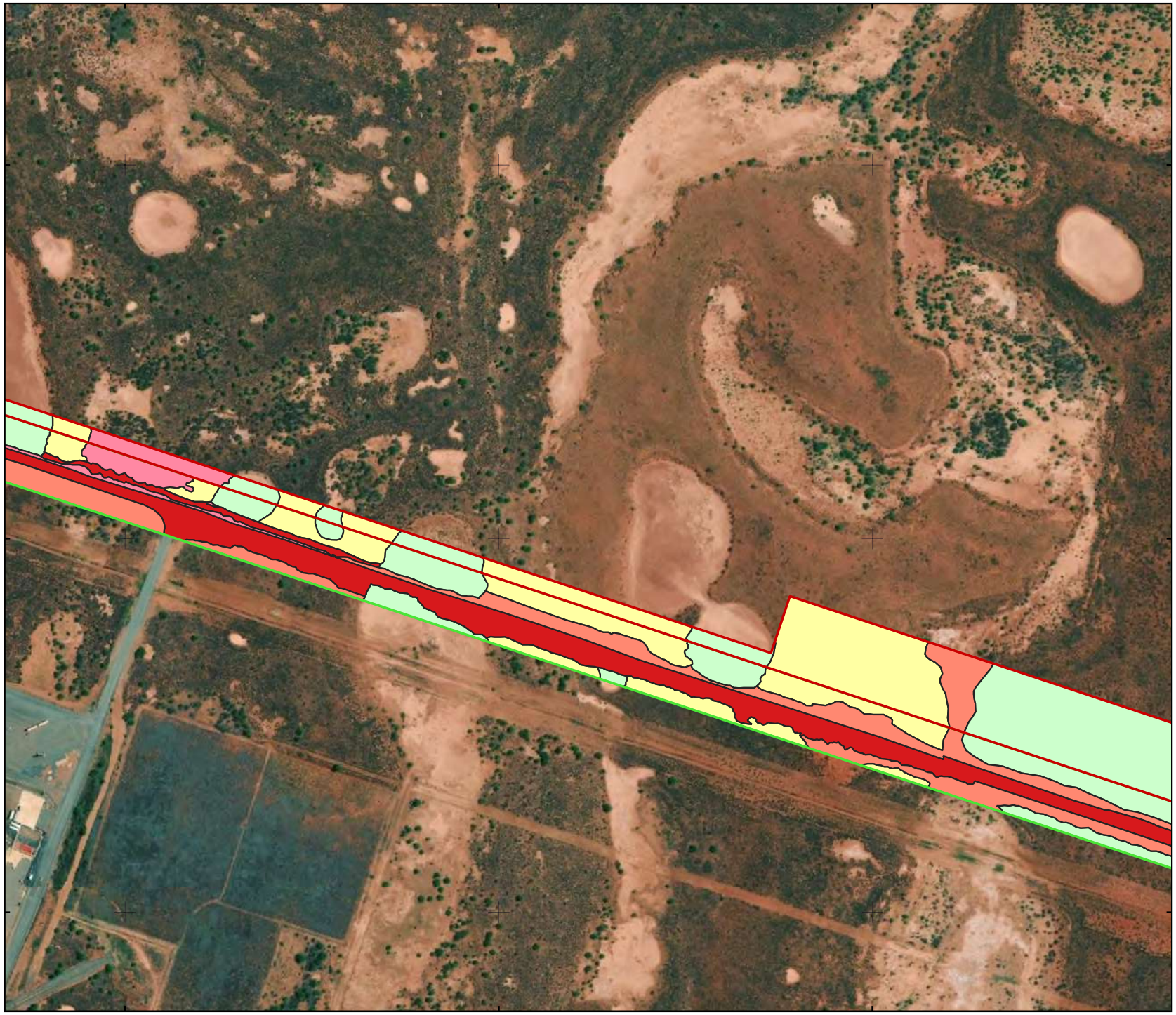
Date: 20-01-2023

Vegetation Condition - Map G

Warrirda Road Vegetation Extension

MAP 20

Prepared for
Mineral Resources



Legend

- Disturbance Footprint
- Survey Area (Spectrum Ecology, 2022)

Flora Survey Sites (Spectrum Ecology, 2022)

- Quadrat
- Releve

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Author: CS

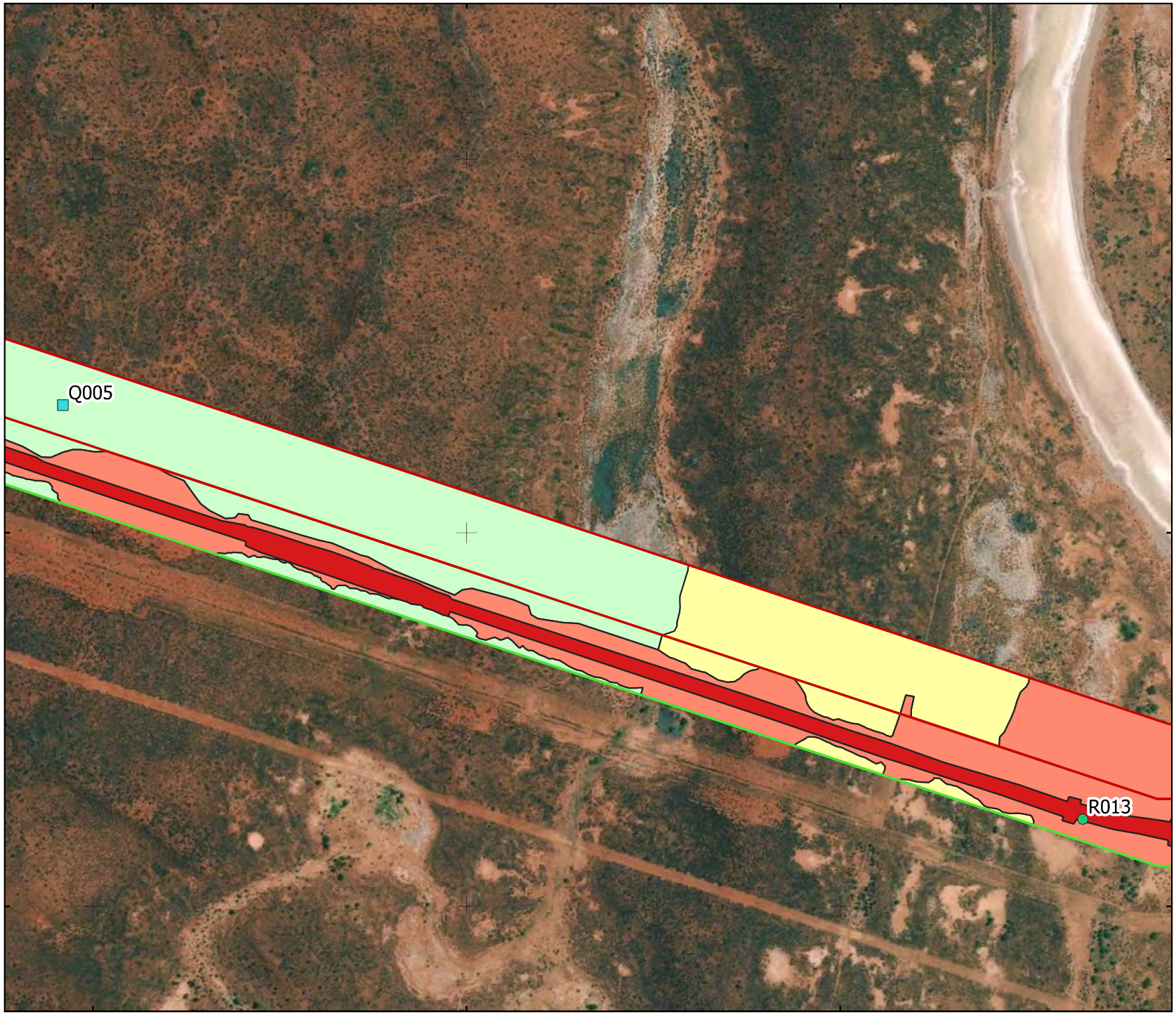
Date: 20-01-2023

Vegetation Condition - Map H

Warrirda Road Vegetation Extension

MAP 21

Prepared for
Mineral Resources



Legend

- Disturbance Footprint
- Survey Area (Spectrum Ecology, 2022)

Flora Survey Sites (Spectrum Ecology, 2022)

- Quadrat
- Releve

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Ecology + Spatial

Author: CS

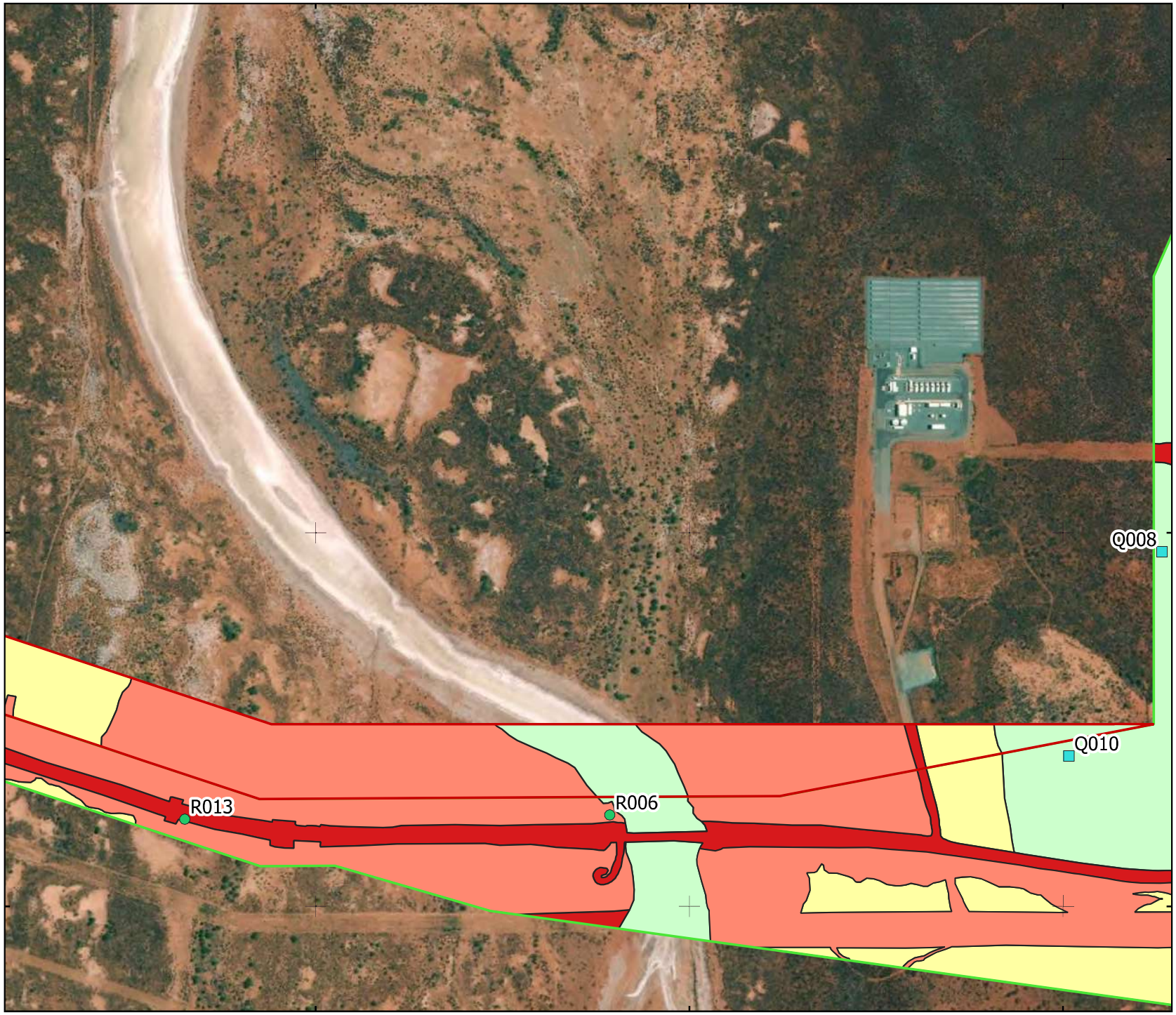
Date: 20-01-2023

Vegetation Condition - Map I

Warrirda Road Vegetation Extension

MAP 22

Prepared for
Mineral Resources



Legend

- Disturbance Footprint
- Survey Area (Spectrum Ecology, 2022)

Flora Survey Sites (Spectrum Ecology, 2022)

- Quadrat
- Releve

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Author: CS

Date: 20-01-2023

Vegetation Condition - Map J

Warrirda Road Vegetation Extension

MAP 23

Prepared for
Mineral Resources

4. CONCLUSION

The Disturbance Footprint was traversed by two botanists to determine if the vegetation types and condition recorded in a previous survey were appropriate to extend into the new area. Seven of the eight vegetation types previously recorded were extended into the Disturbance Footprint. No new vegetation types were recorded in the Disturbance Footprint.

