Prepared for
Rio Tinto Group
ABN: 96 0044 584 04

AECOM

Karijini Monitoring Bores Native Vegetation Clearing Permit

Flora, Vegetation and Fauna Habitat Survey

09-Feb-2023
Doc No. 60680395_1

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Karijini Monitoring Bores Native Vegetation Clearing Permit

Flora, Vegetation and Fauna Habitat Survey

Client: Rio Tinto Group

ABN: 96 0044 584 04

Prepared by

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Quality Information

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Prepared by Floora de Wit

Reviewed by Kate Thomson

Revision History

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			Name/Position	Signature
A	02-Aug-2022	Draft for Client Review	Kate Thomson Team Leader - Impact Assessment and Permitting	
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1	09-Feb-2023	Final	Kate Thomson Team Leader - Impact Assessment and Permitting	

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Acronym	Description
AECOM	AECOM Australia Pty Ltd
ALA	Atlas of Living Australia
BC Act	Biodiversity Conservation Act
Biota	Biota Environmental Sciences
BOM	Bureau of Meteorology
Cons. Status	Conservation Status
DAWE	Department of Agricultural, Water and Environment
DBCA	Department of Biodiversity Conservation and Attractions
DPaW	Department of Parks and Wildlife
DCCEEW	Department of Climate Change, Energy, the Environment and Water
EPA	Environmental Protection Authority
EPBC Act	Environment Protection and Biodiversity Conservation Act
ESA	Environmentally Sensitive Area
GPS	Global Positioning System
Ha	Hectares
IBRA	Interim Biogeographical Region of Australia
Km	Kilometres
M	Metres
NVCP	Native Vegetation Clearing Permit
NVIS	National Vegetation Information System
NHP	National Heritage Place
PEC	Priority Ecological Community
PMST	Protected Matters Search Tool
Rio Tinto	Rio Tinto Group
SRE	Short Range Endemics
sp.	Species
TEC	Threatened Ecological Community
WA	Western Australia
WAH	Western Australian Herbarium

Executive Summary

Rio Tinto engaged AECOM Australia Pty Ltd (AECOM) to complete biological surveys for a 39.59 ha linear corridor within Karijini National Park. The surveys will inform a native vegetation clearing permit application required to clear tracks to existing water bores to monitor water levels within the National Park.

The surveys were undertaken by two Rio Tinto botanists and one AECOM botanist and included a hybrid reconnaissance/detailed flora and vegetation assessment and a fauna habitat assessment. The entire survey area was traversed on foot using a helicopter to gain access to the survey area.

A summary of the results is presented below:

- No TECs or PECs were anticipated to occur and none were identified
- Five native vegetation communities were recorded, and their delineation was supported by comparing the floristic data
- One Priority 2 species *Eremophila pusilliflora* was recorded throughout the survey area and in areas adjacent to the survey area
- One Priority 3 species, *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727), has a high likelihood of occurring but will need further verification during its flowering period. Two samples were collected on calcrete rocky terrain however no identification was possible due to the absence of flowers and fruit
- Three fauna habitats were recorded, all representing suitable foraging habitat for four significant fauna species including Ghost Bat, Pilbara Leaf-nosed Bat, Peregrine Falcon, Grey Falcon and Fork-tailed Swift
- The Hummock Grasslands represents suitable habitat for the Western Pebble-mound Mouse listed as Priority 4.

Rainfall was below average in the months leading up to the survey. This was evident in the lack of suitable flowering material for ephemeral species and led to the inability to confidently identify two samples collected that may represent *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727) (P3). Additional surveys may be required during the flowering period of *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727) to verify the presence of this species.

1.0 Introduction

1.1 Background

Rio Tinto propose to clear an access track to a series of bores within the southeast corner of Karijini National Park. Access to this network of bores is required to monitor and manage potential drawdown effects on Karijini National Park and provide data for ongoing groundwater modelling. Bores are currently only accessible via helicopter with evidence of an old track remaining. Rio Tinto require a flora, vegetation and fauna habitat assessment to describe the existing ecological values and use this information to support a Native Vegetation Clearing Permit (NVCP).

1.2 Location

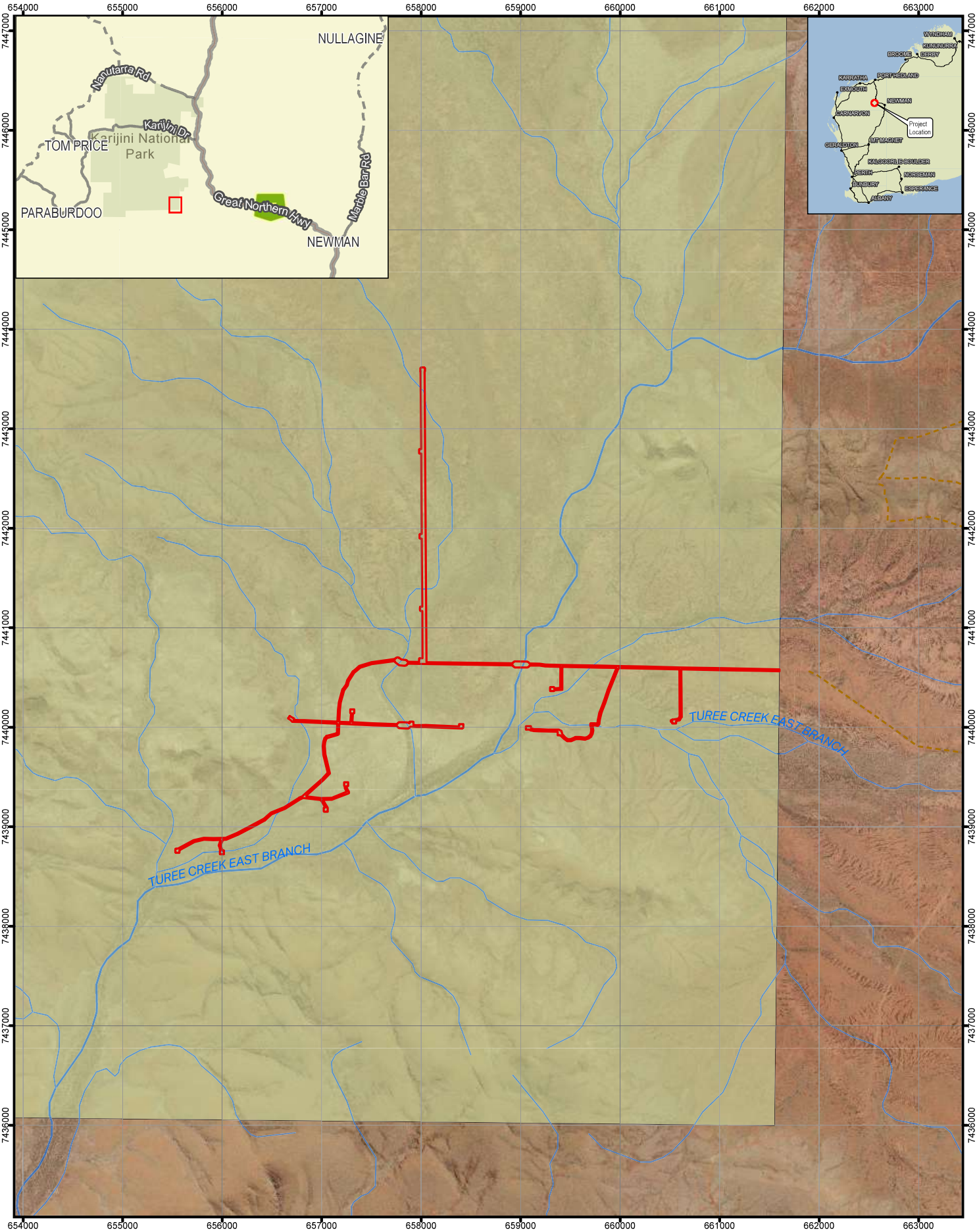
The Karijini survey area is in the Pilbara region of Western Australia, approximately 126 km west of Newman in the Shire of East Pilbara (Figure 1). The survey area encompasses 39.59 ha of linear corridors connecting the water bores.

1.3 Objective and Scope

The objective of the work is to assess the ecological values of the defined survey area to support a NVCP application. The objective was achieved through the implementation of a flora, vegetation and fauna habitat assessment, specifically:

- A hybrid of a reconnaissance and detailed flora and vegetation assessment including targeted flora searches and considerable survey effort using relevés
- Fauna habitat assessment
- One concise technical report.

Surveys were undertaken in accordance with relevant legislation and EPA guidelines to inform an assessment of the ten clearing principles and support the NVCP application.



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LEGEND
- Survey Area
- Karijini National Park

Survey Area

RIO TINTO GROUP

KARIJINI MONITORING BORES NATIVE VEGETATION CLEARING PERMIT

Figure
1

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2.0 Existing Environment

2.1 Climate

The survey area is located in the Shire of East Pilbara which experiences a semi-arid climate. The nearest weather station is Newman Aero (station 7176) which opened in 1971. Rainfall was near or below average in the months preceding the survey. Hardly any rain occurred between July and December 2021, with some rain in January. This lack of rain was somewhat evident. Many grasses were sterile, and some annual species were already at the end of their lifecycle.

Total annual rainfall in the 12 months prior to the survey was considerably lower, with 206.8 mm recorded between April 2021 and March 2022 compared to a mean annual rainfall of 313.5 mm (BOM, 2022). The below-average rainfall was evident in the lack of annual species present and lack of flowering material available on some grasses.

Temperatures were not far from normal, with milder conditions in January, February and March leading up to the survey. Temperatures are not considered to have influenced the field survey.

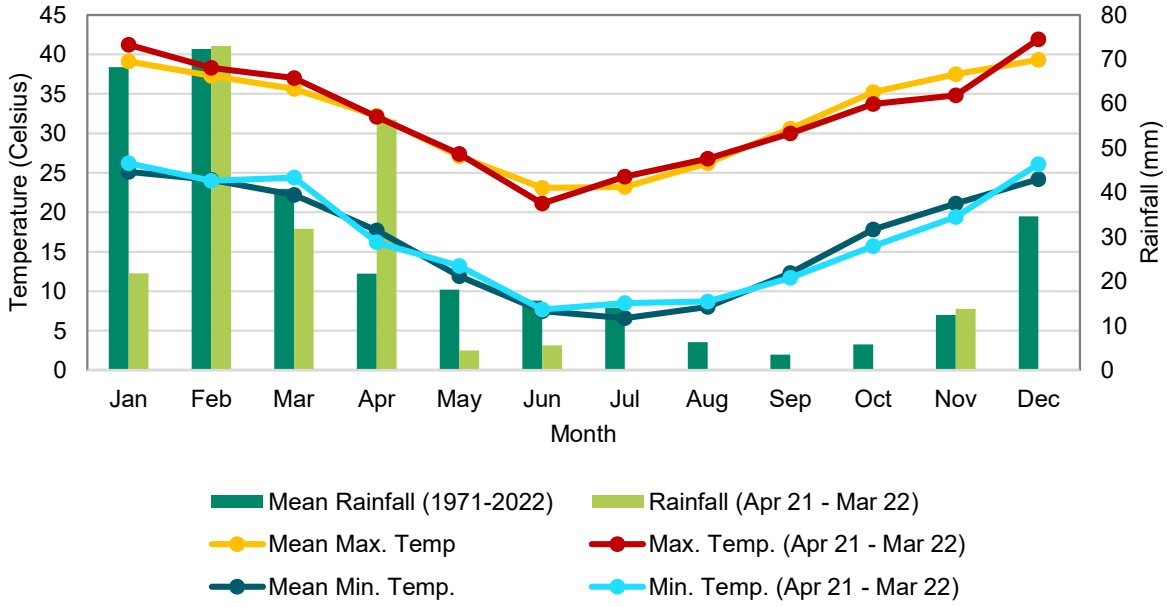


Figure 2 Climate Data from Newman Aero 7176 (BOM 2021)

2.2 IBRA Region

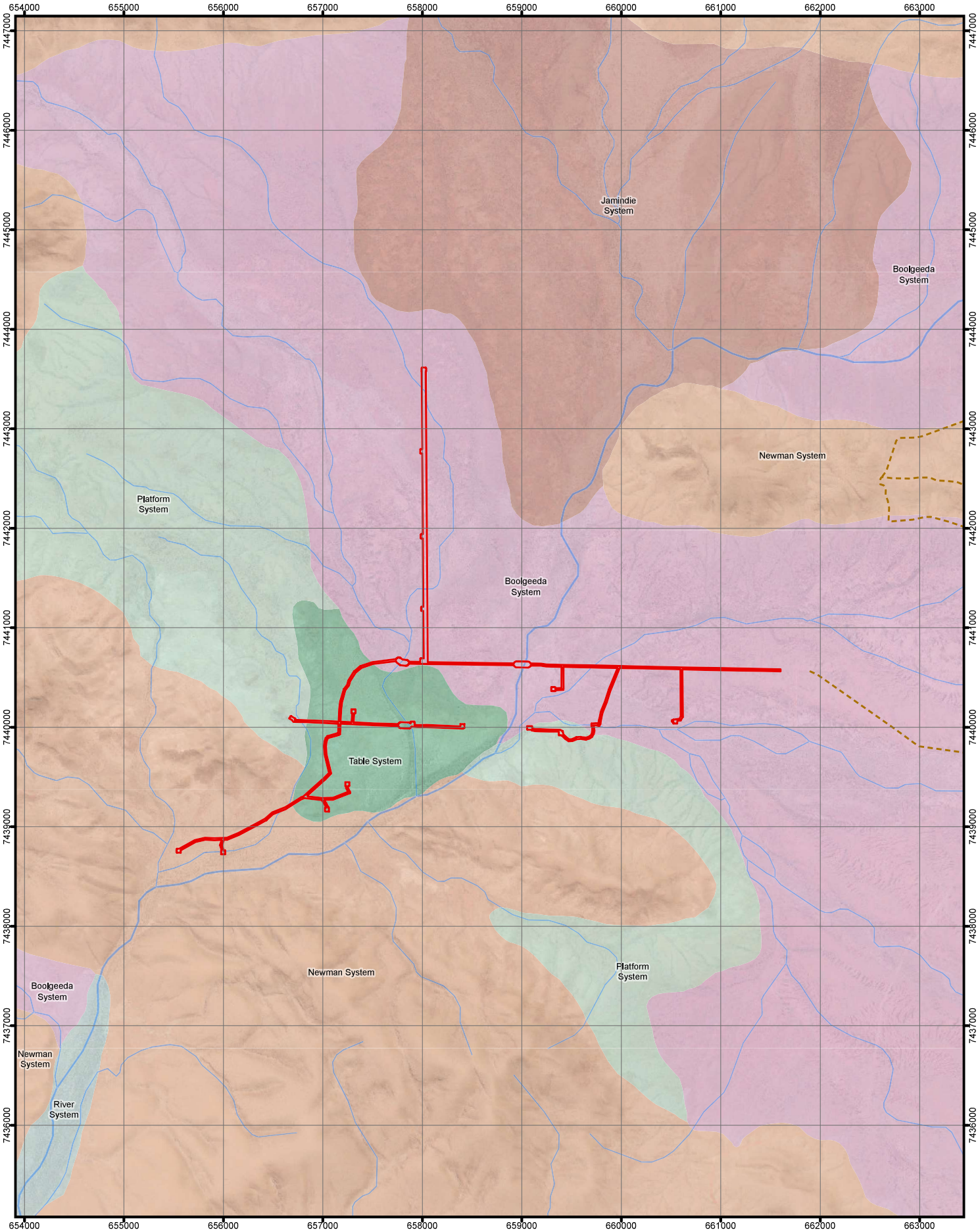
There are 89 recognised IBRA regions across Australia that have been defined based on climate, geology, landforms and characteristic vegetation and fauna (DoEE 2012; IBRA7). The Pilbara bioregion is further divided into four subregions, with the survey area located in the Hamersley subregion.

The Hamersley subregion, described by Kendrick (2001), is the southern section of the Pilbara Craton and consists of a mountainous area of Proterozoic sedimentary ranges and plateaux dissected by gorges. The vegetation consists of Mulga low woodland over bunch grasses on valley floors with *Eucalyptus leucophloia* over *Triodia* on skeletal soils of ranges. Rare features of the subregion include the Gorges of the Hamersley Range (particularly in Karijini National Park), Palm Spring and Duck Creek, *Themeda* grasslands of the Pilbara, and Red Hill Station Mulga stands in the extreme west of the subregion.

2.3 Land Systems

Four land systems have been mapped within the survey area (van Vreeswyk et al. 2004) (Figure 3):

- Boolgeeda System – stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands
- Table System – low calcrete plateaux, mesas and lower plains supporting mulga and cassia shrublands and minor spinifex grasslands
- Platform System – dissected slopes and raised plains supporting shrubby hard spinifex grasslands
- Newman System – rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.



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LEGEND
- Survey Area

Land Systems
- Boolgeeda System
- Jamindie System
- Newman System
- Platform System
- River System
- Table System

Land Systems

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KARIJINI MONITORING BORES
NATIVE VEGETATION CLEARING PERMIT

Figure
3

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2.4 Geology and Soils

The survey area lies in the Fortescue Province which is described at a regional level by Tille (2006) as hills and ranges (with stony plains and some alluvial plains and sandplains) on the volcanic granitic and sedimentary rocks of the Pilbara Craton. Soils are stony with red loamy earths and red shallow loams (and some red/brown non-cracking clays), red deep sandy duplexes and red deep sands (Tille, 2006).

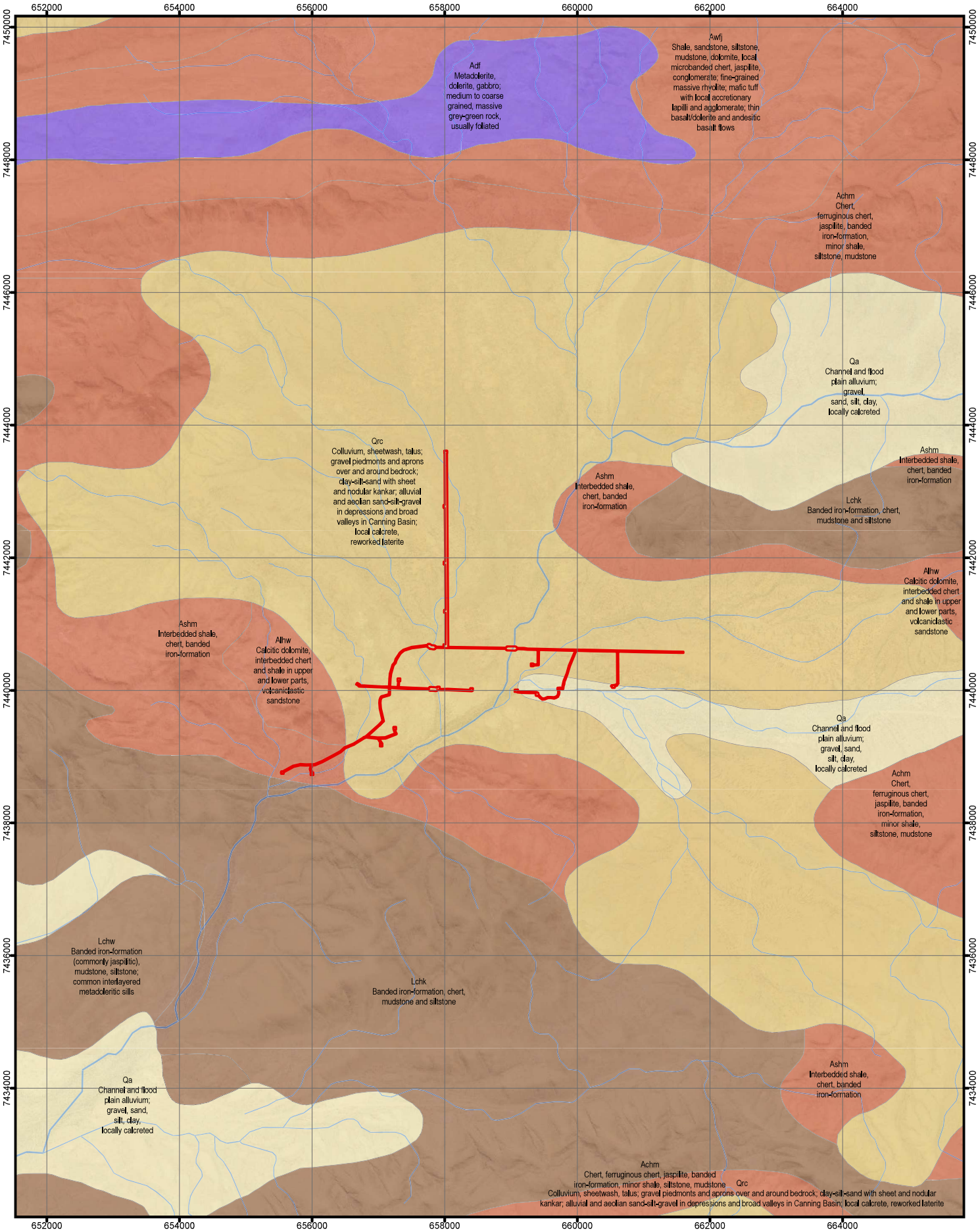
Three geological units intersect with the survey area (Table 1; Figure 4).

Table 1 Geological Units that Occur Within the Survey Area (Geological Series WA 2001)

Unit Code	Geological Description
Ahw	Calcitic dolomite, interbedded chert and shale in upper parts and lower parts, volcaniclastic sandstone.
Qa	Channel and flood plain alluvium, gravel, sand, silt, clay, locally calcreted.
Qrc	Colluvium sheetwash talus; gravel piedmonts and aprons over and around bedrock; clay-silt-sand with sheet and nodular kankar; alluvial and aeolian sand-silt-gravel in depressions and broad valleys in Canning Basin; local calcrete, networked laterite.

The survey area intersects with four soil types (Figure 4):

- 285Ta: calcareous shallow loam
- 285Pl: stony soil
- 285Ne stony soil
- 285Bg red shallow loam.



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LEGEND

Survey Area

Surface geology of Australia 1:1,000,000 scale, Western Australia (Geoscience Australia)

QUATERNARY
- Qa
- Qrc

PALEOPROTEROZOIC
- Lchk
- Lchw

ARCHEAN
- Alhw
- Ashm
- Adf
- Awfj
- Achm

Geology

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KARIJINI MONITORING BORES NATIVE VEGETATION CLEARING PERMIT

Figure 4

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2.5 Vegetation

Beard (1975) mapping is used to determine the current extent of remnant vegetation remaining when compared to pre-European vegetation extent (Table 2; Figure 5). There are two pre-European vegetation associations within the survey area, all of which have more than 99% of pre-European native vegetation remaining.

Table 2 Pre-European Vegetation Associations (Beard 1975) Extent Within the Survey Area (rounded to whole number) Including Percentage of pre-European Extent Remaining (Govt. of WA 2018)

Association Description		State	Pilbara IBRA Region	Shire of East Pilbara
18 Low woodland; mulga (*Acacia aneura*)	Pre-European Extent	19,892,306 ha	676,557 ha	359,372 ha
	Current Extent	19,843,148 ha	671,843 ha	355,446 ha
	% Remaining	99.75 %	99.30 %	98.91 %
	Within Survey Area	37.83 ha		
82 Hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*	Pre-European Extent	2,565,901 ha	2,563,583 ha	927,710 ha
	Current Extent	2,553,206 ha	2,550,888	919,072 ha
	% Remaining	99.51 %	99.50%	99.07%
	Within Survey Area	1.76 ha		

2.6 Conservation Reserves and Environmentally Sensitive Areas

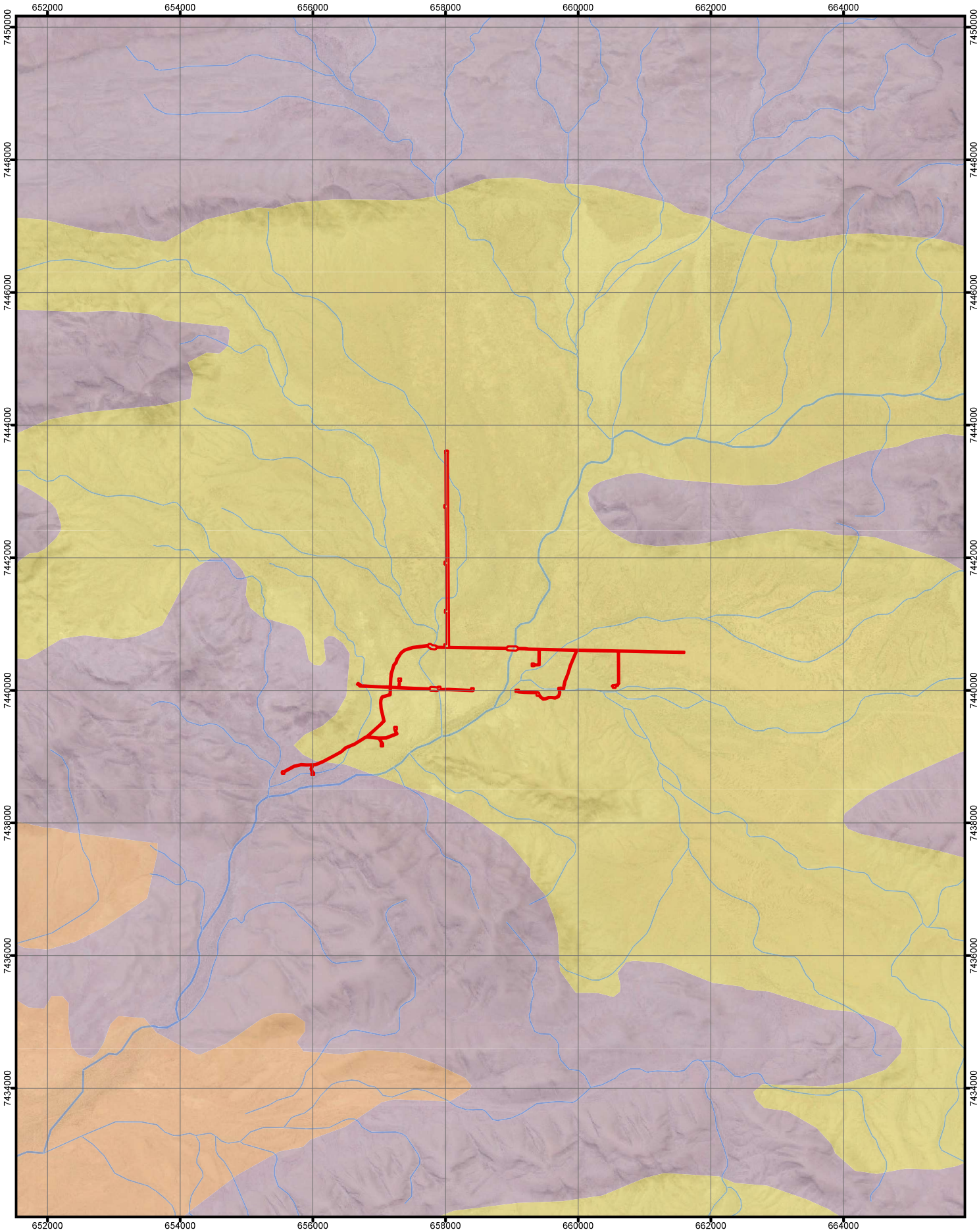
The survey area is wholly within Karijini National Park. Karijini National Park offers rugged scenery, ancient geological formations, a variety of arid-land ecosystems and recreational experiences (DPaW, 2022). The Park includes 627,422 ha in the Hamersley Ranges and includes mountains, escarpments, high plateaus dissected by gorges and stony, tree-lined watercourse (DPaW, 2022).

One reserve, unnamed reserve WA 41696 is located in the study area (50 km buffer of the survey area).

There is one ‘registered site’ and two ‘other heritage place’ listings near the study area:

- Site 11174 – registered site, painting
- Site 24376 – other heritage place, lodged artefacts / scatter
- Site 24373 – other heritage place, lodged artefacts / scatter.

These places are shown on Figure 6.



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LEGEND

Survey Area

Pre-European Vegetation (DPIRD-006)

18: Mulga *Acacia aneura* and associated species.

82: Hummock grassland with scattered bloodwoods and snappy gum *Triodia* spp., *Corymbia dichromophloia, Eucalyptus leucophloia*

169: Wattle, teatree and other species *Acacia spp. Melaleuca spp.*

Pre-European Vegetation

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Figure
5

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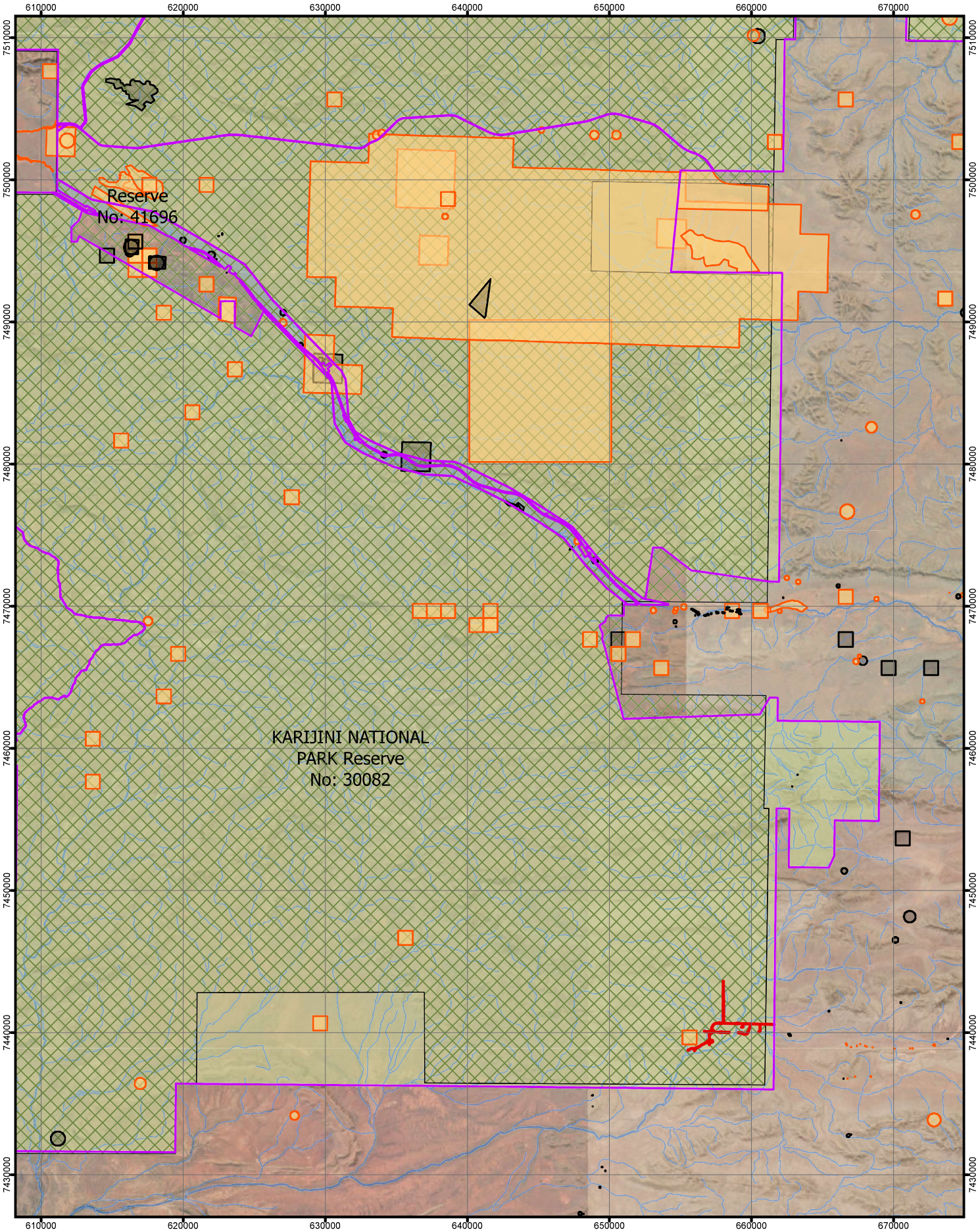

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WMS:

LEGEND

- Survey Area
- Aboriginal Heritage Places (DPLH-001)
  - Registered Site
  - Lodged
- Clearing Regulations - Environmentally Sensitive Areas (DWER-046)
- Reserves (LGATE-227)
- DBCA - Legislated Lands and Waters (DBCA-011)
  - Karijini National Park
  - Section 5(1)(g) Reserve

Heritage and Conservation Estates

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KARIJINI MONITORING BORES NATIVE VEGETATION CLEARING PERMIT

Figure
6

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3.0 Previous Surveys

Two ecological surveys that are directly relevant to this Project have been undertaken (Table 3). The most significant findings were in the Rio Tinto (2020) survey where 13 Priority flora were recorded in close proximity to the survey area.

Table 3 Previous Surveys Conducted in the Vicinity of the Survey Area

Author	Title and Short Description	Significant Findings
Astron 2020	West Angelas Desktop Mapping – December 2020 Letter report prepared for a section 45C for the MAR study area.	Vegetation: none significant Flora: not applicable Fauna: not applicable
Rio Tinto 2020	Karijini National Park, HD4 and Juna Downs Flora Searches, RTIO-HSE-0348764. Targeted survey by Hayden Ajduk and Natalie Murdock in the vicinity of this survey area.	Vegetation: not applicable Flora: 13 Priority flora recorded (see comprehensive desktop results in Appendix B. Fauna: not applicable

4.0 Methodology

4.1 Desktop Assessment

A desktop assessment was undertaken to identify significant environmental values that are likely to be present in the survey area including Threatened and Priority flora, fauna and vegetation communities. Desktop database searches were requested from the following government databases:

- Department of Biodiversity Conservation and Attractions (DBCA) Threatened Species and Communities database including Threatened and Priority flora, fauna and communities with a 50 km buffer, although some fauna species are outside this buffer
- Western Australian Herbarium (WAH) records
- Protected Matters Search Tool (PMST) with a 50 km buffer
- Atlas of Living Australia with approximate 20 km buffer
- Rio Tinto Flora and Fauna Database.

Fauna species listed as Marine were not further considered for this Project.

The likelihood of significant flora species occurring in the survey area was systematically assessed using a point-based system (Table 4). The assessment takes into account proximity of records, date of record, and habitat presence. For the purpose of this assessment flora records are considered to occur locally if they are within 5 km, known regionally if they are within 20 km, and considered a recent record if the record is less than 20 years old.

The fauna assessment uses distance of known records with 50 km and 20 km as indicators, and presence of quality habitat including consideration of core (breeding, roosting), foraging, and/or specific unique habitat (Table 5).

Table 4 Categories of Likelihood of Occurrence for Flora Species

Likelihood of Occurrence	Score	Definition
Known	6	Species known to occur in survey area.
Likely	4, 5	Suitable habitat present AND recent record in local area or region
Possible/May	3, 4	Suitable habitat present with known records in region (not recent), OR Habitat marginal with recent record in local area or region.
Unlikely	2, 3	Habitat marginal and record in region AND/OR local area AND/OR recent.
Negligible (Suitable Habitat not Present)	1, 2, 3	Habitat in survey area not suitable.

Table 5 Categories of Likelihood of Occurrence for Fauna Species

Likelihood of Occurrence	Definition
Known	Species has been recorded in the survey area. Suitable habitat is present.
Likely	Species has been recorded in vicinity (20km). Suitable habitat is present, including core/breeding/roosting habitat.
Possible	Species has been recorded in the study area (50km) Suitable habitat for foraging is present. Core/breeding/roosting habitat is absent
Unlikely	Foraging, breeding or roosting habitat absent. Species dependent on specific habitat that is absent. Survey area outside known range of species.

4.2 Flora and Vegetation Assessment

A reconnaissance flora and vegetation assessment was undertaken utilising methods outlined in the EPA (2016) Flora Survey Technical Guide. The field survey was undertaken by Floora De Wit (collection permit FB62000137), Caroline Gill (collection permit FB620000151) and Julijanna Hantzis (collection permit FB62000132-1b). Floora and Carrie have more than 10 years' experience and Julijanna has more than 4 years' experience undertaking field surveys in the Pilbara.

The field survey was undertaken between 21 to 24 March 2022. Floristic data was collected from 20 relevés including the presence of plant species, their cover abundance, structural composition of vegetation, physical environment, and presence/absence of disturbance. Each site was given a unique site number, and the following parameters recorded:

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

4.2.1 Mapping

Approximately 15-30 minutes was spent searching at each relevé. Vegetation communities were described and mapped based on changes in dominant species composition and landform. Vegetation community descriptions were based on the National Vegetation Information System (NVIS) framework (DotEE 2018).

Vegetation condition was mapped using the Trudgen (1988) condition scale, including Excellent, Very Good, Good, Poor, Degraded and Completely Degraded.

4.2.2 Targeted Flora Searches

Targeted searches were undertaken for conservation significant flora species considered likely to occur. This was informed by the desktop assessment and included:

- *Aristida jerichoensis* var. *subspinulifera* (P3)
- *Eremophila pusilliflora* (P2)
- *Grevillea saxicola* (P3)
- *Lepidium catapycnon* (P4)
- *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3)
- *Sida* sp. Barlee Range (S. van Leeuwen 1642) (P4)
- *Solanum kentrocaule* (P3)
- *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (P3).

Linear traverses were walked approximately 20 m apart in areas of likely habitat. The Rio Tinto & DPAW 'Rare and Priority Plants of the Pilbara' mobile app (2015) and descriptions of each species were used to support identification of specimens in the field.

Significant flora species were marked using a hand-held GPS, a collection was made in representative habitats, photographed, and number of individuals counted where the location represented more than one individual. Samples were submitted to taxonomist Udani Sirisena. Samples that were thought to represent significant flora species were submitted to Steve Dillon for formal identification at the WA Herbarium.

