April

2021

Vegetation Clearing (Purpose) Permit Application – Supporting Information

Matsu Iron Ore Project

East Kimberley, Western Australia

Prepared on behalf of Habrok (Rydges) Pty Ltd by:

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TENEMENTS:

M80/625, L80/82, L80/84, L80/85, G80/21 & G80/22

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PROJECT TERMS

Meaning	Meaning
Access Track	Access track option under consideration for accessing the Matsu deposit and the processing area.
Vegetation Clearing Permit Envelope	The area encompassing the access track option and associated corridor, the Matsu deposit which will be subjected to mining operations and the area proposed for processing infrastructure.
Disturbance Area	Proposed disturbance area of for mining and infrastructure within the Project area.
Matsu Deposit	Matsu iron ore deposit.
Project	Proposed development of Matsu which includes the access track, processing area and Matsu deposit.
Project Area	Area encompassing the Matsu deposit, the access track and the processing area (261.41 hectares).
RIOP	Ridges Iron Ore Project.

LIST OF ABBREVIATIONS

Abbreviation	Meaning
aff.	Affiliated
APM	Animal Plant Mineral Pty Ltd
BC Act	*Biodiversity Conservation Act 2016*
BoM	Bureau of Meteorology
DAWE	Department of Agriculture, Water and the Environment
DBCA	Department of Biodiversity, Conservation and Attractions
DMIRS	Department of Mines, Industry, Regulation and Safety
DPIRD	Department of Primary Industries and Regional Development
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GDE	Groundwater Dependent Ecosystem
Golder	Golder Associates Pty Ltd
Habrok	Habrok (Rydges) Pty Ltd
IBRA	Interim Biogeographic Regionalisation for Australia
i.e.,	That is
KMG	Kimberley Metals Group Pty Ltd

Abbreviation	Meaning
MI	Migratory
NT	Northern Territory
EPA	Environmental Protection Authority
OVP1	Ord Subregion
PEC	Priority Ecological Community
P (1-4)	Priority Species
RIOP	Ridges Iron Ore Project
RMC	Resource Mining Corporation
ROM	Run-of-Mine
sp.	Species
subsp.	Sub species
TEC	Threatened Ecological Community
var.	Variety
VCP	Vegetation Clearing Permit
WA	Western Australia
WRL	Waste Rock Landform

SYMBOLS AND UNITS OF MEASURE

Symbols and Units	Meaning
*	Introduced plant species
%	Percentage
°C	Degrees Celsius
cm	centimetre
ha	Hectare
km	Kilometre
km^2	Square Kilometre
m	Metre
mm	Millimetre

1 OVERVIEW

Habrok (Rydges) Pty Ltd (**Habrok**) is proposing to develop the Matsu Iron Ore Project (**the Project**) in the East Kimberley Region of Western Australia (**WA**). The tenements are held by Kimberley Metals Group Pty Ltd (**KMG**), with the Project operating under Habrok.

The Matsu Project is located approximately 175 kilometres (**km**) south-southeast of Wyndham, WA, and is accessed via the Great Northern Highway. The nearest infrastructure is the Argyle Diamond Mine, approximately 5 km south east of the Matsu Project area. The location of the Project is shown in

Figure **1-1**.

The Matsu Project is approximately 10 km south-southeast of the Ridges Iron Ore Project (**RIOP**), which is owned by KMG. The RIOP consists of the mine site (165 km south of Wyndham) and Barge Loading Facility situated at Wyndham. The Matsu deposit was proposed for development by KMG in 2015, but the Project did not proceed at that time.

The Matsu Project will consist of an open cut pit, Waste Rock Landforms (WRLs), processing plant, haul road and support infrastructure on tenements M80/625, L80/82, L80/84, L80/85, G80/21 and G80/22. The Project will involve mining of up to 2.1 Million tonnes of iron ore (high and low grade) over an approximate three-year period, commencing in mid-2021. Iron ore will be crushed on site using a mobile crushing plant then trucked to the Barge Loading Facility at Wyndham for export to overseas customers.

The Matsu Project was referred to the Environmental Protection Authority (**EPA**) on 30 April 2014 (ref: 14-783871) and to the Department of Agriculture, Water and the Environment (**DAWE**, formerly the Department of the Environment) on 13 May 2014 (ref: EPBC 2014/7216). A decision to not formally assess the Project was made by the EPA on 21 July 2014 and the DAWE determined that the Project was 'not a controlled action if undertaken in a particular manner' on 5 November 2014.