The vegetation condition within the Survey Area including the Disturbance Footprint ranged from Very Good to Completely Degraded.

5. REFERENCES

Bureau of Meteorology. (2022). *Climate Data Online*. http://www.bom.gov.au/climate/data/

Department of Biodiversity Conservation and Attractions. (2017). *Threatened and Priority Flora Report Form - Field Manual*. Department of Biodiversity, Conservation and Attractions.

Environmental Protection Authority. (2016a). *EPA Environmental Factor Guideline: Flora and Vegetation*. EPA.

Environmental Protection Authority. (2016b). *EPA Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment*. EPA.

ESCAVI. (2003). *Australian Vegetation Attribute Manual: National Vegetation Information System, Version 6.0*. Executive Steering Committee for Australian Vegetation information. Department of Environment and Heritage.

Spectrum Ecology. (2022). *Warrirda Road Detailed & Targeted Flora & Basic Fauna Assessment*.

17 April 2023

RE: Warrirda Road Priority Flora Likelihood of Occurrence Assessment

Gregory Oliver
Senior Environmental Advisor
Mineral Resources

Dear Gregory,

Spectrum Ecology & Spatial (Spectrum) have undertaken a likelihood of occurrence of *Eremophila forrestii* subsp. *viridis* and *Triumfetta echinata* within two extension areas for a Native Vegetation Clearing Permit (NVCP) application. The two separate extensions (Area A and B) total 4.1 ha, and adjoin the original Disturbance Envelope (Map 1). The likelihood of occurrence assessment was completed using the previously recorded locations of the Priority flora taxa, and habitat suitability using vegetation mapping from the May 2021 (Spectrum 2022) and December 2022 (Spectrum 2023) surveys.

Spectrum undertook a detailed flora and vegetation survey of the majority of the Disturbance Envelope in May 2021, where vegetation types were mapped, and Priority flora searches were undertaken in appropriate habitat (Spectrum 2022). The Disturbance Envelope was altered, and supplementary surveys were undertaken in additional areas in December 2022; where Priority flora searches were conducted, and required areas were visited to confirm vegetation types (Spectrum 2023).

Two additional areas were added to the Disturbance Envelope in April 2023, and the vegetation mapping was extrapolated using data from the original assessments, and analysing aerial imagery. This extrapolation is considered to be accurate, as both areas were directly adjacent to the previously mapped area and were relatively small, and the vegetation of the area is very uniform and easy to identify from aerial imagery. The following was mapped within the additional areas (Table 1):

- Area A: was mapped entirely as vegetation type P1b; and
- Area B: the majority was mapped as P1a, with small sections of C1 and C2.

Table 1: Vegetation Types in Disturbance Envelope & NVCP Extension

Code	Vegetation Description (NVIS)	Landform	Habitat for Priority Flora	Area		
				Area A	Area B	Original Disturbance Envelope
Claypans						
C1	*Tecticornia auriculata* or *Tecticornia indica* subsp. *leiostachya* low open shrubland over *Eragrostis pergracilis* and/or **Cenchrus ciliaris* low sparse tussock grassland.	Drainage plain, salt pans on clay soils.	-	-	0.1 ha	3.4 ha
C2	+/-*Tecticornia auriculata* low isolated shrubs.	Bare clay pans, tidal mud flats.	-	-	0.3 ha	7.4 ha
Dunes						
D1	+/-*Grevillea stenobotrya* tall sparse shrubland over *Scaevola sericophylla*, +/-*Acacia stellaticeps* mid sparse shrubland over *Triodia epactia* open hummock grassland.	Sand dunes, swales, low rises.	*Eremophila forrestii* subsp. *viridis* *Triumfetta echinata*	-	-	19.2 ha

Code	Vegetation Description (NVIS)	Landform	Habitat for Priority Flora	Area		
				Area A	Area B	Original Disturbance Envelope
Plains						
P1a	*+/-Acacia tetragonophylla* tall isolated shrubs over *Triodia epactia* open hummock grassland.	Flat plains on sand/sandy clay/ clay soils.	-	-	1.8 ha	4.9 ha
P1b	**Cenchrus ciliaris* low open tussock grassland, with *+/-Triodia epactia* sparse hummock grassland.	Flat plains / Floodplains on sandy clay soils. Structurally separated from P1a due to dominance of **Cenchrus ciliaris*.	-	1.9 ha	-	9.9 ha
P2	*Acacia synchronicia*, *Acacia tetragonophylla* and **Vachellia farnesiana* tall sparse shrubland over *Scaevola spinescens* and *Sesbania cannabina* mid sparse shrubland over *Diplachne fusca* subsp. *fusca*, *Eulalia aurea*, and **Cenchrus ciliaris* sparse tussock grassland.	Minor depressions on clay to sandy clay soils.	-	-	-	0.4 ha
P3	**Prosopis pallida* tall closed shrubland over **Cenchrus ciliaris* open tussock grassland.	Unnatural depression on sandy clay soils. Degraded condition. Mostly no native species present.	-	-	-	1.3 ha
Other						
-	Cleared (no vegetation)	N/A	-	-	-	0.2 ha
Total Disturbance Envelope Area						**50.8 ha**

Eremophila forrestii subsp. *viridis* (Priority 3) was recorded within the original survey area and Disturbance Envelope (Map 1). It was widespread across the swales and footslopes of the red sand dunes, with 100% of records that were within the vegetation mapping extent, within vegetation type D1. *Eremophila forrestii* subsp. *viridis* is well known from the local area, and has commonly been recorded on the swales and footslopes of red sand dunes and is not locally restricted. It is known from multiple locations across Western Australia, and has been recorded on sandy and rocky habitats across six IBRA regions (Carnarvon, Pilbara, Little Sandy Desert, Great Sandy Desert, Great Victoria Desert, Central Ranges) and is therefore not regionally restricted (Chinnock, 2007).

The closest known record of *Eremophila forrestii* subsp. *viridis* to Area A was 1.7 km, and to Area B was 1.3 km. The vegetation types within Area A (P1b) and B (P1a, C1, and C2) are unlikely to provide habitat for the occurrence of this species. Additionally, a targeted traverse was undertaken by Spectrum 2023 along the southern boundary of both areas, where no individuals were recorded. Therefore *Eremophila forrestii* subsp. *viridis* has been assigned a low likelihood of occurrence within Area A and Area B.

Triumfetta echinata (Priority 3) was recorded within the original survey area and Disturbance Envelope (Map 1), with 100% of records that were within the vegetation mapping extent, within vegetation type D1. *Triumfetta echinata* is known from multiple records in the local area, predominantly on crests and slopes of red sand dunes and is not locally restricted. It is known from multiple locations across Western Australia, and has been recorded on red sand and sand dune habitats across three IBRA regions (Carnarvon, Gascoyne, and Pilbara) and is therefore not regionally restricted (Western Australian Herbarium, 2023).

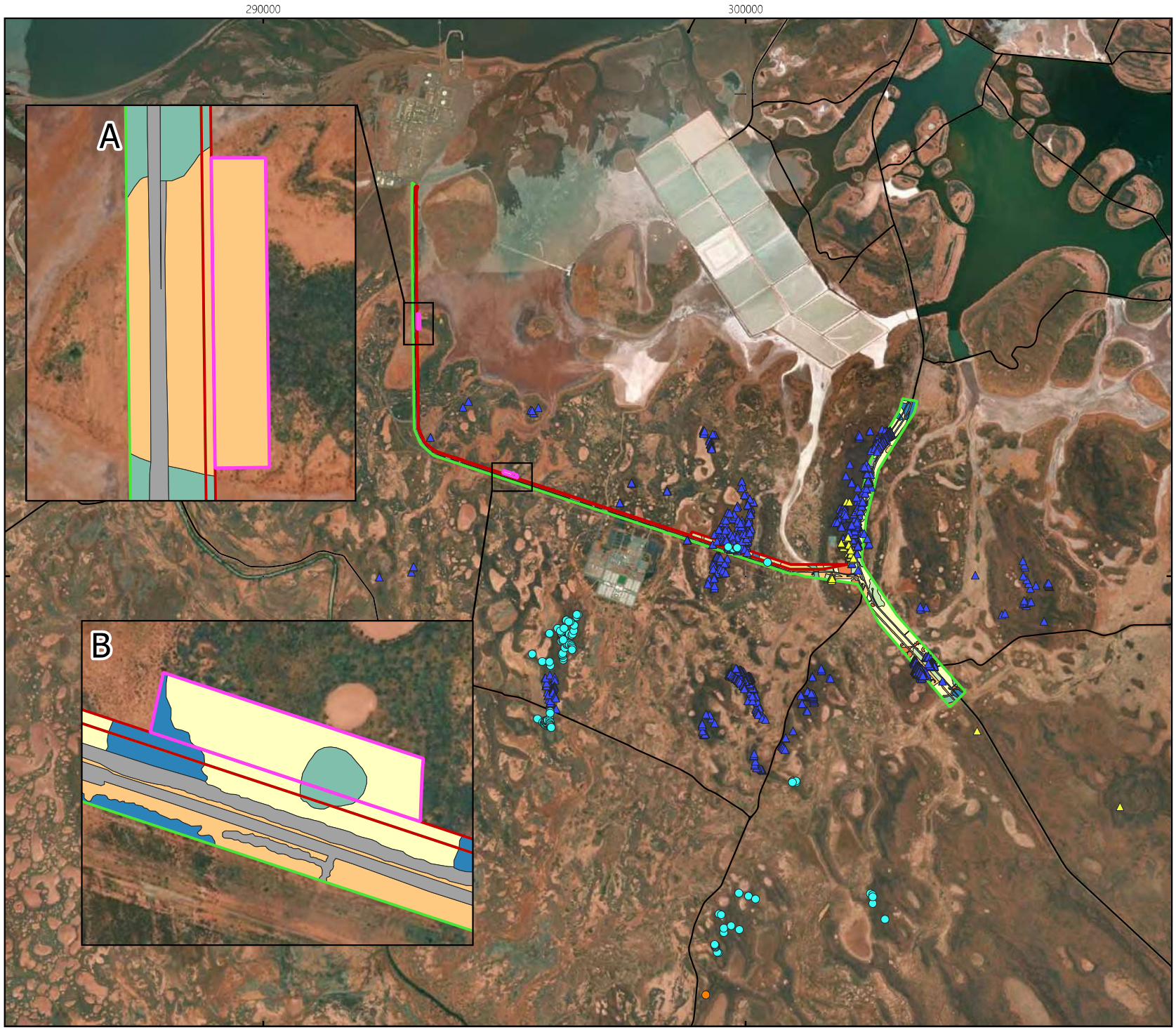
The closest known record of *Triumfetta echinata* to Area A was 6.9 km, and to Area B was 10.0 km (Map 1). The vegetation types within Area A (P1b) and B (P1a, C1, and C2) are unlikely to provide habitat for the occurrence of this species. Additionally, a targeted traverse was undertaken by Spectrum 2023 along the

southern boundary of both areas, where no individuals were recorded. Therefore *Triumfetta echinata* has been assigned a low likelihood of occurrence within Area A and Area B.

Please contact me if you require any further information in relation to the above.