4.3 Fauna Habitat Assessment

A fauna habitat survey was undertaken simultaneously with the flora and vegetation survey. A fauna habitat assessment was completed within each of the defined fauna habitats as informed by on-ground observations and vegetation community mapping. The parameters for assessing fauna habitats include defining the structure, complexity and continuity of the habitat present, and documenting the presence and abundance of habitat features (caves, large mature trees, dense vegetation, rocky hills, open plains, incised creeklines).

The assessment focused on confirming habitat suitability for conservation significant fauna species identified during the desktop assessment, predominantly cave systems and significant landforms.

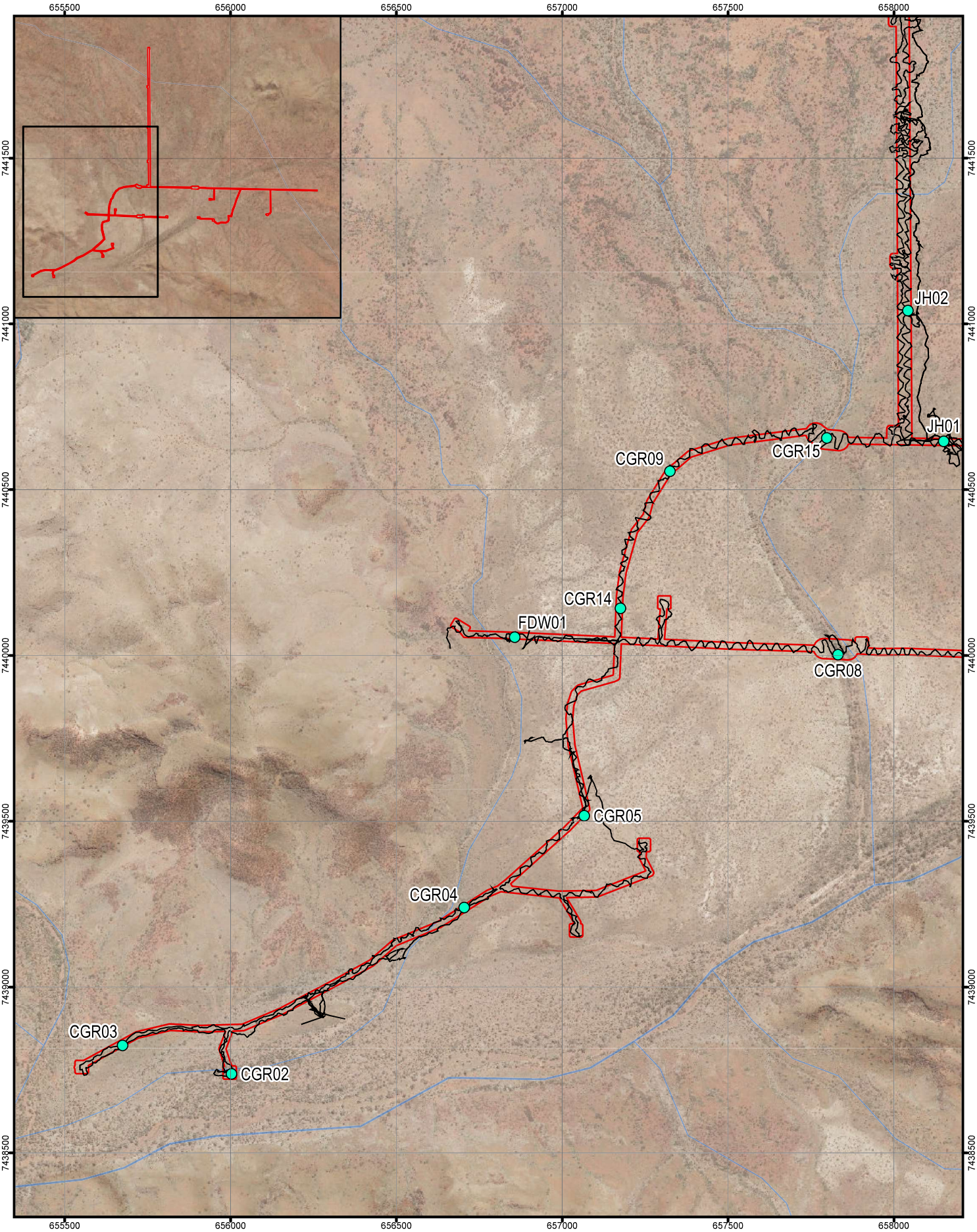
4.4 Limitations

Limitations of the survey are discussed in Table 6.

Table 6 Limitations of the Ecological Surveys

Limitation	Outcome
Availability of contextual information on the region	**Not a limitation** Rio Tinto had recently conducted targeted surveys within 10 km of the survey area, including some overlap of areas. DBCA database results, Atlas of Living Australia and the Protected Matters Search Tool were also used to define potential significant species and habitat that may be present. Local and regional significance of vegetation was based on observations made of vegetation adjacent to the linear corridor, and the assessment of TECs and PECs.
Competency/experience of consultant conducting survey	**Not a limitation** The flora assessment was undertaken by three botanists who have completed surveys of similar scope in the Pilbara. Field team members communicated regularly to ensure a consistent approach was implemented for collecting data. The fauna assessment focussed on identifying unique habitat features and assessing habitat suitability for significant fauna species. Flora taxonomy was completed by Udani Sirisena who somewhat specialises in Pilbara specimens and has considerable experience in taxonomy. Any species unable to be confidently identified were submitted ot Steve Dillon taxonomist at the WA Herbarium for formal identification including potential Priority species.
Proportion of flora/fauna identified, recorded and/or collected (based on sampling, timing and intensity)	**Not a limitation** The entire survey area was traversed on foot and all flora species encountered were recorded and/or collected. The species list is considered comprehensive. Survey effort reflects a hybrid of reconnaissance and detailed flora and vegetation assessment as described by EPA (2016).
Completion (is further work needed)	**Moderate limitation** The field survey did not identify any unusual or surprising results. There were no Priority flora recorded that were unexpected and therefore not accurately counted.

Limitation	Outcome
	The survey effort is considered adequate for the purpose of supporting a NVCP application. No fauna observations were recorded during the survey. The survey focussed on habitat assessments and suitability for use by significant fauna species only. It is considered a moderate limitation because the Priority 3 *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727) was unable to be confirmed due to lack of suitable identification material. This is further addressed under 'timing, weather, season, cycle".
Remoteness and/or access problems	**Not a limitation** The entire survey area was accessible with a helicopter.
Timing, weather, season, cycle	**Moderate limitation** The field surveys were undertaken 21-24 March 2022 which is considered a suitable time for undertaking flora and vegetation surveys according to the EPA (2016) Flora Survey Technical Guide. Lack of rainfall in the months preceding the survey meant that fruiting material for ephemeral species was not common. The Priority 2 species *Eremophila pusilliflora* was able to be correctly identified from old flowers and pedicels. The Priority 3 species *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727) lacked suitable material for confident identification. Flowering period of this species is not listed on Florabase (WAH 1998; Rio Tinto & DPaW 2015) and is anticipated to coincide with rainfall events. The timing of the field survey appeared inadequate to detect this species.
Disturbances (e.g. fire flood, accidental human intervention) which affected results of the survey	**Not a limitation** No disturbances occurred that may have influenced the outcome of the flora and fauna assessment.



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WMS:

LEGEND
- Survey Area
- Survey Sites
- Tracklog

Survey Effort

RIO TINTO GROUP

KARIJINI MONITORING BORES NATIVE VEGETATION CLEARING PERMIT

Figure
7.1

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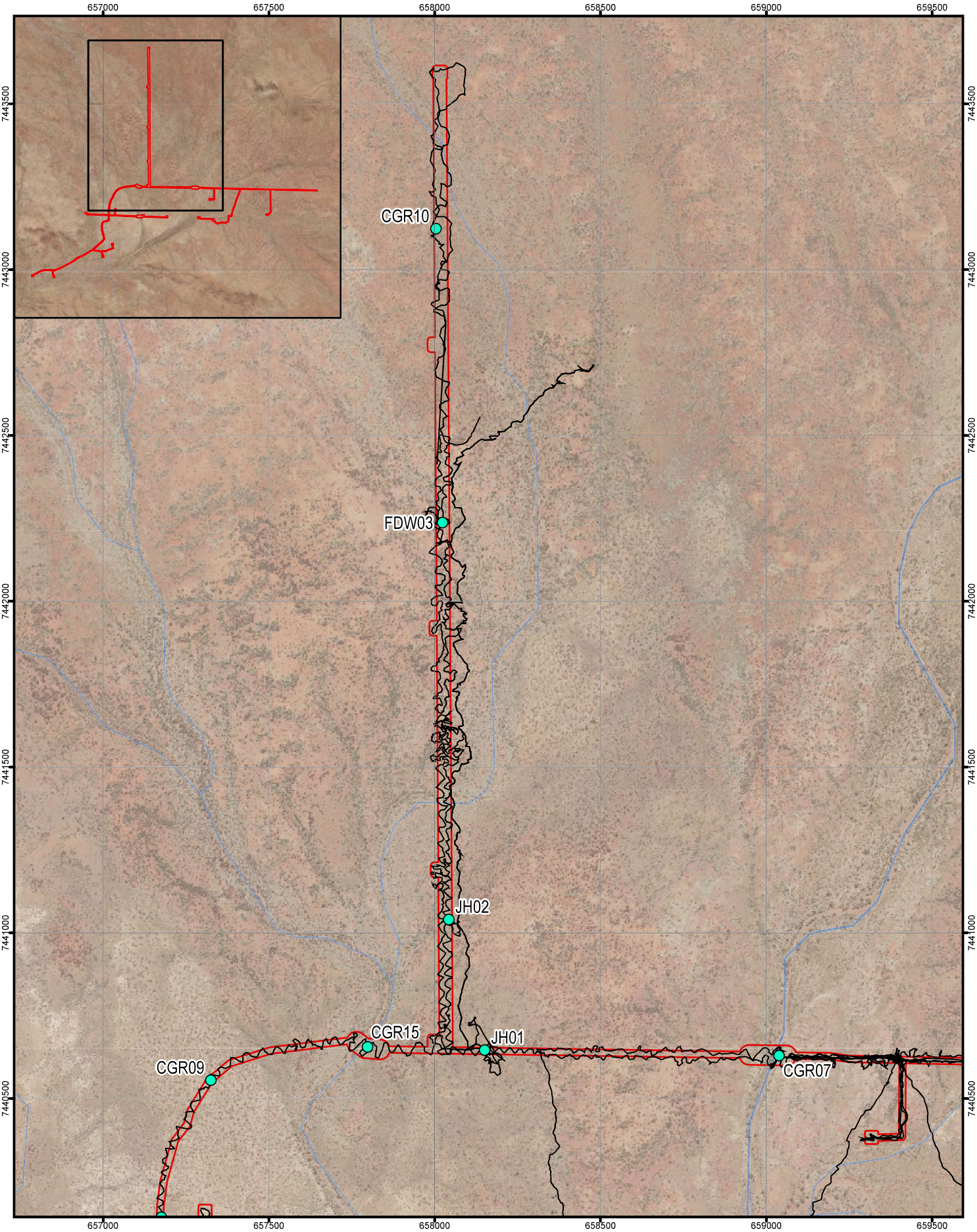

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WMS:

LEGEND
- Survey Area
- Survey Sites
- Tracklog

Survey Effort

RIO TINTO GROUP

KARIJINI MONITORING BORES NATIVE VEGETATION CLEARING PERMIT

Figure
7.2

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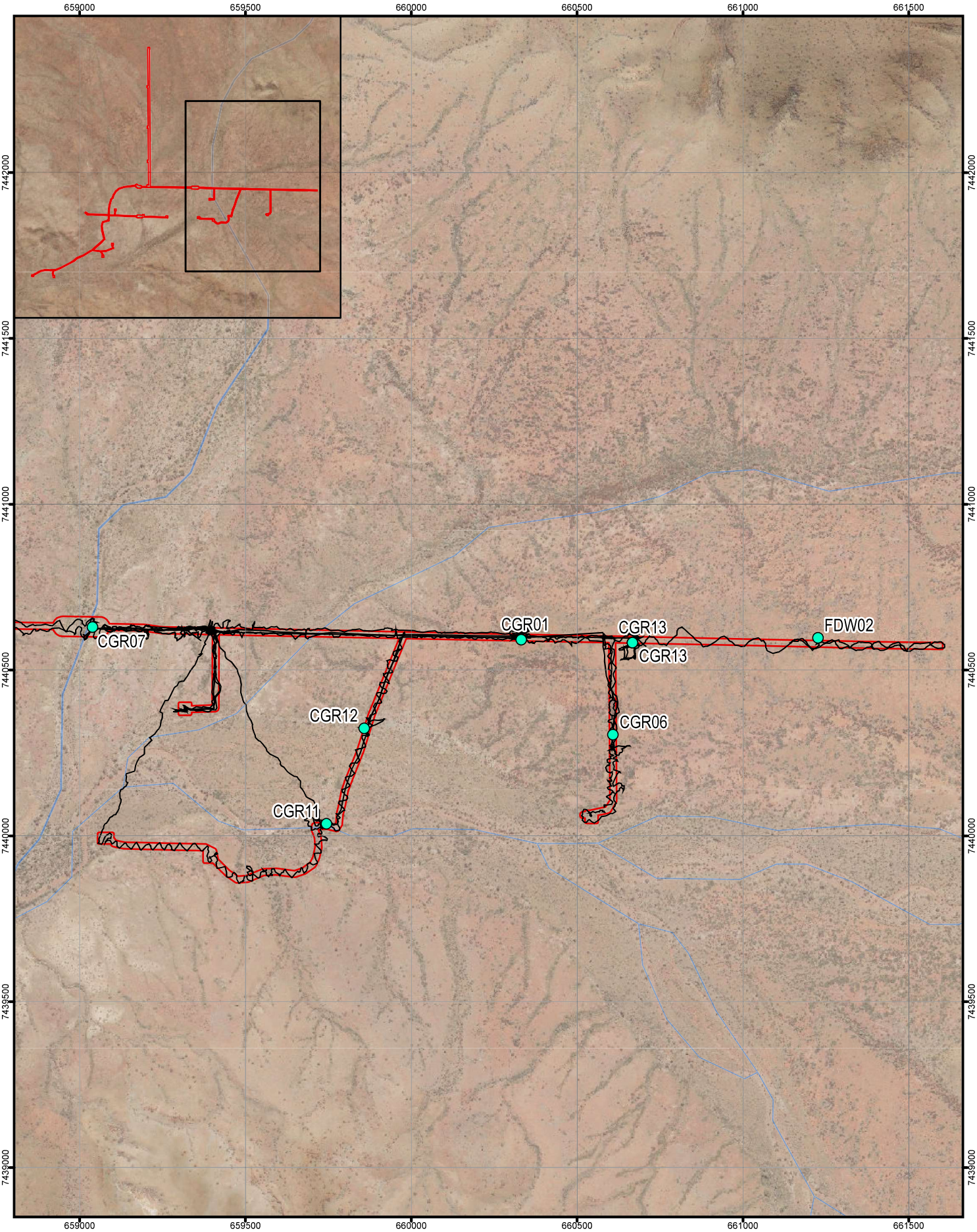

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LEGEND
Survey Area
Survey Sites
Tracklog

Survey Effort

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Figure
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5.0 Desktop Assessment

5.1 Conservation Significant Communities

No Threatened Ecological Communities listed under the EPBC Act or BC Act are known to occur within the local area according to the DBCA Threatened Ecological Community and Priority Ecological Community (TEC and PEC) database. Three Priority 1 PECs are known from within 20 km of the survey area (Table 7). Of these, the Brockman Iron Cracking Clay Communities of the Hamersley Range may occur as there is one record 2.5 km from the survey area (Figure 8.1).

Following field survey completion, no PECs are considered likely to occur.

Table 7 Priority Ecological Communities known to occur within 50 km of the survey area

Community Name and Description (DBCA, 2021)	Cons. Status[1]	Distance from Survey Area	Likelihood	
			Pre-survey	Post-survey
Brockman Iron Cracking Clay Communities of the Hamersley Range	P1	2.5 km	May	Unlikely, not recorded
West Angelas Cracking-Clays Open tussock grasslands of *Astrebla pectinata, A. elymoides, Aristida latifolia*, in combination with low scattered shrubs of *Sida fibulifera*, on basalt (Jerrinah formation) derived cracking-clay loam depressions and flowlines. Occurs throughout the central and eastern Hamersley Range from near Tom Price east to Newman.	P1	6.2 km	Unlikely	Unlikely, not recorded
Coolibah – Lignum Flats: sub type 2: Coolibah woodlands over lignum (*Duma florulenta*) over swamp wanderrie (Lake Robinson)	P1	18.0 km	Unlikely	Unlikely, not recorded

1. P Priority

5.2 Conservation Significant Flora

A total of 78 significant flora species were identified during the desktop assessment including two species listed as Threatened under the EPBC Act and BC Act, and 76 Priority flora. The likelihood assessment determined:

- one species is known to occur based on previous surveys in the area (Rio Tinto 2020), described in Table 8
- Four species are likely to occur, described in Table 8
- eleven species 'may' occur
- sixty-two species are unlikely to occur or have a negligible likelihood, that is there is no suitable habitat present.

Significant flora records are presented in Figure 8.1. The comprehensive species list of the desktop flora results is presented in Appendix B.

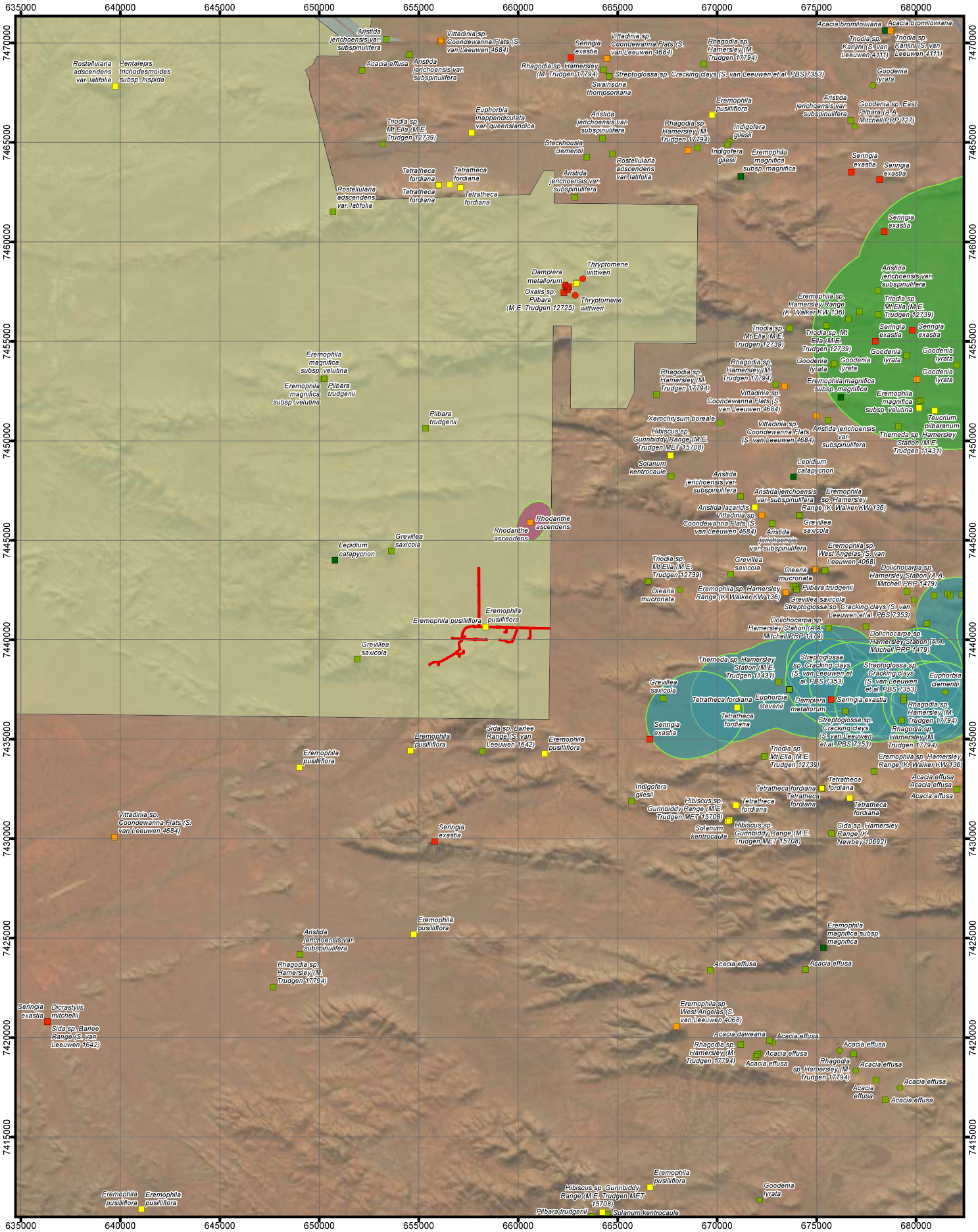
Table 8 Priority Flora Species that were "known" or "likely" to occur

Taxon	Habitat	Cons. Status		Likelihood
		EPBC Act	BC Act/WA	
Aristida jerichoensis var. *subspinulifera*	Hardpan plains.		P3	Likely
Aristida lazaridis	Confined to sand or loam soils. Low open woodland, closed tussock grassland, hummock grassland.		P2	Likely
Eremophila pusilliflora	Found on seasonally inundated alluvial plains between Turee Creek, Pingandy Creek and drainage systems leading into the Ashburton River, growing in red-brown sandy loams soils in open low shrubland (Nuytsia).		P2	Known
Rhagodia sp. Hamersley (M. Trudgen 17794)	Commonly recorded from hardpan plains dominated by Mulga shrubs and trees with the understorey consisting of scattered *Eremophila* spp., *Ptilotus* spp., *Senna* spp. shrubs over annual and perennial grasses. Individuals have been recorded from low hillslopes, stony plains, gullies, low hills, floodplains and claypans.		P3	Likely
Xerochrysum boreale	Loamy, sandy, or gravelly soils in grassland or woodland, sometimes in seasonally inundated areas.		P3	Likely

1. DBCA Priority
2. Sourced from WA Herbarium unless otherwise referenced.

5.3 Conservation Significant Fauna

The desktop assessment identified 30 conservation significant fauna species. This included 17 bird, 4 reptile 8 mammal and one fish species. Their occurrence is mapped in Figure 8 and their habitat requirements, conservation code and post-survey likelihood is presented in Appendix C.



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LEGEND

Survey Area

DBCA Desktop Communities
- Brockman Iron cracking clay communities of the Hamersley Range (Priority 1)
- Coolibah - Lignum Flats: sub type 2: Coolibah woodlands over lignum (Duma florulenta) over swamp wanderrie (Lake Robinson) (Priority 1)
- West Angelas Cracking-Clays (Priority 1)

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

WA Herbarium database (WAHERB)
- Threatened
- P1
- P2
- P3
- P4

DBCA - Legislated Lands and Waters (DBCA-011)
- Karijini National Park
- Section 5(1)(g) Reserve

Conservation Significant Flora Desktop Results

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KARIJINI MONITORING BORES NATIVE VEGETATION CLEARING PERMIT

Figure
8.1

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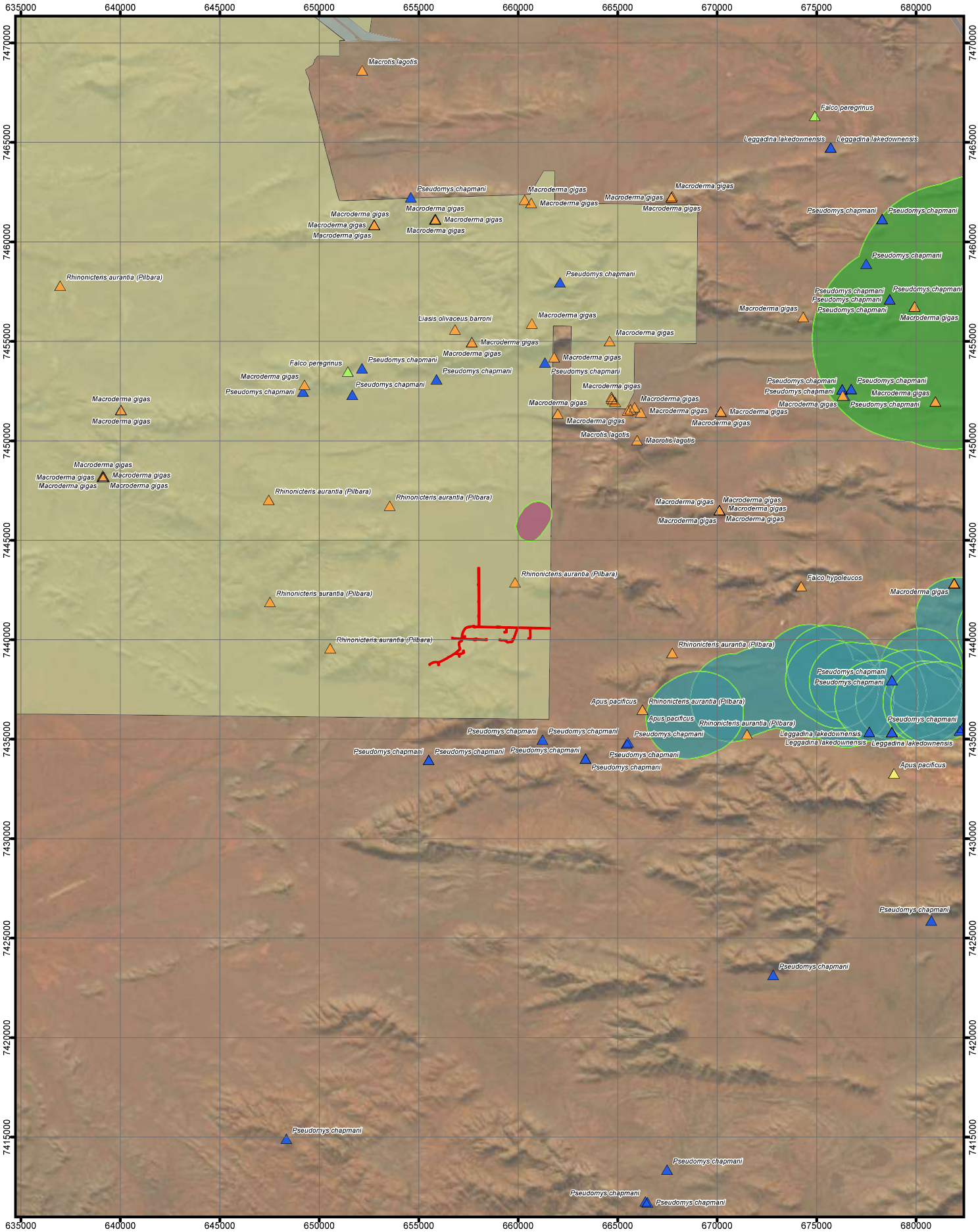

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LEGEND

Survey Area

DBCA Desktop Communities
- Brockman Iron cracking clay communities of the Hamersley Range (Priority 1)
- Coolibah - Lignum Flats: sub type 2: Coolibah woodlands over lignum (Duma florulenta) over swamp wanderrie (Lake Robinson) (Priority 1)
- West Angelas Cracking-Clays (Priority 1)

Threatened Fauna database (DBCA)
- Vulnerable
- Migratory Species
- Specially Protected
- Priority 4

DBCA - Legislated Lands and Waters (DBCA-011)
- Karijini National Park
- Section 5(1)(g) Reserve

Conservation Significant Fauna Desktop Results

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KARIJINI MONITORING BORES NATIVE VEGETATION CLEARING PERMIT

Figure
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6.0 Field Survey Results

6.1 Vegetation

6.1.1 Condition

Vegetation condition was considered excellent for all areas of native vegetation in the survey area. A few tracks have been captured as ‘cleared’, representing 0.92 ha of old tracks devoid of vegetation. Vegetation condition is not represented on a figure for this report.

6.1.2 Communities

Five vegetation communities were described and mapped across 38.66 ha:

- three Hummock Grasslands on undulating and flat terrain
- one Mixed Woodland associated with major and minor drainage lines
- one Mulga Woodland on red clay flats.

The vegetation communities recorded in the survey area are described in Table 9 and mapped in Figure 10 at the end of this document.

Table 9 Vegetation Community Descriptions and Photographs

Description	Additional Detail	Photograph
AcPlEa W1 *Acacia citrinoviridis, Eucalyptus victrix* and *Eucalyptus camaldulensis* low open woodland over *Petalostylis labicheoides, Acacia pyrifolia* and *Acacia bivenosa* tall open shrubland over *Eulalia aurea, Eriachne helmsii* and *Enneapogon lindleyanus* low open tussock grassland. Represents major drainage line and tributaries thereof. Includes patches of **Cenchrus ciliaris*. Density of trees varies along creek.	Survey effort: five relevés CGR2, CGR7, CGR8, CGR11, CGR15 Species richness: 56 native and 2 weed species	
EtAbTw G1 *Eucalyptus trivalva, Acacia macraneura* and *Acacia pruinocarpa* isolated low trees over *Acacia bivenosa, Senna artemisioides* subsp. *oligophylla* and *Capparis lasiantha* mid sparse shrubland over *Triodia wiseana* and *Triodia longiceps* low hummock grassland. On lower slopes and undulating terrain. Soils are rocky and include some calcrete on surface in places.	Survey effort: six relevés CGR3, CGR4, CGR5, CGR9, CGR14, JH02 Species richness: 45 native and 1 weed species	

Description	Additional Detail	Photograph
SaTw G2 *Senna artemisioides* subsp. *helmsii x oligophylla*/*oligophylla, Acacia bivenosa* and *Acacia* sp. mid to low isolated shrubs over *Triodia wiseana* and occasional *Triodia longiceps* low hummock grassland. Recorded on flat to undulating terrain with red clay loam with rocks on surface.	Survey effort: three relevés FDW01, FDW02, JH01 Species richness: 26 native species	
ApAbTe G3 *Acacia pruinocarpa, Acacia aptaneura* and *Codonocarpus cotinifolius* low open to sparse trees over *Acacia bivenosa, Ptilotus obovatus* and *Senna artemisioides* subsp. *oligophylla* mid to low sparse shrubland over *Triodia epactia* low hummock grassland. Associated with floodplains and terraces next to major drainage. Includes gravel surface on red clay loams.	Survey effort: two relevés CGR1, CGR6, CGR10, CGR12 and CGR13 Species richness: 53 native species	

Description	Additional Detail	Photograph
AmReTl M1 *Acacia macraneura* and *Acacia pruinocarpa* mid isolated trees over *Rhagodia eremaea* and *Acacia tetragonophylla* mid to low sparse shrubs over *Triodia longiceps, Enneapogon lindleyanus* and *Themeda triandra* low isolated clumps of tussock and hummock grasses. This community occurs intermittently with open bare areas on red clay loam flats with some small rocks on surface. Includes population(s) of *Eremophila pusilliflora* (P2).	Survey effort: one relevé FDW3 Species richness: 35 native and one weed species	

6.2 Flora

6.2.1 Conservation Significant Flora

Two Priority flora species were recorded, described in detail below.

***Eremophila pusilliflora* (P2)**

E. pusilliflora was recorded extensively within and outside the survey area (Figure 9.1-9.3). The data suggests at least three populations with up to three sub-populations where clusters of records are within 500 m of one another. A total of 2,794 individual were recorded, of which 1,107 occur inside the survey area.

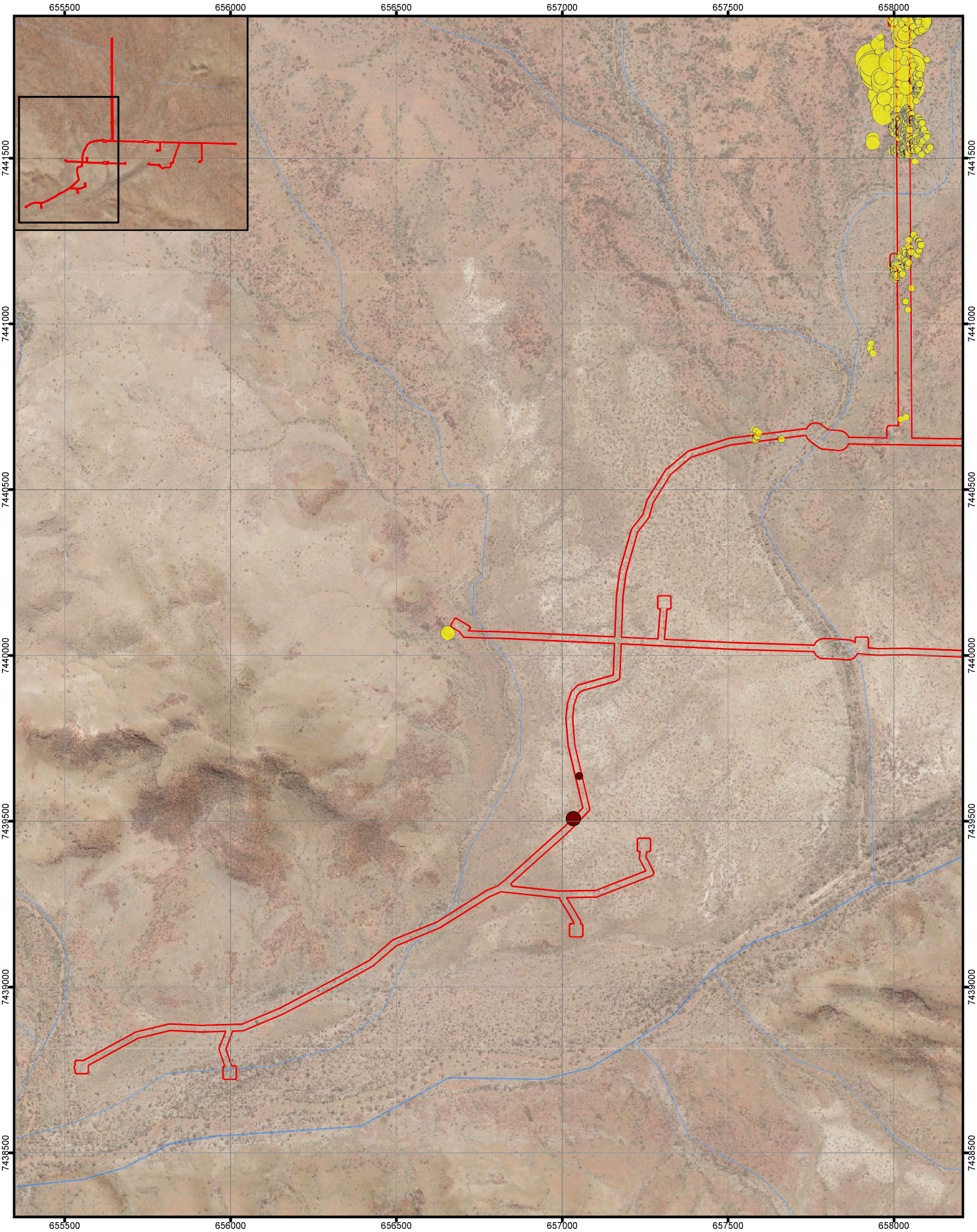
E. pusilliflora was considered likely to occur prior to commencing the field survey. Rio Tinto had undertaken regional targeted surveys for this species and recorded it at 108 locations representing 2,776 individuals within and directly adjacent to the survey area (see Figure 8).

This species was found on rocky undulating terrain amongst hummock grasses and Mulga Woodlands. Some specimens were in flower or had remains of old flowers (Plate 1). The morphological features of the leaves and flowers led to correct and confident identification in the field. Six samples were collected from within and outside the survey area (FdW220323-17, FdW22032, 4-40, JH-02, JH-73, JH-75, JH-76) and verified by Steve Dillon at the WA Herbarium.

Plate 1 *Eremophila pusilliflora* habitat (left) and shrub leaf morphology (right)

***Goodenia ?*sp. East Pilbara (A.A. Mitchell PRP 727) (P3)**

Two *Goodenia* samples were collected (JH25 andJH29) opportunistically during the survey. These were submitted to Steve Dillon for formal identification. No confident identification was possible due to the absence of flowers and fruit. It is noted to be part of the *G. pascua* complex and if growing on calcrete then likely to be this (the Priority 3 species), if not then likely to be *G. pascua*" (Steve Dillon *pers. comm.*). The locations of *G.* sp. East Pilbara (A.A. Mitchell PRP 727) are presented in Figure 9.1.