A Vegetation Clearing Permit (**VCP**) was issued for the segment of the Project overlying Argyle Diamonds tenement M 80/259SA on 28 February 2013 (5432/1), but expired on 23 March 2018.

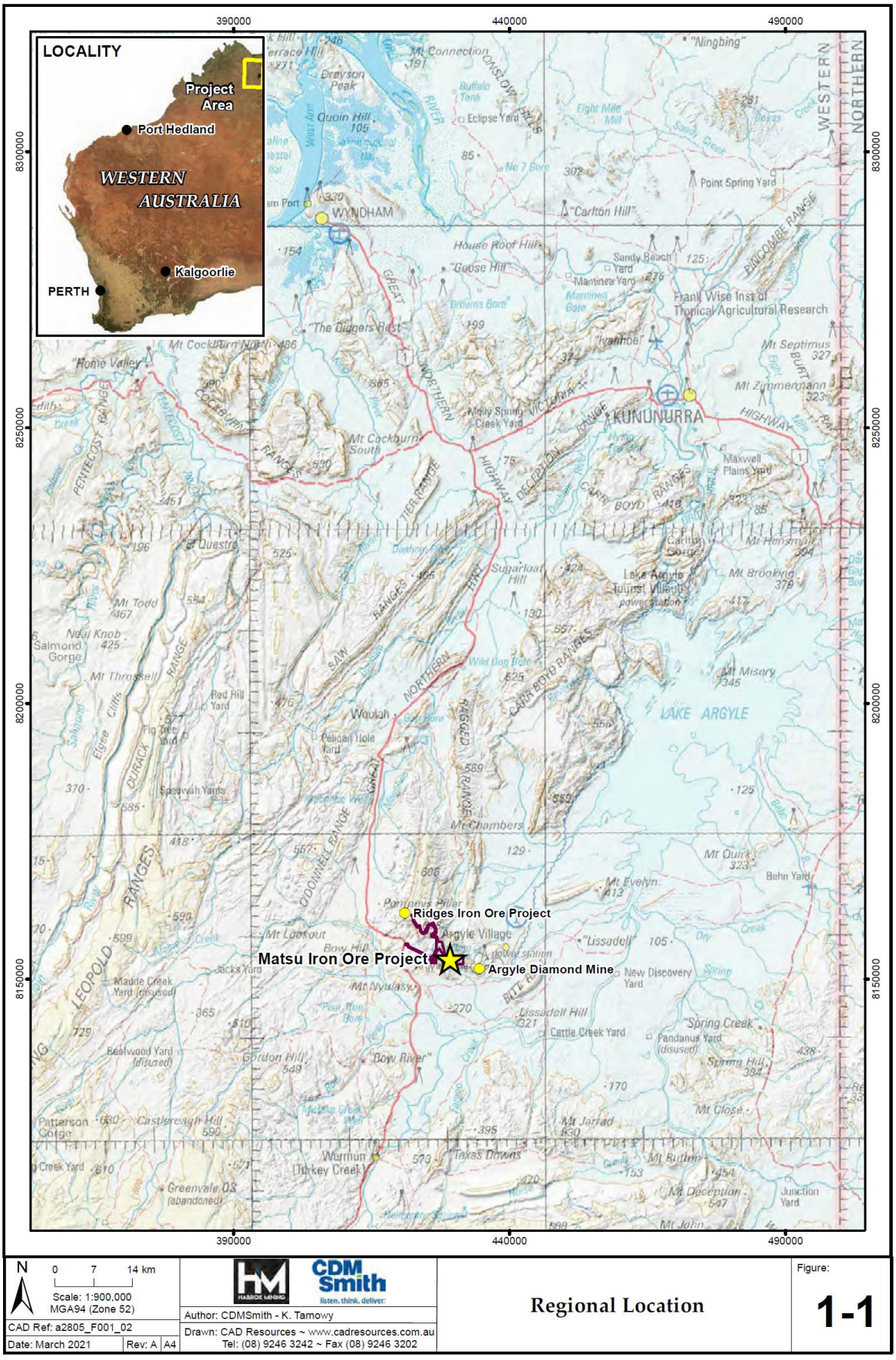

Figure 1-1: Matsu Project Regional Location

1.1 TENEMENT DETAILS

This Clearing Permit Application relates to Matsu Project tenements M80/625, L80/82, L80/84, L80/85, G80/21 and G80/22 (Table 1-1).