Yours sincerely,
Sarah Boys
Botanist

© Spectrum Ecology Pty
PO Box 314 Leederville WA 6902
Ph: (08) 9317 8233
w: www.spectrumecology.com.au
e: info@spectrumecology.com.au



Legend

- Roads & Tracks

Survey Area

- NVCP Extension
- Disturbance Envelope
- Survey Area (Spectrum, 2022)

Vegetation Mapping

- C1
- C2
- D1
- P1a
- P1b
- P2
- P3
- Cleared

Priority Flora (Spectrum, 2023)

- P3 - Eremophila forrestii subsp. viridis
- P3 - Triumfetta echinata

Priority Flora - Desktop Assessment

- P3 - Eremophila forrestii subsp. viridis
- P3 - Triumfetta echinata

N

0 1 2 3 4 km

Scale 1:110,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Ecology + Spatial

Author: CS

Date: 17-04-2023

Desktop Assessment Eremophila forresttii subsp. viridis & Triumfetta echinata

Warrirda Road Desktop Assessment Memo

MAP

Prepared for
Mineral Resources

1

MEMO

WARRIRDA ROAD VEGETATION MAPPING EXTENSION

PREPARED FOR: MINERAL RESOURCES

© Spectrum Ecology Pty Ltd
ABN 68 615 115 243
PO Box 314 Leederville
Western Australia 6902
Ph: (08) 9317 8233
Email: info@spectrumecology.com.au

Project ID: 2249	Warrirda Road Vegetation Mapping Extension
Prepared for:	Mineral Resources
Date of issue:	17/04/2023
Prepared by:	Christopher Shaw, Sarah Boys
Spectrum Review:	Melissa Hay

1. INTRODUCTION

1.1. Project Background

Mineral Resources Limited (MinRes) has required additional survey work on the north side of the Warrirda Road to accommodate additional land to support construction of a haul road from their west Pilbara iron ore projects to the Port of Ashburton (Map 1). Spectrum Ecology & Spatial (Spectrum) undertook the original flora and fauna surveys in the area in 2021 (Spectrum Ecology, 2022) to support a Native Vegetation Clearing Permit (NVCP) within the Main Roads WA reserve (adjoining Warrirda and Onslow Roads), which was granted on 9 November 2022. MinRes, with the authority of the landowner – DevWA, plan to apply for a Native Vegetation Clearing Permit (NVCP) of lands immediately adjacent to the Main Roads road reserve and CPS9534/1.

The Disturbance Envelope is located approximately 16 km south of Onslow, Western Australia, and covers 50.8 ha. Spectrum Ecology's (2022) Survey Area covered 372.2 ha. CPS9534/1 permits the clearing of 234.44 ha.

1.2. Project Scope

The project scope was to confirm that the vegetation types present within the Disturbance Envelope were consistent with those described by Spectrum (Spectrum Ecology, 2022), and to extend vegetation mapping into any unmapped areas.

1.3. Legislation & Guidelines

Flora in Western Australia are protected by various legislation, including:

- *Biodiversity Conservation Act 2016* (BC Act);
- *Environmental Protection Act 1986* (EP Act); and
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The survey was compliant with survey guidelines, as outlined in:

- EPA Environmental Factor Guideline: Flora and Vegetation (Environmental Protection Authority, 2016a);
- EPA Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (Environmental Protection Authority, 2016b);
- DBCA Threatened and Priority Flora Report Form – Field Manual (Department of Biodiversity Conservation and Attractions, 2017); and
- National Vegetation Information System (NVIS) Australian Vegetation Attribute Manual (ESCAVI, 2003).

Legend

- Cities & Towns

Survey Area

- Disturbance Envelope
- Survey Area (Spectrum, 2022)
- Roads & Tracks
- Conservation Estates

N

0 2 4 6 km

Scale 1:180,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

Author: CS

Date: 17-04-2023

Location of the Survey Area

Warrirda Road Vegetation Extension

MAP 1

Prepared for
Mineral Resources

2. METHODS

2.1. Field Methods & Sampling Effort

There were 18.1 km of traverses undertaken during the assessment to map the boundaries of the vegetation types. A traverse is an unmarked route along which data is collected. Traverses are useful for identifying the boundaries and characteristics of vegetation types, selecting sites for detailed survey, and targeting significant flora or vegetation. Information recorded along a traverse is similar to relevés, with the addition of noting vegetation changes and relationships between vegetation and substrate. Vegetation types were compared to the descriptions provided in Spectrum Ecology (2022) and assigned a unit when they matched.

Two additional areas (4.1 ha in total) were added to the Disturbance Envelope in April 2023 where the vegetation mapping and vegetation condition was determined using aerial imagery and extrapolating on-ground data.

2.1.1. Vegetation Condition

Vegetation condition was recorded in the same way as the vegetation types throughout the Disturbance Envelope. The vegetation condition was mapped at the same scale as the vegetation mapping. Vegetation condition ratings follow the scale recommended for the Eremaean Botanical Province (Environmental Protection Authority, 2016b).

Table 1: Vegetation & Condition Scale – Eremaean Botanical Province

Condition	Disturbance Criteria
Excellent	Pristine or nearly so, no obvious signs of damage caused by human activities since European settlement.
Very Good	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	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 obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
Degraded	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 multiple weed species present including very aggressive species.
Completely Degraded	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.

2.2. Project Team

Spectrum personnel involved with this assessment are listed in Table 2, along with their role and years of experience.

Table 2: Project Team & Licences

Staff	Qualification	Role	Project Tasks	Years of Experience	Flora Licence
Dr Christopher Shaw	Phd	Senior Botanist	Project management, field survey, data management, reporting	7 years	FB62000241
Steven Spragg	BSc	Botanist	Field survey	2 years	FB62000501
Melissa Hay	Bsc (Hons)	Principal Botanist	Review	16 years	n/a
Sarah Boys	Bsc (Hons)	Botanist	Reporting	5 years	n/a

2.3. Survey Timing

The field assessment was undertaken over three days from the 5 to the 7 of December 2022. Monthly climate data was sourced from the nearest Bureau of Meteorology (BOM) station with complete data (Onslow Airport #5017), located approximately 13 km north of the Disturbance Envelope (Bureau of Meteorology, 2022). Additionally, the median monthly rainfall recorded from 1886 to 2012 at the closed Onslow (#5016) BOM station was included. Rainfall recorded 12 months prior to the survey and median monthly rainfall is presented in Figure 2.1.

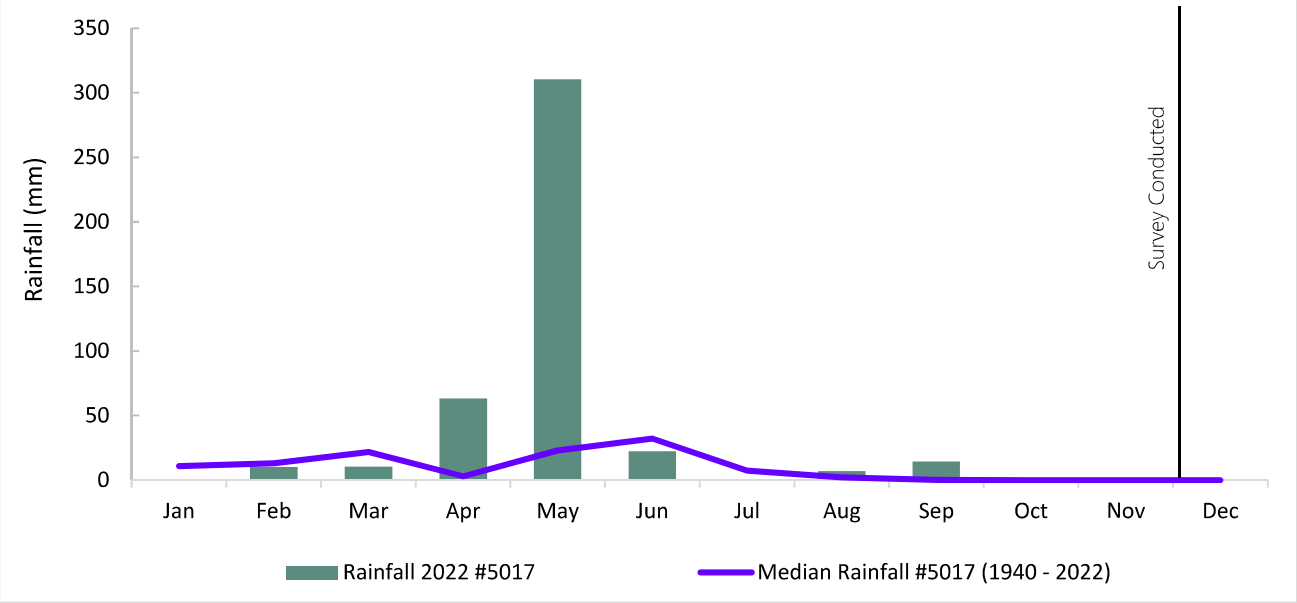


Figure 2.1: Mean Temperature & Rainfall for the 12 Months Preceding the Survey

The following rainfall was recorded at Onslow Airport (#5017) prior to the survey:

- The 12 months preceding the field survey (January to December 2022) recorded 438.6 mm of rainfall, 159.2 mm higher than the sum of the long-term annual median of 279.4 mm; and
- The three-months preceding the field survey (September – November 2022) recorded 14.4 mm of rainfall, 14.2 mm higher than the sum of the long-term annual median for the same three months (0.2 mm).

3. RESULTS & DISCUSSION

3.1. Vegetation Types

A total of eight vegetation types were described from the Spectrum Ecology (2022) Survey Area (Table 3). Seven vegetation types were recorded and extended into the Disturbance Envelope (Table 3) and are displayed on Map 2 to Map 12. No new vegetation types were recorded in the Disturbance Envelope during the current assessment.

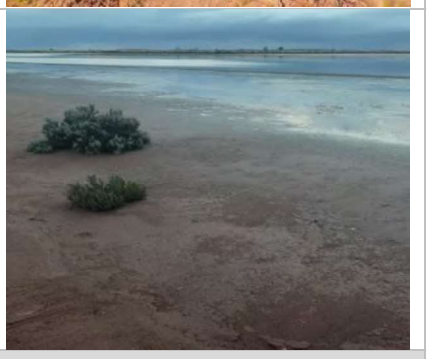
The dune (D1) vegetation type was the most common and covered 19.2 ha (37.8%) of the Disturbance Envelope. The dune (D1) vegetation type covered 96.3 ha or 22.8% over the entire Survey Area when the Disturbance Envelope was included.

The P1a and P1b plains vegetation types covered 6.7 ha (13.2%) and 11.8 ha (23.1%) of the Disturbance Envelope, respectively. The P1a vegetation type covered 115.0 ha (27.2%) and P1b covered 69.8 ha (16.5%) when the Disturbance Envelope was included in the Survey Area. The P2 and P3 vegetation types were uncommon in the Survey Area and covered 13.6 ha (3.2%) and 3.2 ha (0.8%) when the Disturbance Envelope was included, respectively.

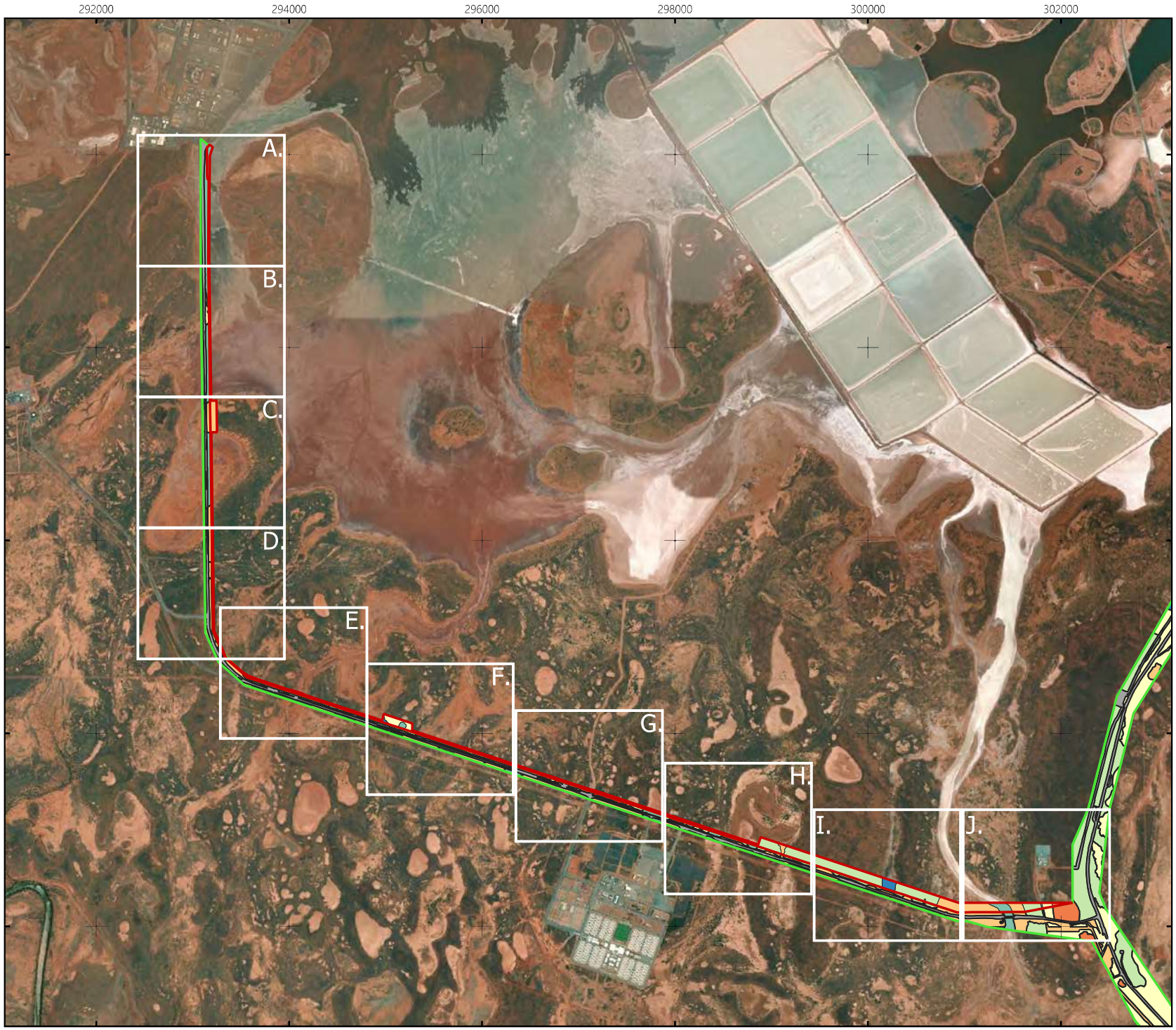
The C1 and C2 plains vegetation types covered 3.5 ha (6.9%) and 7.7 ha (15.2%) of the Disturbance Envelope, respectively. The C1 vegetation type covered 18.9 ha (4.5%) and C2 covered 34.2 ha (8.1%) when the Disturbance Envelope was included in the Survey Area.