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LEGEND

Survey Area

Goodenia ? sp. East Pilbara (A.A. Mitchell PRP 727) (P3)
Population Size
1 - 2
3 - 5

Eremophila pusilliflora (P2)
Population Size
1 - 2
3 - 5
6 - 10
11 - 50

Significant Flora

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Figure
9.1

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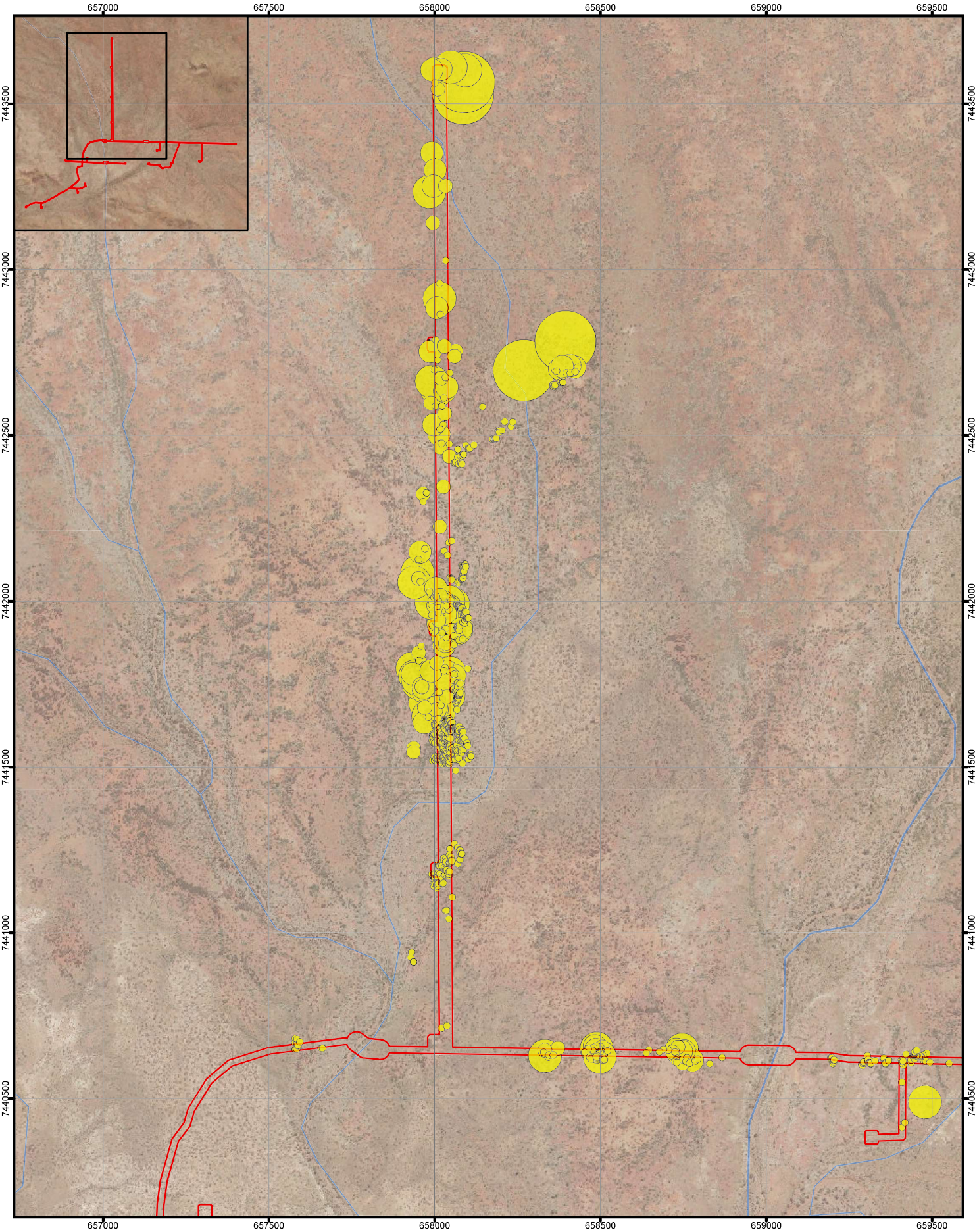

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LEGEND
Survey Area
Eremophila pusilliflora (P2)
Population Size
1 - 2
3 - 5
6 - 10
11 - 50
51 - 100

Significant Flora

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Figure
9.2

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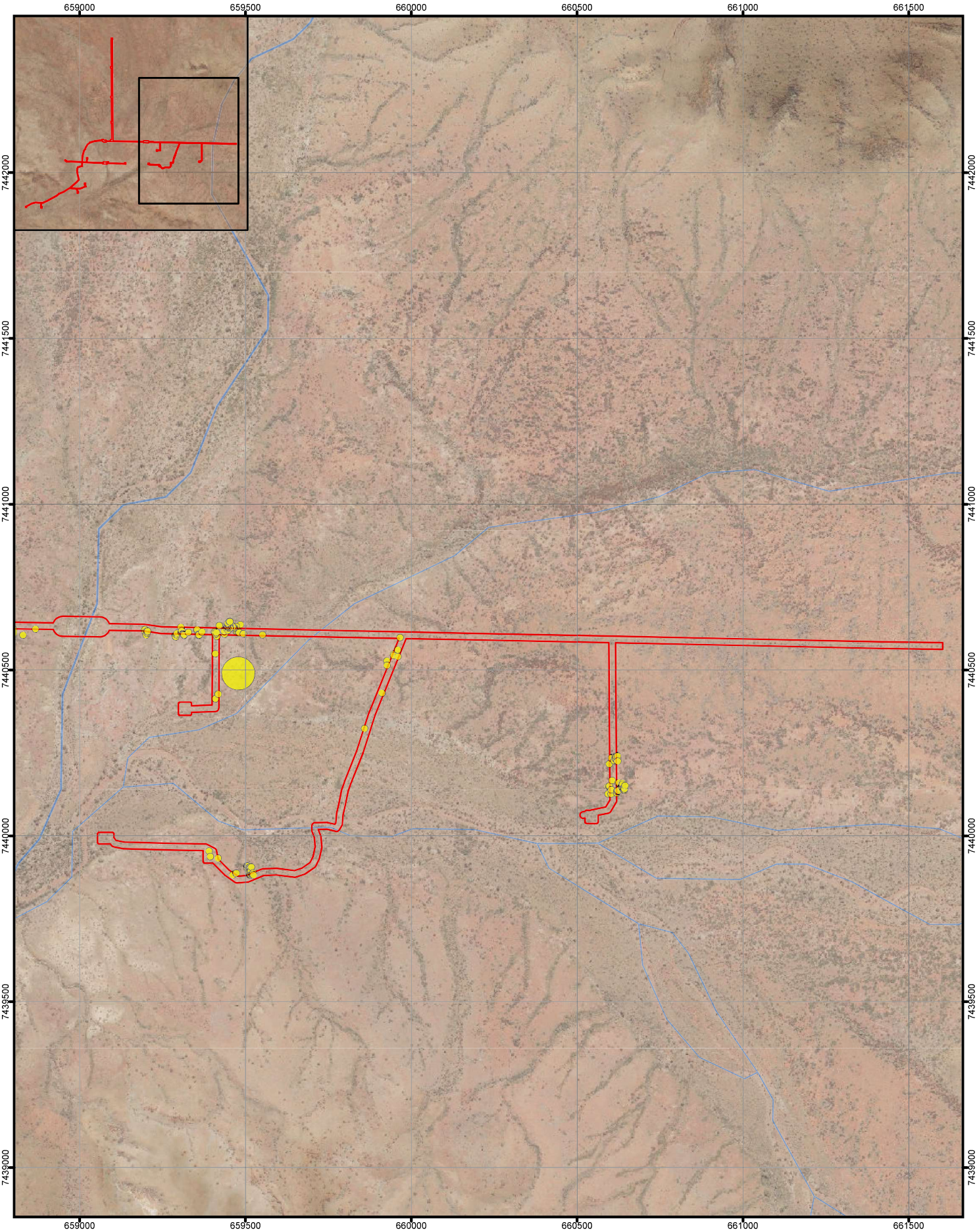

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LEGEND
Survey Area
Eremophila pusilliflora (P2)
Population Size
1 - 2
3 - 5
6 - 10
11 - 50

Significant Flora

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KARIJINI MONITORING BORES NATIVE VEGETATION CLEARING PERMIT

Figure
9.3

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6.2.2 Flora Diversity

A total of 149 native plant species were recorded in the survey area, comprising 70 genera and 33 families. The best represented families include Fabaceae (28 native species), Poaceae (21 native species), Malvaceae (18 native species) and Amaranthaceae (10 native species).

Three weed species were recorded, with **Cenchrus ciliaris* the most common weed species. **Cenchrus ciliaris* was prevalent along the banks of major drainage in small thickets. **Bidens bipinnata* was present in low numbers at two sites, while **Malvastrum americanum* was observed at one location, also associated with drainage. No Declared Pest species or Weed of National Significance was recorded.

The comprehensive species list by relevé by community matrix is presented in Appendix D.

6.3 Fauna Habitat

Three fauna habitats were defined and mapped during the field survey:

- Hummock Grassland: predominantly on rocky undulating terrain, sometimes open flats.
- Major and Minor Drainage: creeklines with tussock grasses, shrubs and trees sometimes with an open creekbed and deep channels.
- Mulga on Clay Flats: bands of mulga over tussock grasses, herbs and shrubs intermittent with large open areas with high bare ground and hummock grasses.

The habitat is suitable for the Priority 4 Western Pebble-mound Mouse *Pseudomys chapmani*, considered likely to occur post-survey. Five significant fauna species are considered likely to, or may, forage in the area. These species are unlikely to roost or breed, but may fly over:

- Ghost Bat *Macroderma gigas* (EPBC Act and BC Act Vulnerable)
- Pilbara Leaf-nosed Bat *Rhinonicteris aurantia* (EPBC Act and BC Act Vulnerable)
- Peregrine Falcon *Falco peregrinus* (BC Act Other specially protected fauna)
- Grey Falcon *Falco hypoleucos* (EPBC Act and BC Act Vulnerable)
- Fork-tailed Swift *Apus pacificus* (EPBC Act and BC Act Migratory).

Fauna habitats are described in Table 10 and mapped in Figure 10.

Table 10 Fauna Habitats of the Survey Area

Description	Conservation Significant Fauna Habitat	Photograph
Hummock Grassland Grasslands on rocky undulating terrain with sparse litter and open to sparse shrub and tree cover. Minimal to no logs present. Includes areas with calcrete and quartz. Soils are skeletal to clay loam with rocks on surface.	Suitable habitat for: - Western Pebble-mound Mouse Suitable foraging habitat for: - Ghost Bat - Pilbara Leaf-nosed Bat - Peregrine Falcon - Grey Falcon - Fork-tailed Swift	
Major and Minor Drainage Ephemeral creeks that intersect existing railway. Includes mature trees in varying densities with some hollows, some logs of moderate size, and moderate density groundcover of tussock grasses, herbs and shrubs. Soils are grey to red and include river stones and pebbles. Leaf litter is medium to high on banks, and sparse in the river bed.	Foraging habitat for: - Ghost Bat - Pilbara Leaf-nosed Bat - Peregrine Falcon - Grey Falcon - Fork-tailed Swift	

Description	Conservation Significant Fauna Habitat	Photograph
Mulga on Clay Flats Red clay flats with stands of Mulga and open bare ground often with a gravelly surface. Understorey density includes tussock and hummock grasses at varying densities. Leaf litter medium to high under Mulga, interspersed with sparse open ground.	Foraging habitat for: - Ghost Bat - Pilbara Leaf-nosed Bat - Peregrine Falcon - Grey Falcon - Fork-tailed Swift	

7.0 Discussion

7.1 Vegetation

Five native vegetation communities were mapped across the linear survey area described as Hummock Grasslands (three types), Mixed Woodland along major drainage, and Mulga Woodland on red clay flats. None of the vegetation communities represent a TEC or PEC in the absence of cracking clays (Brockman Iron Cracking Clay PEC and West Angeles Cracking Clays PEC) and no Coolibah-Lignum Flats were observed.

7.2 Flora

Flora diversity was relatively high, with 149 native flora species recorded. This reflects the survey effort including 20 relevés and opportunistic collecting. The entire survey area was traversed on foot and species not represented in relevés were recorded opportunistically.

Two Priority flora species were recorded including *Eremophila pusilliflora* (P2) and *Goodenia* ?sp. East Pilbara (A.A. Mitchell PRP 727) (P3). *E. pusilliflora* was known to occur in the area from previous surveys (Rio Tinto 2020) and was therefore targeted. Habitat was described as "seasonally inundated alluvial plains between Turee Creek, Pingandy Creek and drainage systems leading into the Ashburton River" (Buirchell & Brown, 2016).

In the survey area *E. pusilliflora* was recorded on rocky undulating terrain amongst hummock grasses and Mulga Woodlands. It was recorded at 1,257 locations representing 2,794 individuals. This habitat was common within and adjacent to the survey area. The 2020 Rio Tinto surveys demonstrate that suitable habitat is prevalent in the local area, with 108 locations representing 2,776 individuals recorded in the study area (50 km radius of survey area).

Goodenia ?sp. East Pilbara (A.A. Mitchell PRP 727) was targeted during the field survey. It was collected at two locations however was unable to be confidently identified due to lack of suitable material. Both collections were made on calcrete and therefore considered likely to represent the Priority 3 species (S. Dillon pers. comm.). The survey area includes a large patch of calcrete skeletal soils (part of G1 – EtAbTw). There are 42 WA Herbarium records and 29 TPFL records from within 50 km (although not within 10 km). Further investigation would be required following suitable rainfall events to verify the identification of this species within the survey area.

The likelihood of conservation significant flora species occurring int eh survey area was reduced for all species previously considered to have a high (likely) or moderate (possible) likelihood ranking. This is supported by significant survey effort for this Program, and the targeted surveys undertaken by Rio Tinto in the vicinity of the survey area. These species are briefly discussed below.

Aristida jerichoensis var. *subspinulifera* (P3) is associated with hard plains. There are 15 DBCA records and 4 Rio Tinto records within 50 km. Hardpan plains were present, including in the form of AmReTl and ApAbTe however no individuals were recorded. Four *Aristida* samples were collected however none represented the P3 species. Following the survey, it is considered unlikely that *A. jerichoensis* var. *subspinulifera* occurs within the survey area.

Aristida lazaridis (P2) grows in low open woodland with tussock or hummock grassland. There are 18 records in the study area, of which one record from 2011 is 15 km from the survey area recorded on a gently inclined plain in low shrubland. It is restricted to sandy or loam soils which were not mapped in the survey area. As such, this species occurrence is reduced to negligible.

Rhagodia sp. Hamersley (M. Trudgen 17794) (P3) was considered likely to occur and was targeted during the field survey. This plant was not recorded. All three survey team members are familiar with the morphology of this species, and it was targeted as part of the survey. It is now considered unlikely to occur.

Xerochrysum boreale is known in the study area from two unverified records with one record from 2012 which is 16 km from the survey area. this species prefers loam, sand or gravel soils in grassland or woodland with WA herbarium records found in typical Mulga woodland in the Pilbara region. This coincides with several vegetation communities including AcPlEa, ApAbTe and AmReTl. Based on the

survey effort of this Program and previous surveys, the likelihood of this species has been reduced to low (unlikely).

7.3 Fauna

The desktop assessment identified 34 conservation significant fauna species including 20 bird, 9 mammal, four reptile and one fish species.

Four conservation significant fauna species were considered to have a high likelihood to occur comprising two Threatened species listed under the EPBC Act and BC Act (Ghost Bat and Pilbara Leaf-nosed Bat), one Priority species (Western Pebble-mound Mouse), and one Other Specially Protected Fauna Species (Peregrine Falcon).

The Ghost Bat *Macroderma gigas* is known from the local area, with 172 DBCA records and more than 7,000 Rio Tinto records known from within 50 km. Several records are less than 10 km away including direct sightings and indirect evidence (scats). Given the proximity of the survey area to suitable roosting habitat (caves, rock crevices) all habitat within and surrounding the survey area is considered suitable foraging habitat but not critical to the survival of the species.

The Pilbara Leaf-nosed Bat *Rhinonicteris aurantia* (Pilbara) was considered to have a high likelihood of occurrence as there are 87 DBCA records in the vicinity including within 20 km and within 20 years. The Bat roosts in caves and old mine shafts which were not recorded within the survey area. However, given the proximity of the survey area to known roosting sites it is likely to forage in the survey area. Habitat in the survey area is homogenous with the adjacent habitat. The species is unlikely to rely on habitat in the survey area for its survival.

The Western Pebble-mound Mouse *Pseudomys chapmani* is a Priority 4 mammal that was considered likely to utilise Hummock Grassland habitat in the survey area. No pebble mounds were recorded during the survey however given the significant number of records in the vicinity (298 DBCA records, 80 Rio Tinto records) it is still considered likely to occur.

The Peregrine Falcon *Falco peregrinus,* Grey Falcon *Falco hypoleucos* and Fork-tailed Swift *Apus pacificus* are bird species listed as significant (Other Specially Protected fauna, Vulnerable and Migratory respectively). There are numerous records of these species in the vicinity of the survey area and they occur in a variety of habitats. These species may fly over and forage in the area. Habitats are homogenous in the vicinity therefore species are unlikely to rely on this habitat for their survival.

8.0 Conclusion

Biological surveys were undertaken for a linear corridor within a corner of Karijini National Park to support a clearing permit application. The surveys included a reconnaissance/detailed hybrid flora and vegetation assessment, fauna habitat assessment and targeted searches for significant flora.

Three botanists assessed the survey area using a helicopter and traversing the entire area on foot. At the time little rainfall had occurred in the local area. This was prevalent by the absence of some ephemeral species and suitable identification material. This was demonstrated by the inability to confidently identify two samples of *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727) that was collected during the survey.

A summary of the results is presented below:

- No TECs or PECs were anticipated to occur and none were identified.
- Five native vegetation communities were recorded, their delineation was supported by comparing the floristic data.
- One Priority 2 species *Eremophila pusilliflora* was confidently identified and recorded throughout the survey area and in areas adjacent to the survey area.
- One Priority 3 species *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727) has a high likelihood of occurring but will need further verification during its flowering period which is assumed to be following significant rainfall.
- Three fauna habitats were recorded. All three habitats are suitable foraging habitat for four significant fauna species listed under the EPBC Act and/or BC Act including the Ghost Bat, Pilbara Leaf-nosed Bat, Peregrine Falcon, Grey Falcon and Fork-tailed Swift
- The Hummock Grasslands are suitable habitat for the Priority 4 Western Pebble-mound Mouse.
- Habitats were homogenous in the local area and did not support any significant features (i.e. caves, rock crevices, breakaways or permanent water bodies). Therefore none of these significant fauna species are anticipated to rely on habitats of the survey area for their survival.

Vegetation communities and fauna habitats were considered common in the local area, extending outside the linear survey area corridor. Habitats and vegetation were therefore not considered unique.

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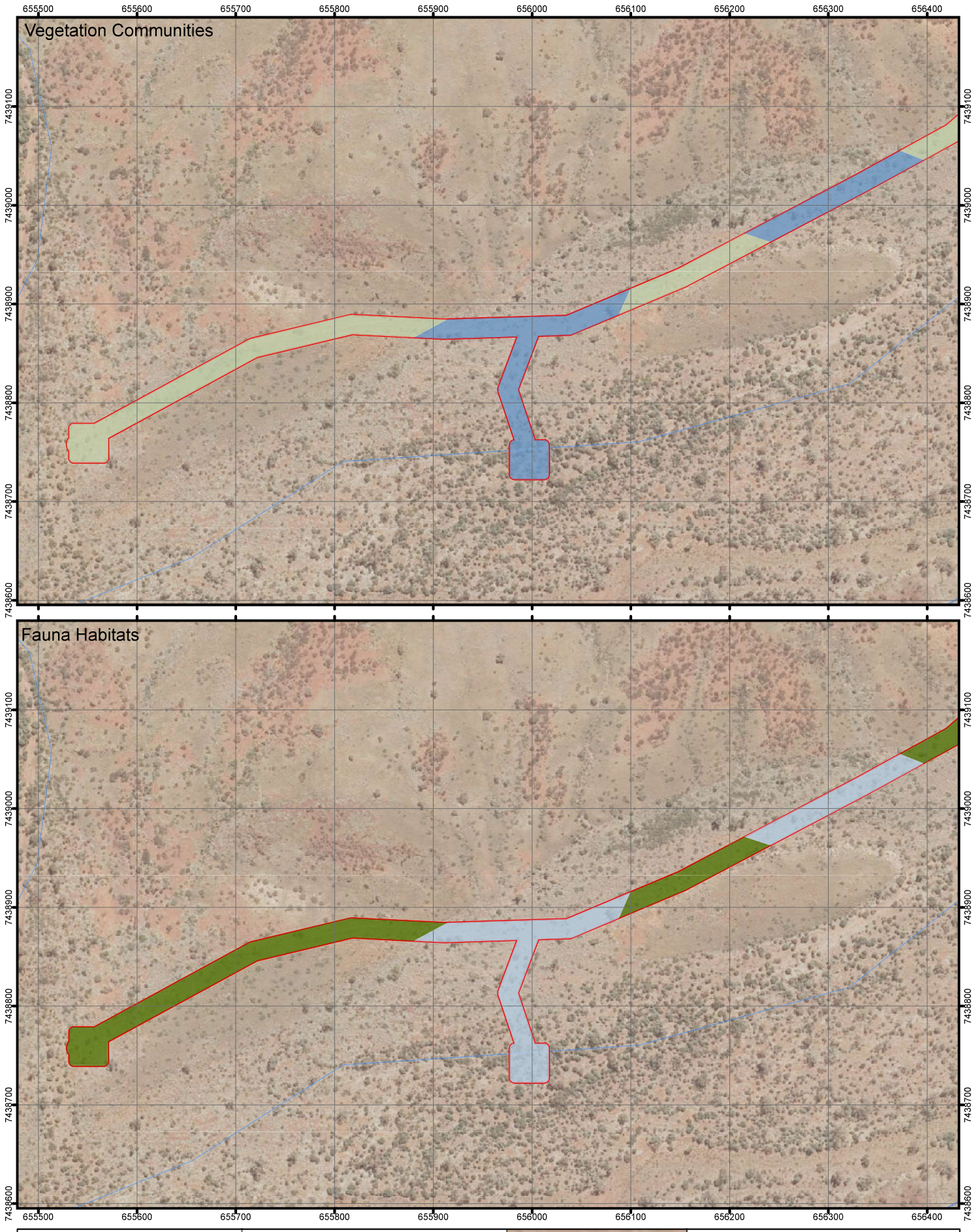

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Veg Code
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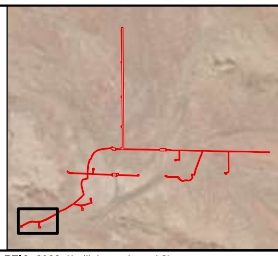
W1
Fauna Habitat
Hummock Grassland
Major and Minor Drainage



Vegetation Communities and Fauna Habitats

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KARIJINI MONITORING BORES NATIVE VEGETATION CLEARING PERMIT

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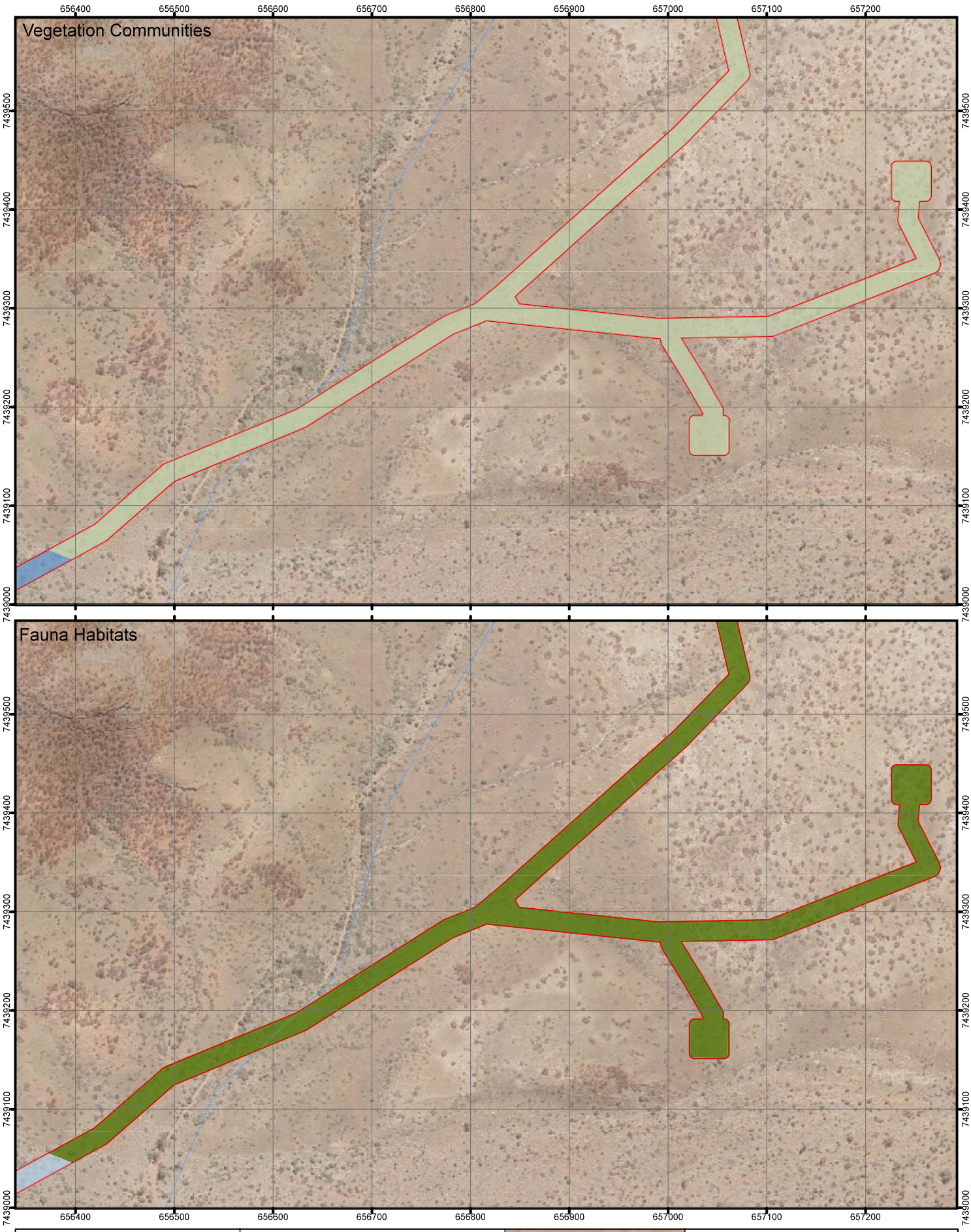

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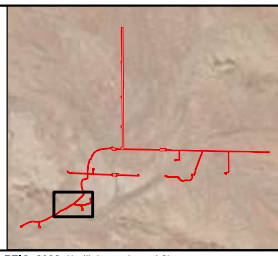
LEGEND
Survey Area
Veg Code
G1
W1
Fauna Habitat
Hummock Grassland
Major and Minor Drainage



Vegetation Communities and Fauna Habitats

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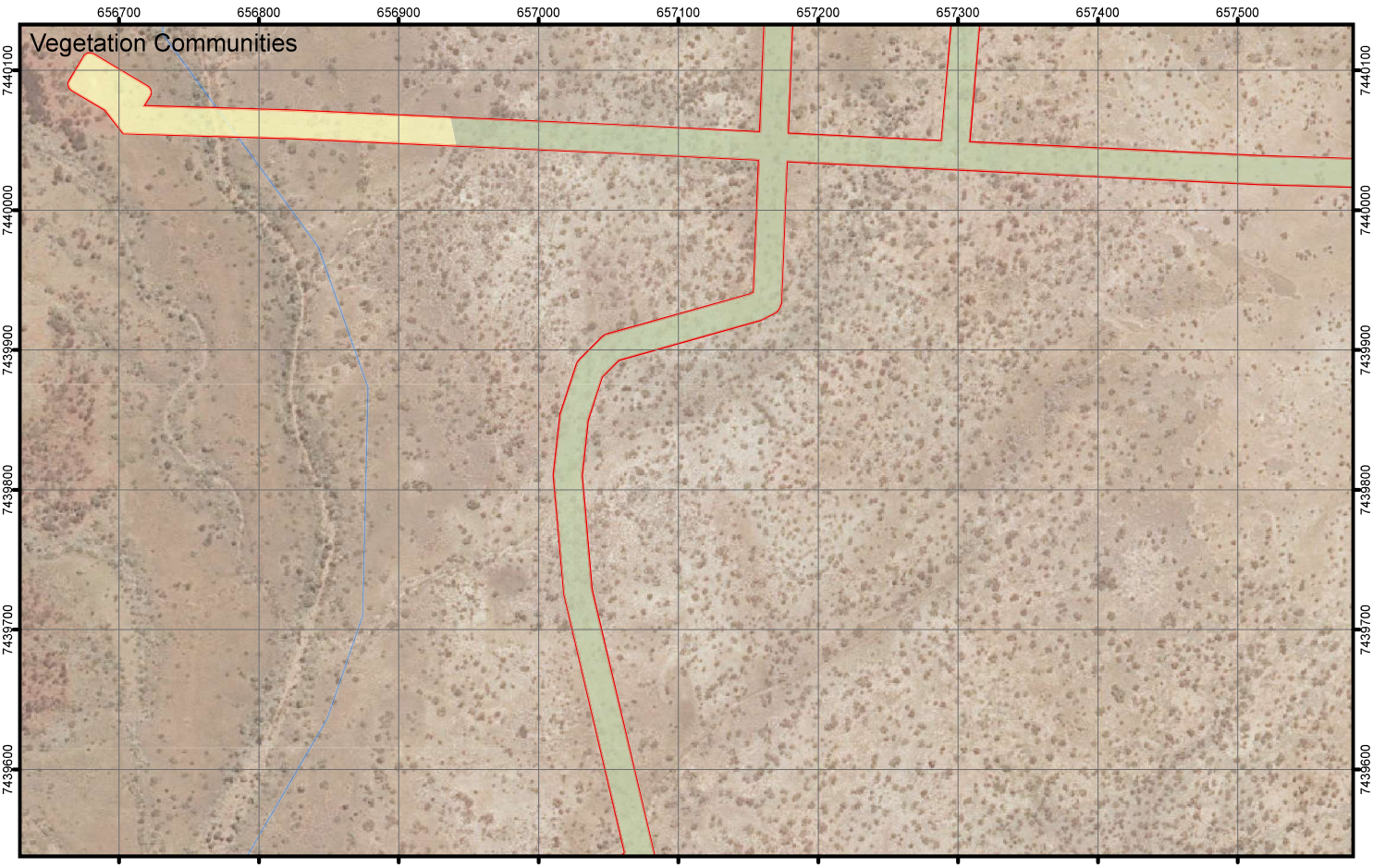

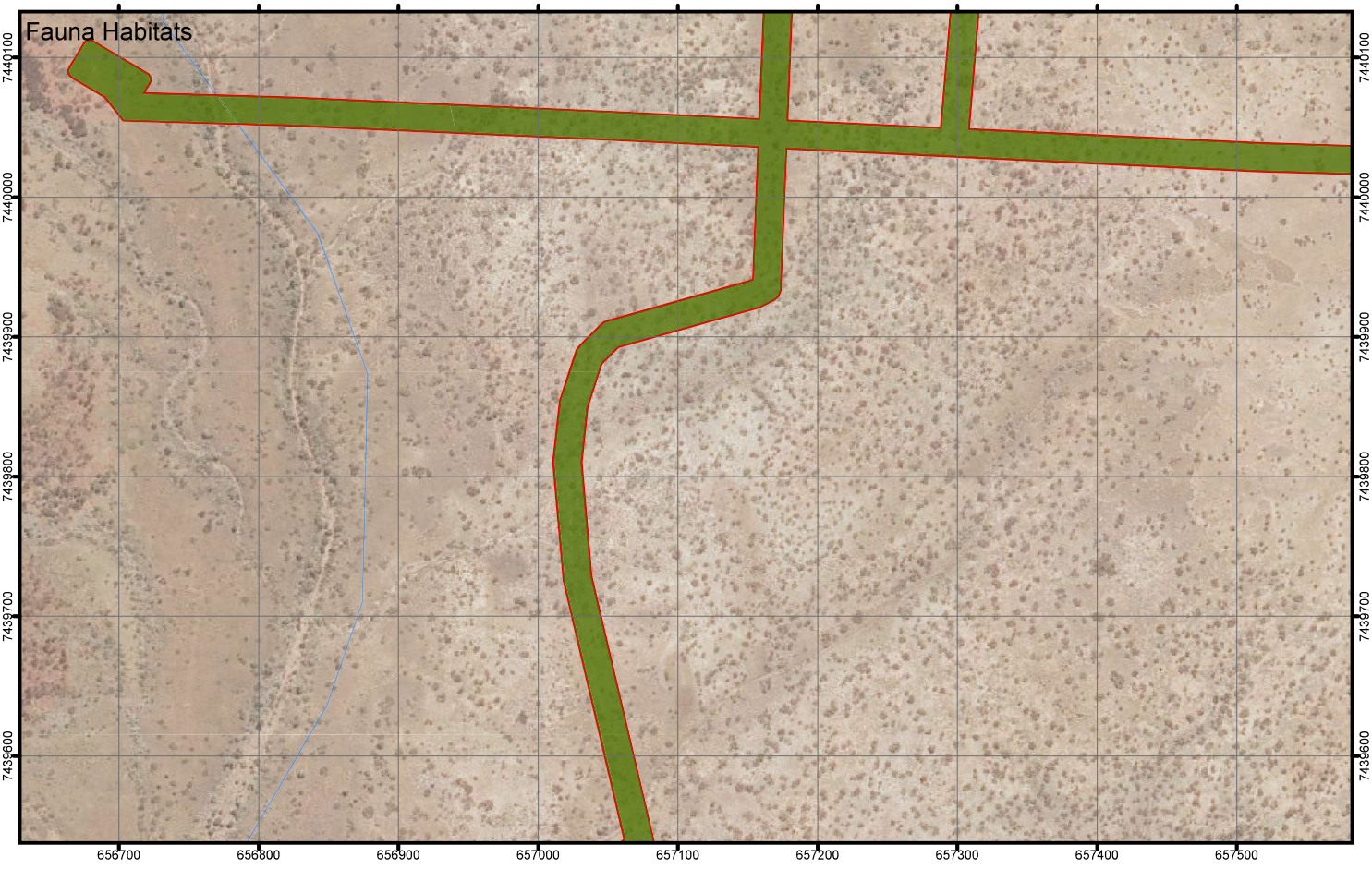

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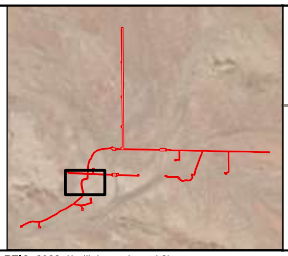
LEGEND
Survey Area
Veg Code
G1
G2
Fauna Habitat
Hummock Grassland



Vegetation Communities and Fauna Habitats

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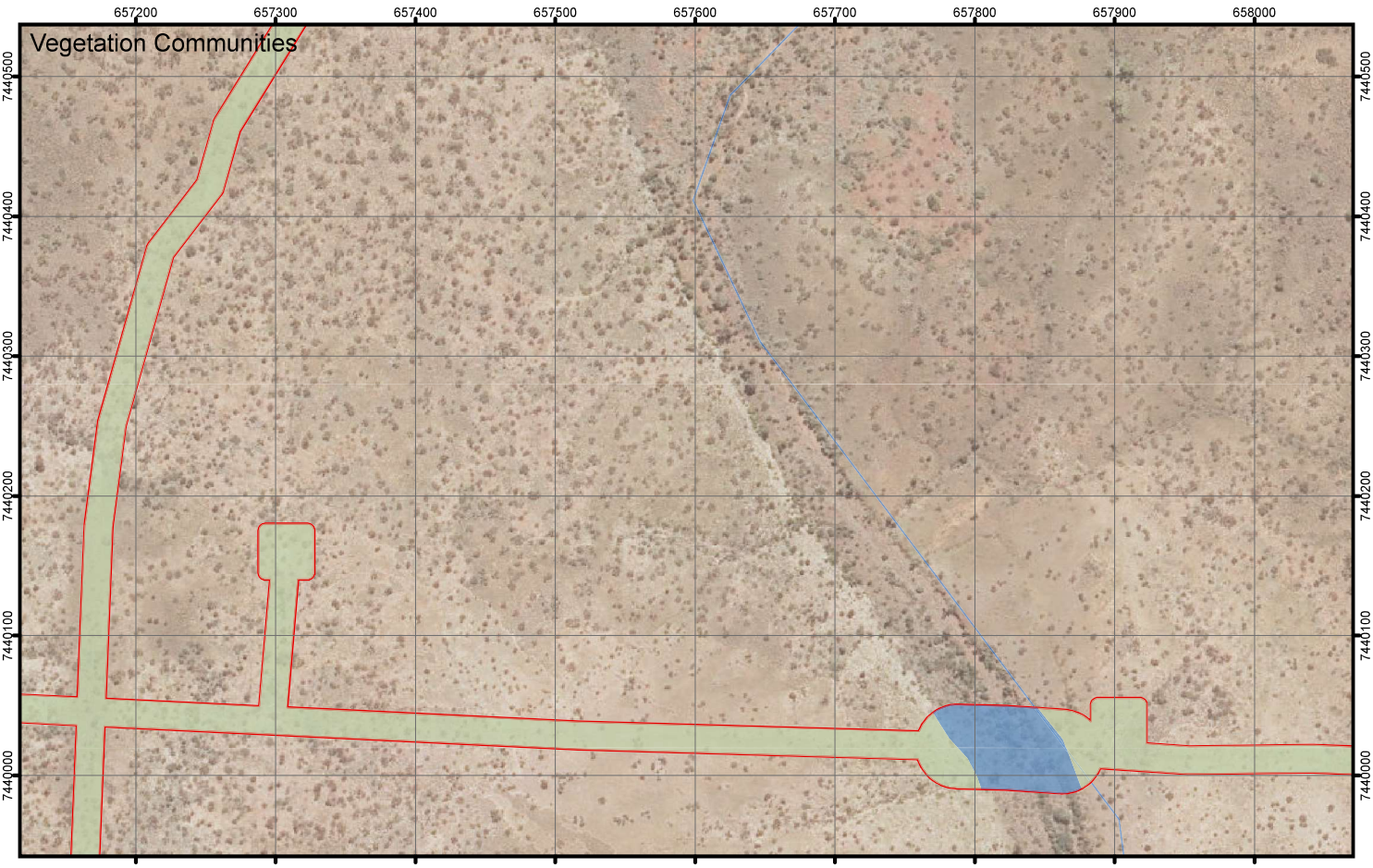