Table 1-1: Matsu Project Tenure

Tenement	Holder	Area (ha)	Grant Date	Expiry Date
M80/625	KMG	540.00	18/12/2014	17/12/2035
L80/82		208.90	07/12/2015	06/12/2036
L80/84		257.10	18/12/2014	17/12/2035
L80/85		42.35	18/12/2014	17/12/2035
G80/21		94.50	18/12/2014	17/12/2035
G80/22		9.75	18/12/2014	17/12/2035

1.2 EXISTING DISTURBANCE AREAS

There are no current approvals except a Programme of Work (Reg ID 37803) associated with the Matsu Project and no existing facilities at the site. The Project area is predominantly covered by native vegetation. Historically, it has been subjected to minor pastoral activities from Glen Hill Station, with some evidence of cattle and horse impact on the lower slopes and plains at the base of the Carr Boyd Range. There is evidence of historical drilling by Western Mining Corporation in the 1960s and 1970s, with an access track visible from the air. Fire appears to have had the greatest impact on the region, with a fire in April 2012 burning through approximately 10% of the Matsu area.

2 MINE ACTIVITY DETAILS

Clearing will be undertaken for a variety of Key Mining Activities and Other Mine Activities.

Figure 2-1 provides the VCP Envelope for the Project, which has been provided as a shapefile with this submission. All disturbance will occur within the defined VCP Envelope.

Comparable to the Sam and Tony Deposits at the RIOP, the Matsu mineralisation is situated along the back slope of the Hensman Sandstone ridge and is located near the surface. The resultant open pit will therefore be very shallow (less than 40 m) with minimal overburden. The base of the pit will be approximately 10 m above the groundwater level.

Conventional open pit mining methods will be utilised for ore and waste material extraction. Drill and blast techniques and load and haul operations will be utilised as the mining method at Matsu. The envelope has been allocated to leave a 10 m buffer between the disturbance envelope and the crest of the escarpment.

Ore will be hauled to the processing area on G80/21 and waste rock material will be placed on the two Matsu WRLs on M80/625 and used for backfilling into the pit. It is expected the pit will be partially backfilled.

Infrastructure will be required for development of the Project. Infrastructure that will be required may include, but is not limited to, the following:

- Access Track from Great Northern Highway.
- First aid facilities.
- Crib Hut and ablution facilities.
- Site office.
- Communications facilities.
- Workshop.
- Hydrocarbon storage facility.
- Screening and crushing facility.
- Explosives magazine.
- Borefield and associated infrastructure.

Camp, potable water supply and landfill facilities present at the RIOP will also be used.

2.1 CLEARING REQUIREMENTS

The Project will require clearing totalling 261.41 ha, inclusive of disturbance for the pit, WRLs, access track, haul road, stockpiles and associated infrastructure. This clearing will occur within the disturbance envelope as shown on Figure 2-1 and Figure 2-2. The disturbance envelope falls within a tenement area totalling 1,420.57 ha.

Previous exploration activities have resulted in ground disturbances within the clearing envelope. These areas will be utilised as much as possible.