The drainage lines (DL1) were not recorded in the Disturbance Envelope. Cleared vegetation was recorded covering 0.2 ha (0.3%) of the Disturbance Envelope and 69.8 ha (16.5%) of the total Survey Area with the Disturbance Envelope included.

Table 3: Vegetation Types

Code	Vegetation Description (NVIS)	Landform & Condition	Area ha & %		Representative Photo
			Disturbance Envelope	Total Mapped	
Claypans					
C1	*Tecticornia auriculata* or *Tecticornia indica* subsp. *leiostachya* low open shrubland over *Eragrostis pergracilis* and/or **Cenchrus ciliaris* low sparse tussock grassland.	Drainage plain, salt pans on clay soils.	3.5 ha 6.9%	18.9 ha 4.5%	
C2	+/-*Tecticornia auriculata* low isolated shrubs.	Bare clay pans, tidal mud flats.	7.7 ha 15.2%	34.2 ha 8.1%	
Dunes					
D1	+/-*Grevillea stenobotrya* tall sparse shrubland over *Scaevola sericophylla*, +/-*Acacia stellaticeps* mid sparse shrubland over *Triodia epactia* open hummock grassland.	Sand dunes, swales, low rises.	19.2 ha 37.8%	96.3 ha 22.8%	
Drainage Line					
DL1	+/-*Eucalyptus camaldulensis* subsp. *refulgens* low isolated trees over *Acacia tetragonophylla* and **Vachellia farnesiana* tall open shrubland over **Cenchrus ciliaris* sparse tussock grassland.	Drainage line. Degraded condition. Mostly no native species present.	-	2.1 ha 0.5%	

Code	Vegetation Description (NVIS)	Landform & Condition	Area ha & %		Representative Photo
			Disturbance Envelope	Total Mapped	
Plains					
P1a	*+/-Acacia tetragonophylla* tall isolated shrubs over *Triodia epactia* open hummock grassland.	Flat plains on sand/sandy clay/ clay soils.	6.7 ha 13.2%	115..0 ha 27.2%	
P1b	**Cenchrus ciliaris* low open tussock grassland, with +/-*Triodia epactia* sparse hummock grassland.	Flat plains / Floodplains on sandy clay soils. Structurally separated from P1a due to dominance of **Cenchrus ciliaris.*	11.8 ha 23.1%	69.8 ha 16.5%	
P2	*Acacia synchronicia*, *Acacia tetragonophylla* and **Vachellia farnesiana* tall sparse shrubland over *Scaevola spinescens* and *Sesbania cannabina* mid sparse shrubland over *Diplachne fusca* subsp. *fusca*, *Eulalia aurea*, and **Cenchrus ciliaris* sparse tussock grassland.	Minor depressions on clay to sandy clay soils.	0.4 ha 0.8%	13.6 ha 3.2%	
P3	**Prosopis pallida* tall closed shrubland over **Cenchrus ciliaris* open tussock grassland.	Unnatural depression on sandy clay soils. Degraded condition. Mostly no native species present.	1.3 ha 2.6%	3.2 ha 0.8%	
Other					
-	Cleared (no vegetation)	N/A	0.2 ha 0.3%	69.8 ha 16.5%	-



Legend

- Disturbance Envelope
- Survey Area (Spectrum, 2022)

Vegetation Unit

- C1
- C2
- D1
- P1a
- P1b
- P2
- P3
- Cleared

N

0 1 2 km

Scale 1:55,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

Author: CS

Date: 17-04-2023

Vegetation Types - Overview

Warrirda Road Vegetation Extension

MAP 2

Prepared for
Mineral Resources

Legend

- Disturbance Footprint
- Survey Area (Spectrum, 2022)

Flora Survey Sites (Spectrum, 2022)

- Quadrat
- Releve

Vegetation Unit

- C1
- C2
- D1
- P1a
- P1b
- P2
- P3
- Cleared

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Ecology + Spatial

Author: CS

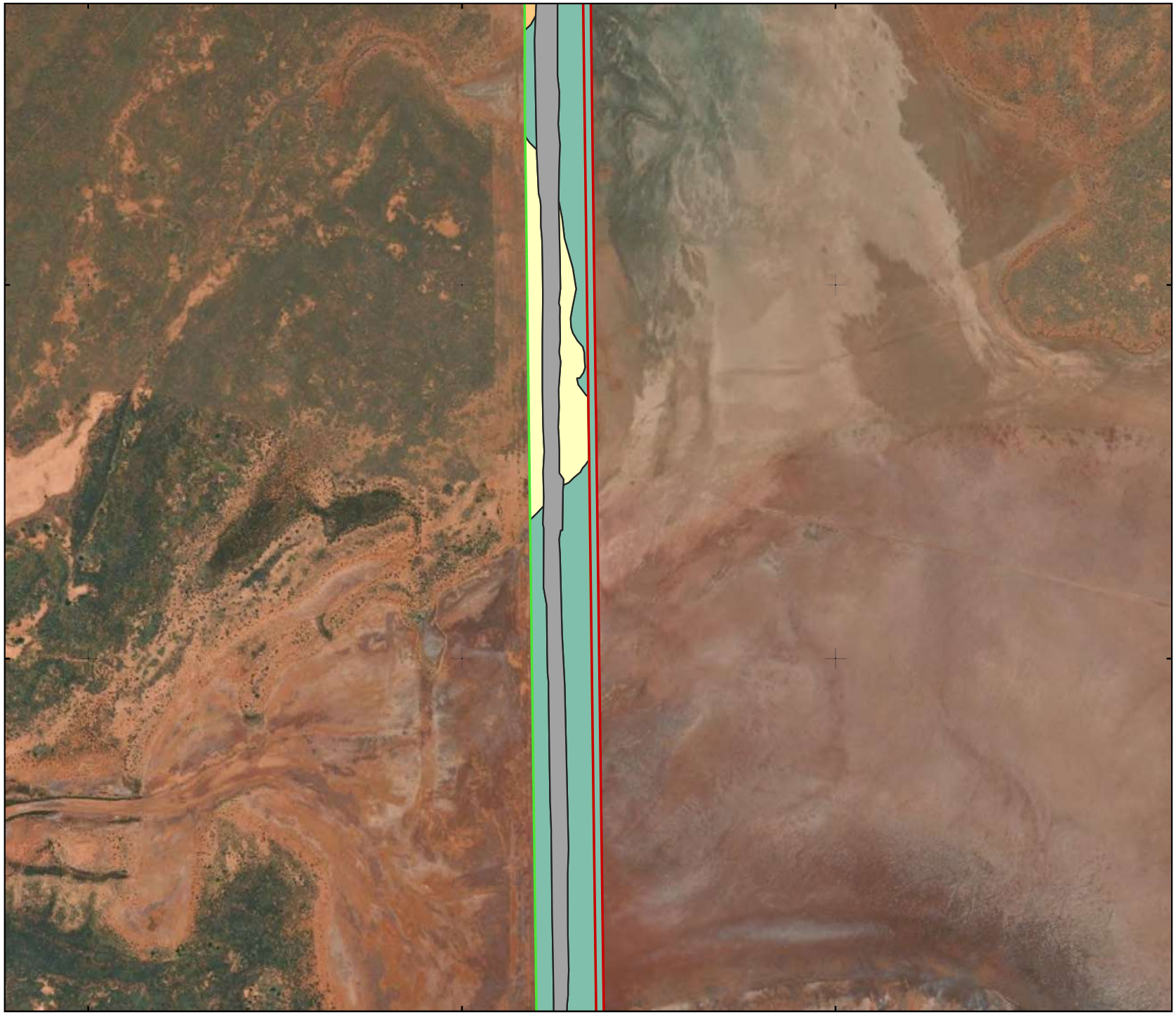
Date: 13-04-2023

Vegetation Types - Map A

Warrirda Road Vegetation Extension

MAP 3

Prepared for
Mineral Resources



Legend

- Disturbance Envelope
- Survey Area (Spectrum, 2022)

Flora Survey Sites (Spectrum, 2022)

- Quadrat
- Releve

Vegetation Unit

- C1
- C2
- D1
- P1a
- P1b
- P2
- P3
- Cleared

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

Author: CS

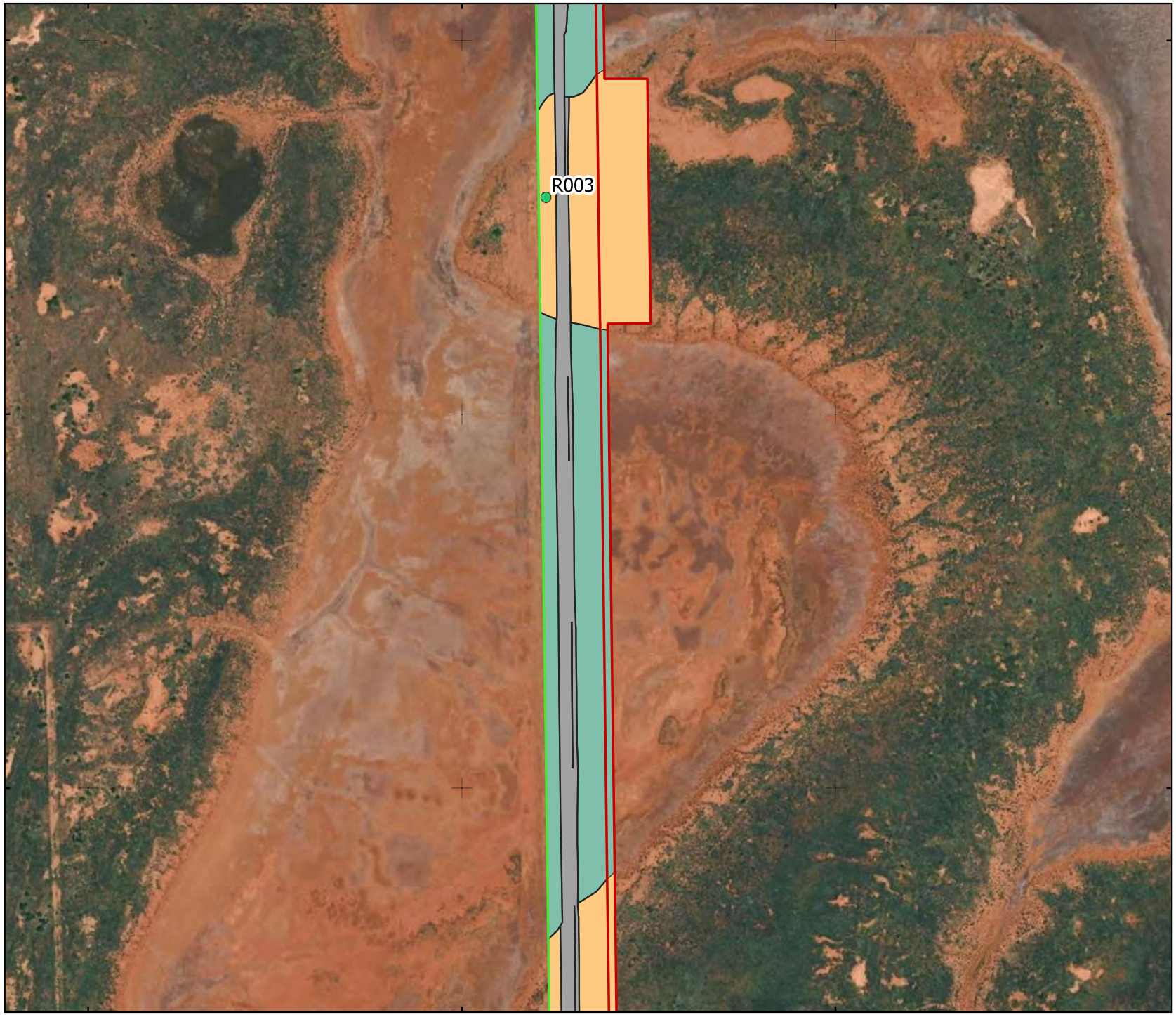
Date: 17-04-2023

Vegetation Types - Map B

Warrirda Road Vegetation Extension

MAP 4

Prepared for
Mineral Resources



Legend

- Disturbance Envelope
- Survey Area (Spectrum, 2022)