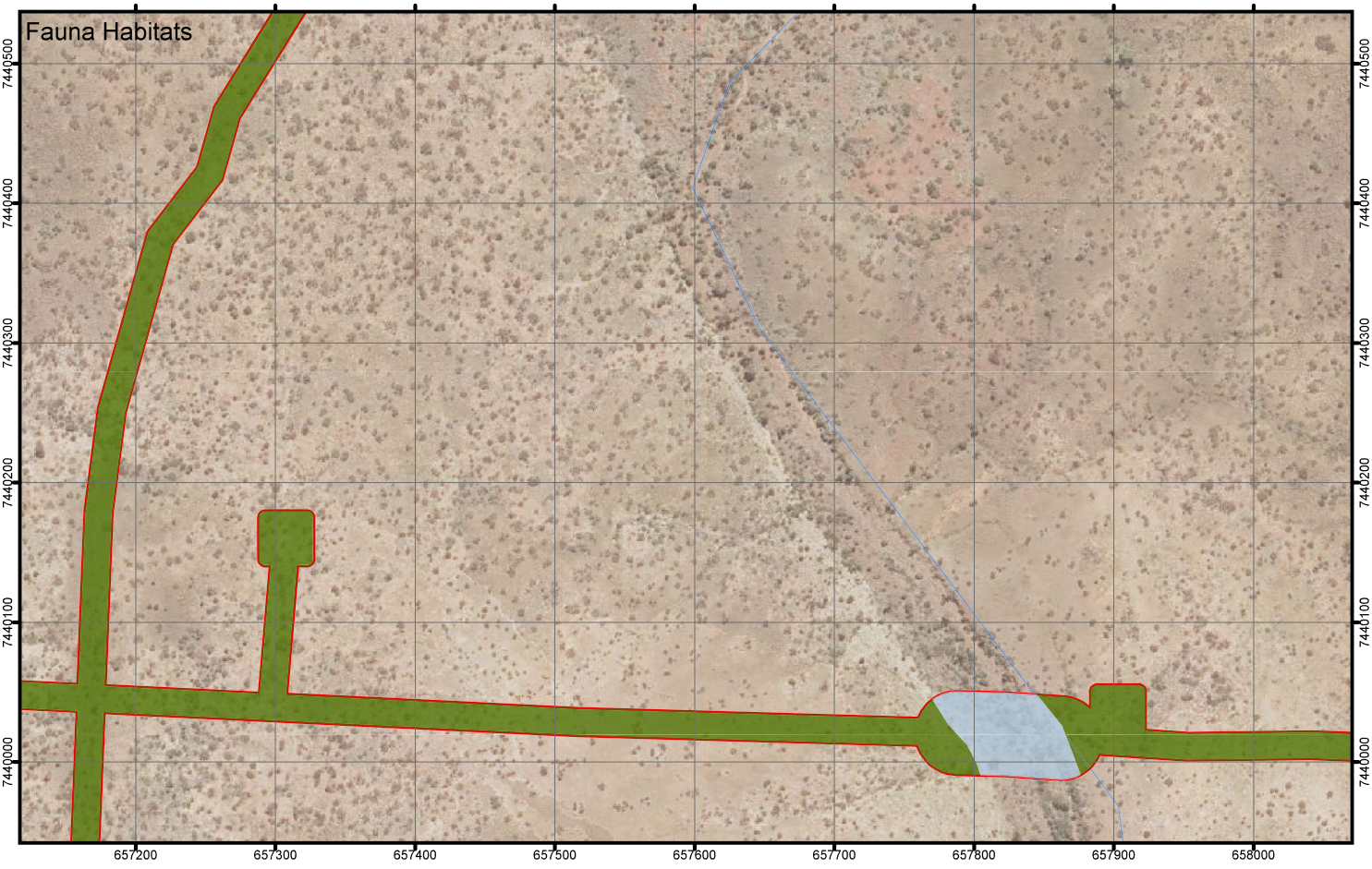

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LEGEND
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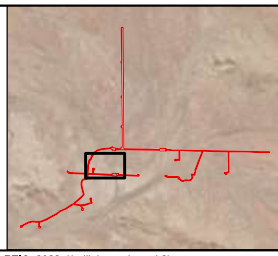
G1
W1
Fauna Habitat
Hummock Grassland
Major and Minor Drainage



Vegetation Communities and Fauna Habitats

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Figure 10.4

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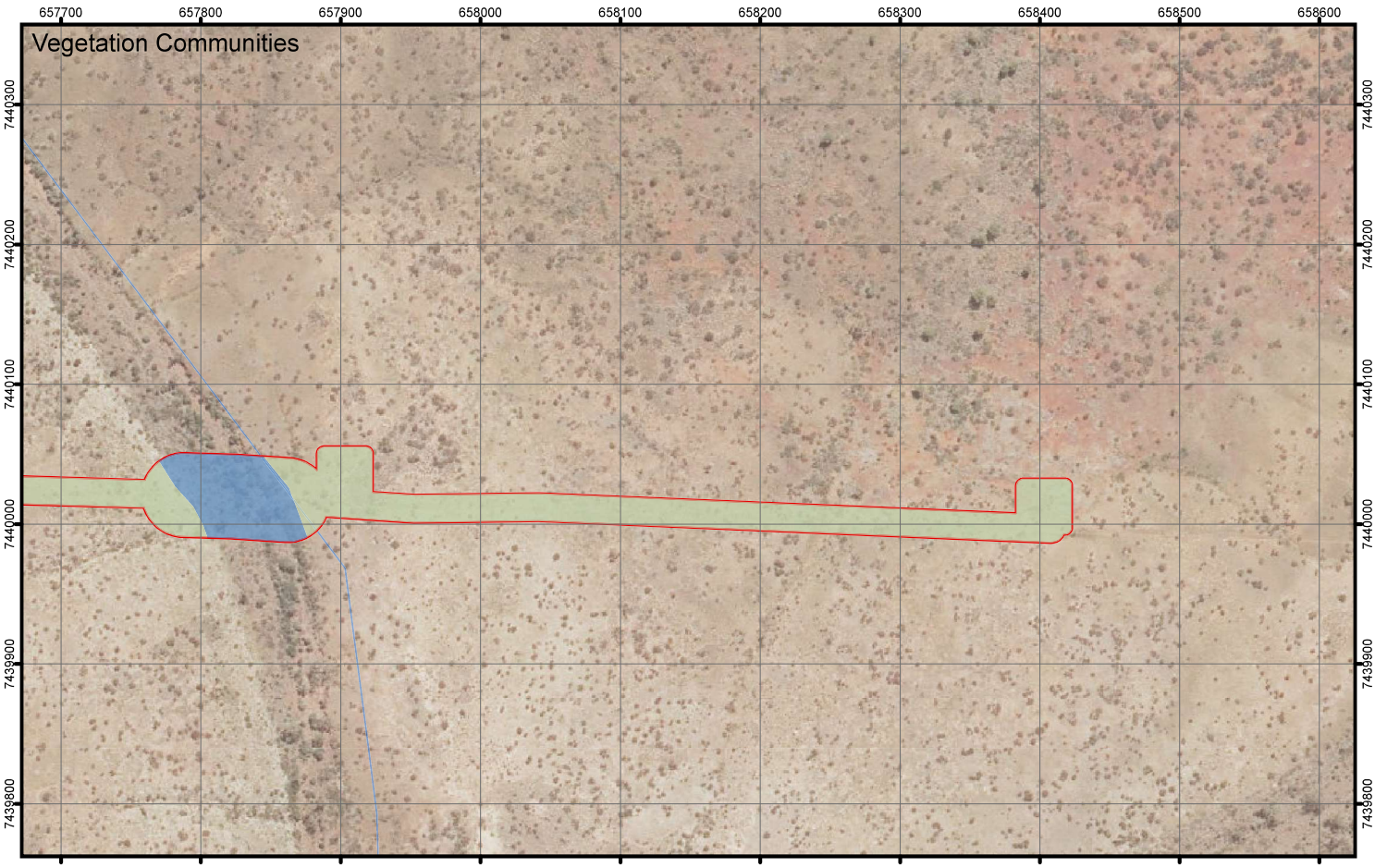

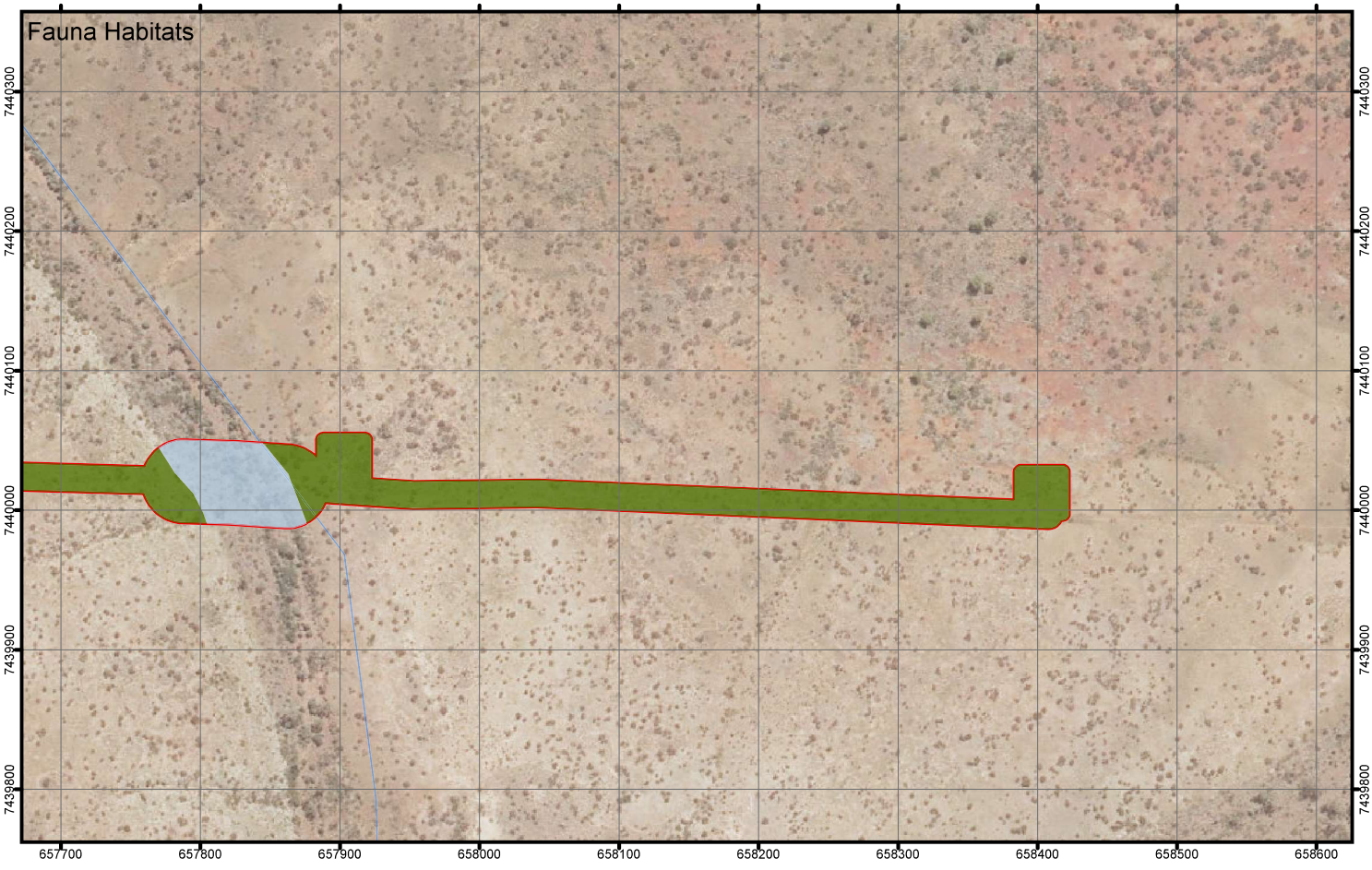

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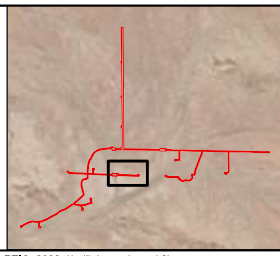
LEGEND

Survey Area

Veg Code	Fauna Habitat
G1	Hummock Grassland
W1	Major and Minor Drainage



Vegetation Communities and Fauna Habitats

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KARIJINI MONITORING BORES NATIVE VEGETATION CLEARING PERMIT

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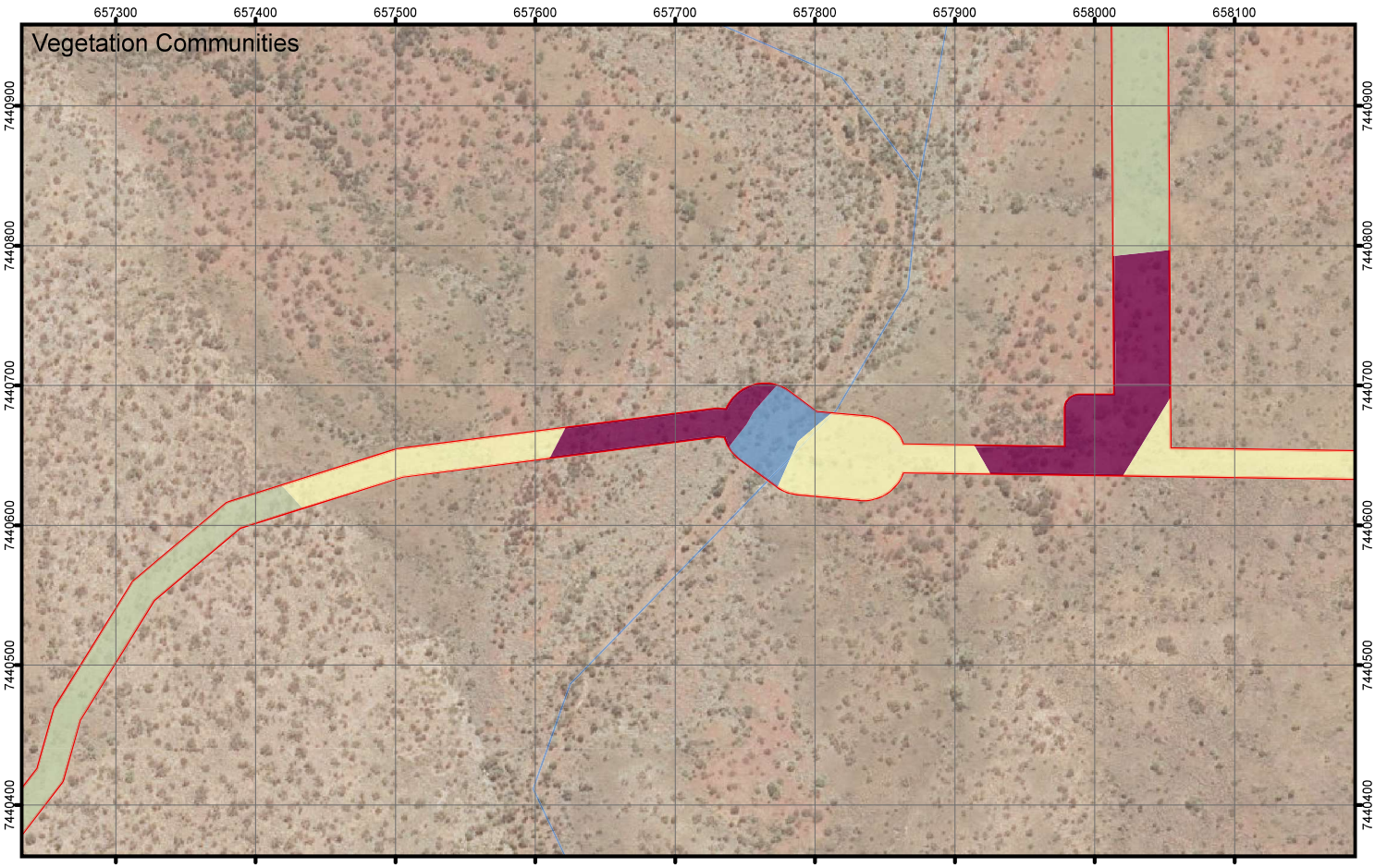

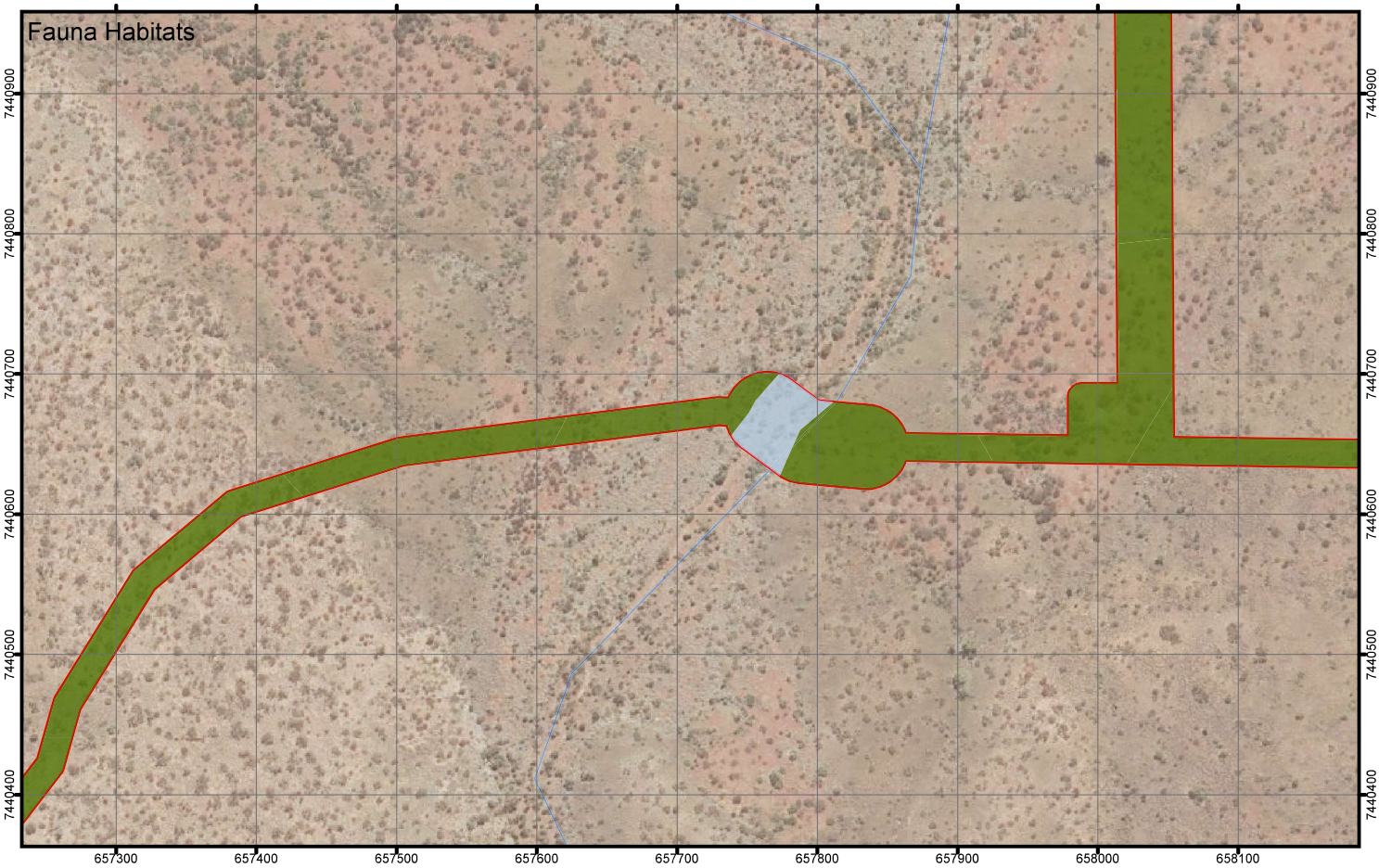

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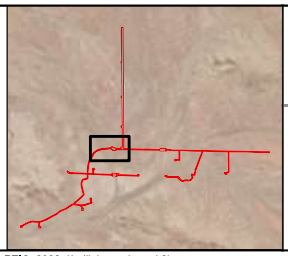
LEGEND
Survey Area
Veg Code
G1
G2
G3
W1
Fauna Habitat
Hummock Grassland
Major and Minor Drainage



Vegetation Communities and Fauna Habitats

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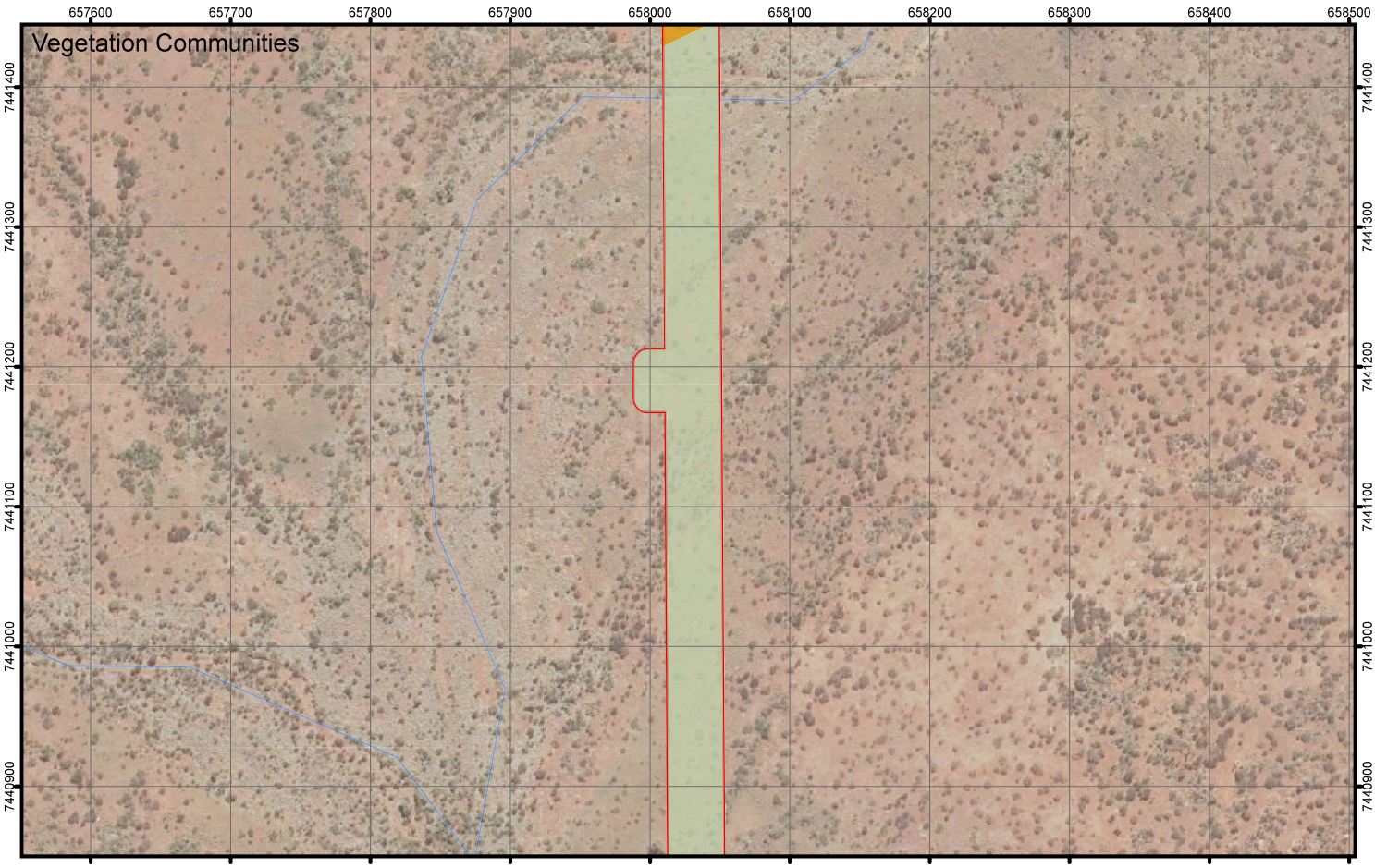

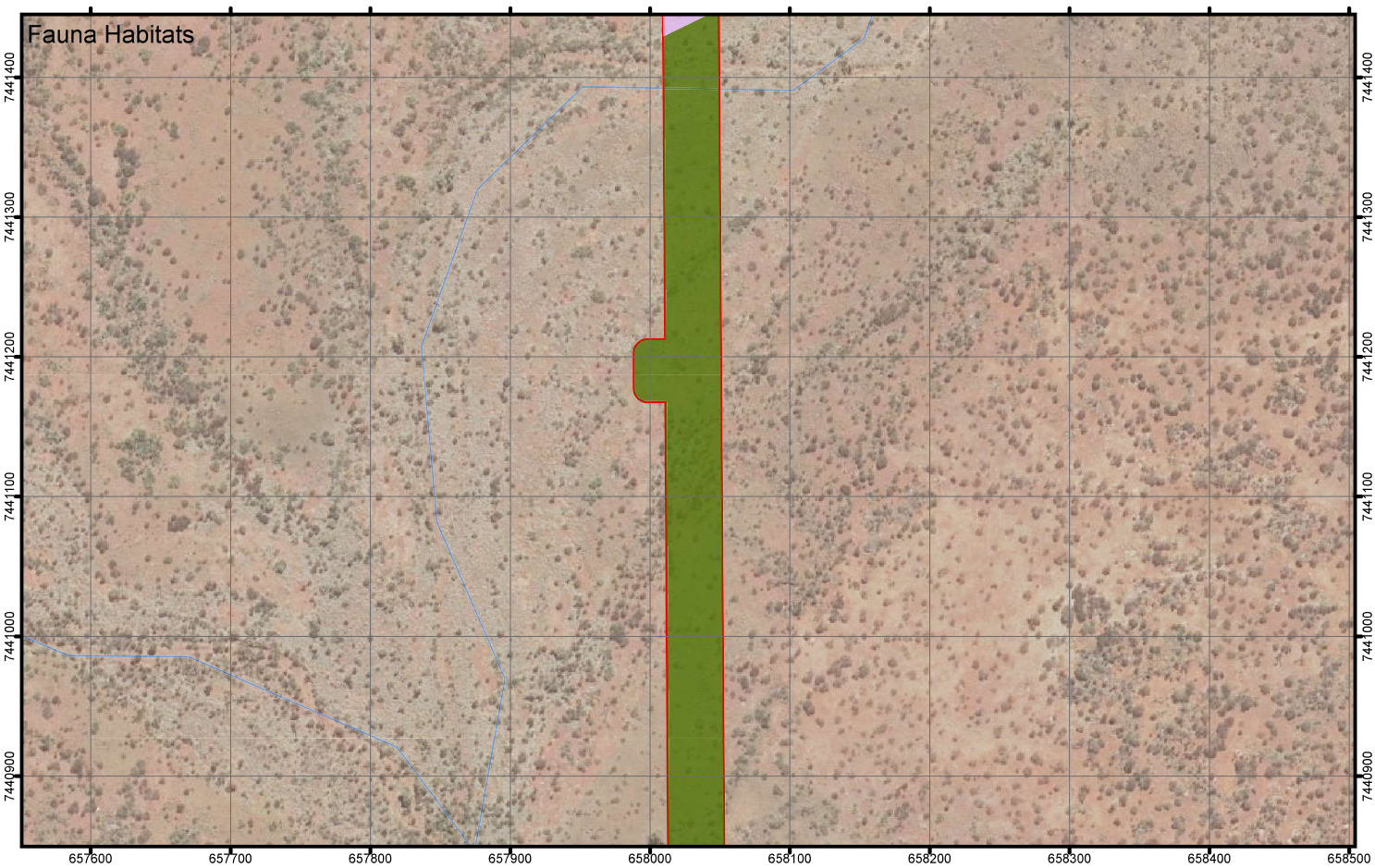

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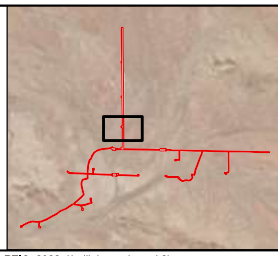
LEGEND

Survey Area

Veg Code	Fauna Habitat
G1	Hummock Grassland
M1	Mulga on Clay Flats



Vegetation Communities and Fauna Habitats

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KARIJINI MONITORING BORES NATIVE VEGETATION CLEARING PERMIT

Figure
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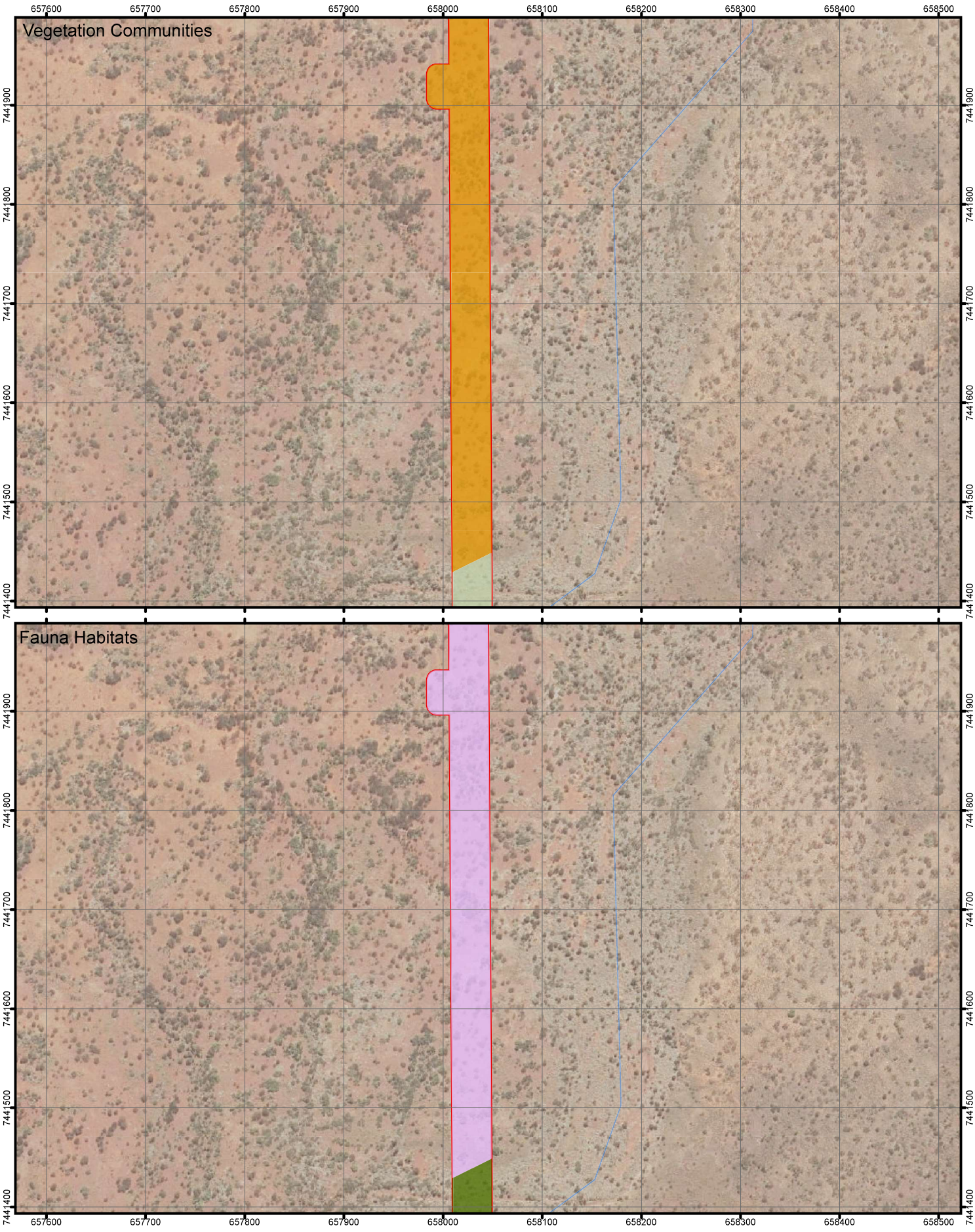

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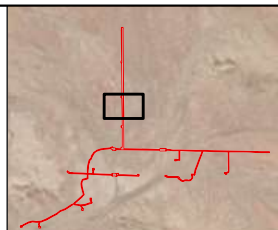
LEGEND

Survey Area

Veg Code	Fauna Habitat
G1	Hummock Grassland
M1	Mulga on Clay Flats



Vegetation Communities and Fauna Habitats

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Figure
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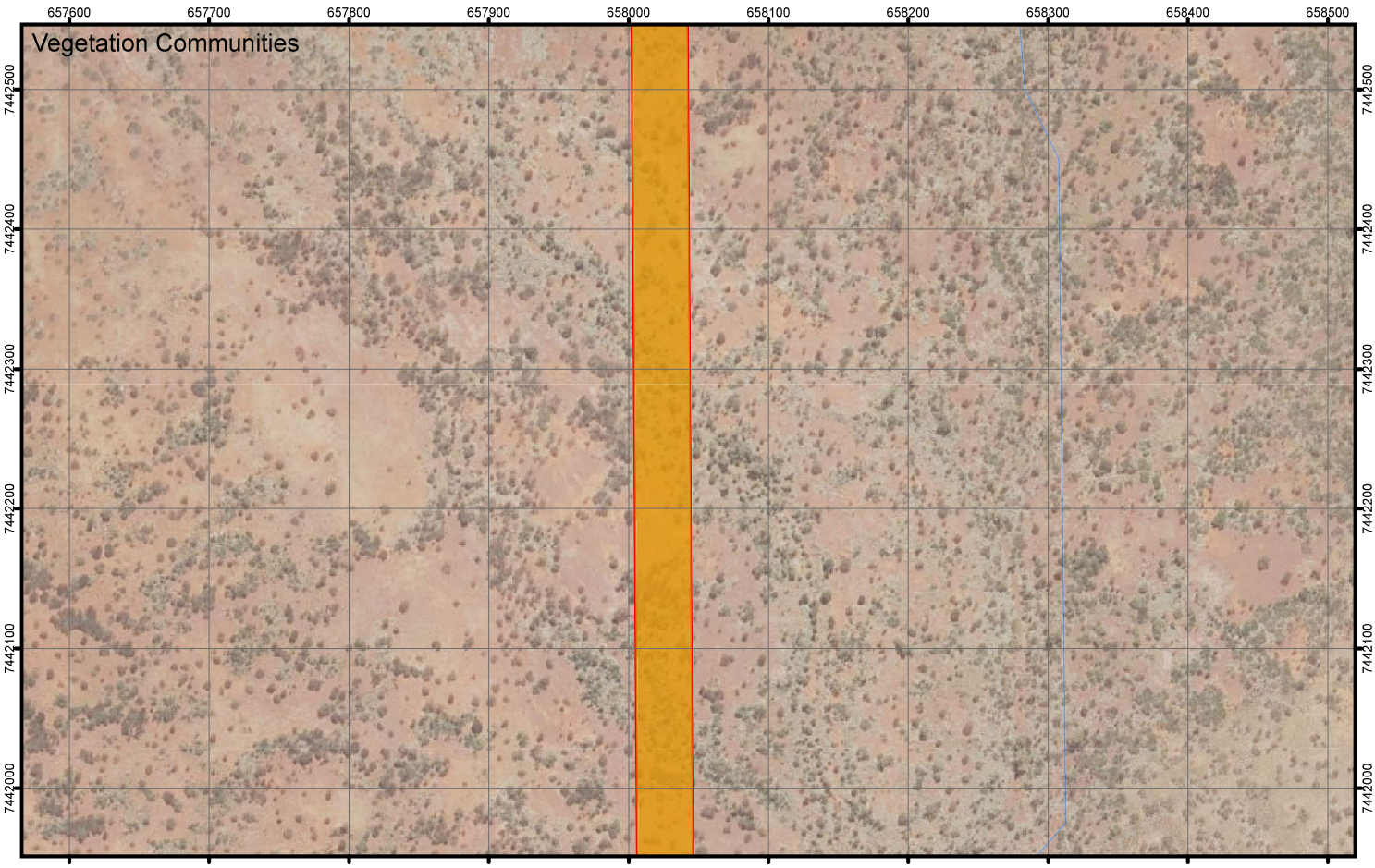