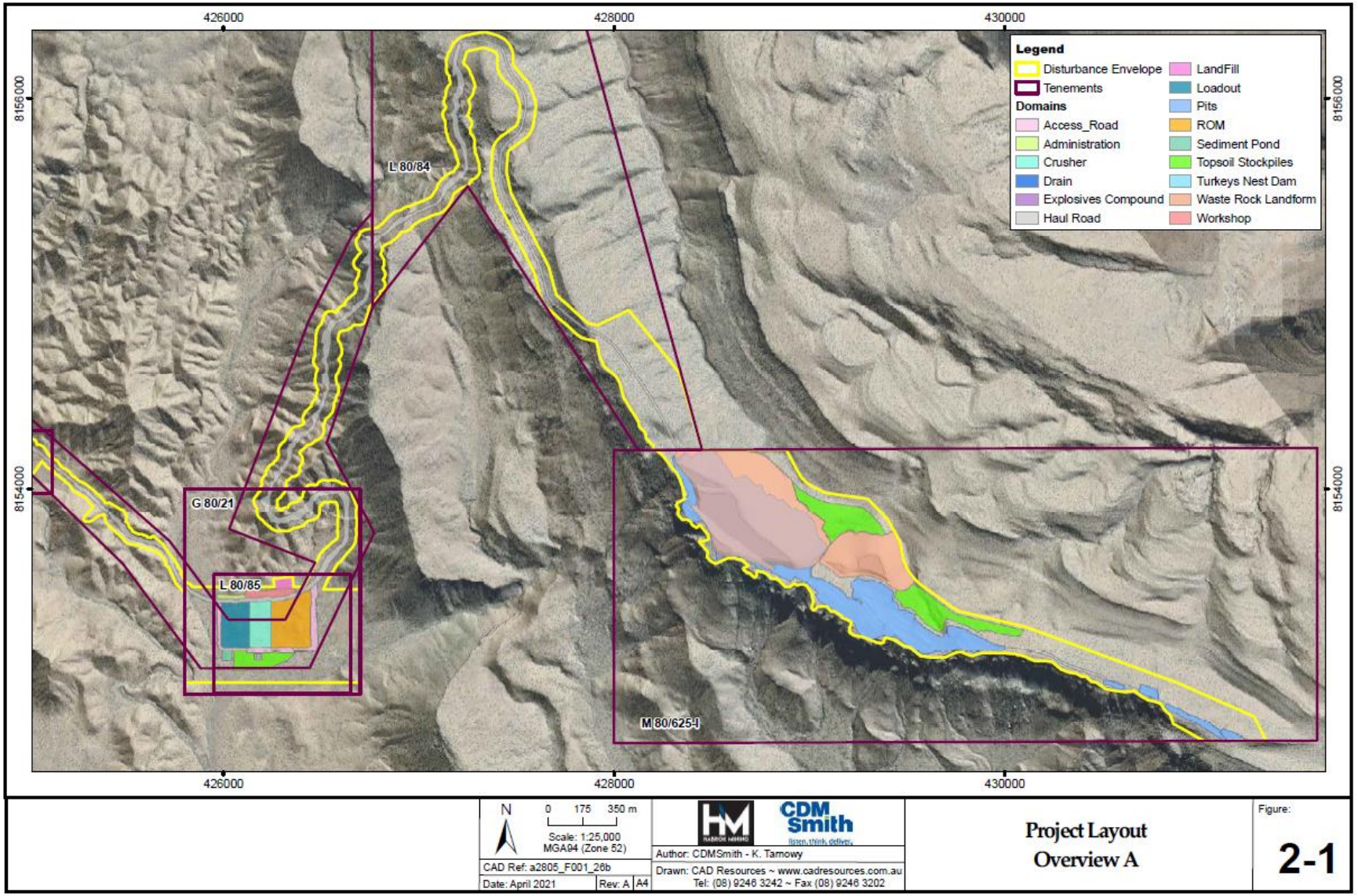

Figure 2-1: Project Layout Overview A

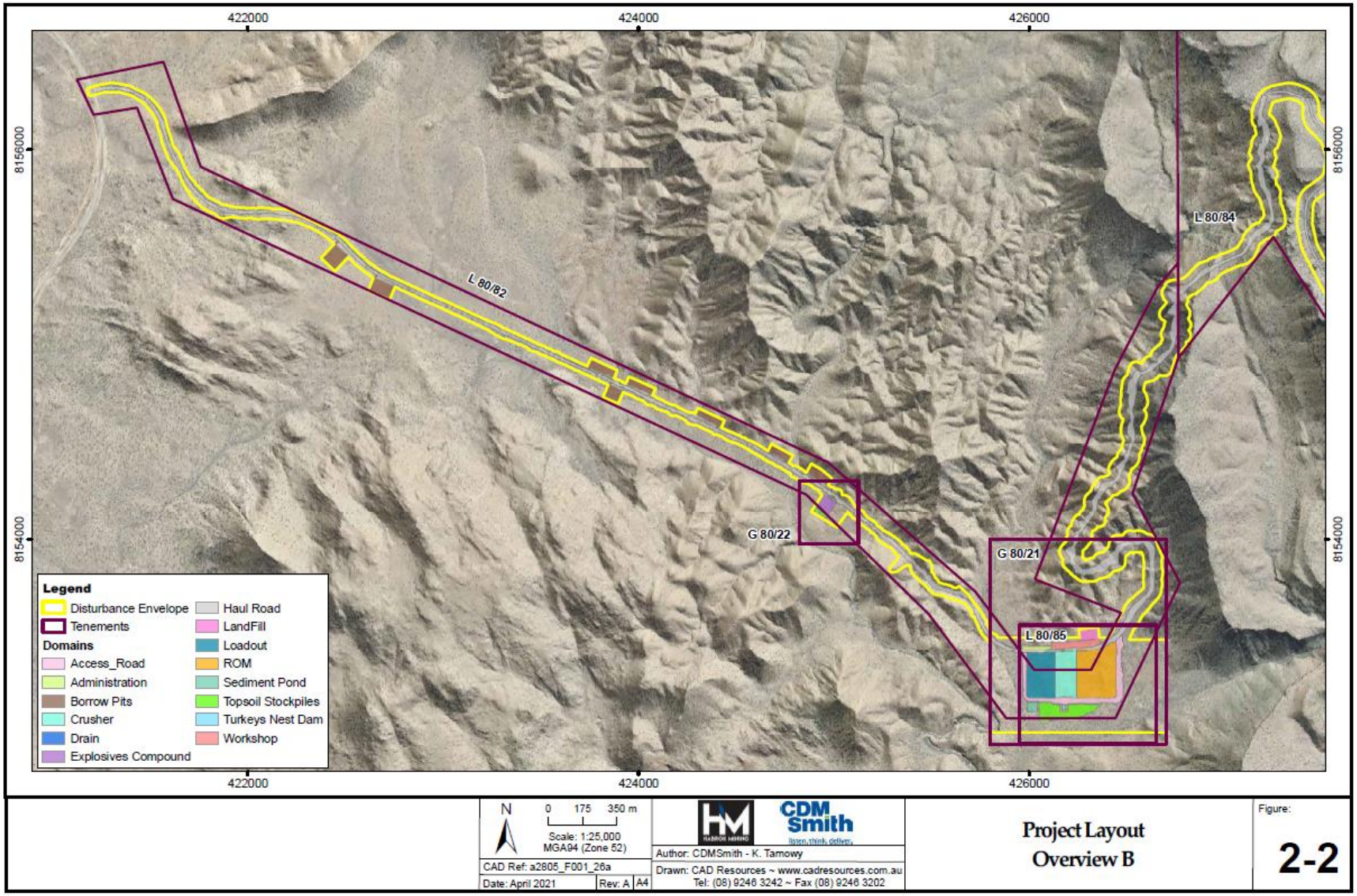

Figure 2-2: Project Layout Overview B

3 BASELINE ENVIRONMENTAL DATA

3.1 CLIMATE

The East Kimberley region is subject to a hot and humid wet season from November to April, with highly variable rainfall resulting from monsoonal depressions and tropical cyclones, and a warm dry season extending from May to September. The region receives approximately 90% of its annual rainfall during the wet season with torrential rain events often leading to wide-scale flooding. The dry season experiences infrequent rainfall with consecutive dry months common. Evaporation rates are high, with the average annual evaporation exceeding the average annual rainfall by a factor of 3.5.

The Bureau of Meteorology (**BoM**) has been recording rainfall since 1986 and temperature since 1994 at the Argyle Aerodrome (BoM Site Number 002064), 15 km north east of the Matsu Project area. Table 3-1 presents the average monthly temperature and rainfall data. Recorded data suggests that the Project area is likely to receive approximately 734 mm of rain on an annual basis and experience temperatures ranging between 15 and 39°C. Rainfall in the Kimberley region can be sporadic and localised. Although rainfall and daily temperatures in the Project area may vary slightly, data from the Argyle Aerodrome provide a good indication of climatic conditions within the region.

Table 3-1: Argyle Aerodrome Meteorological Data