Flora Survey Sites (Spectrum, 2022)

- Quadrat
- Releve

Vegetation Unit

- C1
- C2
- D1
- P1a
- P1b
- P2
- P3
- Cleared

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

Author: CS

Date: 17-04-2023

Vegetation Types - Map C

Warrirda Road Vegetation Extension

MAP 5

Prepared for
Mineral Resources

Legend

- Disturbance Envelope
- Survey Area (Spectrum, 2022)

Flora Survey Sites (Spectrum, 2022)

- Quadrat
- Releve

Vegetation Unit

- C1
- C2
- D1
- P1a
- P1b
- P2
- P3
- Cleared

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Author: CS

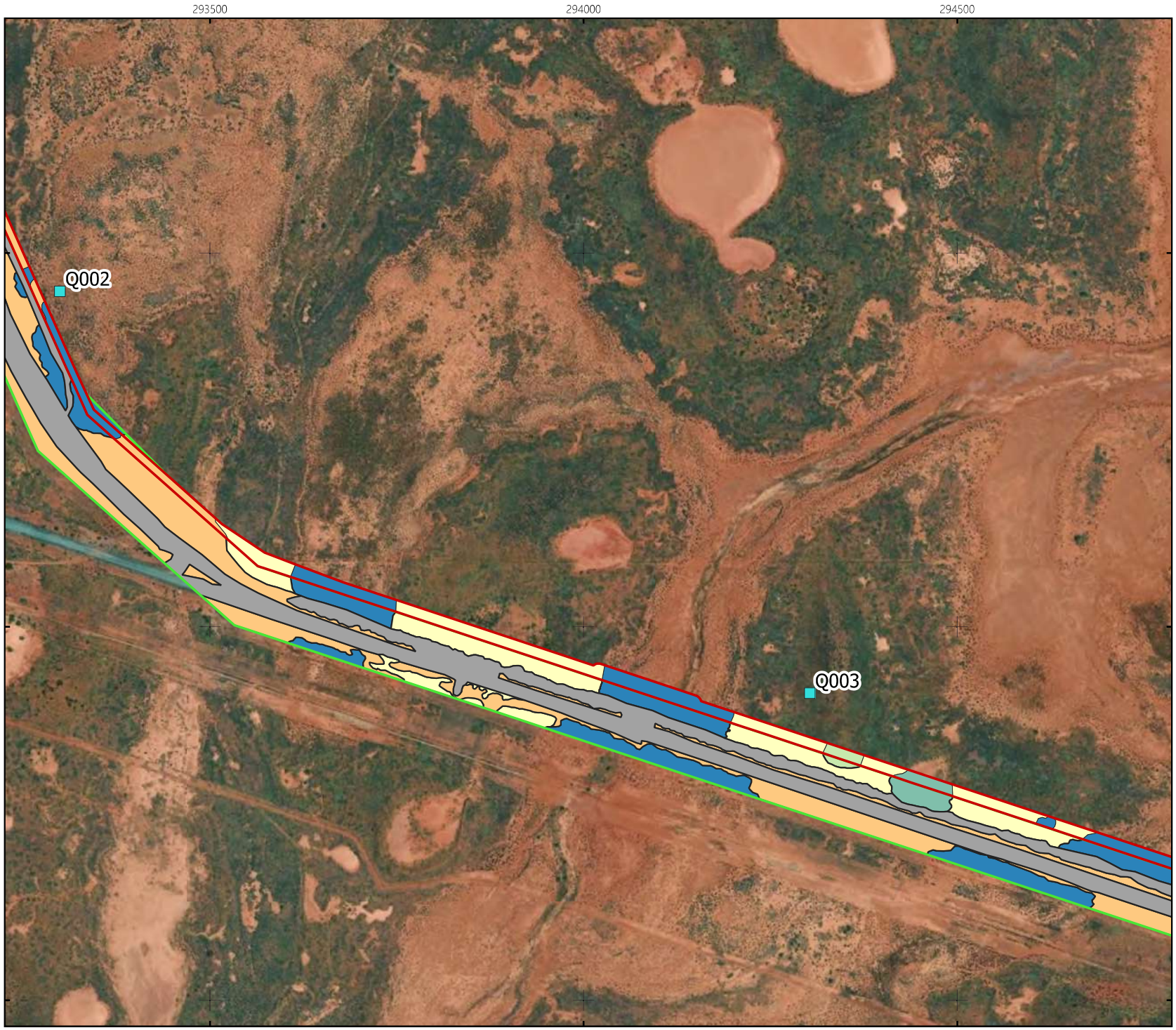
Date: 17-04-2023

Vegetation Types - Map D

Warrirda Road Vegetation Extension

MAP 6

Prepared for
Mineral Resources



Legend

- Disturbance Envelope
- Survey Area (Spectrum, 2022)

Flora Survey Sites (Spectrum, 2022)

- Quadrat
- Releve

Vegetation Unit

- C1
- C2
- D1
- P1a
- P1b
- P2
- P3
- Cleared

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

Author: CS

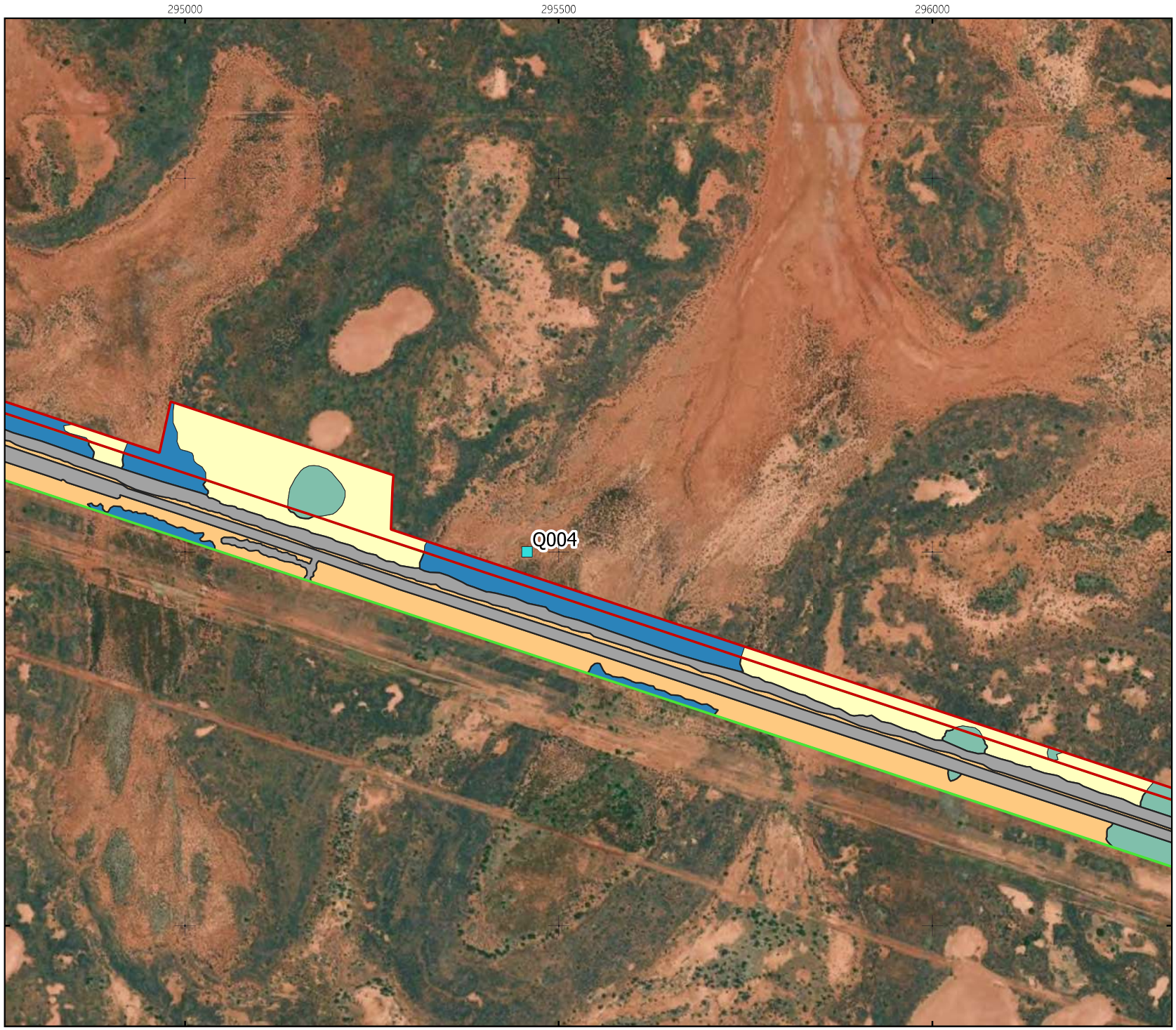
Date: 17-04-2023

Vegetation Types - Map E

Warrirda Road Vegetation Extension

MAP 7

Prepared for
Mineral Resources



Legend

- Disturbance Envelope
- Survey Area (Spectrum, 2022)

Flora Survey Sites (Spectrum, 2022)

- Quadrat
- Releve

Vegetation Unit

- C1
- C2
- D1
- P1a
- P1b
- P2
- P3
- Cleared

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

Author: CS

Date: 17-04-2023

Vegetation Types - Map F

Warrirda Road Vegetation Extension

MAP 8

Prepared for
Mineral Resources

Legend

- Disturbance Envelope
- Survey Area (Spectrum, 2022)

Flora Survey Sites (Spectrum, 2022)

- Quadrat
- Releve

Vegetation Unit

- C1
- C2
- D1
- P1a
- P1b
- P2
- P3
- Cleared

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

Author: CS

Date: 17-04-2023

Vegetation Types - Map G

Warrirda Road Vegetation Extension

MAP 9

Prepared for
Mineral Resources

Legend

- Disturbance Envelope
- Survey Area (Spectrum, 2022)

Flora Survey Sites (Spectrum, 2022)