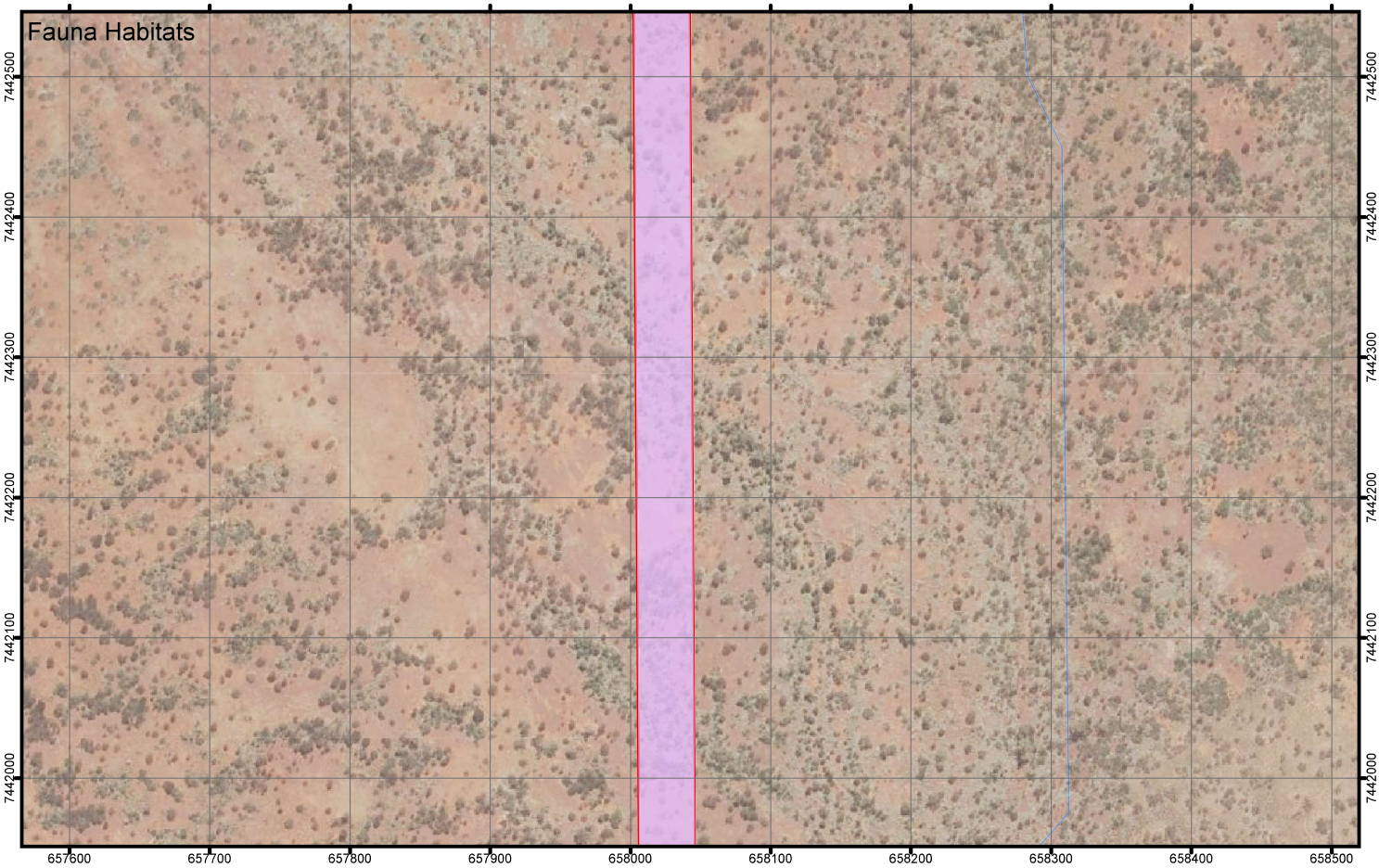

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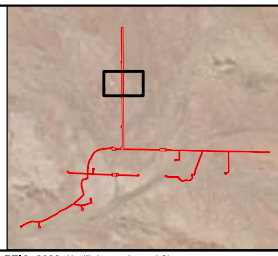
LEGEND
Survey Area
Veg Code
M1
Fauna Habitat
Mulga on Clay Flats



Vegetation Communities and Fauna Habitats

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Figure
10.9

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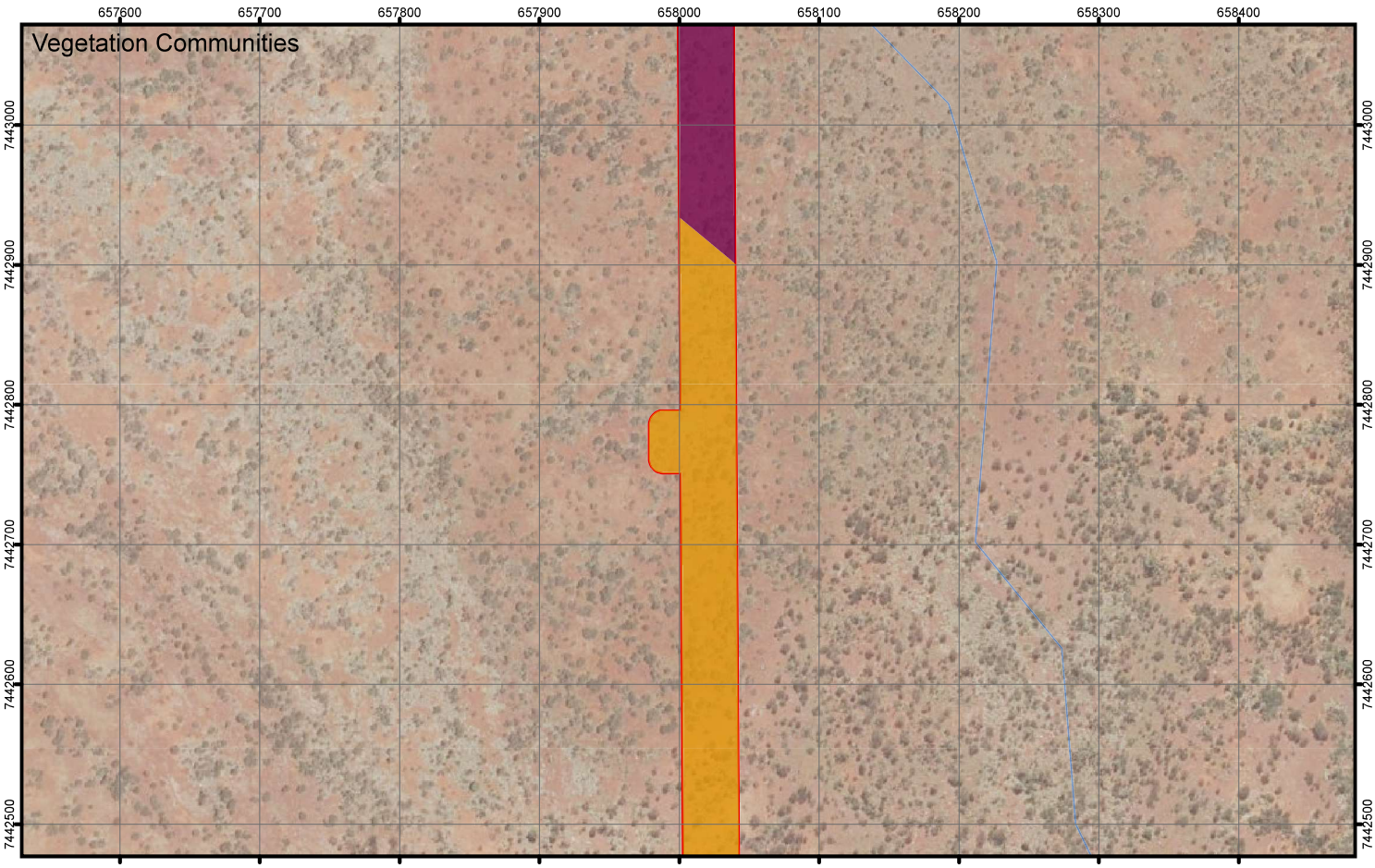

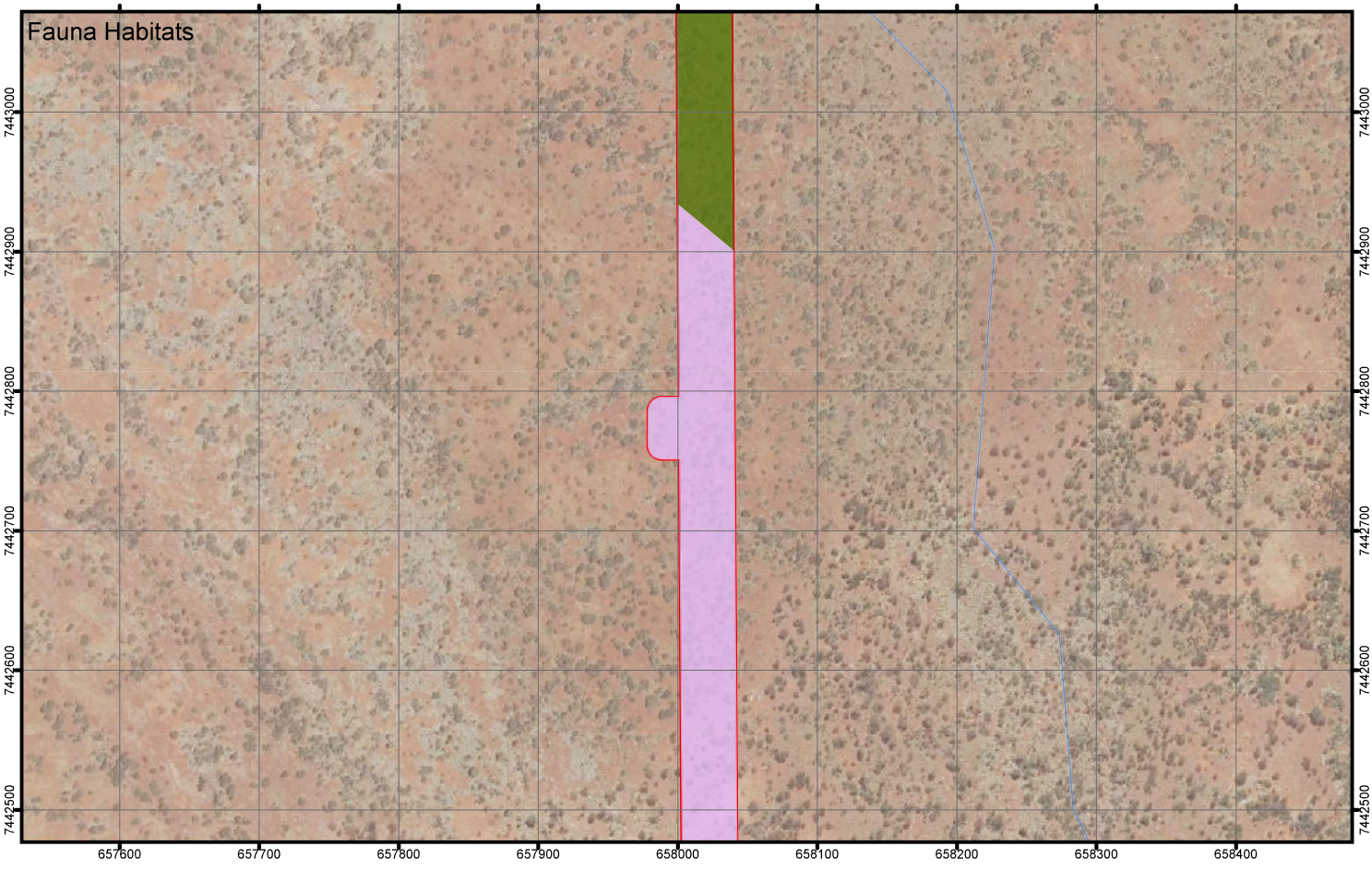

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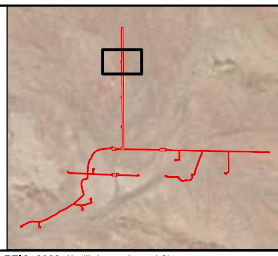
LEGEND

Survey Area

Veg Code
- G3
- M1

Fauna Habitat
- Hummock Grassland
- Mulga on Clay Flats



Vegetation Communities and Fauna Habitats

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Figure
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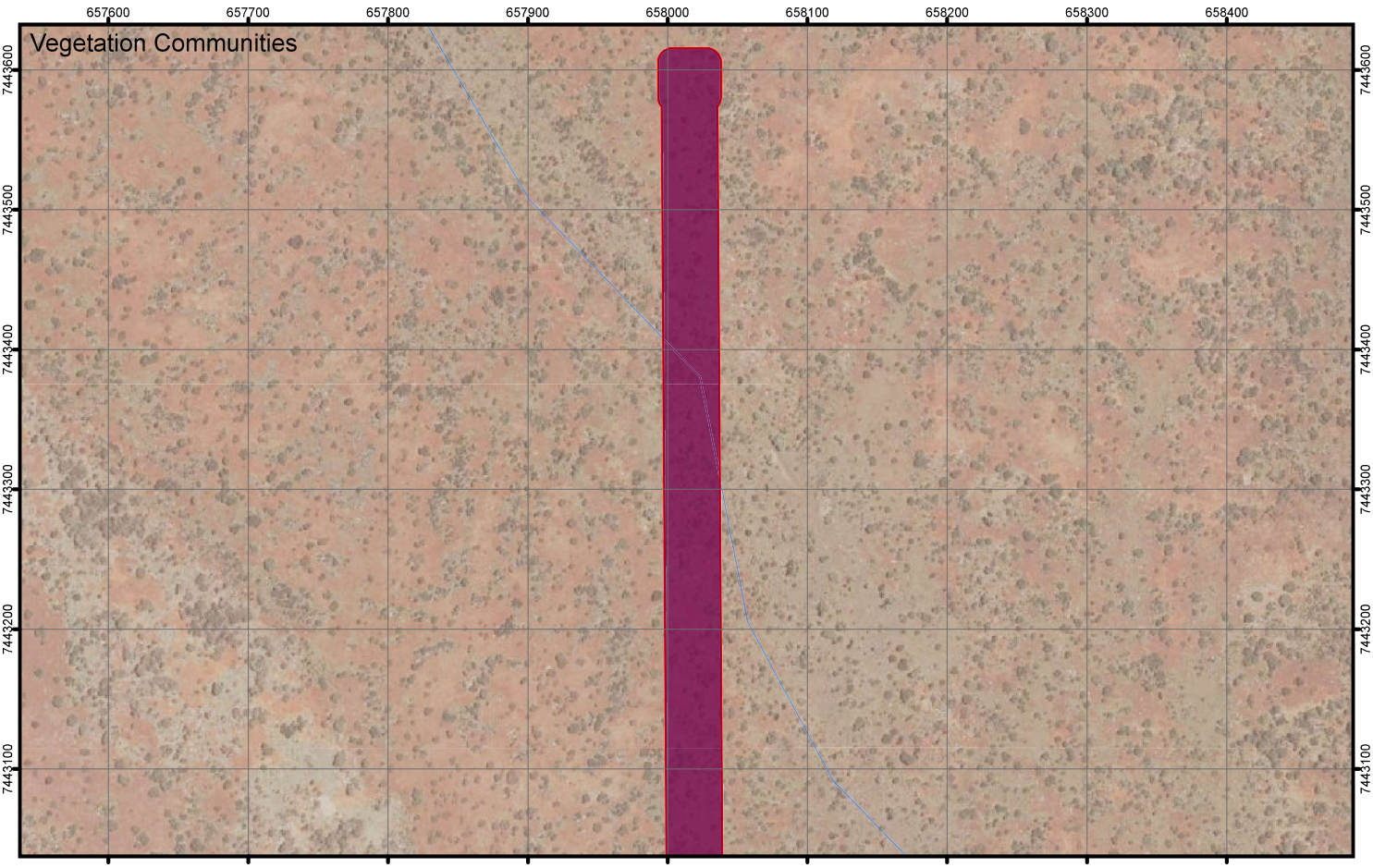

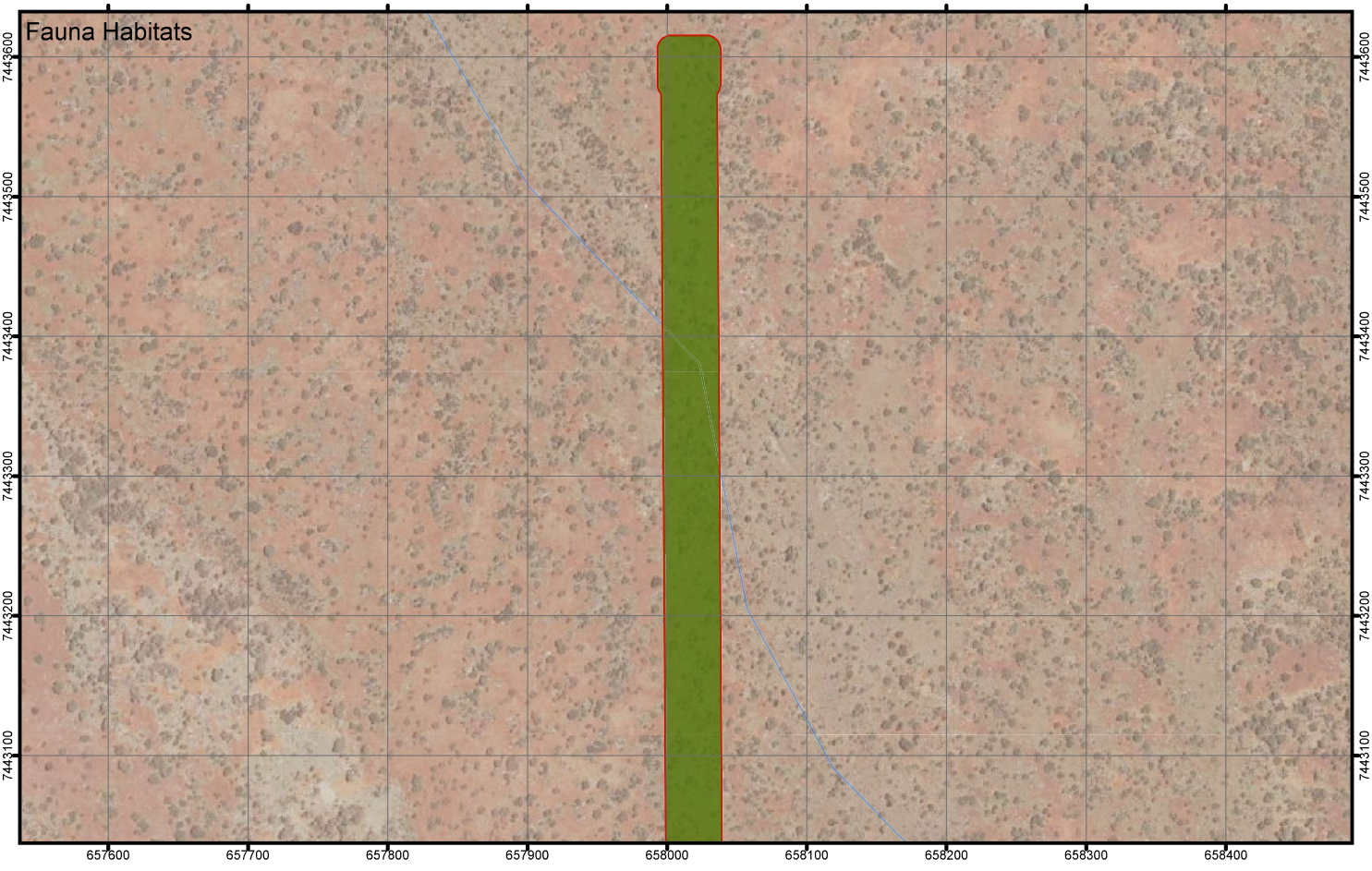

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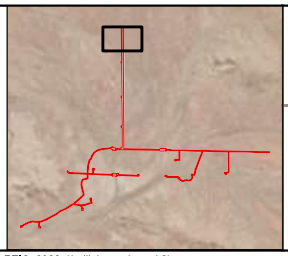
LEGEND
Survey Area
Veg Code
G3
Fauna Habitat
Hummock Grassland



Vegetation Communities and Fauna Habitats

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Figure
10.11

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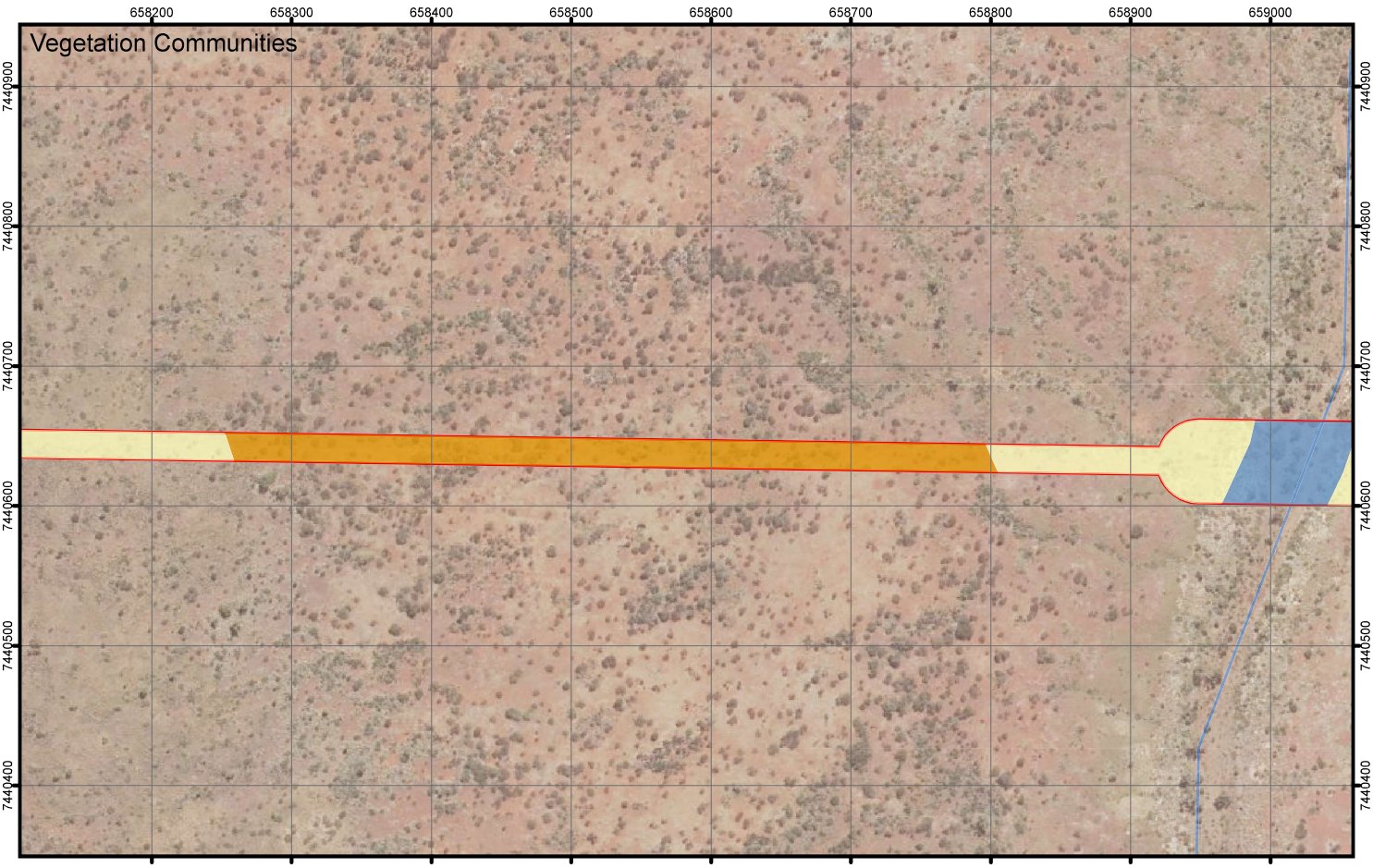

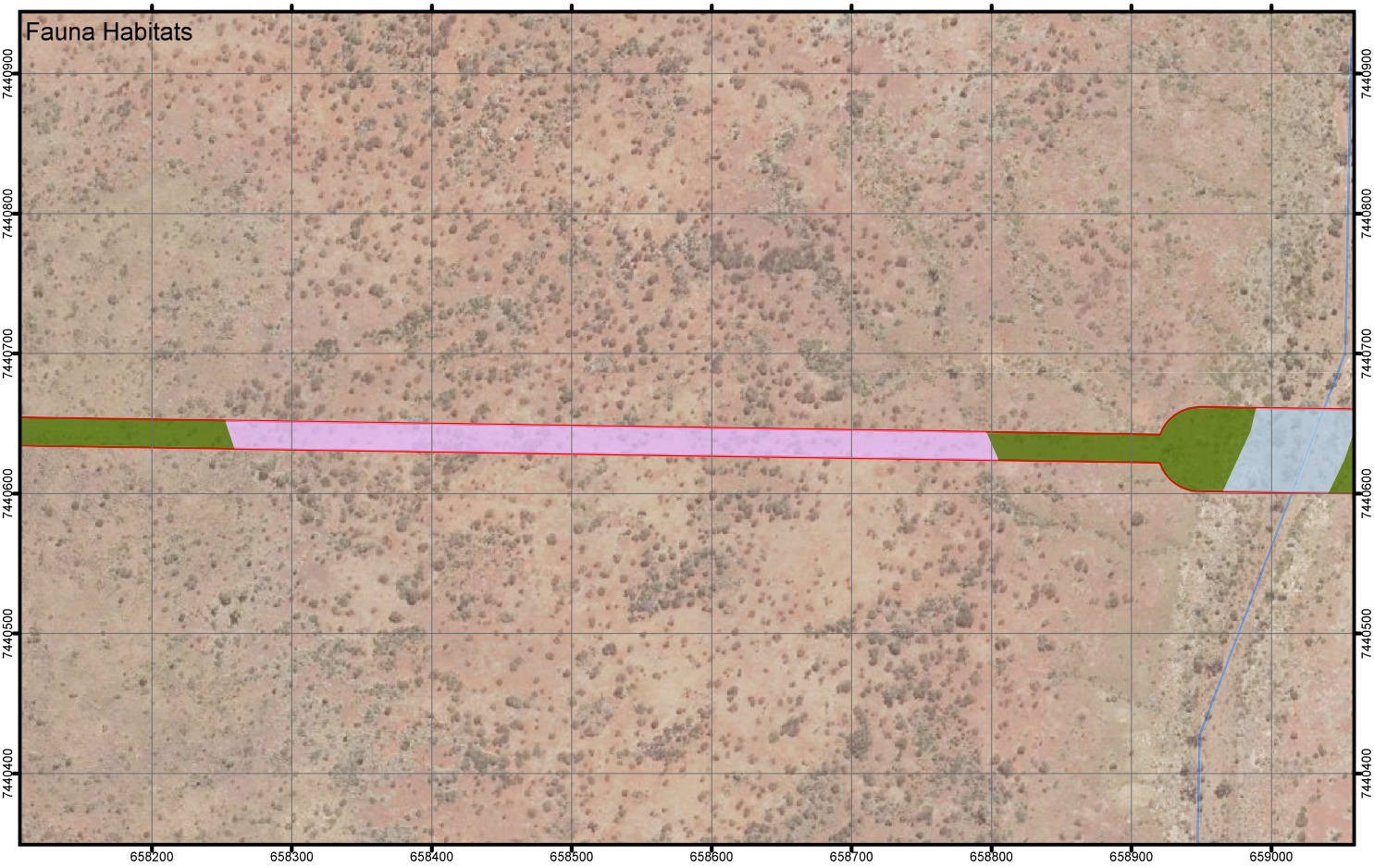

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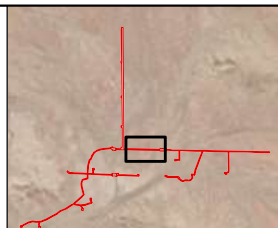
LEGEND

Survey Area

Veg Code	Fauna Habitat
G2	Hummock Grassland
M1	Major and Minor Drainage
W1	Mulga on Clay Flats



Vegetation Communities and Fauna Habitats

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Figure
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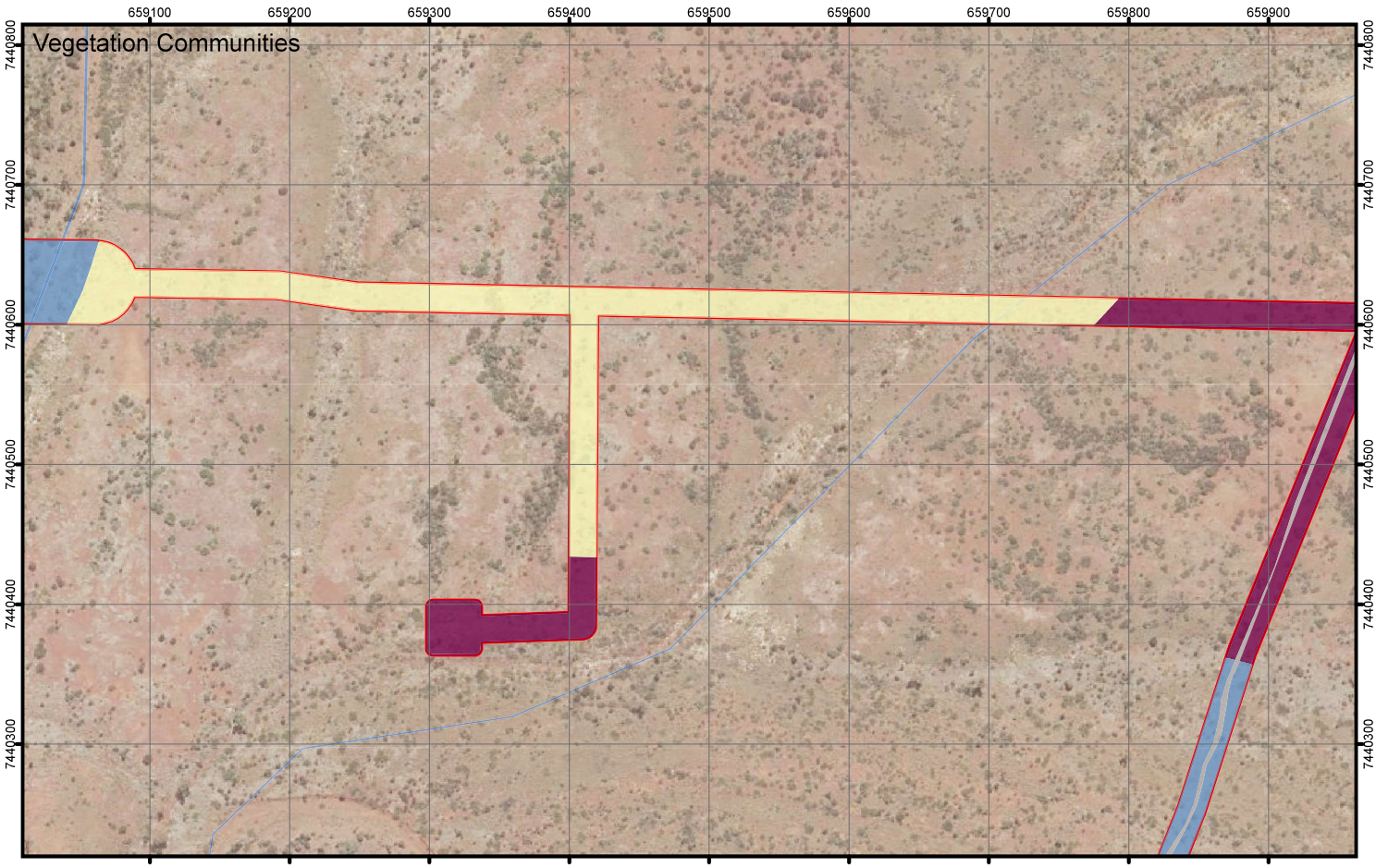

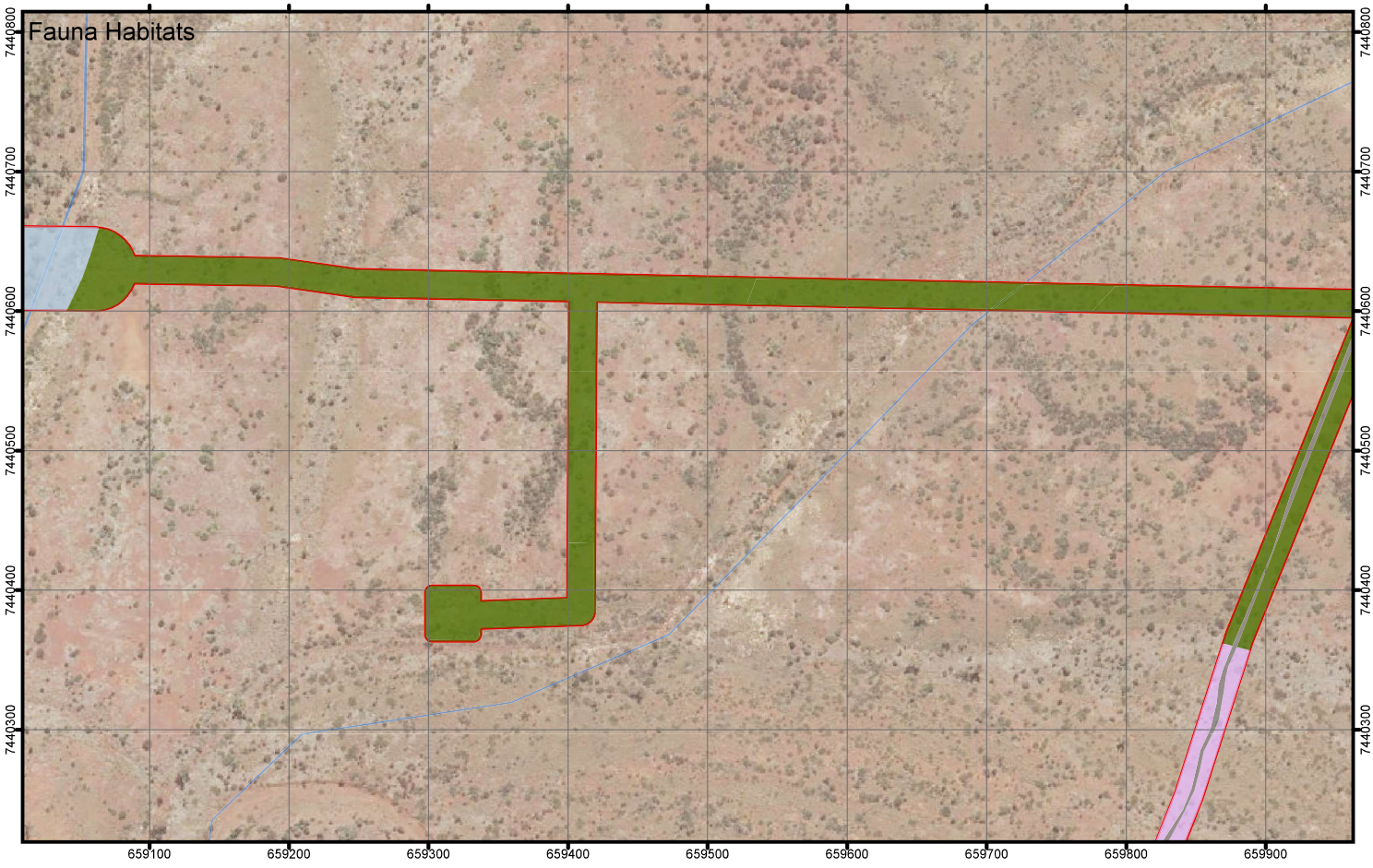

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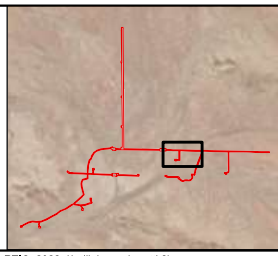
LEGEND

Survey Area

Veg Code	Fauna Habitat
G2	Cleared
G3	Hummock Grassland
W1	Major and Minor Drainage
CL	Mulga on Clay Flats



Vegetation Communities and Fauna Habitats

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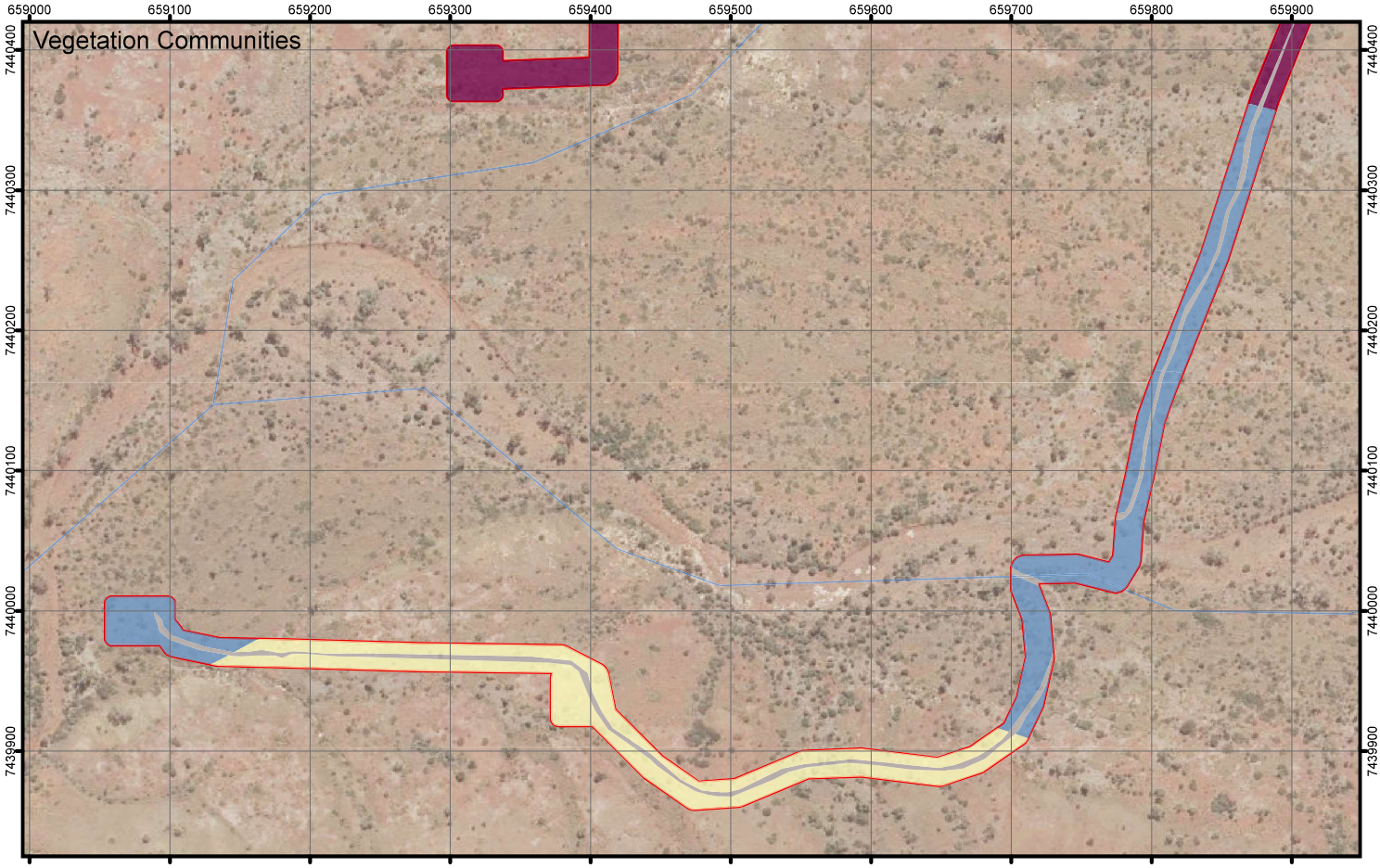