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
Mean Maximum Temp (°C)	36.5	35.9	35.8	35.3	32.1	29.5	30.0	32.2	36.6	38.6	38.9	37.6	34.9
Mean Minimum Temp (°C)	25.7	25.3	24.9	23.1	19.2	16.2	15.9	17.4	22.3	25.3	26.3	26.1	22.3
Mean Rainfall (mm)	158.2	180.9	142.6	23.8	8.1	3.7	1.4	0.3	2.5	31.2	60.9	133.7	734.0

Source: BoM (2021a)

3.2 IBRA 7 BIOGEOGRAPHIC SUBREGIONS

The IBRA7 bioregional map places the majority of the Project in the Purnululu Subregion of the Ord Victoria Plain Bioregion. The western extent of the Access Track (approximately 250 m), where it meets the Great Northern Highway, is within the Keep subregion of the Victoria Bonaparte Region.

The Ord Victoria Plain occurs in northern WA and the Northern Territory (NT) and covers much of the upper catchments of the Ord and Victoria River systems. It includes ridges, plateaus and undulating plains with scattered mesas and buttes. Vegetation consists mainly of Eucalyptus woodlands over hard/soft spinifex and annual grasslands (DSEWPaC 2012). The region includes Purnululu (Bungle Bungle) National Park, part of the Gregory National Park in the NT, Lake Argyle and the Argyle Diamond Mine (DSEWPaC 2012).

3.3 LANDSCAPE

The regional landscape consists of level to gently undulating plains with scattered hills on Cambrian volcanics and Proterozoic sedimentary rocks; vertosols on plains; and predominantly skeletal soils on hills. The overall vegetation is grassland with scattered bloodwoods (*Eucalyptus* spp.) and snappy gum (*Eucalyptus brevifolia*) with spinifex and annual grasses (Graham 2001).