- Quadrat
- Releve

Vegetation Unit

- C1
- C2
- D1
- P1a
- P1b
- P2
- P3
- Cleared

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

Author: CS

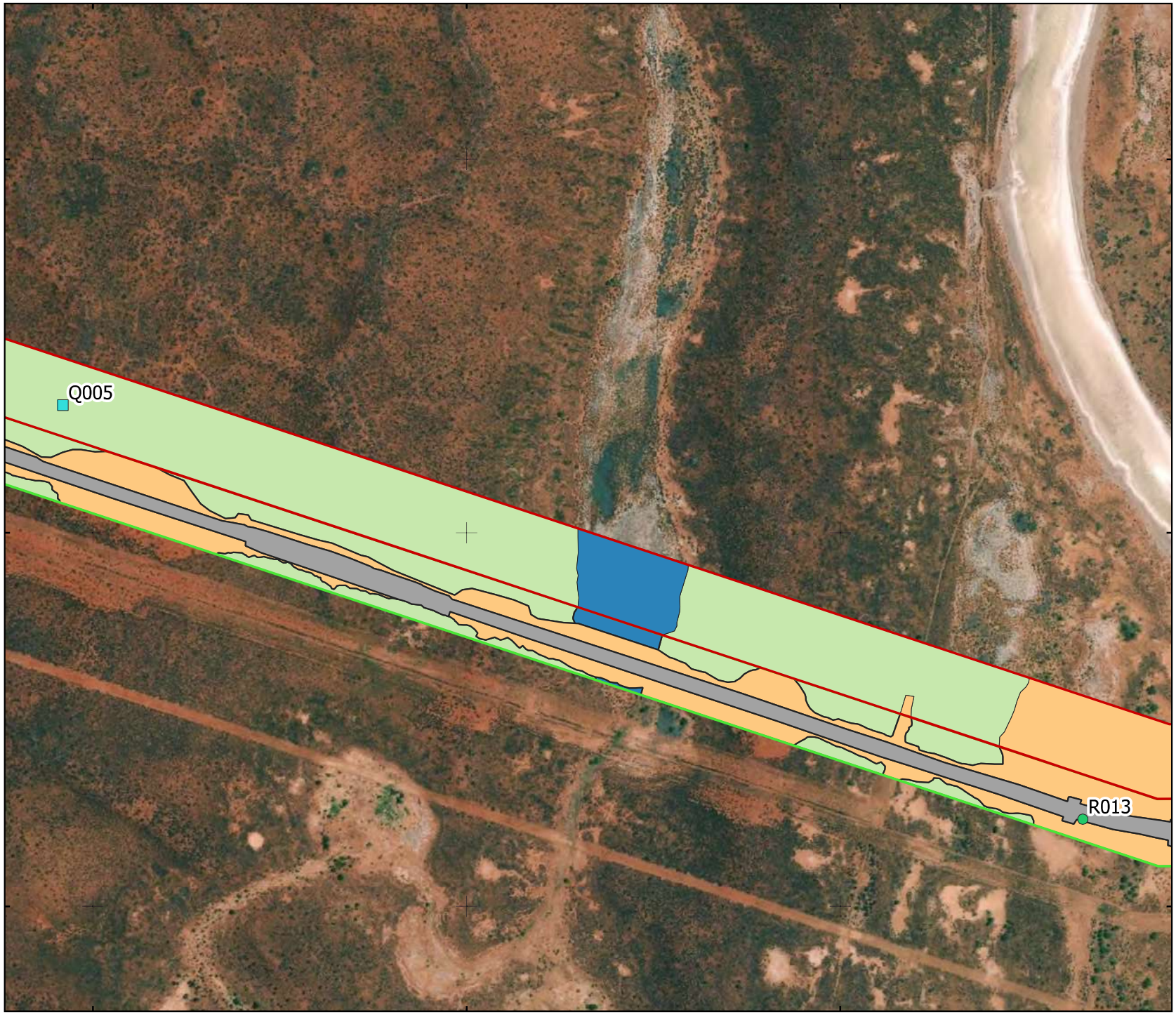
Date: 17-04-2023

Vegetation Types - Map H

Warrirda Road Vegetation Extension

MAP 10

Prepared for
Mineral Resources



Legend

- Disturbance Envelope
- Survey Area (Spectrum, 2022)

Flora Survey Sites (Spectrum, 2022)

- Quadrat
- Releve

Vegetation Unit

- C1
- C2
- D1
- P1a
- P1b
- P2
- P3
- Cleared

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

Author: CS

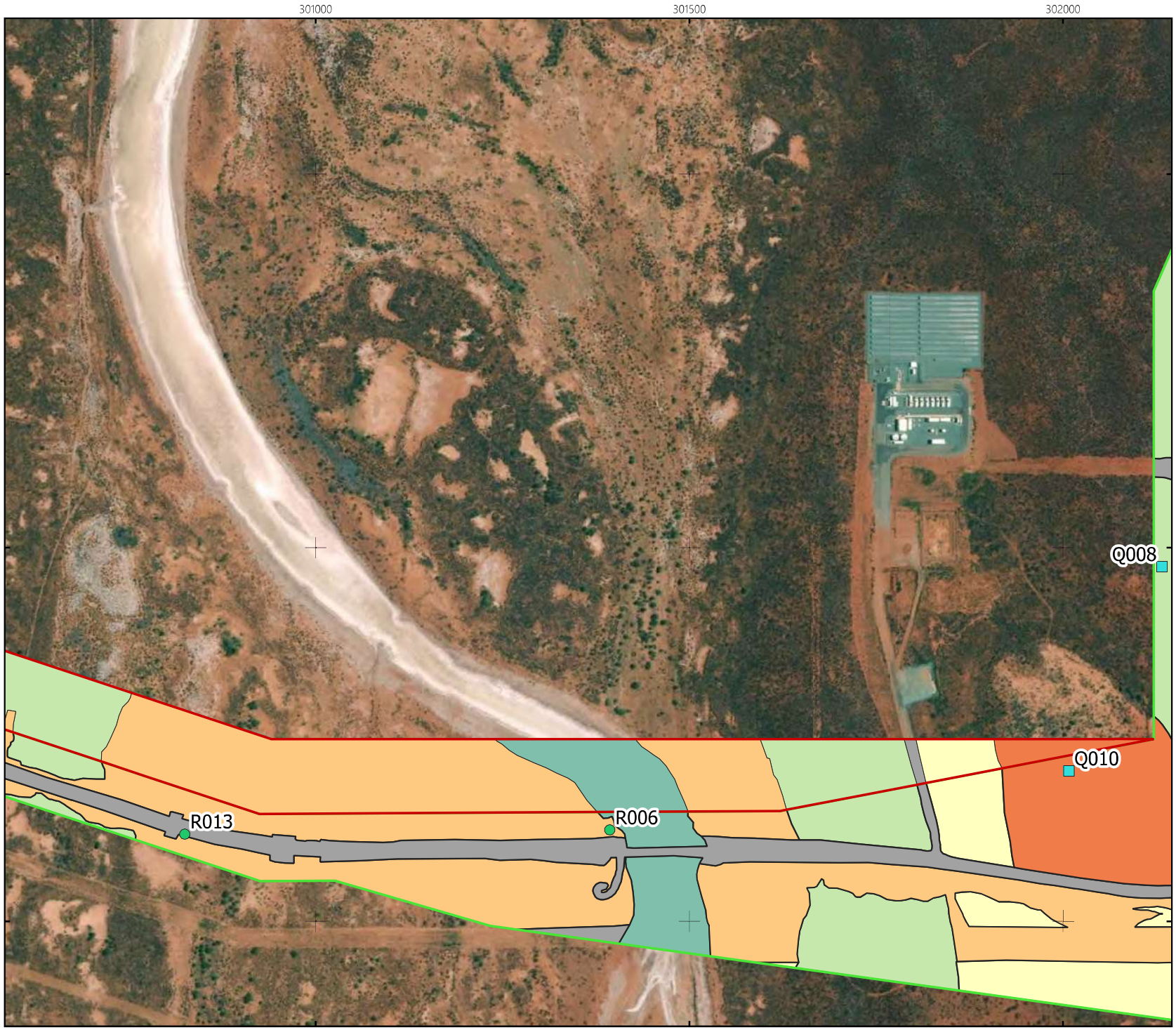
Date: 17-04-2023

Vegetation Types - Map I

Warrirda Road Vegetation Extension

MAP 11

Prepared for
Mineral Resources



Legend

- Disturbance Envelope
- Survey Area (Spectrum, 2022)

Flora Survey Sites (Spectrum, 2022)

- Quadrat
- Releve

Vegetation Unit

- C1
- C2
- D1
- P1a
- P1b
- P2
- P3
- Cleared

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum Ecology + Spatial

Author: CS

Date: 17-04-2023

Vegetation Types - Map J

Warrirda Road Vegetation Extension

MAP 12

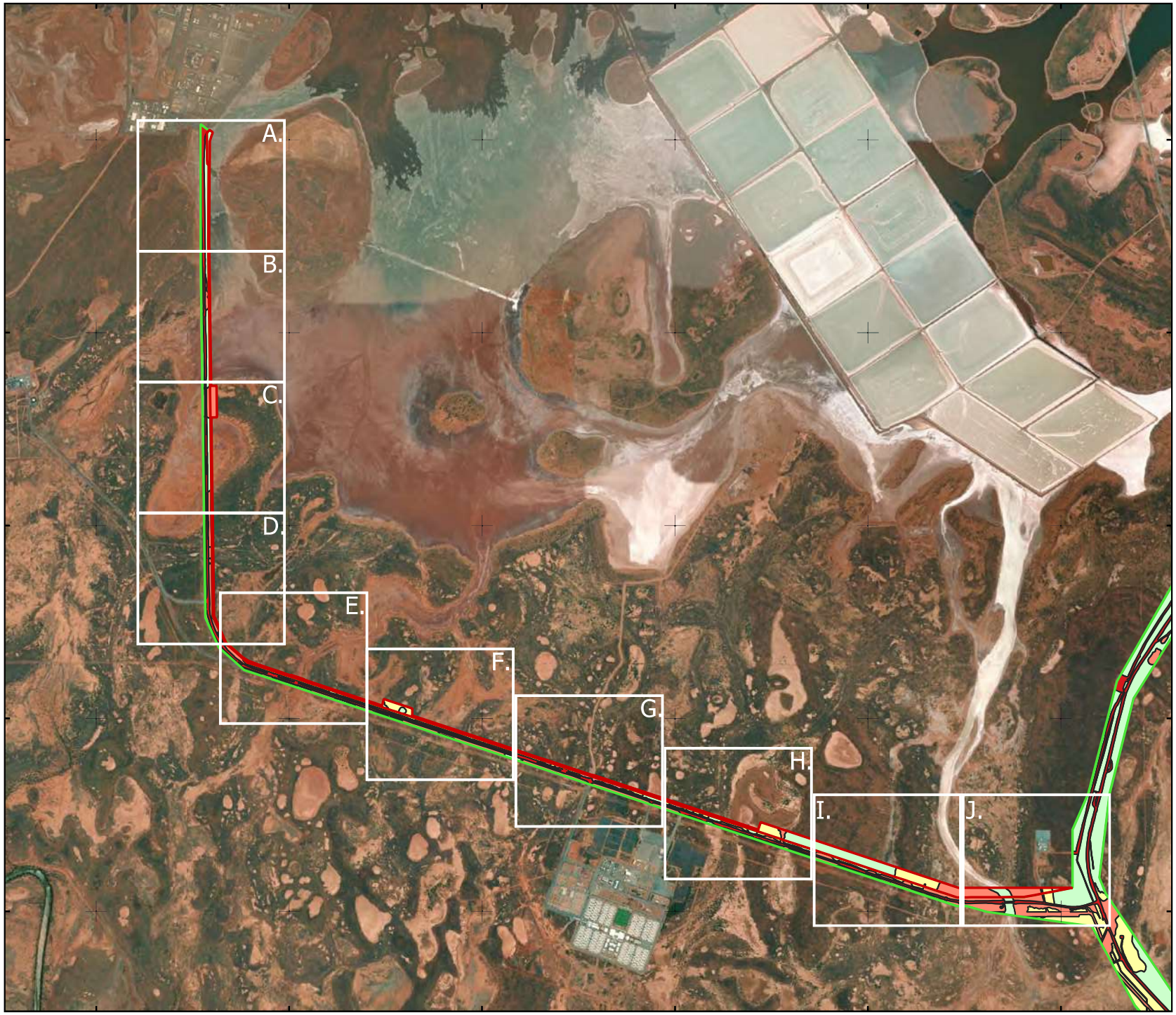
Prepared for
Mineral Resources

3.2. Vegetation Condition

The vegetation condition within the Disturbance Envelope ranged from Very Good (43.9%) to Completely Degraded (0.3%; Table 4). The vegetation condition within Survey Area was updated to include the Disturbance Envelope in Table 4, and condition ranged from Very Good (48.4%) to Completely Degraded (16.5%).