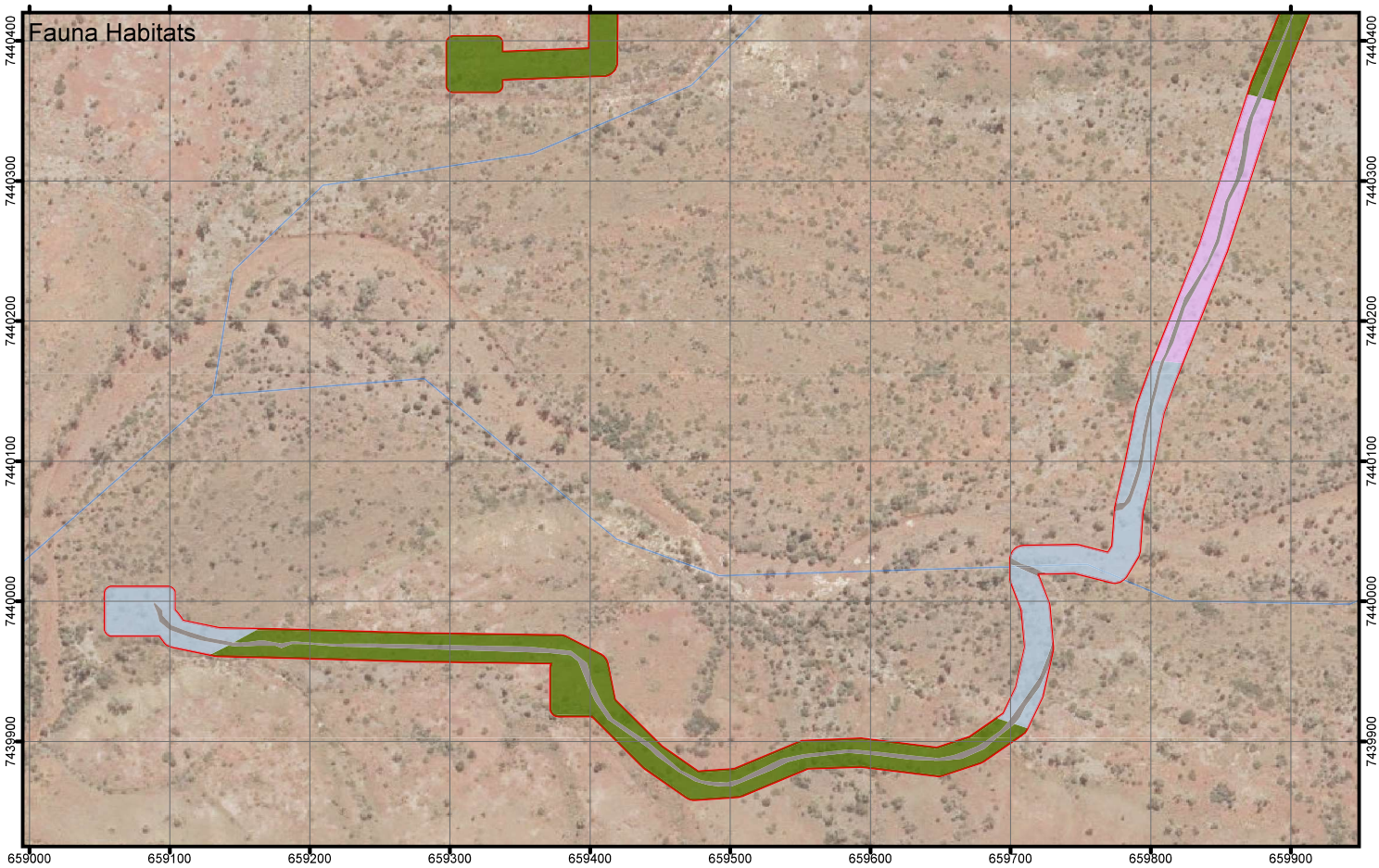

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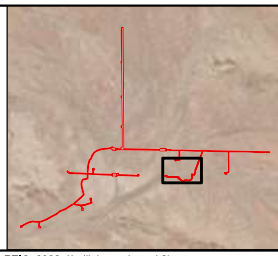
LEGEND

Survey Area

Veg Code	Fauna Habitat
G2	Cleared
G3	Hummock Grassland
W1	Major and Minor Drainage
CL	Mulga on Clay Flats



Vegetation Communities and Fauna Habitats

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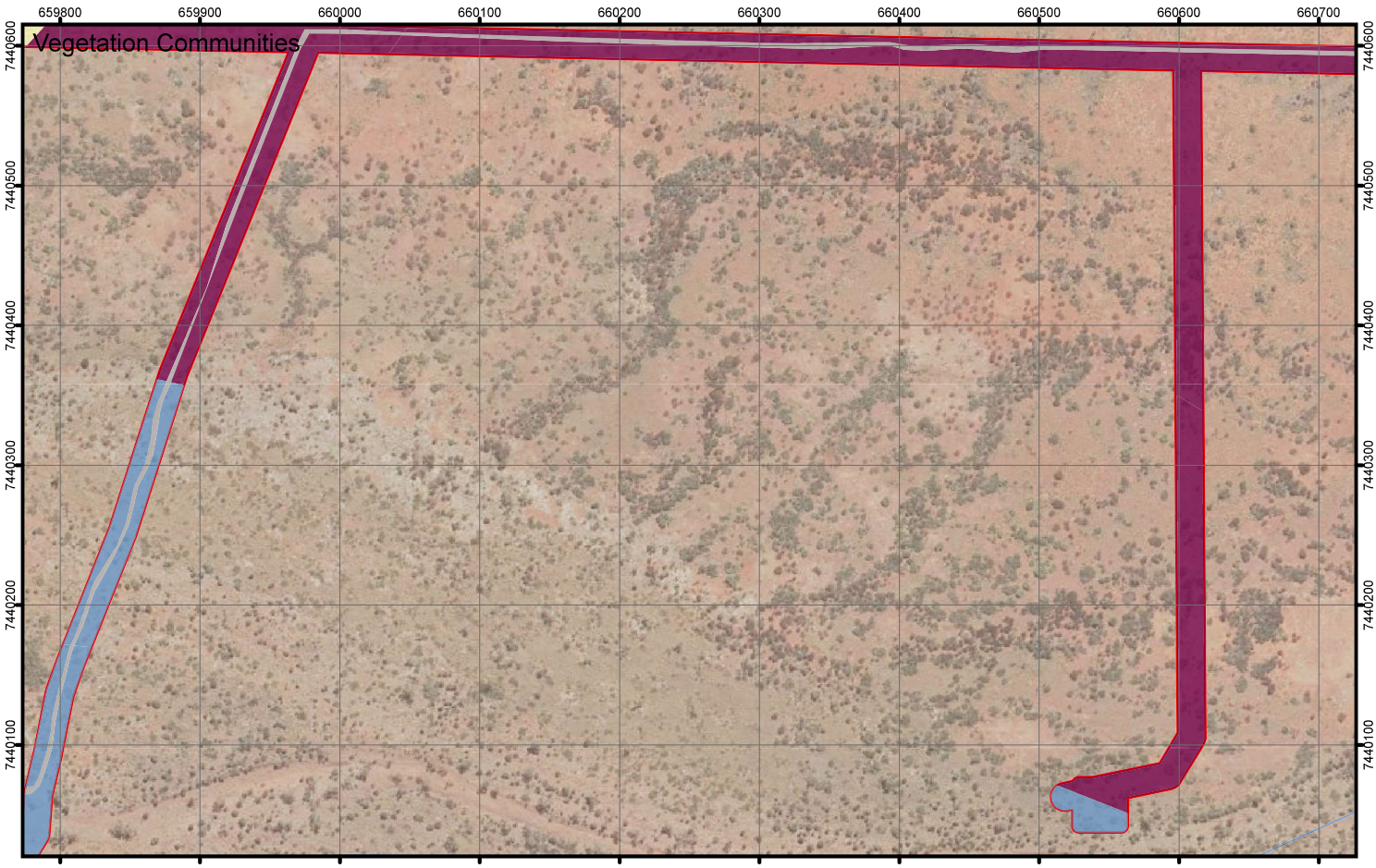

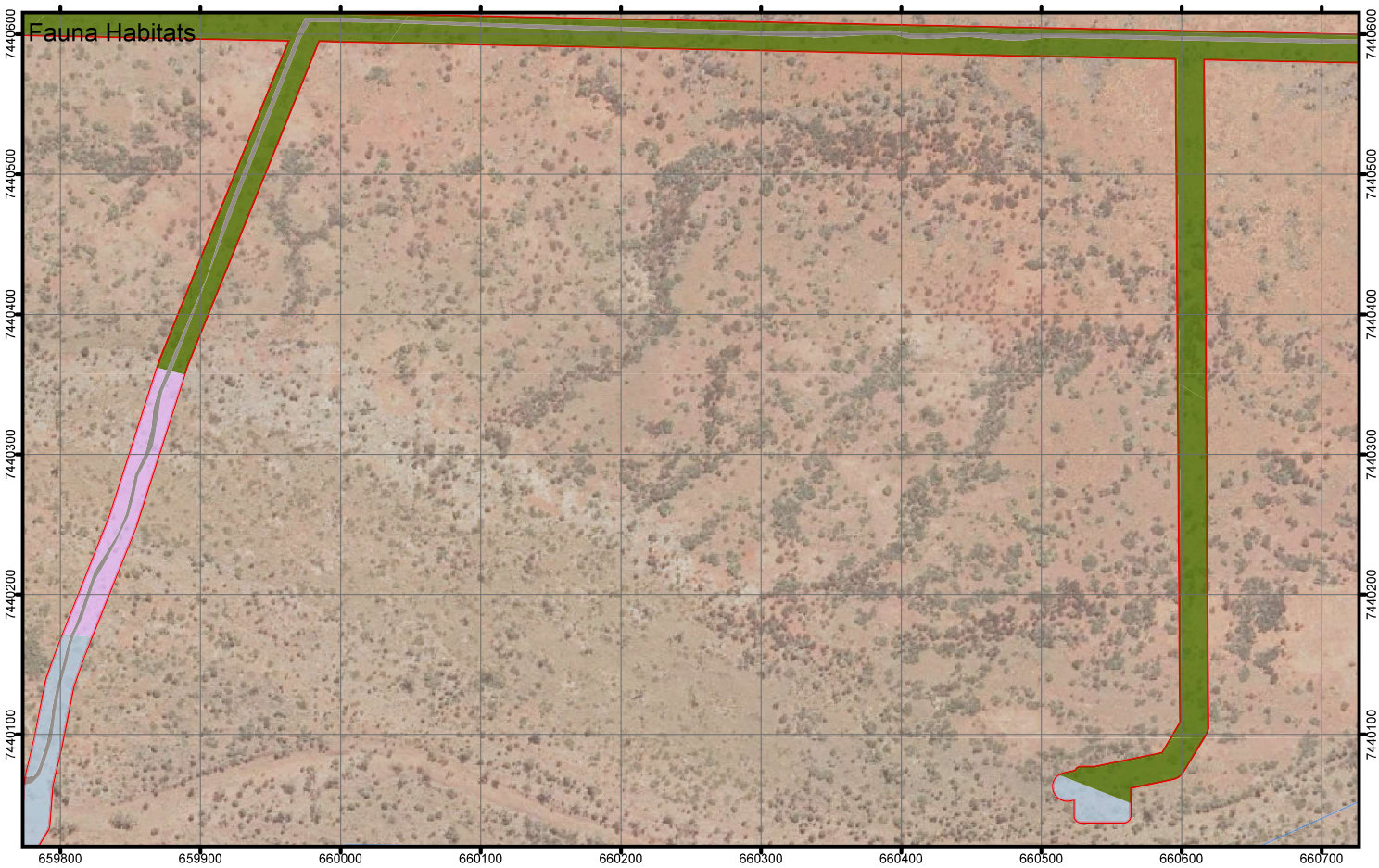

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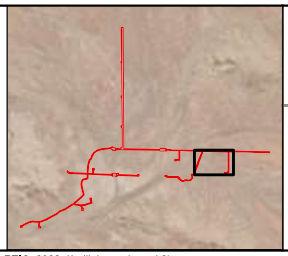
LEGEND

Survey Area

Veg Code	Fauna Habitat
G2	Cleared
G3	Hummock Grassland
W1	Major and Minor Drainage
CL	Mulga on Clay Flats



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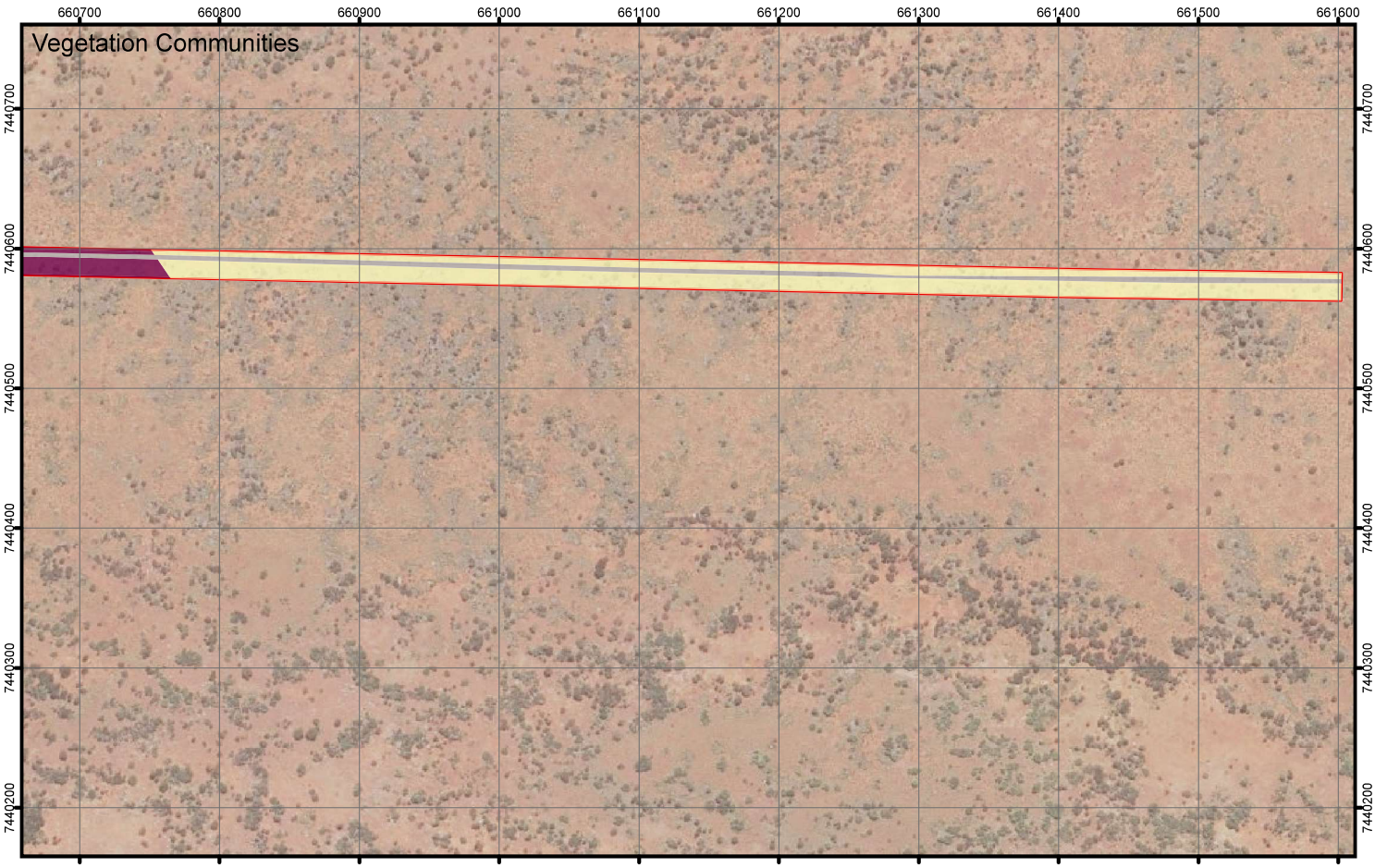

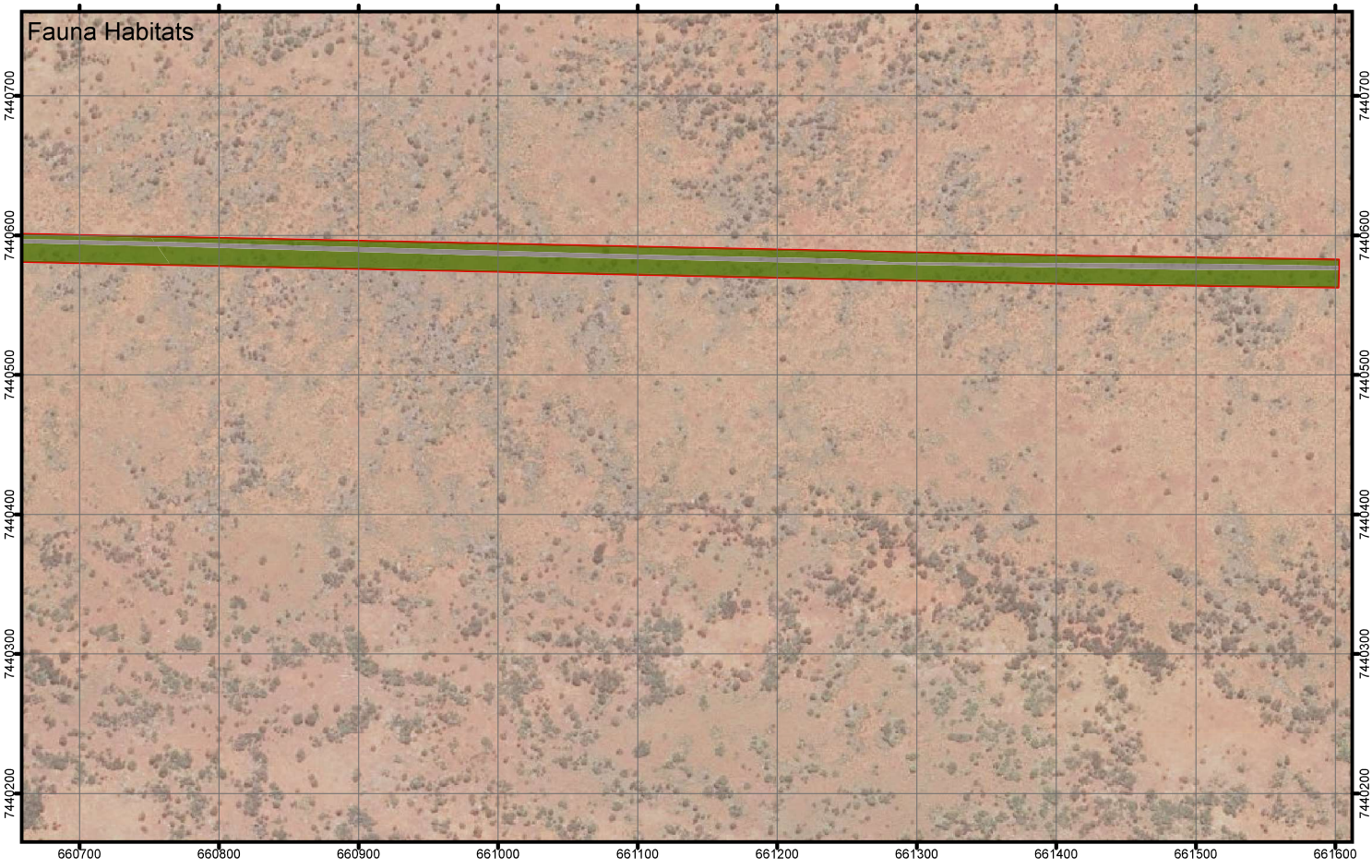

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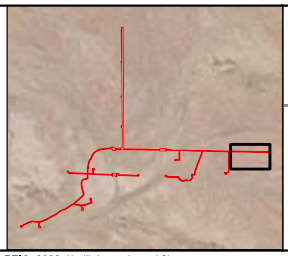
LEGEND
Survey Area
Veg Code
G2
G3
CL
Fauna Habitat
Cleared
Hummock Grassland



Vegetation Communities and Fauna Habitats

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KARIJINI MONITORING BORES NATIVE VEGETATION CLEARING PERMIT

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Appendix A

Federal and State Legislation

1.0 Appendix A Federal and State Legislation

1.1 Commonwealth

The EPBC Act is the main piece of Federal legislation protecting biodiversity in Australia. Flora species at risk of extinction are recognised at a Commonwealth level and are categorised in one of six categories as outlined in Table 1.

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

Code	Conservation Category
Ex	Extinct Taxa
ExW	Extinct in the Wild
CE	Critically Endangered
E	Endangered
V	Vulnerable
CD	Conservation Dependent

Communities can be classified as Threatened Ecological Communities (TECs) under the EPBC Act. The EPBC Act protects Australia's ecological communities by providing for:

- identification and listing of ecological communities as threatened
- development of conservation advice and recovery plans for listed ecological communities
- recognition of key threatening processes
- reduction of the impact of these processes through threat abatement plans.

Categories of federally listed TECs are described in Table 2.

Table 2 Categories of TECs that are listed under the EPBC Act

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

1.2 Western Australia

1.2.1 Flora and Fauna Species

The *Biodiversity Conservation Act 2016* (BC ACT) Provides for the conservation and protection of Western Australia's biodiversity and biodiversity components. Conservation codes and explanations are derived from DBCA (2019).

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).

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. It includes species listed as Threatened (Table 3), extinct (Table 4) or specially protected (Table 5)

Table 3 Categories for Threatened Flora and Fauna Species (Jan 2019)

Code	Conservation Category
CR	Critically Endangered 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".
EN	Endangered 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".
VU	Vulnerable 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".

Table 4 Categories for Extinct Flora and Fauna Species (Jan 2019)

Code	Conservation Category
EX	Extinct Species Species where "there is no reasonable doubt that the last member of the species has died", and listing is otherwise in accordance with the ministerial guidelines (section 24 of the BC Act).
EW	Extinct in the Wild 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.

Table 5 Categories for Other Protected Species (Jan 2019)

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

Code	Conservation Category
	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.
CD	Species of special conservation interest (conservation dependent fauna) Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened.
OS	Other specially protected fauna Fauna otherwise in need of special protection to ensure their conservation, and listing is otherwise in accordance with the ministerial guidelines (section 18 of the BC Act).

Species that have not yet been adequately surveyed to warrant being listed under the BC Act, or are otherwise data deficient, are added to a Priority Lists under Priorities 1, 2 or 3 by the State Minister for Environment. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. Categories and definitions of Priority flora species are summarised in Table 6.

Table 6 Conservation codes for WA flora and fauna

Code	Conservation Category
P1	Priority One – Poorly Known Species 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.
P2	Priority Two – Poorly Known Species 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.
P3	Priority Three – Poorly Known Species Species that are known from several locations, and the species does not appear to be under imminent threat.
P4	Priority Four – Rare, Near Threatened and other species in need of monitoring Includes rare species and near threatened species.

1.2.2 Ecological Communities

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

Vegetation communities in Western Australia are described as TECs if they have been endorsed by the Western Australian Minister for Environment following recommendations made by the Threatened Species Scientific Committee. A TEC is one which is found to fit into one of four categories, summarised in Table 7 (DEC, 2013).

Table 7 Conservation codes for State listed ecological communities

Conservation Code	Category
PD	Presumed Totally Destroyed Adequately searched for but no representative occurrence have been located.
CR	Critically Endangered Adequately surveyed, subject to major contraction, in danger of significant modification in the immediate future.
EN	Endangered Adequately surveyed, subject to major contraction, in danger of significant modification in the near future.
VU	Vulnerable Adequately surveyed, declining in distribution and/or condition, security not yet assured and may move into a category of higher threat in near future.

Possible TECs that do not meet survey criteria or are not adequately defined are listed as Priority Ecological Communities (PECs) and listed in one of five categories, summarised in Table 8.

Table 8 Conservation categories for Priority Ecological Communities

Code	Conservation Category
P1	Priority One: poorly-known ecological communities
P2	Priority Two: poorly-known ecological communities
P3	Priority Three: poorly known ecological communities
P4	Priority Four: ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list.
P5	Priority Five: conservation dependent ecological communities

Appendix B

Conservation Significant Flora Desktop Results

Appendix B Significant Flora Desktop Results

Taxon	Habitat	Cons. Status		Distance from Survey Area			Date			PMST	Likelihood Assessment					Total Score	Likelihood		Justification
		EPBC Act	BC Act/WA	WAHerb	TPFL	Rio Tinto	WA Herb	TPFL	Rio Tinto		Recorded in survey area	Known occurrence <5km	Known occurrence <20km	Recent Record (<20 years)	Habitat suitability (0,1,2)		Pre-Survey	Post-Survey	
Acacia bromilowiana	Red skeletal stony loam, orange-brown pebbly, gravel loam, laterite, banded ironstone, basalt. Rocky hills, breakaways, scree slopes, gorges, creek beds.		P4	26	24.6		2011	2006			0	0	0	1	1	2	Unlikely	Negligible	No suitable habitat.
Acacia daweana	Stony red loamy soils. Low rocky rises, along drainage lines.		P3	25	38.3		2004	1988			0	0	0	1	2	3	Possible	Unlikely	Suitable habitat, not recorded during survey.
Acacia effusa	Stony red loam. Scree slopes of low ranges.		P3	25	22		2012	2006			0	0	0	1	0	1	Negligible	Negligible	No suitable habitat.
Acacia subtiliformis	On rocky calcrete plateau.		P3	58	58.8		2012	2007			0	0	0	1	1	2	Unlikely	Negligible	No suitable habitat.
Adiantum capillus-veneris	Moist, sheltered sites in gorges and on cliff walls.		P2	71			1978				0	0	0	0	0	0	Negligible	Negligible	No suitable habitat.
Amaranthus centralis	Red sand in ephemeral watercourses, sandy to clayey loam on river banks and edges of permanent pools in eucalypt lined channels, or *Acacia* shrubland. Also occurs in areas of permanent watering, e.g. bore overflows, gardens and cultivation (Nuytsia).		P3	68			2015				0	0	0	1	0	1	Negligible	Negligible	No suitable habitat.
Ampelopteris prolifera	Near water or in wet ground.		P3	72			1974				0	0	0	0	0	0	Negligible	Negligible	No suitable habitat.
Aristida jerichoensis var. *subspinulifera*	Hardpan plains.		P3	15		4	2016		2012		0	1	1	1	2	5	Likely	Unlikely	Suitable habitat, not recorded during survey.
Aristida lazaridis	Confined to sand or loam soils. Low open woodland, closed tussock grassland, hummock grassland.		P2	15			2018				0	0	1	1	1	3	Likely	Negligible	No suitable habitat.
Arthropodium vanleeuwenii	Known from two small populations growing above 900m on south-facing hillslopes of Brockman Iron Formation in the Pilbara region. Often found growing under *Triodia* spp. and occasionally under the *Themeda triandra*, very rarely growing in the open (Nuytsia).		P2	35			2018				0	0	0	1	1	2	Unlikely	Negligible	No suitable habitat.
Barbula ehrenbergii	No habitat information available.		P1	72			1975				0	0	0	0	0	0	Negligible	Negligible	No suitable habitat.
Cladium procerum	Perennial pools.		P2	70			2014				0	0	0	1	0	1	Negligible	Negligible	No suitable habitat.
Dampiera anonyma	Skeletal red-brown to brown gravelly soil over banded ironstone, basalt, shale and jaspilite. Hill summits, upper slopes (above 1000m).		P3	66	65.8		2002	1998			0	0	0	0	0	0	Negligible	Negligible	No suitable habitat.
Dampiera metallorum	Skeletal red-brown gravelly soil over banded ironstone. Steep slopes, summits of hills.		P3	18	15		2011	2007			0	0	1	1	0	2	Negligible	Negligible	No suitable habitat.
Dicrastylis mitchellii	Sand or clay soils. Around dunes.		P1	29			2000				0	0	0	0	0	0	Negligible	Negligible	No suitable habitat.
Dolichocarpa sp. Hamersley Station (A.A. Mitchell PRP 1479)	Cracking clay, basalt. Gently undulating plain with large surface rocks, flat crabholed plain.		P3	17			2017				0	0	1	1	0	2	Negligible	Negligible	No suitable habitat.
Eragrostis crateriformis	Clayey loam or clay. Creek banks, depressions.		P3	63			2017				0	0	0	1	0	1	Negligible	Negligible	No suitable habitat.
Eragrostis sp. Mt Robinson (S. van Leeuwen 4109)	Red-brown skeletal soils, ironstone. Steep slopes, summits.		P1	36	33		2011	1998			0	0	0	1	0	1	Negligible	Negligible	No suitable habitat.
Eremophila coacta	Laterite, shale soils. Ironstone hills, creeklines.		P3	60	65		2003	2004			0	0	0	1	1	2	Unlikely	Negligible	No suitable habitat.
Eremophila demissa	Silcrete plain.		P1		58			2003			1	1	0	0	0	2	Negligible	Negligible	No suitable habitat.
Eremophila magnifica subsp. *magnifica*	Skeletal soils over ironstone. Rocky screes.		P4	22			2012				0	0	0	1	0	1	Negligible	Negligible	No suitable habitat.
Eremophila magnifica subsp. *velutina*	Skeletal soils over ironstone. Summits.		P3	15	12		2012	1998			0	0	1	1	0	2	Negligible	Negligible	No suitable habitat.

Appendix B Significant Flora Desktop Results

Taxon	Habitat	Cons. Status		Distance from Survey Area			Date			PMST	Likelihood Assessment					Total Score	Likelihood		Justification
		EPBC Act	BC Act/WA	WAHerb	TPFL	Rio Tinto	WA Herb	TPFL	Rio Tinto		Recorded in survey area	Known occurrence <5km	Known occurrence <20km	Recent Record (<20 years)	Habitat suitability (0,1,2)		Pre-Survey	Post-Survey	
Eremophila pusilliflora	Found on seasonally inundated alluvial plains between Turee Creek, Pingandy Creek and drainage systems leading into the Ashburton River, growing in red-brown sandy loams soils in open low shrubland (Nuytsia).		P2	< 0.5	0	0	2014	2000	2021		1	1	1	1	2	6	Known	Known	Recorded in survey area
Eremophila rigida	Red sand alluvium. Hardpan plains, stony clay depressions.		P3	44			2014				0	0	0	1	2	3	Possible	Unlikely	Suitable habitat, not recorded during survey.
Eremophila sp. Hamersley Range (K. Walker KW 136)	Open rocky slopes, gullies and rock faces associated with large hills and cliffs, high in the landscape, skeletal red-brown soils (Greater Paraburdoo – Detailed Flora and Vegetation Survey, April 2018).		P3	15		4	2018		2019		0	1	1	1	0	3	Negligible	Negligible	No suitable habitat.
Eremophila sp. Mt Channar Range (C. Keating & M.E. Trudgen CK 408)	Rocky slope, south facing slope (Greater Paraburdoo – Detailed Flora and Vegetation Survey, April 2018).		P1	61			2007				0	0	0	1	0	1	Negligible	Negligible	No suitable habitat.
Eremophila sp. Snowy Mountain (S. van Leeuwen 3737)	Summit of hill, high in the landscape, skeletal red gritty soils over massive ironstone of the Brockman Iron Formation (Greater Paraburdoo – Detailed Flora and Vegetation Survey, April 2018).		P1	57			1998				0	0	0	0	0	0	Negligible	Negligible	No suitable habitat.
Eremophila sp. West Angelas (S. van Leeuwen 4068)	Slopes, skeletal brown-red/red stoney soils over massive banded Brockman Iron Formation (WAHerb).		P1	15			2011				0	0	1	1	0	2	Negligible	Negligible	No suitable habitat.
Eucalyptus rowleyi	Usually growns on broad floodplains or in open mallee vegetation. Only known from the area between Marble Bar, Newman and the Rudall River National Park in the Little Sandy Desert and Pilbara biogeographic regions (bie.ala.org.au).		P3	71			2002				0	0	0	0	0	0	Negligible	Negligible	No suitable habitat, outside known range.
Euphorbia australis var. *glabra*	Sump, low in the landscape on alluvial cracking clay loamy soil, gritty with ironstone fragments, saline flats (Greater Paraburdoo – Detailed Flora and Vegetation Survey, April 2018.		P3	62	64		2017	1998			0	0	0	1	0	1	Negligible	Negligible	No suitable habitat.
Euphorbia clementii	Gravelly hillsides, stony grounds.		P3		20			2006			0	0	1	0	1	2	Unlikely	Negligible	No suitable habitat.
Euphorbia inappendiculata var. *queenslandica*	Clay soils on plains (plantnet.rbgsyd.nsw.gov.au).		P2	25			2017				0	0	0	1	2	3	Possible	Negligible	No suitable habitat.
Euphorbia stevenii	Clay, sandy soils.		P3	16			1997				0	0	1	0	2	3	Possible	Unlikely	Suitable habitat, not recorded during survey.
Fimbristylis sieberiana	Mud, skeletal soil pockets. Pool edges, sandstone cliffs.		P3	70	70		2014	1991			0	0	0	1	0	1	Negligible	Negligible	No suitable habitat.
Geijera salicifolia	Skeletal soils, stony soils. Massive rock scree, gorges.		P3	62			1984				0	0	0	0	0	0	Negligible	Negligible	No suitable habitat.
Glycine falcata	Black clayey sand. Along drainage depressions in crabhole plains on river floodplains.		P3	60	63		2017	1998			0	0	0	1	0	1	Negligible	Negligible	No suitable habitat.
Gompholobium karijini	Occurs in open *Triodia* hummock grassland with scattered shrubs and trees on ironstone gravel (Nuytsia).		P2	64			2006				0	0	0	1	0	1	Negligible	Negligible	No suitable habitat.
Goodenia lyrata	Red sandy loam. Near claypan.		P3	22	21		2012	2006			0	0	0	1	0	1	Negligible	Negligible	No suitable habitat.

Appendix B Significant Flora Desktop Results

Taxon	Habitat	Cons. Status		Distance from Survey Area			Date			PMST	Likelihood Assessment					Total Score	Likelihood		Justification
		EPBC Act	BC Act/WA	WAHerb	TPFL	Rio Tinto	WA Herb	TPFL	Rio Tinto		Recorded in survey area	Known occurrence <5km	Known occurrence <20km	Recent Record (<20 years)	Habitat suitability (0,1,2)		Pre-Survey	Post-Survey	
Goodenia nuda	Open shrubland of *Acacia aneura* , open low woodland. Slight slope well away from hills at one site, another site valley floor between hills.		P4	29	62		2016	2008			0	0	0	1	2	3	Possible	Unlikely	Suitable habitat, not recorded during survey.
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)	Red-brown clay soil, calcrete pebbles. Low undulating plain, swampy plains.		P3	42	29		2014	2006			0	0	0	1	2	3	Possible	Known	Recorded in survey area, no confirmed identification.
Grevillea saxicola	Orange-brown to red-brown loam soils on the upper scree/breakaway slopes and crests often associated with banded iron formation outcropping. Often found growing in Mulga woodland (Nuytsia).		P3	6		4	2012		2015		0	1	1	1	0	3	Negligible	Negligible	No suitable habitat.
Gymnanthera cunninghamii	Sandy soils.		P3	72			2011				0	0	0	1	0	1	Negligible	Negligible	No suitable habitat.
Hibiscus campanulatus	Hill slopes and base of slopes, sheltered or rocky drainage lines below associated cliff-lines or rocky ridges, soils often associated with Canga detrital formations (Greater Paraburdoo – Detailed Flora and Vegetation Survey, April 2018).		P1	55			2017				0	0	0	1	0	1	Negligible	Negligible	No suitable habitat.
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)	Sheltered or rocky drainage lines below associated cliff-lines or rocky ridges, skeletal red-brown stony soil over massive ironstone of the Brockman Iron Formation (Greater Paraburdoo – Detailed Flora and Vegetation Survey, April 2018).		P2	10.5		4	2015		2019		0	1	1	1	0	3	Negligible	Negligible	No suitable habitat.
Indigofera gilesii	Pebbly loam. Amongst boulders and outcrops, hills.		P3	9.7	22	4	2014	2006	2014		0	1	0	1	0	2	Negligible	Negligible	No suitable habitat.
Indigofera ixocarpa	Skeletal red soils over massive ironstone.		P2	58	56		2006	1994			0	0	0	1	0	1	Negligible	Negligible	No suitable habitat.
Iotasperma sessilifolium	Cracking clay, black loam. Edges of waterholes, plains.		P3	65			1998				0	0	0	0	0	0	Negligible	Negligible	No suitable habitat.
Ipomoea racemigera	Sandy soils along watercourses (flora.sa.gov.au).		P2	64			2017				0	0	0	1	1	2	Unlikely	Unlikely	Suitable habitat, not recorded during survey.
Isotropis parviflora	Valley slope of ironstone plateau.		P2	43			2017				0	0	0	1	0	1	Negligible	Negligible	No suitable habitat.
Kohautia australiensis	Calcarete hills. Orange skeletal fine clay. Calcrete plain with brown sandy loam soil.		P2	60			2017				0	0	0	1	1	2	Unlikely	Negligible	No suitable habitat.
Lepidium catapycnon	Skeletal soils. Hillsides. Open low woodlands of *Eucalyptus leucophloia* . Open hummock grassland.		P4	8	25		2014	2012			0	0	0	1	0	1	Negligible	Negligible	No suitable habitat.
Olearia mucronata	Schistose hills, along drainage channels.		P3	16	7		2012	2004			0	0	1	1	0	2	Negligible	Negligible	No suitable habitat.
Oxalis sp. Pilbara (M.E. Trudgen 12725)	Shaded areas around rock outcrops and gullies and on gully walls (Greater Paraburdoo – Detailed Flora and Vegetation Survey, April 2018).		P2	18		4	2016		2019		0	1	1	1	0	3	Negligible	Negligible	No suitable habitat.
Pentalepis trichodesmoides subsp. *hispida*	Found in *Triodia* hummock grassland, often in the understorey of a shrubland of *Acacia* spp., *Gossypium* spp., *Senna* spp., *Brachychiton* spp. and *Eucalyptus* spp., on summits and slopes of low hills, on basaltic soils, at altitudes to 1150 m (Nuytsia).		P2	33			1995				0	0	0	0	0	0	Negligible	Negligible	No suitable habitat.
Pilbara trudgenii	Skeletal, red stony soil over ironstone. Hill summits, steep slopes, screes, cliff faces.		P3	10	12		2014	2005			0	0	1	1	0	2	Negligible	Negligible	No suitable habitat.
Pityrodia augustensis	Amongst rocks on slopes or in drainage lines.	VU	VU							Yes	1	1	1	0	0	3	Negligible	Negligible	No suitable habitat.
Ptilotus mollis	Stony hills and screes.		P4	37			2015				0	0	0	1	0	1	Negligible	Negligible	No suitable habitat.