The region has a rugged terrain which has developed over fold belts with hilly country dominating. Elevations range from sea level to over 600 m AHD, with up to half of the landscape in the south sitting above 400 m. There are rocky ridges, hogbacks, cuestas and structural plateaux of sandstone, siltstone, and shale; mountainous sandstone country with narrow or restricted basalt valleys; mountains with narrow valleys and lower slopes on crystalline and metamorphic rocks; mountains, mesas, buttes and rounded hills on basalt ordolerite; massive granite domes with colluvial lower slopes; and broad quartzite ridges (Tille 2006).

Between uplands are stony plains and undulating granite country with low lateritic plateaux and scattered hills on granite and gneiss, extensive lower slopes and undulating country on shale and stony gently undulating basalt country. Alluvial and river plains are present as a minor component of the landscape (Tille 2006).

The Soil Landscape Mapping - Best Available (DPIRD-027) spatial dataset (DPIRD 2019) uses the descriptions and mapping of Payne and Schoknecht (2011) to provide expected soil, vegetation and landform attributes for the Kimberley. The Project area intersects four Land Systems. These land systems are described as:

Wickham: Rugged plateaux, ridges and hills formed on sedimentary rocks supporting snappy gum low woodland over soft or curly spinifex.

Pompey: Rugged, boulder hill, granite country with sandy soils supporting sparse low eucalypt woodlands and spinifex.

MacPhee: Undulating plains of sandy granite country with eucalypt woodlands and mixed grasses.

Dockrell: Rocky mountain ridges on metamorphic rocks, skeletal soils, open stunted woodlands with spinifex.

3.4 GEOLOGY

Matsu occurs within the meta-sediments of the once extensive Carr Boyd Basin, which consists of interbedded sandstone, siltstone and mudstone sequences deposited in a shallow-water environment. These basin sediments were deposited onto the existing Proterozoic granite-gneiss terrain of the Lamboo Complex which forms the relatively flat granitic plain area surrounding the ridges. The basal portion of the Carr Boyd Basin consists predominantly of a sandstone end-member (the Hensman Sandstone). Unconformably overlying the Hensman Sandstone is the Golden Gate Siltstone, which was subsequently covered by the Lissadell Formation (Soil Water Consultants 2010; Appendix 1).

Uplifting of the basin sediments and subsequent erosion during the Mesozoic to Palaeozoic periods exposed the basal Hensman Sandstone along the western edge of the basin. Extensive lateritic weathering of the exposed sandstone during the Tertiary Period and subsequent supergene mineralisation of iron resulted in the formation of the iron ore deposits at Matsu. The eastern extent of the magnetite-hematite deposit is constrained by the presence of the remnant Golden Gate Siltstone; the presence of the fine-textured siltstone has limited the extent of lateritic weathering of the underlying sandstone and the enrichment of iron (Soil Water Consultants, 2010).

3.5 SOILS

The soils within the RIOP have been mapped at a regional-scale by the Department of Agriculture as part of the rangelands and Arid Interior Soil - Landscape Survey (Tille 2006) and at a local-scale by Soil Water Consultants (2010, Appendix 1). These documents describe areas near the Project area and are relevant descriptions of soil types that occur in the same aspect and situation as Matsu. Although no site-specific soil survey has been

completed at Matsu, the geological formations are the same as those occurring at RIOP, so the soil types at Matsu are expected to be generally the same as at RIOP. In addition, biological surveys undertaken at Matsu indicate that the surface soils are the same or similar to RIOP soil types.

Stony soils dominate most of the hilly terrain. Red/brown non-cracking clays are found on the basalt hills. Other minor soils include yellow loamy earths, red deep sands, yellow deep sands, red loamy earths, self-mulching cracking clays and red shallow loams (Tille 2006).

The soils along the escarpment consist of shallow (<10 centimetres [**m**] in thickness), often gravelly, loamy sands overlying a solid siltstone or ironstone base. The high gravel fraction of the surface soils results in them having a high permeability and rainfall rapidly infiltrates the soil surface with minimal surface runoff in the undisturbed state (SWC 2010).

3.6 HYDROLOGY

3.6.1 SURFACE WATER

In mid-2014, Golder Associates (Golder) was commissioned by KMG to undertake a hydrology (surface water) and hydrogeology (groundwater) assessment of the Matsu Project area. The site-specific surface water risks and surface water, drainage and sediment management requirements for the Matsu Project were assessed. The Golder surface water report is included in Appendix 2.