Table 4: Vegetation Condition

Condition	Area (ha) & %		Disturbance Detail in Survey Area
	Disturbance Envelope	Mapped Total	
Excellent	-	-	-
Very Good	22.4 ha 43.9%	204.8 ha 48.4%	Scattered weeds, low levels of grazing within areas of undisturbed native vegetation.
Good	13.8 ha 27.2%	61.5 ha 14.6%	Moderate weed cover within undisturbed native vegetation.
Poor	13.2 ha 25.9%	78.5 ha 18.6%	Vegetation along roadside or larger areas that may have been cleared, dominated by weeds, but maintains some natural vegetation structural components.
Degraded	1.4 ha 2.7%	8.3 ha 2.0%	Previously cleared areas that have regenerated with very few native species along roadsides and areas dominated by weeds with no native species present.
Completely Degraded	0.2 ha 0.3%	69.8 ha 16.5%	Includes the parkland cleared and developed areas, including roads and roadsides with no vegetation present. Mapped as 'Cleared' in vegetation mapping and vegetation condition for this project.



Legend

- Disturbance Envelope
- Survey Area (Spectrum, 2022)

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

N

0 1 2 km

Scale 1:55,000 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

Author: CS

Date: 17-04-2023

Vegetation Condition - Overview

Warrirda Road Vegetation Extension

MAP 13

Prepared for
Mineral Resources

Legend

- Disturbance Envelope
- Survey Area (Spectrum, 2022)

Flora Survey Sites (Spectrum, 2022)

- Quadrat
- Releve

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Author: CS

Date: 17-04-2023

Vegetation Condition - Map A

Warrirda Road Vegetation Extension

MAP 14

Prepared for
Mineral Resources

Legend

- Disturbance Envelope
- Survey Area (Spectrum, 2022)

Flora Survey Sites (Spectrum, 2022)

- Quadrat
- Releve

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Author: CS

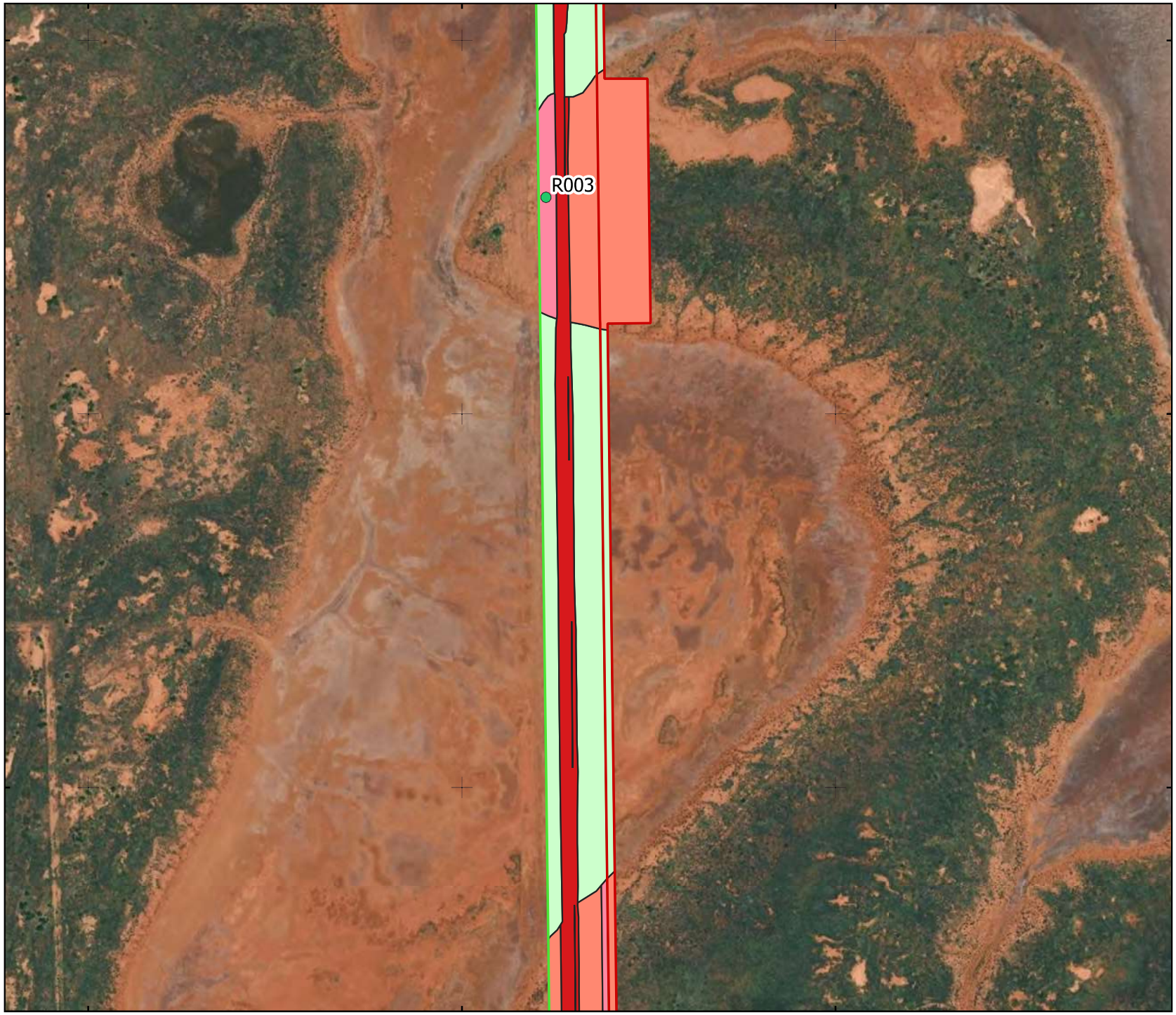
Date: 17-04-2023

Vegetation Condition - Map B

Warrirda Road Vegetation Extension

MAP 15

Prepared for
Mineral Resources



Legend

- Disturbance Envelope
- Survey Area (Spectrum, 2022)

Flora Survey Sites (Spectrum, 2022)

- Quadrat
- Releve

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

Author: CS

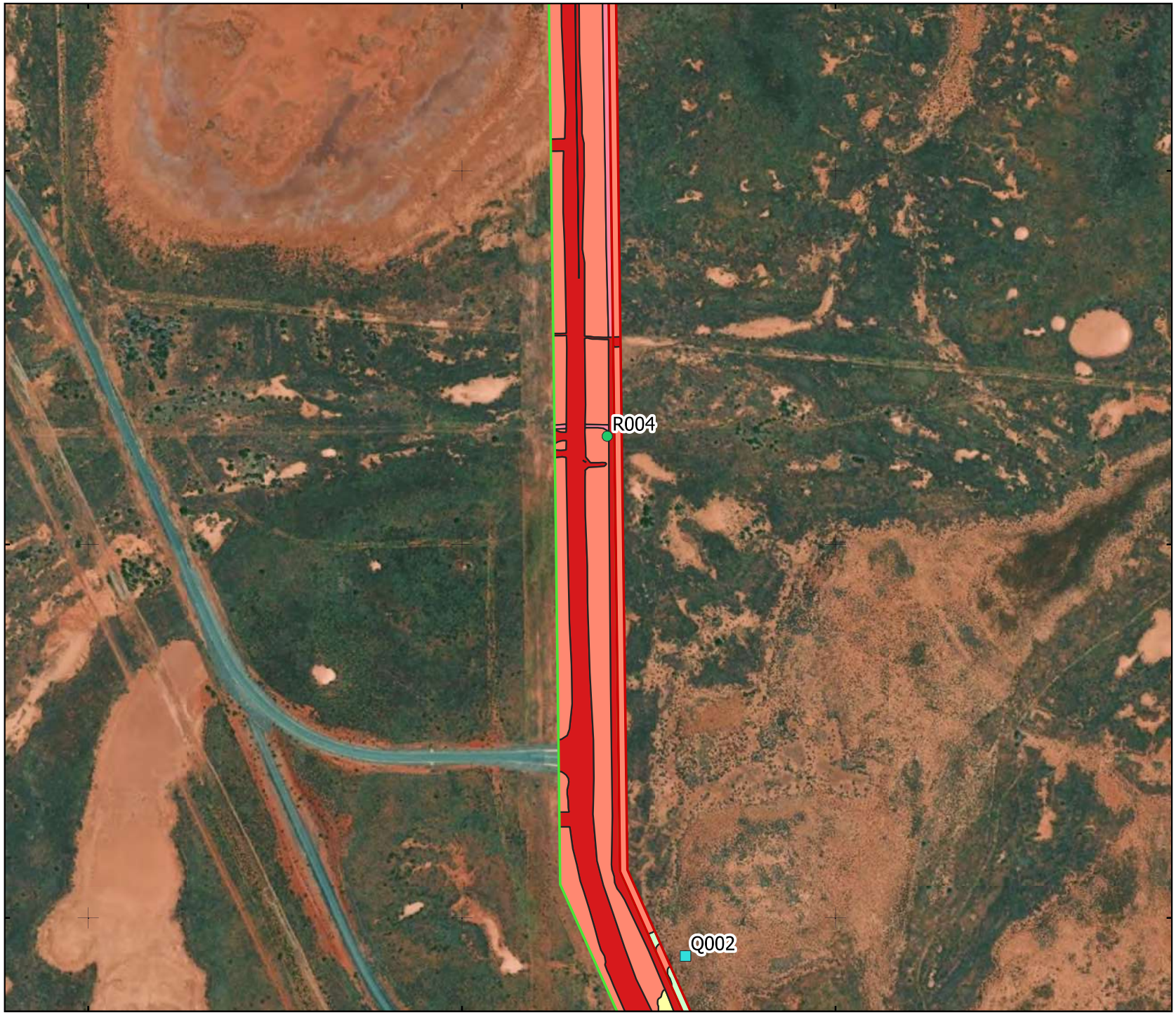
Date: 17-04-2023

Vegetation Condition - Map C

Warrirda Road Vegetation Extension

MAP 16

Prepared for
Mineral Resources



Legend

- Disturbance Envelope
- Survey Area (Spectrum, 2022)

Flora Survey Sites (Spectrum, 2022)

- Quadrat
- Releve

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Author: CS

Date: 17-04-2023

Vegetation Condition - Map D

Warrirda Road Vegetation Extension

MAP 17

Prepared for
Mineral Resources

Legend

- Disturbance Envelope
- Survey Area (Spectrum, 2022)

Flora Survey Sites (Spectrum, 2022)

- Quadrat
- Releve

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

Author: CS

Date: 17-04-2023

Vegetation Condition - Map E

Warrirda Road Vegetation Extension

MAP 18

Prepared for
Mineral Resources

Legend

- Disturbance Envelope
- Survey Area (Spectrum, 2022)

Flora Survey Sites (Spectrum, 2022)

- Quadrat
- Releve

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

Author: CS

Date: 17-04-2023

Vegetation Condition - Map F

Warrirda Road Vegetation Extension

MAP 19

Prepared for
Mineral Resources

Legend

- Disturbance Envelope
- Survey Area (Spectrum, 2022)

Flora Survey Sites (Spectrum, 2022)