Appendix B Significant Flora Desktop Results

Taxon	Habitat	Cons. Status		Distance from Survey Area			Date			PMST	Likelihood Assessment					Total Score	Likelihood		Justification
		EPBC Act	BC Act/WA	WAHerb	TPFL	Rio Tinto	WA Herb	TPFL	Rio Tinto		Recorded in survey area	Known occurrence <5km	Known occurrence <20km	Recent Record (<20 years)	Habitat suitability (0,1,2)		Pre-Survey	Post-Survey	
Rhagodia sp. Hamersley (M. Trudgen 17794)	Commonly recorded from hardpan plains dominated by Mulga shrubs and trees with the understorey consisting of scattered *Eremophila* spp., *Ptilotus* spp., *Senna* spp. shrubs over annual and perennial grasses. Individuals have been recorded from low hillslopes, stony plains, gullies, low hills, floodplains and claypans.		P3	15	18	0.2	2017	2008	2021		0	1	1	1	2	5	Likely	Unlikely	Suitable habitat, not recorded during survey.
Rhodanthe ascendens	Roadside verge. In open shrub of *Acacia aneura* over open tussock grass of *Aristida* spp. over dense herbs of *Erodium cygnorum, Stenopetalum decipiens, Rhodanthe charsleyae*.		P1	6	3		1998	1998			0	1	1	0	2	4	Possible	Unlikely	Suitable habitat, not recorded during survey. One unverified old record nearby.
Rostellularia adscendens var. *latifolia*	Ironstone soils. Near creeks, rocky hills.		P3	22			2017				0	0	0	1	0	1	Negligible	Negligible	No suitable habitat.
Scaevola sp. Hamersley Range basalts (S. van Leeuwen 3675)	Skeletal, brown gritty soil over basalt. Summits of hills, steep hills.		P2	47	45		1998	1998			0	0	0	0	0	0	Negligible	Negligible	No suitable habitat.
Sida sp. Barlee Range (S. van Leeuwen 1642)	Skeletal red soils pockets. Steep slope.		P4	6		5	2012		######		0	1	1	1	0	3	Negligible	Negligible	No suitable habitat.
Sida sp. Hamersley Range (K. Newbey 10692)	Low open woodland over hummock grassland of *Triodia* sp.		P3	20			2013				0	0	1	1	2	4	Possible	Unlikely	Suitable habitat, not recorded during survey. One unverified record nearby 20km from survey area.
Solanum kentrocaule	Endemic to WA, has been found only in the Hamersley Range between 700m to 1250m altitude. Inhabits hillsides and mountaintops, or occasionally creek-beds, in skeletal red-brown soil over ironstone or on basalt scree.		P3	12		3	2014		2019		0	1	1	1	0	3	Negligible	Negligible	No suitable habitat.
Solanum pycnotrichum	Scattered occurrence near the west coast of WA. On rocky sites, often drainage lines, with siltstone or banded ironstone in shrubland.		P2	56			2017				0	0	0	1	0	1	Negligible	Negligible	No suitable habitat.
Stackhousia clementii	Skeletal soils. Sandstone hills.		P3	24			2015				0	0	0	1	0	1	Negligible	Negligible	No suitable habitat.
Streptoglossa sp. Cracking clays (S. van Leeuwen et al. PBS 7353)	*Acacia aneura*, high open shrubland. Generally in soft deep clay loams and/or cracking clays.		P3	16			2006				0	0	1	1	0	2	Negligible	Negligible	No suitable habitat.
Stylidium weeliwolli	Gritty sand soil, sandy clay. Edge of watercourses.		P3	63	69		2011	1975			0	0	0	1	0	1	Negligible	Negligible	No suitable habitat.
Swainsona thompsoniana	Open flood plains on heavy clay soils. Occurs in Hamersley Range.		P3	16			2006				0	0	1	1	1	3	Possible	Negligible	No suitable habitat.
Tetratheca fordiana	Open shrubland to scattered shrubs of mixed species. Scattered low trees of *Eucalyptus leucophloia*. Cliff face.		P2	13	10		2015	1987			0	0	1	1	0	2	Negligible	Negligible	No suitable habitat.
Teucrium pilbaranum	Low slope. Red loam, cobbles, pebbles, rocks, rocky outcrops. Burnt 2-5 years ago. Medium - low trees, low shrubland, grassland (WAHerb).		P2	25			2007				0	0	0	1	2	3	Possible	Negligible	No suitable habitat.
Themeda sp. Hamersley Station (M.E. Trudgen 11431)	*Acacia aneura* shrubland. High open and tall shrubland. Claypan. Clayey plain with crabholes. Cracking clay (WAHerb).		P3	15			2020				0	0	1	1	1	3	Possible	Negligible	No suitable habitat.

Appendix B Significant Flora Desktop Results

Taxon	Habitat	Cons. Status		Distance from Survey Area			Date			PMST	Likelihood Assessment					Total Score	Likelihood		Justification
		EPBC Act	BC Act/WA	WAHerb	TPFL	Rio Tinto	WA Herb	TPFL	Rio Tinto		Recorded in survey area	Known occurrence <5km	Known occurrence <20km	Recent Record (<20 years)	Habitat suitability (0,1,2)		Pre-Survey	Post-Survey	
Thryptomene wittweri	Skeletal red stony soils. Breakaways, stony creek beds.	VU	VU	17	15		2000	1995			0	0	1	0	0	1	Negligible	Negligible	No suitable habitat.
Triodia basitricha	Occurs on rocky and gravelly slopes of mountains or low hills (keys.lucidcentral.org).		P3	43			2017				0	0	0	1	0	1	Negligible	Negligible	No suitable habitat.
Triodia sp. Karijini (S. van Leeuwen 4111)	Hummock grassland. Hillslope, summit of hill. Grey silty loam (WAHerb).		P1	33			2016				0	0	0	1	0	1	Negligible	Negligible	No suitable habitat.
Triodia sp. Mt Ella (M.E. Trudgen 12739)	Light orange-brown, pebbly loam. Amongst rocks and outcrops, gully slopes.		P3	9		2	2016		2019		0	1	1	1	0	3	Negligible	Negligible	No suitable habitat.
Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684)	Recorded from clay loams, clays, cracking clays and gilgai (DPaW & Rio Tinto, 2016).		P1	15			2017				0	0	1	1	0	2	Negligible	Negligible	No suitable habitat.
Xerochrysum boreale	Loamy, sandy, or gravelly soils in grassland or woodland, sometimes in seasonally inundated areas.		P3	16			2012				0	0	1	1	2	4	Likely	Unlikely	Suitable habitat, not recorded during survey.

Appendix C

Conservation Significant Fauna Desktop Results

Appendix C Conservation Significant Fauna Desktop Results

Taxon	Common Name	Habitat	Cons. Code		Distance from		No. of Records		Date of Record		PMST	Likelihood	Justification
			EPBC Act	BC Act/WA	DBCA	Rio Tinto	DBCA	Rio Tinto	DBCA	Rio Tinto		Post-Survey	
Actitis hypoleucos	Common Sandpiper	The Common Sandpiper utilises a wide range of coastal wetlands and some inland wetlands and is mostly found around muddy margins or rocky shores and rarely on mudflats.	MI	MI			5		2014		May	Unlikely	Several records identified (no date). No coastal habitat present.
Anilios ganei	Gane's Blind Snake (Pilbara)	Gane's Blind Snake is known from Newman to Pannawonicka where it is associated with moist gorges and gullies (Wilson & Swan, 2010).		P1	38		4		2014			Unlikely	A few records <50km from survey area. No suitable habitat (moist gorges and gullies) present.
Apus pacificus	Fork-Tailed Swift	The Fork-tailed Swift is almost exclusively aerial, and a non-breeding visitor to Australia. They are rarely seen roosting on land.	MI	MI	6	1.8	553	20	2013	2020		May	Numerous records in close proximtiy. Habitat is not specific, species is likely to fly over the area however no breeding/roosting is likely.
Calidris ferruginea	Curlew Sandpiper	Curlew Sandpipers occur on intertidal mudflats in sheltered coastal areas such as estuaries, bays, inlets and lagoons. They are sometimes recorded inland around ephemeral and permanent lakes, dams, waterholes and bore drains with bare sandy/muddy edges.	CR	CE, MI							May	Unlikely	No suitable habitat, no records in vicinity.
Calidris melanotos	Pectoral Sandpiper	The Pectoral Sandpiper occupies shallow, fresh waters often containing low grass or other small herbs. It is also observed in swamp margins, flooded pastures and saltmarshes. Rarely recorded in Western Australia (DAWE, 2022).	MI	MI							May	Unlikely	No suitable habitat, no records in vicinity.
Charadrius veredus	Oriental Plover, Oriental Dotterel	The Oriental Plover occurs in coastal and northern inland Australia, this species can venture far from water and has been observed frequenting ploughed land, bare claypans, margins of coastal margins and open plains (Pizzey & Knight, 2007).	MI	MI							May	Unlikely	No suitable habitat, no records in vicinity.
Dasycercus blythi	Brush-tailed Mulgara	The brush-tailed mulgara inhibits spinifex grasslands and in central Australia lives in burrows that it digs on flats between sand dunes (Van Dyck & Strahan 2008).		P4	38		12		2014		-	Unlikely	Records in vicinity <50km from survey area. No sand dunes were present in survey area.
Dasyurus hallucatus	Northern Quoll	The Northern Quoll occupies a wide range of habitats including, rocky areas, deserts, eucalypt forests and woodlands, hummock grass (Plechtrachne spp.), basalt hills, mesas, high and low plateaux, lower slopes, occasional tor fields and stony plains supporting either hard or soft spinifex grasslands (Braithwaite & Griffiths 1994; van Vreeswyk et al. 2004).	E	EN	47		18		2018		Known	Unlikely	Numerous records almost 50km from survey area. Habitat unlikely to be suitable for this species, denning habitat is absent.
Elanus scriptus	Letter-winged Kite	The Letter-winged Kite prefers open country and grasslands throughout arid and semi-arid regions in Australia.		P4	38		1		2018			Unlikely	Suitable habitat present. Unlikely to utilise habitat specifically in the survey area.
Falco hypoleucos	Grey Falcon	The Grey Falcon inhabits inland plains, gibber deserts, pastoral lands and timbered watercourses (Pizzey & Knight, 2007).	V	VU	13		5		2008		Known	May	Suitable habitat present. Species may forage in area but are unlikely to breed or be reliant upon habitats present.
Falco peregrinus	Peregrine Falcon	The Peregrine Falcon is widespread across Australia and inhabits a variety of habitats.		OS	14		15		2018			May	Suitable habitat present. Species may forage in area but are unlikely to breed or be reliant upon habitats present.
Hirundo rustica	Barn Swallow	The Barn Swallow is recorded in open country in coastal lowlands, often near water, towns and cities. Birds are often sighted perched on overhead wires (Pizzey 1980; Blakers et al. 1984), freshwater wetlands, paperbark Melaleuca woodland, mesophyll shrub thickets and tussock grassland (Schodde & Mason 1999).	MI	MI			-		-		May	Unlikely	No suitable habitat

Appendix C Conservation Significant Fauna Desktop Results

Taxon	Common Name	Habitat	EPBC Act	BC Act/WA	DBCA	Rio Tinto	DBCA	Rio Tinto	DBCA	Rio Tinto	PMST	Post-Survey	Justification
Leggadina lakedownensis	Northern Short-tailed Mouse, Lakeland Downs Mouse, Kerakenga	The Lakeland Down's short-tailed mouse occurs on sandy soils and cracking clays in Western Australia.		P4	17		8		1997			Unlikely	Numerous records nearby however no cracking clay or sandy soils present that would represent suitable habitat.
Leiopotherapon aheneus	Fortescue Grunter	The Fortescue Grunter is known from Ashburton River and Fortescue River where it inhabits slow to fast flowing clear freshwater streams and pools over sandy and rocky bottoms.		P4	70		2		1977			Unlikely	No permanent water in survey area.
Lerista macropisthopus remota	Unpatterned Robust Slider (Robertson Range)	The Unpatterned Robust Slider occurs in the central interior of Australia where it forms shelter in loose soil under leaf litter at bases of shrubs.		P2	51		3		2012			Unlikely	Only three records >50km from survey area. Species is therefore considered unlikely.
Liasis olivaceus barroni	Pilbara Olive Python	The Olive Python prefers rocky gorges with permanent water, or along well vegetated watercourses, although it has also been observed in locations distant from water. These include granite outcrops, elevated mesas and spinifex plains on stony ground (Bush & Maryan, 2011).	V	VU	12		6		2014		Likely	Unlikely	Numerous recods in vicinity, however there are no permanent water courses present and none in the vicintiy of the survey area. Rocky outcrops are also absent.
Macroderma gigas	Ghost Bat	The Ghost Bat occupy arid Pilbara landcsape where they roost in caves, rock crevices and old mines during the day. Foraging occurs at night, with their diet comprising brids, other bats, reptiles, frogs and large insects (TSSC ,2016a).	V	VU	8	4	172	7006	2018	2020	Known	Likely	Suitable foraging habitat present. Numerous records nearby. Unlikely to specifically utilise habitat in survey area. No rocky crevices or caves present.
Macrotis lagotis	Bilby, Dalgyte, Ninu	The Greater Bilby inhabits open tussock grassland on uplands and hills, *Acacia aneura* woodland/shrubland on ridges and rises, and hummock grasslands on plains and alluvial areas (TSSC, 2016b).	V	VU	10		1		1991		Likely	Unlikely	Habitat present however survey area is outside the current known distribution of the Bilby. The record nearby is old and may not be an accurate reflection of location.
Motacilla cinerea	Grey Wagtail	The Grey Wagtail is most commonly associated with water and are found across a wide variety of wetlands, watercourses and on the banks of lakes and marshes (DotE, 2015)	MI	MI							May	Unlikely	No suitable habitat, no records in vicinity.
Motacilla flava	Yellow Wagtail	The Yellow Wagtail inhabits open country near water, such as wet meadows.	MI	MI							May	Unlikely	No suitable habitat, no records in vicinity.
Pandion cristatus	Osprey, Eastern Osprey	The Osprey inhabits littoral and coastal habitats and terrestrial wetlands of tropical and temperate Australia and offshore islands. Found mostly in coastal areas but can travel inland along major rivers.	MI	MI	68		1		1981			Unlikely	No suitable habitat, one record >50km from survey area.
Pezoporus occidentalis	Night Parrot	Night Parrots are essentially birds of the arid zone and apparently require dense, low vegetation, under or in which they hide during the day (TSSC, 2016c). This includes hummock grasslands and samphire shurblands, often near water holes (Blyth, 1996).	E	CE							Likely	Unlikely	No suitable habitat, no records in vicinity.
Plegadis falcinellus	Glossy Ibis	The Glossy Ibis occupies well vegetated wetlands, wet pastures, floodwaters, brackish wetlands and mudflats (Pizzey & Knight, 2007).	MI	MI	63		1		1979		-	Unlikely	No suitable habitat, no records in vicinity.
Polytelis alexandrae	Princess Parrot	The Princess Parrot inhabits sand dunes and sand flats in the arid zone of western and central Australia. It occurs in open savanna woodlands and shrublands that usually consist of scattered stands of Eucalypts over shrubs over Triodia.		P4								Unlikely	No suitable habitat, no records in vicinity.
Pseudomys chapmani	Western Pebble-mound Mouse, Ngadji	Colonies occur on the gentler slopes of rocky ranges where the ground is covered by a stony mulch and vegetated by hard spinifex, often with a sparse overstorey of eucalyptus and scattered shrubs, typically Senna, Acacia and Ptilotus (Van Dyck & Strahan 2008).		P4	5	Yes	298	80	2018	2021		Likely	Suitable habitat present, many records in close proximity. Targeted searches likely to find evidence of this species.

Appendix C Conservation Significant Fauna Desktop Results

Taxon	Common Name	Habitat	EPBC Act	BC Act/WA	DBCA	Rio Tinto	DBCA	Rio Tinto	DBCA	Rio Tinto	PMST	Post-Survey	Justification
Rhinonicteris aurantia (Pilbara)	Pilbara Leaf-nosed Bat	The Pilbara Leaf-nosed Bat requires caves or mines with hot humid microclimates for roosting. They can sometimes roost in trees.	V	VU	1.8		87		2018		Known	Likely	Suitable foraging habitat present. Numerous records nearby. Survey area habitat restricted to foraging only in the absence of suitable roosting caves and crevices.
Rostratula australis	Australian Painted Snipe	The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans (DAWE, 2022).	E	E							May	Unlikely	No suitable habitat, no records in vicinity.
Sminthopsis longicaudata	Long-tailed Dunnart	The Long-tailed Dunnart inhabits exposed rock and stony soils with hummock grasses and shrubs including flat-topped hills, lateritic plateaus, sandstone ranges and breakaways with sparse Mulga (WA Museum Collections, 2022).		P4	61		8		2006		-	Unlikely	Numerous records in proximity to survey area, however there is no exposed rock, plateaus and flat-topped hills, sandstone ranges or breakaways occur in the survey area. Species likely associated with rocky plateaus and ranges north of survey area.
Tringa nebularia	Common Greenshank, Greenshank	The Common Greenshank is a wader found in inland wetlands and sheltered coastal habitats.	MI	MI	62		2		2011		-	Unlikely	No wetlands present that would represent habitat for this species. Two records from >50km from survey area.
Underwoodisaurus seorsus	Pilbara barking gecko	The Pilbara Barking Gecko has been recorded in rocky areas of the Hamersley Range including major gullies, rock slabs, and gorges (Wilson & Swan, 2010).		P2	25		19		2013		-	Unlikely	No rocky gullies or ranges present in the survey area. This species likely to be assocaited with ranges north of survey area.

Appendix D

Flora Species by Community Matrix

Appendix D Flora by Family by Community Matrix

Family	Taxon	ApAbTe					AcPlEa					AmReTl	EtAbTw						SaTw			Oppo
		CGR01	CGR06	CGR10	CGR12	CGR13	CGR02	CGR07	CGR08	CGR11	CGR15	FDW03	CGR03	CGR04	CGR05	CGR09	CGR14	JHR02	FDW01	FDW02	JH01	
Acanthaceae																						
	Dicladanthera forrestii								x													
	Dipteracanthus australasicus subsp. *australasicus*										x											
Amaranthaceae																						
	?Ptilotus obovatus															x						
	Gomphrena ?cunninghamii									x												
	Gomphrena kanisii											x										
	Ptilotus astrolasius																					x
	Ptilotus calostachyus																	x				
	Ptilotus exaltatus											x					x	x			x	
	Ptilotus helipteroides				x																	
	Ptilotus obovatus	x	x		x		x					x	x	x		x	x			x	x	
	Ptilotus roei																					x
	Ptilotus schwartzii																					x
	Ptilotus sp.																		x			
Apocynaceae																						
	Leichhardtia australis																					x
Asteraceae																						
*	*Bidens bipinnata*											x				x						
	Olearia fluvialis								x													
	Streptoglossa sp.			x																		
Boraginaceae																						
	Euploca chrysocarpa								x						x						x	
	Euploca cunninghamii																					x
	Euploca heterantha																					x
	Trichodesma zeylanicum var. *zeylanicum*						x															
Brassicaceae																						x
	Lepidium pedicellosum																					x
Capparaceae																						
	Capparis lasiantha			x	x									x		x	x		x			
Caryophyllaceae																						
	Polycarpaea longiflora									x	x											
Chenopodiaceae																						
	Enchylaena tomentosa		x				x															
	Maireana georgei																					x
	Maireana planifolia	x																				
	Maireana sp.											x										
	Maireana triptera																					x
	Maireana villosa		x																			
	Rhagodia ?sp. Hamersley (M. Trudgen 17794) (P3)																					x
	Rhagodia eremaea					x	x					x		x								
	Salsola australis			x			x	x				x			x				x		x	
Cleomaceae																						
	Arivela viscosa				2		x	x	x	x		x										
Convolvulaceae																						
	Duperreya commixta	x	x	x	x		x	x	x	x	x	x	x				x					
	Evolvulus alsinoides var. *villosicalyx*							2				x										
Cucurbitaceae																						
	Cucumis variabilis						x									x						
Euphorbiaceae																						
	Euphorbia australis var. *hispidula*																					x
	Euphorbia biconvexa								x													

Family	Taxon	ApAbTe					AcPlEa					AmReTl	EtAbTw						SaTw			Oppo
		CGR01	CGR06	CGR10	CGR12	CGR13	CGR02	CGR07	CGR08	CGR11	CGR15	FDW03	CGR03	CGR04	CGR05	CGR09	CGR14	JHR02	FDW01	FDW02	JH01	
	Euphorbia ferdinandi var. *ferdinandi*					x																
Fabaceae																						
	Acacia ?aptaneura		x																			
	Acacia ?citrinoviridis						x															
	Acacia ?sibirica																				x	
	Acacia aneura		x																			
	Acacia aptaneura			2	x	2						x				x						
	Acacia bivenosa	x	x	x	x	x		x	x		x	x	x	x	x	x	x	x	x	x	x	
	Acacia citrinoviridis							x	x	x	x			x								
	Acacia macraneura	x										x	x									
	Acacia pachyacra																					x
	Acacia pruinocarpa	x	x	x	x	x		x				x		x	x		x	x		x	x	
	Acacia pyrifolia							x	x	x	x											
	Acacia sibirica																					x
	Acacia synchronicia		x											x		x	x	x				
	Acacia tetragonophylla			x								x				x	x					
	Acacia victoriae																		x			
	Crotalaria medicaginea							x														
	Glycine canescens											x										
	Indigofera georgei																					x
	Indigofera monophylla			x																		
	Petalostylis labicheoides				x		x	x	x	x	x		x	x								
	Rhynchosia minima							x														
	Senna artemisioides subsp. *filifolia*						x							x								
	Senna artemisioides subsp. *helmsii*	x																				
	Senna artemisioides subsp. *helmsii x oligophylla*											x									x	
	Senna artemisioides subsp. *oligophylla*	x			x	x						x	x	x	x	x	x	x	x	x	x	
	Senna glutinosa subsp. *glutinosa*												x									
	Senna glutinosa subsp. *pruinosa*																	x				
	Senna glutinosa subsp. *xleurssenii*		x													x	x	x				
	Tephrosia rosea								x	x	x											
	Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)							x	x													
Goodeniaceae																						
	Goodenia muelleriana											x										
	Goodenia ?sp. East Pilbara (A.A. Mitchell PRP 727) (P3)																					
	Scaevola acacioides																					x
Gyrostemonaceae																						
	Codonocarpus cotinifolius	x	x	x		x							x			x		x		x	x	
Malvaceae																						
	Abutilon ?fraseri																					x
	Abutilon cryptopetalum											x										
	Abutilon leucopetalum			x				x	x							x	x					
	Androcalva luteiflora						x		x		x	x										
	Corchorus crozophorifolius							x		x												
	Corchorus lasiocarpus																					x
	Gossypium robinsonii									x												
	Hibiscus burtonii			x		x														x		
	Hibiscus coatesii																					x
	Hibiscus sturtii var. *campylochlamys*																					x
*	*Malvastrum americanum*						x															
	Melhania oblongifolia															x						

Family	Taxon	ApAbTe					AcPlEa					AmReTl	EtAbTw						SaTw			Oppo
		CGR01	CGR06	CGR10	CGR12	CGR13	CGR02	CGR07	CGR08	CGR11	CGR15	FDW03	CGR03	CGR04	CGR05	CGR09	CGR14	JHR02	FDW01	FDW02	JH01	
	Seringia nephrosperma		x																			
	Sida sp. dark green fruits (S. van Leeuwen 2260)																					x
	Sida sp. Golden calyces glabrous (H.N. Foote 32)					x																
	Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)																					x
	Sida sp. Supplejack Station (T.S. Henshall 2345)																					x
	Waltheria indica	x								x												
Myrtaceae																						
	Corymbia hamersleyana				x							x		x							x	
	Eucalyptus ?camaldulensis									x												
	Eucalyptus ?xerothermica												x									
	Eucalyptus camaldulensis						x		x													
	Eucalyptus leucophloia													x			x					
	Eucalyptus trivalva				x										x	x	x		x			
	Eucalyptus victrix						x	x	x		x											
	Eucalyptus xerothermica								x		x			x								
	Melaleuca eleuterostachya														x							
Nyctaginaceae																						
	Boerhavia coccinea											x										
Oleaceae																						
	Jasminum didymum subsp. *lineare*										x	x		x								
Phyllanthaceae																						
	Phyllanthus maderaspatensis								x	x												
Poaceae																						
	Aristida contorta				x			x										x				
	Aristida holathera var. *holathera*					x																
	Aristida ingrata																					x
*	*Cenchrus ciliaris*						x	x	x		x											
*	Cenchrus sp.																					x
	Chrysopogon fallax				x							x										
	Cymbopogon ambiguus							x	x	x	x					x						
	Enneapogon caerulescens																				x	
	Enneapogon lindleyanus	x		x	x		x	x	x	x	x	x		x		x	x					
	Enneapogon polyphyllus					x			x							x	x					
	Eragrostis desertorum					x																
	Eragrostis eriopoda																					x
	Eragrostis setifolia																			x		
	Eriachne helmsii								x	x												
	Eriachne mucronata							x	x													
	Eriachne pulchella subsp. *pulchella*									x												
	Eulalia aurea							x		x												
	Paraneurachne muelleri											x									x	
	Themeda triandra							x	x		x	x										
	Triodia epactia	x	x	x	x	x		x			x											
	Triodia longiceps								x			x	x	x	x	x	x		x			
	Triodia pungens											x						x				
	Triodia wiseana												x	x	x	x	x	x	x	x	x	
Portulacaceae																						
	Portulaca oleracea																					x
Proteaceae																						
	Grevillea ?berryana			x		x													x	x		
	Hakea chordophylla				x								x									
	Hakea lorea subsp. *lorea*		x	x								x		x								

Family	Taxon	ApAbTe					AcPlEa					AmReTl	EtAbTw						SaTw			Oppo
		CGR01	CGR06	CGR10	CGR12	CGR13	CGR02	CGR07	CGR08	CGR11	CGR15	FDW03	CGR03	CGR04	CGR05	CGR09	CGR14	JHR02	FDW01	FDW02	JH01	
Pteridaceae																						
	Cheilanthes sieberi																					x
Rhamnaceae																						
	Ventilago viminalis								x		x											
Rubiaceae																						
	Psydrax latifolia			x		x						x										
Santalaceae																						
	Anthobolus leptomerioides			x																		
	Santalum acuminatum		x						x							x						
	Santalum lanceolatum	x												x								
Scrophulariaceae																						
	Eremophila ?jucunda																				x	
	Eremophila ?maculata subsp. *maculata*															x	x				x	
	Eremophila caespitosa					x						x										
	Eremophila forrestii subsp. *forrestii*			x					x					x		x	x		x			
	Eremophila fraseri																					x
	Eremophila jucunda subsp. *pulcherrima*																					x
	Eremophila longifolia		x				x							x								
	Eremophila phyllopoda subsp. *obliqua*																					x
	Eremophila pusilliflora			x	x							x										
	Olearia fluvialis																					x
Solanaceae																						
	Solanum ferocissimum											x										
	Solanum lasiophyllum		x		x	x														x		
	Solanum sp.															x						
Surianaceae																						
	Stylobasium spathulatum								x													
Violaceae																						
	Afrohybanthus aurantiacus							x		x	x											
Zygophyllaceae																						
	Tribulus suberosus	x	x	x		x										x	x	x				

Appendix E

Relevé Data

Appendix E – Flora Site Data

Site No: CGR1	**Date**: 22/03/2022	**Longitude**:	**Latitude**:

Type: Relevé
Topography: Flat plain
Vegetation Condition: Excellent
Fire: 2-4 yrs
Vegetation Type: Hummock grasslands

Soil Types: Sand loam clay
Soil Colour: Reddish brown
Condition Notes: None

ApAbTe: *Acacia pruinocarpa, Acacia aptaneura* and *Codonocarpus cotinifolius* low open to sparse trees over *Acacia bivenosa, Ptilotus obovatus* and *Senna artemisioides* subsp. *oligophylla* mid to low sparse shrubland over *Triodia epactia* low hummock grassland.

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
	Acacia bivenosa	120	2	
CGR01-05	*Acacia macraneura*	500	2	scattered
	Acacia pruinocarpa	400	4	
	Codonocarpus cotinifolius	600	1	
	Duperreya commixta	cr	+	
CGR01-04	*Enneapogon lindleyanus*	50	+	
CGR01-06	*Maireana planifolia*	80	+	

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
CGR01-02	*Ptilotus obovatus*	50	1	
	Ptilotus obovatus	50	+	
CGR01-03	*Santalum lanceolatum*	200	+	
	Senna artemisioides subsp. helmsii	70	+	
	Senna artemisioides subsp. oligophylla	100	+	
	Tribulus suberosus	60	+	
CGR01-01	*Triodia epactia*	40	15	
	Waltheria indica	40	+	

Site No: CGR2	**Date**: 22/03/2022	**Longitude**:	**Latitude**:

Type: Relevé
Topography: Broad channel
Vegetation Condition: Very good
Fire: 8-12 yrs
Vegetation Type: Drainage

Soil Types: Sand loam clay
Soil Colour: Light brown
Condition Notes: Some weeds

AcPlEa*: Acacia citrinoviridis, Eucalyptus victrix* and *Eucalyptus camaldulensis* low open woodland over *Petalostylis labicheoides, Acacia pyrifolia* and *Acacia bivenosa* tall open shrubland over *Eulalia aurea, Eriachne helmsii* and *Enneapogon lindleyanus* low open tussock grassland.

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
	Acacia ?citrinoviridis	600	15	
	Arivela viscosa	30	+	
	Cenchrus ciliaris	40	+	
	Cucumis variabilis	CR	+	
	Duperreya commixta	CR	+	
	Enchylaena tomentosa	100	+	
	Enneapogon lindleyanus	80	10	
	Eremophila longifolia	200	+	
	Eucalyptus camaldulensis	800	+	
	Eucalyptus victrix	800	10	

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
	Malvastrum americanum	60	+	
	Petalostylis labicheoides	250	+	
CGR01-02	*Ptilotus obovatus*	80	0.5	
	Rhagodia eremaea	120	+	
	Salsola australis	100	+	
	Senna artemisioides subsp. filifolia	100	+	
CGR02-01	*Androcalva luteiflora*	300	0.5	Androcalva sp.
	Trichodesma zeylanicum var. zeylanicum	150	+	

Site No: CGR3	**Date**: 22/03/2022	**Longitude**:	**Latitude**:

Type: Relevé
Soil Types: Stony gravelly sand loam
Topography: Stony rise
Soil Colour: Brown
Vegetation Condition: Excellent
Condition Notes: None
Fire: 8-12 yrs
Vegetation Type: Hummock on skeletal soils

EtAbTw*: Eucalyptus trivalva, Acacia macraneura* and *Acacia pruinocarpa* isolated low trees over *Acacia bivenosa, Senna artemisioides* subsp. *oligophylla* and *Capparis lasiantha* mid sparse shrubland over *Triodia wiseana* and *Triodia longiceps* low hummock grassland.

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
CGR03-02	*Acacia bivenosa*	150	5	
CGR01-05	*Acacia macraneura*	300	2	In isolated clumps
	Codonocarpus cotinifolius	400	0.5	
	Duperreya commixta	CR	+	
	Hakea chordophylla	250	0.2	Glabrous
	Petalostylis labicheoides	150	+	
CGR01-02	*Ptilotus obovatus*	50	+	

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
	Senna artemisioides subsp. oligophylla	50	0.2	
	Senna glutinosa subsp. glutinosa	150	+	
CGR03-01	*Eucalyptus ?xerothermica*	600	0.2	photo CG091734, rough bark
CGR03-04	*Triodia longiceps*	50	15	
	Triodia wiseana	30	15	

Site No: CGR4	**Date**: 22/03/2022	**Longitude**:	**Latitude**:

Type: Relevé
Topography: Stony rise
Vegetation Condition: Excellent
Fire: 2-4 yrs
Vegetation Type: Hummock on skeletal soils

Soil Types: Sandy clay loam
Soil Colour: reddish brown
Condition Notes: None

EtAbTw*: Eucalyptus trivalva, Acacia macraneura* and *Acacia pruinocarpa* isolated low trees over *Acacia bivenosa, Senna artemisioides* subsp. *oligophylla* and *Capparis lasiantha* mid sparse shrubland over *Triodia wiseana* and *Triodia longiceps* low hummock grassland.

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
CGR03-02	*Acacia bivenosa*	120	4	
	Acacia citrinoviridis	200	+	
	Acacia pruinocarpa	180	+	
	Acacia synchronicia	50	+	
	Capparis lasiantha	100	+	
	Corymbia hamersleyana	600	0.5	
CGR01-04	*Enneapogon lindleyanus*	40	+	
	Eremophila forrestii subsp. forrestii	60	+	
	Eremophila longifolia	150	+	
	Eucalyptus leucophloia	500	+	

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
	Eucalyptus xerothermica	500	0.05	
	Hakea lorea subsp. lorea	250	+	
	Jasminum didymum subsp. lineare	120	+	
	Petalostylis labicheoides	130	0.2	
CGR01-02	*Ptilotus obovatus*	40	+	
	Rhagodia eremaea	120	+	
CGR01-03	*Santalum lanceolatum*	200	0.1	
CGR04-01	*Senna artemisioides subsp. filifolia*	70	+	
	Senna artemisioides subsp. oligophylla	70	0.5	
CGR03-04	*Triodia longiceps*	50	15	
	Triodia wiseana	30	15	

Site No: CGR5	**Date**: 22/03/2022	**Longitude**:	**Latitude**:

Type: Relevé
Soil Types: Loam with calcrete/ironstone pebbles
Topography: Undulating terrace/rise
Soil Colour: Beige
Vegetation Condition: Excellent
Condition Notes: None
Fire: 4-8 yrs
Vegetation Type: Hummock on skeletal soils

EtAbTw*: Eucalyptus trivalva, Acacia macraneura* and *Acacia pruinocarpa* isolated low trees over *Acacia bivenosa, Senna artemisioides* subsp. *oligophylla* and *Capparis lasiantha* mid sparse shrubland over *Triodia wiseana* and *Triodia longiceps* low hummock grassland.

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
	Acacia bivenosa	110	0.5	
	Acacia pruinocarpa	160	+	
JH	*Euploca chrysocarpa*	30	+	
CGR05-01	*Melaleuca eleuterostachya*	120	0.2	Isolated clumps
	Salsola australis	35	+	
	Senna artemisioides subsp. oligophylla	60	+	
CGR03-03	*Eucalyptus trivalva*	300	2	
CGR03-04	*Triodia longiceps*	40	5	
	Triodia wiseana	40	16	

Site No: CGR6	**Date**: 22/03/2022	**Longitude**:	**Latitude**:

Type: Relevé
Topography: Flat stony plain
Vegetation Condition: Excellent
Fire: 8-12 yrs
Vegetation Type: Hummock grassland

Soil Types: Sandy loam clay
Soil Colour: reddish brown
Condition Notes: Old tracks

ApAbTe: *Acacia pruinocarpa, Acacia aptaneura* and *Codonocarpus cotinifolius* low open to sparse trees over *Acacia bivenosa, Ptilotus obovatus* and *Senna artemisioides* subsp. *oligophylla* mid to low sparse shrubland over *Triodia epactia* low hummock grassland.