The Project area lies directly along the ridge lines of the Carr Boyd Range and is surrounded by highly ephemeral drainage systems, consisting of predominantly small channels, creeks or gullies. These rugged upland drainage systems are characterised by steep, rocky channels flowing through intermittent deep gorges, waterfalls and pools. Hydrological responses in the upper catchment areas are likely to be characterised by intense and often short duration extreme runoff and flood events (Golder 2014a).

Surface water flows may only occur in defined channels where there are sufficient convergence of flows and increases in flow velocities to promote scour and channel formation. Within the smaller, flatter drainage systems with less well-defined channels, surface water flows are dominantly expressed as sheet flow where overland flow moves down slope as a broad shallow front in response to infiltration of excess rainfall prior to channel initiation (Golder 2014a).

The Project are is located close to the catchment boundaries of two larger surface water systems (the Bow River and Smoke Creek), both of which ultimately drain to Lake Argyle.

A summary of the regional drainage pattern for the Matsu Project is described below. Further details are provided in the Golder report (Appendix 2).

- Surface water runoff from the Project site draining to the south and south-west forms the upper reaches of small tributaries of the Bow River. Most of the Project infrastructure (access track, crusher, ROM pad and load-out) are located in these catchments (Attachment A of Appendix 2). The drainage systems flow under the Great Northern Highway and join the main channel of the Bow River, approximately 10 to 15 km downstream of the Matsu Project. The Bow River continues flowing in an easterly direction before turning north-east and flowing into Lake Argyle at its most southerly point.

- The upper catchment area of Wesley Spring Creek drains directly south of the proposed Matsu Project Pit and forms a tributary of the Bow River close to Lissadell Hill. The pit extent is located directly along the northern catchment divide of the Wesley Spring Creek (draining south) and the Flying Fox Creek (draining north – described below). The Wesley Spring is located approximately 3.5 km southeast of the proposed Matsu Project pit. Based on the EPA report (EPA 2005), seepage from the Wesley Spring to the creek is likely to be sourced through elevated groundwater storage that is depleted during the dry season and the spring may naturally cease to flow during extreme dry spells.

- Smoke Creek runs 35 km from the Matsu Range to Lake Argyle and was one of the key locations where alluvial diamonds were found in a sample collected from the creek in 1979 as part of the exploration effort that led to the development of the Argyle Diamond Mine. The proposed Matsu Pit and the final section of road along the top of the ridge linking the pit to the ROM and crusher, are located in the very top of the northern draining Flying Fox Creek catchment, a sub-catchment of Smoke Creek. Site topography consists of rocky hills with moderately inclined to very steeply sloped and incised drainage channels.

The Matsu Project area is not within a Pollution Control Area or Public Drinking Water supply area. However, it is within the Ord River and Tributaries Surface Water Proclamation Area. The Department of Water and Environmental Regulation (DWER) decision tree indicates a bed and banks permit is not required.

3.6.2 GROUNDWATER

The Matsu Project area lies within the Canning-Kimberley Groundwater Proclamation Area.

Golder conducted a hydrogeological desktop study of the Matsu Project area (Golder 2014b). The Groundwater report is included in Appendix 3.

The hydrogeological setting in the Project area is likely to be predominantly a fractured rock setting with groundwater movement and storage occurring in faults, fractures, bedding plane partings and weathered zones within:

- metamorphic and granitic rocks of the Lamboo Complex;
- volcanic (mafic) and sedimentary rocks of the Revolver Creek Formation, and
- siliciclastic rocks of the Carr Boyd Group.

Groundwater salinity in the area is 1,000 mg/L, which is considered to be fresh to marginal (Golder 2014b).

A 26D approval (CAW179993 to drill, construct and conduct pump tests) was received from the Department of Water and Environmental Regulation on 21 November 2014, but is no longer valid. A new 26D application was approved by the Department of Water and Environmental Regulation (DWER) on 4 March 2021 (CAW205591[1]).

Based on water demand and usage at RIOP, the Matsu Project will require a water use of 1 ML per day. A groundwater licence will be applied for, for the purpose of taking this groundwater. A 5C licence application to take water has been submitted.

3.6.2.1 Groundwater Dependent Ecosystems

The Groundwater Dependent Ecosystems Atlas (BoM 2021b) shows no known Groundwater Dependent Ecosystems (**GDE**s) within the Project area. The nearest potential GDE is located 2 km north of the Matsu Project.