- Quadrat
- Releve

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

Author: CS

Date: 17-04-2023

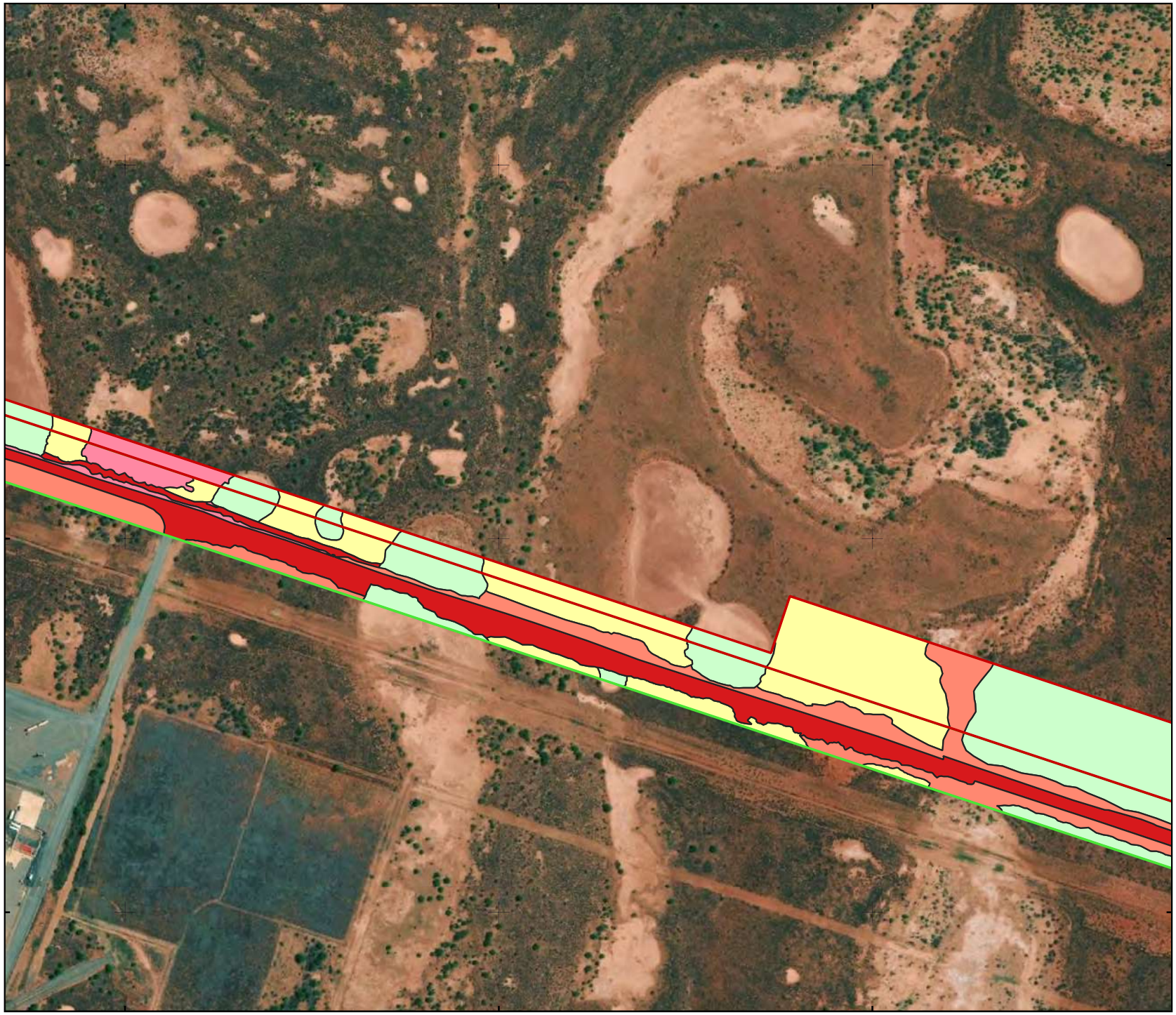
Vegetation Condition - Map G

Warrirda Road Vegetation Extension

MAP

Prepared for
Mineral Resources

20



Legend

- Disturbance Envelope
- Survey Area (Spectrum, 2022)

Flora Survey Sites (Spectrum, 2022)

- Quadrat
- Releve

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Author: CS

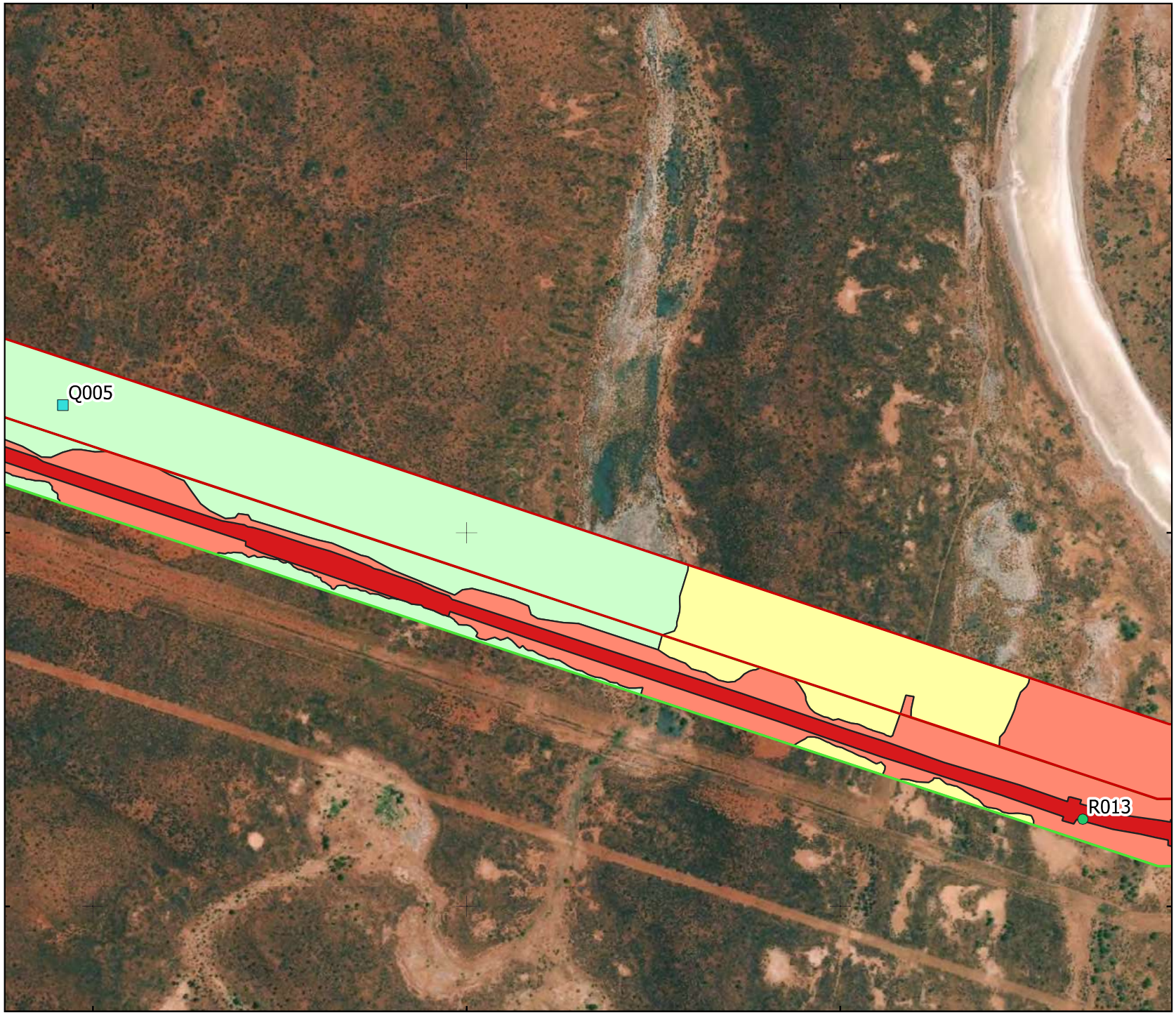
Date: 17-04-2023

Vegetation Condition - Map H

Warrirda Road Vegetation Extension

MAP 21

Prepared for
Mineral Resources



Legend

- Disturbance Envelope
- Survey Area (Spectrum, 2022)

Flora Survey Sites (Spectrum, 2022)

- Quadrat
- Releve

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Spectrum

Author: CS

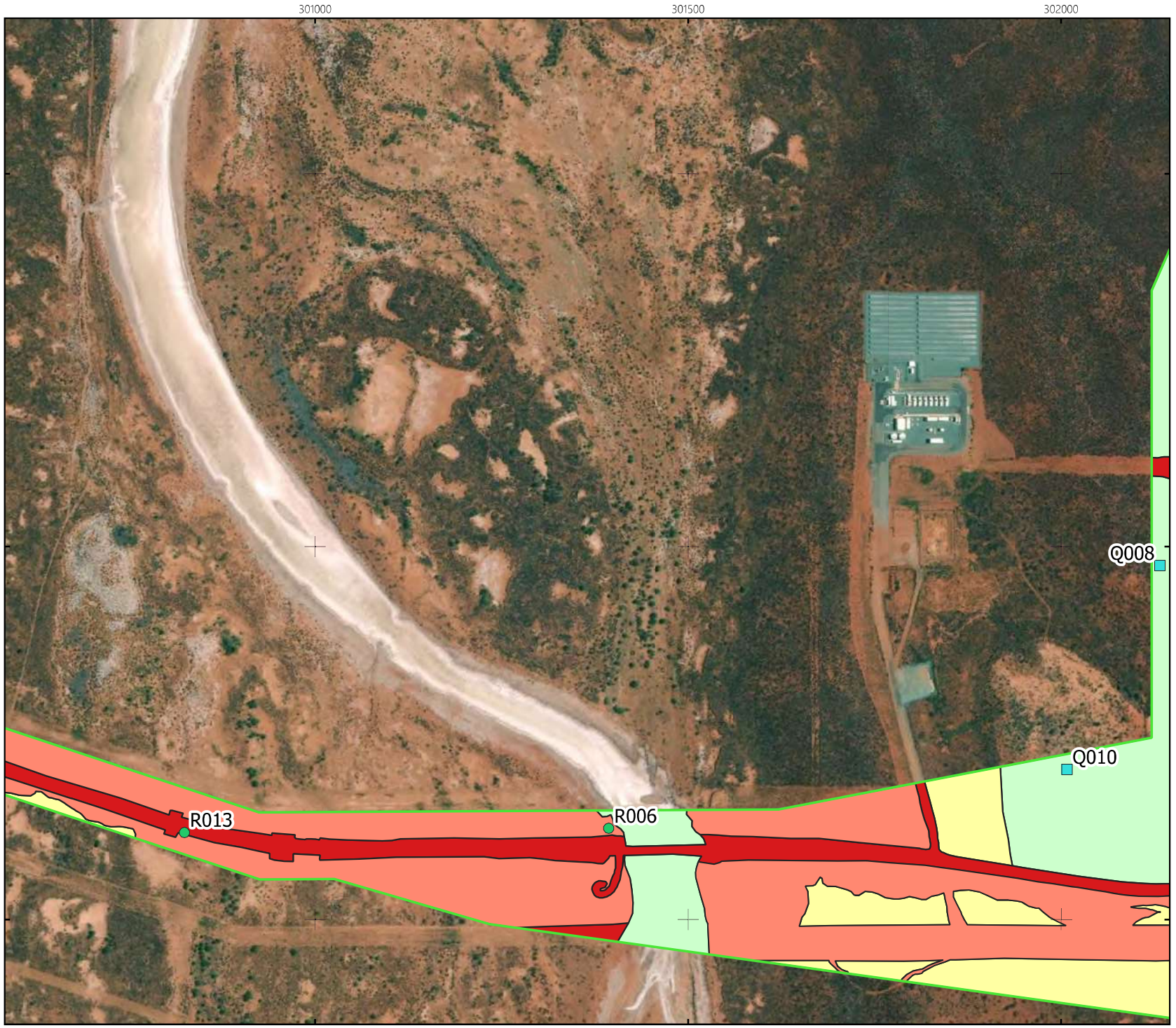
Date: 17-04-2023

Vegetation Condition - Map I

Warrirda Road Vegetation Extension

MAP 22

Prepared for
Mineral Resources



Legend

- Disturbance Envelope
- Survey Area (Spectrum, 2022)

Flora Survey Sites (Spectrum, 2022)

- Quadrat
- Releve

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded

N

0 0.1 0.2 km

Scale 1:7,100 @ A4

Coordinate System: GDA 1994 MGA Zone 50
Projection: Universal Transverse Mercator
Units: Metre

Author: CS

Date: 17-04-2023

Vegetation Condition - Map J

Warrirda Road Vegetation Extension

MAP 23

Prepared for
Mineral Resources

4. CONCLUSION

The Disturbance Envelope was traversed by two botanists to determine if the vegetation types and condition recorded in a previous survey were appropriate to extend into the new area.

Seven of the eight vegetation types previously recorded were extended into the Disturbance Envelope. No new vegetation types were recorded in the Disturbance Envelope. Vegetation of two additional areas was extrapolated using the results of this survey and aerial imagery.

The vegetation condition within the Survey Area including the Disturbance Envelope ranged from Very Good to Completely Degraded.

5. REFERENCES

Bureau of Meteorology. (2022). *Climate Data Online*. http://www.bom.gov.au/climate/data/

Department of Biodiversity Conservation and Attractions. (2017). *Threatened and Priority Flora Report Form - Field Manual*. Department of Biodiversity, Conservation and Attractions.

Environmental Protection Authority. (2016a). *EPA Environmental Factor Guideline: Flora and Vegetation*. EPA.

Environmental Protection Authority. (2016b). *EPA Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment*. EPA.

ESCAVI. (2003). *Australian Vegetation Attribute Manual: National Vegetation Information System, Version 6.0*. Executive Steering Committee for Australian Vegetation information. Department of Environment and Heritage.

Spectrum Ecology. (2022). *Warrirda Road Detailed & Targeted Flora & Basic Fauna Assessment*.

ecological AUSTRALIA
A TETRA TECH COMPANY

1300 646 131
www.ecoaus.com.au