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
CGR06-04	*Acacia ?aptaneura*	300	1	
CGR06-02	*Acacia aneura*	450	1.5	
CGR06-03	*Acacia bivenosa*	250	0.5	
	Acacia pruinocarpa	450	2.5	
	Acacia synchronicia	350	0.5	
	Codonocarpus cotinifolius	350	+	In burnt areas
	Duperreya commixta	CR	+	
	Enchylaena tomentosa	60	+	
	Eremophila longifolia	200	+	
	Hakea lorea subsp. lorea	250	+	

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
CR06-01	*Maireana villosa*	30	+	
CGR01	*Ptilotus obovatus*	50	+	
	Santalum acuminatum	200	+	
	Senna glutinosa subsp. xleurssenii	80	+	
CGR06-06	*Seringia nephrosperma*	100	+	
CGR06-05	*Solanum lasiophyllum*	100	+	
	Tribulus suberosus	100	+	
	Triodia epactia	50	40	

Site No: CGR7	**Date**: 23/03/2022	**Longitude**:	**Latitude**:

Type: Relevé
Soil Types: Sandy loam
Topography: Creekline – bed and banks
Soil Colour: reddish brown
Vegetation Condition: Very Good
Condition Notes: Buffel grass
Fire: 12+ yrs
Vegetation Type: Drainage

AcPlEa*: Acacia citrinoviridis, Eucalyptus victrix* and *Eucalyptus camaldulensis* low open woodland over *Petalostylis labicheoides, Acacia pyrifolia* and *Acacia bivenosa* tall open shrubland over *Eulalia aurea, Eriachne helmsii* and *Enneapogon lindleyanus* low open tussock grassland.

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
CGR07-05	*Abutilon leucopetalum*	50	+	
	Acacia bivenosa	80	+	
	Acacia citrinoviridis	400	2	
	Acacia pruinocarpa	150	+	
	Acacia pyrifolia	200	1	
CGR07-07	*Afrohybanthus aurantiacus*	50	+	
CGR07-01	*Aristida contorta*	30	+	
	Arivela viscosa	40	+	
	Cenchrus ciliaris	60	2	
CGR07-03	*Corchorus crozophorifolius*	80	+	

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
	Crotalaria medicaginea	20	+	
	Cymbopogon ambiguus	160	0.2	
	Duperreya commixta	CR	+	
CGR01-04	*Enneapogon lindleyanus*	50	0.3	
CGR07-08	*Eriachne mucronata*	45	+	
	Eucalyptus victrix	700	0.5	Isolated clumps
CGR07-02	*Eulalia aurea*	60	1	
CGR07-06	*Evolvulus alsinoides var. villosicalyx*	30	+	
	Evolvulus alsinoides var. villosicalyx	20	+	
	Petalostylis labicheoides	250	3	
	Rhynchosia minima	CR	+	
	Salsola australis	40	+	
CGR07-04	*Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)*	40	+	
	Themeda triandra	90	+	
	Triodia epactia	40	2.5	

Site No: CGR8	**Date**: 23/03/2022	**Longitude**:	**Latitude**:

Type: Relevé
Topography: Major drainage
Vegetation Condition: Very Good
Fire: <2 – 2-4yrs
Vegetation Type: Drainage

Soil Types: Sandy loam
Soil Colour: reddish brown
Condition Notes: Buffel grass scattered

AcPlEa*: Acacia citrinoviridis, Eucalyptus victrix* and *Eucalyptus camaldulensis* low open woodland over *Petalostylis labicheoides, Acacia pyrifolia* and *Acacia bivenosa* tall open shrubland over *Eulalia aurea, Eriachne helmsii* and *Enneapogon lindleyanus* low open tussock grassland.

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
CGR07-05	*Abutilon leucopetalum*	100	+	
	Acacia bivenosa	150	6	
	Acacia citrinoviridis	300	2	
	Acacia pyrifolia	170	1	
CGR02-01	*Androcalva luteiflora*	110	1.5	
	Arivela viscosa	20	+	
	Cenchrus ciliaris	60	+	
	Cymbopogon ambiguus	130	+	
CGR08-07	*Dicladanthera forrestii*	20	+	
	Duperreya commixta	CR	+	

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
CGR01-04	*Enneapogon lindleyanus*	60	+	
	Enneapogon polyphyllus	30	+	
	Eremophila forrestii subsp. forrestii	70	+	
CGR08-02	*Eriachne helmsii*	40	5	
	Eriachne mucronata	40	+	
	Eucalyptus camaldulensis	1500	2	1-2, isolated
	Eucalyptus victrix	1000	1	1-2
	Eucalyptus xerothermica	800	+	
CGR08-04	*Euphorbia biconvexa*	20	+	
CGR08-05	*Euploca chrysocarpa*	20	+	
	Petalostylis labicheoides	250	4	
	Phyllanthus maderaspatensis	40	+	
	Santalum acuminatum	130	0.5	
	Stylobasium spathulatum	90	+	
CGR08-03	*Olearia fluvialis*	40	+	
	Tephrosia rosea	50	0.2	
CGR07-04	*Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)*	60	+	
	Themeda triandra	70	3	
CGR08-01	*Triodia longiceps*	10	10	2-10
CGR08-06	*Ventilago viminalis*	200	+	WP072, 100 plants

Site No: CGR9	**Date**: 23/03/2022	**Longitude**:	**Latitude**:

Type: Relevé
Soil Types: Loam
Topography: Calcrete hill
Soil Colour: pale reddish brown
Vegetation Condition: Excellent
Condition Notes:
Fire: 4-8 yrs
Vegetation Type: Hummock on skeletal soils

EtAbTw*: Eucalyptus trivalva, Acacia macraneura* and *Acacia pruinocarpa* isolated low trees over *Acacia bivenosa, Senna artemisioides* subsp. *oligophylla* and *Capparis lasiantha* mid sparse shrubland over *Triodia wiseana* and *Triodia longiceps* low hummock grassland.

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
CGR09-07	*?Ptilotus obovatus*	25	+	
CGR07-05	*Abutilon leucopetalum*	25	+	
CGR09-03	*Acacia aptaneura*	450	0.5	
CGR09-08	*Acacia bivenosa*	170	0.5	
CGR06-03	*Acacia bivenosa*	70	+	
	Acacia synchronicia	40	+	
	Acacia tetragonophylla	300	0.5	
	Capparis lasiantha	100	+	
	Codonocarpus cotinifolius	400	+	
	Cucumis variabilis	CR	+	

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
CGR09-06	*Cymbopogon ambiguus*	120	+	
CGR01-04	*Enneapogon lindleyanus*	60	+	
	Enneapogon polyphyllus	25	+	
	Enneapogon polyphyllus	25	+	
CGR09-02	*Eremophila ?maculata subsp. maculata*	80	+	
CGR09-01	*Eremophila forrestii subsp. forrestii*	60	+	
CGR09-04	*Melhania oblongifolia*	20	+	
CGR	*Ptilotus obovatus*	50	1	
	Santalum acuminatum	300	+	
	Senna artemisioides subsp. oligophylla	40	8	
	Senna glutinosa subsp. x leurssenii	50	+	
	Solanum sp.	50	+	Dead
CGR03-03	*Eucalyptus trivalva*	300	8	
CGR09-05	*Bidens bipinnata*	10	+	
	Tribulus suberosus	50	+	Tribulus suberosus
CGR08-01	*Triodia longiceps*	40	3	
	Triodia wiseana	30	10	

Site No: CGR10	**Date**: 23/03/2022	**Longitude**:	**Latitude**:

Type: Relevé
Soil Types: Sand clay loam
Topography: Flat stony plain
Soil Colour: reddish brown
Vegetation Condition: Excellent
Condition Notes:
Fire: 8-12 yrs
Vegetation Type: Hummock grasslands

ApAbTe: *Acacia pruinocarpa, Acacia aptaneura* and *Codonocarpus cotinifolius* low open to sparse trees over *Acacia bivenosa, Ptilotus obovatus* and *Senna artemisioides* subsp. *oligophylla* mid to low sparse shrubland over *Triodia epactia* low hummock grassland.

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
CGR07-05	*Abutilon leucopetalum*	40	+	
CGR10-02	*Acacia aptaneura*	400	1	broader flat phyllode
CGR10-01	*Acacia aptaneura*	600	3	2-3, narrow flat phyllodes
	Acacia bivenosa	120	0.4	
	Acacia pruinocarpa	450	2	
	Acacia tetragonophylla	200	+	
JH	*Anthobolus leptomerioides*	100	+	
	Capparis lasiantha	90	+	Capparis lasiantha
	Codonocarpus cotinifolius	500	0.2	

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
	Duperreya commixta	CR	+	
CGR01-04	*Enneapogon lindleyanus*	50	+	
	Eremophila forrestii subsp. forrestii	90	+	
	Eremophila pusilliflora	60	+	P2, 2 plants
CGR10-04	*Grevillea ?berryana*	130	+	
	Hakea lorea subsp. lorea	180	+	
CGR10-03	*Hibiscus burtonii*	25	+	
	Indigofera monophylla	60	+	
	Psydrax latifolia	120	+	
	Salsola australis	60	+	
	Streptoglossa sp.	90	+	Dead
	Tribulus suberosus	70	0.2	
	Triodia epactia	50	7	

Site No: CGR11	**Date**: 23/03/2022	**Longitude**:	**Latitude**:

Type: Relevé
Topography: Turree Creek
Vegetation Condition: Excellent
Fire: 4-8 yrs
Vegetation Type: Drainage

Soil Types: Sand clay loam
Soil Colour: reddish brown
Condition Notes:

AcPlEa*: Acacia citrinoviridis, Eucalyptus victrix* and *Eucalyptus camaldulensis* low open woodland over *Petalostylis labicheoides, Acacia pyrifolia* and *Acacia bivenosa* tall open shrubland over *Eulalia aurea, Eriachne helmsii* and *Enneapogon lindleyanus* low open tussock grassland.

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
	Acacia citrinoviridis	450	2	
	Acacia pyrifolia	400	4	
	Afrohybanthus aurantiacus	60	+	
	Arivela viscosa	10	+	
CGR11-02	*Corchorus crozophorifolius*	100	+	
	Cymbopogon ambiguus	120	0.2	
	Duperreya commixta	CR	+	
CGR01-04	*Enneapogon lindleyanus*	60	+	
CGR11-03	*Eriachne helmsii*	50	6	

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
CGR11-05	*Eriachne pulchella subsp. pulchella*	10	+	
	Eulalia aurea	100	12	
CGR11-04	*Gomphrena ?cunninghamii*	5	+	
	Gossypium robinsonii	300	0.1	
	Petalostylis labicheoides	350	2	1-2.
	Phyllanthus maderaspatensis	40	+	
	Polycarpaea longiflora	20	+	
CGR11-01	*Eucalyptus ?camaldulensis*	1500	2	Very difficult to ID without fruits.
	Tephrosia rosea	70	0.2	
	Waltheria indica	25	+	

Site No: CGR12	**Date**: 23/03/2022	**Longitude**:	**Latitude**:

Type: Relevé
Topography: Flat stony plain
Vegetation Condition: Excellent
Fire: 2-4 yrs
Vegetation Type: Hummock grasslands

Soil Types: Sand clay loam
Soil Colour: reddish brown
Condition Notes:

ApAbTe: *Acacia pruinocarpa, Acacia aptaneura* and *Codonocarpus cotinifolius* low open to sparse trees over *Acacia bivenosa, Ptilotus obovatus* and *Senna artemisioides* subsp. *oligophylla* mid to low sparse shrubland over *Triodia epactia* low hummock grassland.

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
CGR10-01	*Acacia aptaneura*	400	0.5	Juvenile
	Acacia bivenosa	100	0.2	
	Acacia pruinocarpa	250	0.5	
CGR12-02	*Aristida contorta*	40	+	
	Arivela viscosa	10	+	
CGR12-04	*Arivela viscosa*	10	+	
	Capparis lasiantha	100	+	
	Chrysopogon fallax	120	+	
	Corymbia hamersleyana	600	+	
	Duperreya commixta	CR	+	

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
	Enneapogon lindleyanus	40	+	
	Eremophila pusilliflora	40	+	P2, 1 plant
	Hakea chordophylla	350	0.5	
	Petalostylis labicheoides	300	0.5	0.5-1
CGR12-03	*Ptilotus helipteroides*	10	+	
	Ptilotus obovatus	80	0.2	
	Senna artemisioides subsp. oligophylla	90	0.5	
	Solanum lasiophyllum	40	+	
CGR12-01	*Eucalyptus trivalva*	800	+	Isolated. ph150044
	Triodia epactia	60	12	

Site No: CGR13	**Date**: 24/03/2022	**Longitude**:	**Latitude**:

Type: Relevé
Soil Types: Clay loam
Topography: Broad wash plain, flat
Soil Colour: reddish brown
Vegetation Condition: Excellent
Condition Notes:
Fire: 2-4 yrs
Vegetation Type: Hummock grassland

ApAbTe: *Acacia pruinocarpa, Acacia aptaneura* and *Codonocarpus cotinifolius* low open to sparse trees over *Acacia bivenosa, Ptilotus obovatus* and *Senna artemisioides* subsp. *oligophylla* mid to low sparse shrubland over *Triodia epactia* low hummock grassland.

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
FdW220323-35	*Acacia aptaneura*	120	0.1	
CGR10-01	*Acacia aptaneura*	180	0.1	
	Acacia bivenosa	100	0.2	
	Acacia pruinocarpa	250	0.5	
	Aristida holathera var. holathera	30	+	
	Codonocarpus cotinifolius	400	1	
CGR13-02	*Enneapogon polyphyllus*	25	+	
CGR13-06	*Eragrostis desertorum*	25	+	
CGR13-01	*Eremophila caespitosa*	30	0.1	
CGR13-03	*Euphorbia ferdinandi var. ferdinandi*	5	+	

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
FdW220322-15	*Grevillea ?berryana*	50	+	
CGR13-05	*Hibiscus burtonii*	40	+	
	Psydrax latifolia	40	0.1	
	Rhagodia eremaea	120	0.1	
	Senna artemisioides subsp. oligophylla	100	+	
CGR13-04	*Sida sp. Golden calyces glabrous (H.N. Foote 32)*	30	+	
	Solanum lasiophyllum	45	+	
	Tribulus suberosus	50	0.1	
	Triodia epactia	40	25	

Site No: CGR14	**Date**: 24/03/2022	**Longitude**:	**Latitude**:

Type: Relevé
Soil Types: Loam
Topography: Calcrete hill
Soil Colour: brown
Vegetation Condition: Excellent
Condition Notes:
Fire: 4-8 yrs
Vegetation Type: Hummock on skeletal soils

EtAbTw*: Eucalyptus trivalva, Acacia macraneura* and *Acacia pruinocarpa* isolated low trees over *Acacia bivenosa, Senna artemisioides* subsp. *oligophylla* and *Capparis lasiantha* mid sparse shrubland over *Triodia wiseana* and *Triodia longiceps* low hummock grassland.

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
CGR07-05	*Abutilon leucopetalum*	25	+	
	Acacia bivenosa	100	0.5	
	Acacia pruinocarpa	150	1	
	Acacia synchronicia	140	+	
	Acacia tetragonophylla	60	0.2	
	Capparis lasiantha	140	0.2	
	Duperreya commixta	CR	+	
CGR01-04	*Enneapogon lindleyanus*	40	+	
	Enneapogon polyphyllus	25	+	
CGR09-02	*Eremophila ?maculata subsp. maculata*	90	+	

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
	Eremophila forrestii subsp. forrestii	60	+	
CGR14-01	*Eremophila forrestii subsp. forrestii*	50	+	
	Eucalyptus leucophloia	500	+	isolated
	Ptilotus exaltatus	60	+	dead
CGR	*Ptilotus obovatus*	50	0.5	
	Senna artemisioides subsp. oligophylla	60	0.5	
	Senna glutinosa subsp. xleurssenii	70	+	
CGR03-03	*Eucalyptus trivalva*	250	5	
	Tribulus suberosus	70	+	
CGR08-01	*Triodia longiceps*	40	8	
	Triodia wiseana	40	8	

Site No: CGR15	**Date**: 24/03/2022	**Longitude**:	**Latitude**:

Type: Relevé
Soil Types: Sand loam
Topography: Creekline
Soil Colour: reddish brown
Vegetation Condition: Excellent
Condition Notes: a bit of buffel
Fire: 4-8 yrs
Vegetation Type: Drainage

AcPlEa*: Acacia citrinoviridis, Eucalyptus victrix* and *Eucalyptus camaldulensis* low open woodland over *Petalostylis labicheoides, Acacia pyrifolia* and *Acacia bivenosa* tall open shrubland over *Eulalia aurea, Eriachne helmsii* and *Enneapogon lindleyanus* low open tussock grassland.

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
	Acacia bivenosa	200	2	
	Acacia citrinoviridis	450	1.5	
	Acacia pyrifolia	150	0.5	
	Afrohybanthus aurantiacus	60	+	
	Androcalva luteiflora	300	1	
	Cenchrus ciliaris	50	+	
	Cymbopogon ambiguus	130	0.2	
CGR15-02	*Dipteracanthus australasicus subsp. australasicus*	20	+	purple flower tubular
	Duperreya commixta	CR	0.1	

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
CGR01-04	*Enneapogon lindleyanus*	70	0.3	
	Eucalyptus victrix	800	1	
	Eucalyptus xerothermica	600	0.5	
	Jasminum didymum subsp. lineare	CR	+	
	Petalostylis labicheoides	400	3	2-3.
CGR15-03	*Polycarpaea longiflora*	30	+	
	Tephrosia rosea	60	0.4	
	Themeda triandra	90	0.2	
	Triodia epactia	40	3	
CGR15-01	*Ventilago viminalis*	300	0.1	

Site No: FdW01	**Date**: 22/03/2022	**Longitude**: 118.532055	**Latitude**: -23.1409266

Type: Relevé
Soil Types: Sand clay loam
Topography: Undulating rocky
Soil Colour: reddish brown
Vegetation Condition: Excellent
Condition Notes:
Fire: 12+ yrs

Vegetation Type: Rocky undulating terrain with hummock grassland

SaTw: *Senna artemisioides* subsp. *helmsii x oligophylla/oligophylla, Acacia bivenosa* and Acacia sp. mid to low isolated shrubs over *Triodia wiseana* and occasional *Triodia longiceps* low hummock grassland.

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
	Acacia bivenosa	50	0.1	
	Acacia victoriae	80	0.5	
	Capparis lasiantha	80	0.1	
	Eremophila forrestii subsp. forrestii	50	0.1	
	Grevillea ?berryana	250	0.01	
	Ptilotus sp.	30	0.01	dead
	Salsola australis	20	0.01	
	Senna artemisioides subsp. oligophylla	50	0.1	
FdW220322-6	*Eucalyptus trivalva*	200	5	
CGR03-04	*Triodia longiceps*	40	1	
FdW220322-7	*Triodia wiseana*	20	30	

Site No: FdW02	**Date**: 22/03/2022	**Longitude**: 118.574661	**Latitude**: -23.135613

Type: Relevé
Soil Types: Sand clay loam
Topography: Flat stony plain
Soil Colour: reddish brown
Vegetation Condition: Excellent
Condition Notes:
Fire: 12+ yrs

Vegetation Type: Hummock grasslands on rocky undulating terrain.

SaTw: *Senna artemisioides* subsp. *helmsii x oligophylla/oligophylla, Acacia bivenosa* and Acacia sp. mid to low isolated shrubs over *Triodia wiseana* and occasional *Triodia longiceps* low hummock grassland.

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
	Acacia bivenosa	120	0.1	
	Acacia pruinocarpa	400	1	
	Codonocarpus cotinifolius	350	0.5	
	Eragrostis setifolia	20	0.01	
	Grevillea ?berryana	20	0.01	
FdW220322-12	*Hibiscus burtonii*	30	0.01	
	Senna artemisioides subsp. oligophylla	100	0.1	
	Solanum lasiophyllum	20	0.01	
CGr01-02	*Acacia sp.*	150	0.5	
	Triodia wiseana	30	25	

Site No: FdW03	**Date**: 23/03/2022	**Longitude**: 118.543218	**Latitude**: -23.121115

Type: Relevé
Topography: Flats
Vegetation Condition: Excellent
Fire: 12+ yrs

Soil Types: Sand clay loam
Soil Colour: reddish brown
Condition Notes:

Vegetation Type: Mulga on flats.
AmReTl*: Acacia macraneura* and *Acacia pruinocarpa* mid isolated trees over *Rhagodia eremaea* and *Acacia tetragonophylla* mid to low sparse shrubs over *Triodia longiceps, Enneapogon lindleyanus* and *Themeda triandra* low isolated clumps of tussock and hummock grasses.

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
FdW220323-28	*Abutilon cryptopetalum*	30	0.1	
FdW220323-35	*Acacia aptaneura*	30	0.01	
	Acacia bivenosa	100	1	
FdW220323-33	*Acacia macraneura*	400	3	
	Acacia pruinocarpa	300	1	
	Acacia tetragonophylla	150	1	
	Androcalva luteiflora	200	0.1	
	Arivela viscosa	5	0.01	
	Boerhavia coccinea	2	0.01	
	Chrysopogon fallax	30	0.1	

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
	Corymbia hamersleyana	200	0.1	burnt?
	Duperreya commixta	cl	0.1	
FdW220323-26	*Enneapogon lindleyanus*	30	2	
	Eremophila caespitosa	30	0.2	
	Eremophila pusilliflora	40	0.1	P2
FdW220323-31	*Evolvulus alsinoides var. villosicalyx*	10	0.1	
FdW220323-34	*Glycine canescens*	cl	0.01	
	Gomphrena kanisii	5	0.01	
FdW220323-38	*Goodenia muelleriana*	4	0.01	
	Hakea lorea subsp. lorea	350	0.1	
	Jasminum didymum subsp. lineare	150	0.5	
	Paraneurachne muelleri	20	0.1	
FdW220323-37	*Psydrax latifolia*	200	0.1	
	Ptilotus exaltatus	20	0.01	dead
	Ptilotus obovatus	30	0.5	
FdW220323-25	*Rhagodia eremaea*	100	2	
	Salsola australis	30	0.01	
	Senna artemisioides subsp. helmsii x oligophylla	50	0.1	
	Senna artemisioides subsp. oligophylla	50	0.1	
FdW220323-32	*Solanum ferocissimum*	20	0.01	
FdW220323-29	*Bidens bipinnata*	3	0.01	
FdW220323-30	*Maireana sp.*	30	0.5	
	Themeda triandra	30	0.5	
	Triodia longiceps	40	4	
FdW220323-36	*Triodia pungens*	40	0.1	

Site No: JH01	**Date**: 23/03/2022	**Longitude**: 118.544623	**Latitude**: -23.1354683

Type: Relevé
Topography: Flats
Soil Types: Sand clay loam
Soil Colour: reddish brown
Vegetation Condition: Excellent
Condition Notes:
Fire: 12+ yrs
Vegetation Type: Hummock on rocky terrain

SaTw: *Senna artemisioides* subsp. *helmsii x oligophylla/oligophylla, Acacia bivenosa* and Acacia sp. mid to low isolated shrubs over *Triodia wiseana* and occasional *Triodia longiceps* low hummock grassland.

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
jhr01-01	*Acacia ?sibirica*	50	0.01	
	Acacia bivenosa	50	1	
	Acacia pruinocarpa	210	2	
	Codonocarpus cotinifolius	130	0.01	
	Corymbia hamersleyana	500		scattered
	Enneapogon caerulescens	20	0.01	
FdW220323-23	*Eremophila ?maculata subsp. maculata*	80	0.1	
JH	*Euploca chrysocarpa*	15	0.01	along track
	Paraneurachne muelleri	20	0.01	
	Ptilotus exaltatus	5	0.01	dead
	Salsola australis	15	0.01	dead

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
	Senna artemisioides subsp. helmsii x oligophylla	40	3	
	Senna artemisioides subsp. oligophylla	50	1	
CG	*Acacia sp.*	10	0.01	
FdW	*Triodia wiseana*	30	0.1	
	Triodia wiseana	20	25	
jhr01-02	*Eremophila ?jucunda*	50	0.1	

Site No: JH02	**Date**: 23/03/2022	**Longitude**:	**Latitude**:

Type: Relevé
Soil Types: Sand clay loam
Topography: Stony mantle
Soil Colour: reddish brown
Vegetation Condition: Excellent
Condition Notes:
Fire: 5-10 yrs
Vegetation Type: Hummock on rocky terrain

EtAbTw: *Eucalyptus trivalva, Acacia macraneura* and *Acacia pruinocarpa* isolated low trees over *Acacia bivenosa, Senna artemisioides* subsp. *oligophylla* and *Capparis lasiantha* mid sparse shrubland over *Triodia wiseana* and *Triodia longiceps* low hummock grassland

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
	Acacia pruinocarpa	1.7	2	
	Triodia wiseana	0.2	24	
	Codonocarpus cotinifolius	0.5	+	
	Acacia bivenosa	0.8	+	
	Ptilotus calostachyus	0.6	+	
	Ptilotus exaltatus	0.4	+	
	Senna artemisioides subsp. *oligophylla*	0.3	+	
	Senna glutinosa subsp.*x luerssenii*	0.5	+	

Coll.	Taxon	Height (cm)	Foliage (%)	Comments
	Tribulus suberosus	0.65	+	
JHR02-01	*Triodia pungens*	0.2	2	
	Aristida contorta	0.1	+	
	Senna artemisioides subsp. *oligophylla x helmsii*	0.4	+	
	Senna glutinosa subsp. *pruinosa*	0.8	+	
	Acacia synchronicia	0.45	+	

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RioTinto

Native Vegetation Clearing Permit – 10 Clearing Principles Assessment

10 Clearing Principles Assessment for Karijini Monitoring Bores Native Vegetation Clearing Permit

March 2023

RTIO-0984623

Hamersley Iron Pty Limited

152-158 St Georges Terrace

Perth WA 6000

Restrictions on use

This report has been prepared by Rio Tinto, on behalf of Hamersley Iron Pty Limited. Neither the report nor its contents may be referred to without the express approval of Rio Tinto, unless the report has been released for referral and assessment of proposals.

Document Status

				Approved for issue	
Rev	**Author**	**Reviewer/s**	**Date**	**Distributed to**	**Date**
0	J. Hantzis	A. Michael	10/03/23		

Executive Summary

The Proposal was assessed against the 10 Clearing Principles as defined in Schedule 5 (Principles for Clearing Native Vegetation) of the *Environmental Protection Act 1986.*

Based on specialist assessment of the application area and discussion below, it is deemed that

- Principles (c), (d), (e), (g), and (i) are not at variance;
- Principles (a), (b), and (j) are not likely to be at variance; and
- Principles (f) and (h) are at variance.

1. Statement addressing the 10 clearing principles

Rio Tinto proposes to clear an existing track of regrowth vegetation in order to access monitoring bores within Karijini National Park to support monitoring of conditions associated with the MAR Part IV at West Angelas Mine. The application area comprises 15.04 ha of native vegetation and 0.82 ha of previously cleared areas and tracks (total area 15.86 ha). 'Survey area' refers to the area surveyed by AECOM and Rio Tinto (2023) and 'application area' refers to the area to which the NVCP applies.

Based on specialist assessment of the application area and discussion below, it is deemed that

- Principles (c), (d), (e), (g), and (i) are not at variance;
- Principles (a), (b), and (j) are not likely to be at variance; and
- Principles (f) and (h) are at variance

1.1 Principle a: Comprises high level of biological diversity

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

The application area is located in the Hamersley subregion of the Pilbara bioregion. The Pilbara is one of Australia's 15 National Biodiversity Hotspots (Department of Biodiversity, Conservation and Attractions 2023) and is a secondary centre of endemism and species richness for *Acacia*, *Triodia*, *Corymbia* and *Sida* spp. in Western Australia (Maslin 2001, Kendrick 2001 and Maslin and van Leeuwen 2008). The Hamersley sub-region of the Pilbara has been identified by the Threatened Species Scientific Committee for the Australian Government Biodiversity Hotspots as it provides habitat for a number of threatened, endemic and fire-sensitive species and communities.

The Hamersley sub-region is described as: 'Mountainous area of Proterozoic sedimentary ranges and plateaux, dissected by gorges (basalt, shale and dolerite). Mulga low woodland over bunch grasses on fine textured soils in valley floors, and *Eucalyptus leucophloia* over *Triodia brizoides* on skeletal soils of the ranges' (Kendrick 2001)

Special features of the Hamersley sub-region include rare features such as gorges of the Hamersley Range (particularly in Karijini National Park), Palm Spring and Duck Creek, *Themeda* grasslands of the Pilbara, and Red Hill Station Mulga stands in the extreme west of the subregion (Kendrick 2001).

Five vegetation types were described from three landforms within the application area: three Tussock Grasslands on undulating and flat terrain, one Mixed Woodland associated with major and minor drainage lines and one Mulga Woodland on red clay flats. None of the vegetation types occurring within the application area are listed as TECs under the EPBC Act or under the WA BC Act. None of the units represent PECs under the State listing maintained by the DBCA.

The vegetation units identified within the survey area are considered to be common in the local area and not considered to be unique (Table 1). (AECOM 2023).

Table 1: Vegetation units of the application area.

Vegetation Code	Condition	Area (ha) within application area	Area % within application area	Total mapped community by AECOM and Rio Tinto (2023) (ha)	% of total mapped community by AECOM and Rio Tinto (2023) within application area
W1	1 (Excellent)	2.54	16.02	3.60	70.55
G1	1 (Excellent)	5.83	36.76	13.12	44.44
G2	1 (Excellent)	3.96	24.97	7.07	56.01
G3	1 (Excellent)	2.17	13.68	7.68	28.26
M1	1 (Excellent)	0.54	3.40	7.20	7.5
Disturbed	0.1 (Completely Degraded)	0.82	5.17	0.92	89.13
Total area		**15.86**	**100**		

A total of 149 taxa from 70 genera representing 33 families were recorded from the survey. The survey was conducted during what is considered suitable timing for a reconnaissance level survey (EPA 2016). Despite the below average seasonal conditions around the timing of the survey, the entire survey area was traversed and therefore it is unlikely any additional significant species would have been detected during the survey.

Two Priority flora species, *Eremophila pusilliflora* (P2) and *Goodenia* ?sp. East Pilbara (A.A. Mitchell PRP 727) (P3) were recorded within the application area.

E. pusilliflora was known to occur in the area from previous surveys (Rio Tinto 2020). The survey effort extended beyond the survey area to demonstrate that this species is locally common in the area. Fifty-eight individuals of *Eremophila pusilliflora* (P2) exist within the application area. There are 11,842 individuals of *Eremophila pusilliflora* (P2) within the Rio Tinto Database (Table 2). Suitable habitat for *Eremophila pusilliflora* (P2) is present within and outside of the application area. Clearing within the application area is unlikely to be significant to the species due to the large representation of landform and vegetation types ideal for supporting this species, and the high number of recorded individuals outside of the application area.

One individual of *Goodenia* ?sp. East Pilbara (A.A. Mitchell PRP 727) exists within the application area. There are three additional records of *Goodenia* ?sp. East Pilbara (A.A. Mitchell PRP 727) within 10m of the application area and there are 72,911 confirmed records of *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727) within the Rio Tinto database (Table 2). Suitable habitat for *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727) is extensive outside the application area. The proposed works within the application area are to be contained within existing windrows, on previously disturbed ground and potential impact to the species is therefore considered to be low to negligible. The one individual that occurs within the application area is growing on an existing windrow and the other three individuals occurring within 10 m of the application area, are approximately 6 m from the existing disturbance and are unlikely to be impacted by the clearing associated with this application. It is likely that additional individuals of *G.* sp. East Pilbara (A.A. Mitchell PRP 727) exist locally outside the application area given that suitable habitat is present, and that the clearing associated with this application will not have a significant impact on this taxon at a local or regional scale.

Table 2: Priority flora found within the application area

Taxon	Number of individuals within application area	No of individuals within Rio Tinto Database	Combined total population	% Of know population within 20km of application area proposed to be impacted
Eremophila pusilliflora	58	11,842	11,900	0.49
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)	1	72,914	72,915	<0.1

Three introduced flora taxa were recorded during the survey, including aggressive weed species **Cenchrus ciliaris, *Malvastrum americanum* and **Bidens bipinnata*. Weeds have the potential to alter the biodiversity of an area, competing with native vegetation for available resources and making areas susceptible to fire. Potential impacts to biodiversity as a result of the proposed clearing may be minimised by the implementation of strict weed hygiene and management. Weed hygiene and management activities will be undertaken in accordance with the Iron Ore (WA) Pilbara Weed Management Strategy (2015) and the Iron Ore (WA) Equipment hygiene inspections procedure (2015).

Three fauna habitat types were defined and mapped within the application area: 'Hummock Grassland', 'Major and Minor Drainage' and 'Mulga on Clay Flats'. These fauna habitats are not considered to be restricted at a local or regional level.

No conservation significant fauna taxa were recorded within the application area.

Based on specialist assessment, the Proposal is **not likely** to be at variance to this Principle.

1.2 Principle b: Potential impact to any significant habitat for fauna indigenous to Western Australia

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.

As stated above three fauna habitats are represented within the survey area. The majority of the survey area (11.96 ha, 75.41%) is Hummock Grasslands with a condition rating of excellent. These fauna habitats are not considered to be restricted at a local or regional level. Disturbance is present within the application area and has been caused by historical access tracks to water bores.

Five conservation significant species have the potential to occur within the survey area, *Macroderma gigas* (Ghost Bat), *Rhinonicteris aurantia* (Pilbara Lead-nosed Bat), *Falco peregrinus* (Peregrine falcon), *Falco hypoleucos* (Grey Falcon), and *Apus pacificus* (Fork-tailed Swift). These taxa were considered to have the 'Potential' to occur within the habitats available in the application area and may forage in the area but are unlikely to breed or be reliant upon habitats present. It is unlikely that any of the taxa listed with the 'Potential' to occur within the survey area, would solely rely on the habitats within the application area for survival.

Due to the small size of the application area, it is considered unlikely the Proposal will negatively impact any of these conservation significant species, on either a local or regional scale.

Based on specialist assessment, the Proposal is **not likely** to be at variance to this Principle.

1.3 Principle c: Potential impact to any rare flora

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

No threatened flora species listed under the EPBC Act or BC Act were recorded within the application area.

It is considered highly unlikely that any additional Threatened Flora species would have been overlooked, nor is any preferred landforms/habitat present that is likely to support Threatened flora.

Based on specialist assessment, the Proposal is considered **not** at variance to this Principle.

1.4 Principle d: Presence of any threatened ecological communities

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 (TEC).

There are no State or Commonwealth listed TECs within or adjacent to the application area.

Based on specialist assessment, the proposal is considered **not** at variance to this Principle.

1.5 Principle e: Significance as a remnant of native vegetation in the area that has been extensively cleared

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

The majority of the Pilbara region has not been extensively cleared. However grazing, inappropriate fire regimes and weed invasion have greatly altered the vegetation in some areas. The application area lies within two of Beard's (1975) mapping units – Hammersley 18 and Hammersley 82.

The current extent of the Beard (1975) mapping unit Hammersley 18 within the Shire of East Pilbara Local Government Area (LGA) has been estimated to be 98.91% of the pre-European extent remaining. The current extent of the Beard (1975) mapping unit Hammerlsey 82 within the Shire of

East Pilbara LGA has been estimated to be 99.07% of the pre-European extent remaining (Government of Western Australia 2019).

Vegetation types within the application area would not represent remnant stands in an area that has been extensively cleared.

Based on specialist assessment, the proposal is considered **not** at variance to this Principle.

1.6 Principle f: Impact on any watercourse and / or wetlands

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

Several minor ephemeral drainage lines transect the application area. These flow lines are not considered to be significant watercourses or wetlands. Turee Creek East Branch intersects with the southern arm of the application area. The proposed works within the application area are to be contained within existing windrows and largely the existing disturbance footprints and impact is therefore considered to be low to negligible. Where new clearing will need to be undertaken across the watercourses, disturbance to riparian vegetation and creek banks will be minimised as far as possible within the application area.

Based on specialist assessment, the Proposal **is** considered at variance to this Principle

1.7 Principle g: Potential to cause appreciable land degradation

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

The application area intersects the Boolgeeda Land System, Table Land system, Platform Land system and the Newman Land system. The Boolgeeda Land System consists of stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands. The Table Land system consists of low calcrete plateaux, mesas and lower plains supporting mulga and cassia shrublands and minor spinifex grasslands. The Platform Land System Consists of dissected slopes and raised plains supporting shrubby hard spinifex grasslands (van Vreeswyk et al. 2004). The Newman Land system consists of rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands. These four systems are generally not susceptible to erosion.

The Proposal is not expected to result in soil erosion, nutrient export, water-logging/flooding, acidification, salinisation or deep subsoil compaction.

Based on specialist assessment, the Proposal is considered **not** at variance to this Principle.

1.8 Principle h: Potential to impact on the environmental values of adjacent or nearby conservation areas

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 application area is located entirely within Karijini National Park, however due to the small, localised scale of the application area and low impact of the proposed works in an existing infrastructure corridor, it is considered unlikely the Proposal will negatively impact this conservation area. The proposed works within the application area are to be contained within existing windrows and largely the existing disturbance footprints and impact is therefore considered to be low to negligible.

Based on specialist assessment, the Proposal **is** considered at variance to this Principle

1.9 Principle i: Potential deterioration in the quality of surface or underground water

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.

No permanent or semi-permanent water features occur in or adjacent to the application area. Given the small scale of the Proposal, it is unlikely that the Proposal would affect groundwater quality in the region.

Based on specialist assessment, the Proposal is considered **not** at variance to this Principle.

1.10 Principle j: Potential of clearing to cause, or exacerbate, the incidence or intensity of flooding

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

Local flooding occurs seasonally in the Pilbara region as a result of cyclonic activity and sporadic thunderstorm activity. The small scale of clearing proposed is not expected to exacerbate the incidence or intensity of flooding in the area.

Based on specialist assessment, the Proposal is **not likely** to be at variance to this Principle.

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