The potential GDE is an inflow dependent ecosystem with a likelihood rating of six. The likelihood is expressed as a range of values between 1 and 10 (low to high), where 10 indicates landscapes that are most likely to access additional water sources. A likelihood of six indicates that the ecosystem is considered moderately dependent on groundwater (BoM 2021b).

3.7 TERRESTRIAL ECOSYSTEMS

3.7.1 BIOLOGICAL SURVEY EFFORT

Seven biodiversity studies have been conducted for Matsu up to 2021. These are as follows:

- A Level 1 flora and fauna survey was conducted in 2012, the results of which are reported in APM (2013).
- A targeted survey for the potential presence of Northern Quoll was conducted in 2012, along with an echolocation survey and an avifauna survey (APM 2013).
- A targeted survey for *Kunzea* sp. Keep River was undertaken in 2013 (APM, 2013). This survey was conducted at Matsu and within the wider region to record the number of populations and estimate the number of individual plants.
- In 2014, four surveys were conducted:
    - A Level 2 flora and vegetation survey (APM 2014a).
    - A desktop fauna assessment of the Matsu access track and processing plant area (APM 2015).
    - A survey for habitat suitable for Gouldian Finch breeding (APM 2014b).
    - A troglofauna survey (Bennelongia 2014).

As the Level 1 and Level 2 studies described above were conducted more than five years ago, APM was commissioned to identify any updates to nomenclature and conservation status that may have occurred since that time. As part of this study, APM reviewed previous local and regional surveys (as listed in Table 3-2) and described the conservation significant communities, flora and fauna recorded at Matsu, along with any habitat attributes. The outcomes of this review are provided in APM (2021). An IBSA Data package containing the field data from the Matsu Level 1 and Level 2 Surveys has been prepared and submitted (IBSASUB-20210222-8DB929FC).

Table 3-2: Flora and Fauna Surveys Conducted in the Project Area and Broader Region

Consultants	Year	Survey Type	Distance from Project area
Project Specific			
Animal Plant Mineral	2021	Desktop Biological Study (Appendix 4).	Project area
Animal Plant Mineral	2014	Level 2 Floristic Survey and Vegetation Mapping (Appendix 5).	Project area
Animal Plant Mineral	2014	Matsu Access Track and Processing Development Envelope Fauna Desktop Assessment (Appendix 6).	Project area
Animal Plant Mineral	2014	Matsu Project Gouldian Finch Nest Hollow Assessment (Appendix 7).	Project area
Bennelongia	2014	Troglofauna Survey	Project area
Animal Plant Mineral	2012	Matsu Level 1 Biological Survey and Targeted Northern Quoll Survey (Appendix 8).	Project area
Regional			
Animal Plant Mineral	2013	*Kunzea* sp. Keep River Regional Survey (APM 2013).	7,100 km^2 survey area extending out from the Matsu deposit.

Consultants	Year	Survey Type	Distance from Project area
Animal Plant Mineral	2012	Level 2 Flora and Vegetation Survey of the North of Sam/McPhee Deposit, RIOP.	Approximately 15 km north west of the Matsu deposit.
Animal Plant Mineral	2012	Dry season Level 2 fauna survey for possible RIOP mining expansion known as Sam North/McPhee.	Approximately 15 km north west of the Matsu deposit.
Animal Plant Mineral	2011	Baseline fauna survey of the Argyle Diamond Mine and Proposed Conservation Reserve	Approximately 6 km south east of the Matsu deposit.
Animal Plant Mineral	2010	Flora and Vegetation Survey of Proposed Mine Infrastructure Impact Areas, RIOP	Approximately 10 km north west of the Matsu deposit.
Animal Plant Mineral	2010	Wet Season Echolocation Survey of Bat Activity in the March Fly Creek area of the East Kimberley	Approximately 13 km north west of the Matsu deposit.
Animal Plant Mineral	2010	Gouldian Finch Nest Hollow Assessment, RIOP	Approximately 10 km north west of the Matsu deposit.
Animal Plant Mineral/Subterranean Ecology	2010	Subterranean Fauna Survey, RIOP	Approximately 10 km north west of the Matsu deposit.
Animal Plant Mineral	2009	Access and Haul Road Botanical Assessment, RIOP	Approximately 10 km north west of the Matsu deposit.
Animal Plant Mineral	2009	Dry Season Fauna Survey, RIOP Mine Site	Approximately 10 km north west of the Matsu deposit.
ecologia Environment	2006	Conservation Significant Flora and Rainforest Thicket Assessment, Argyle Iron Ore Project (now RIOP)	Approximately 10 km north west of the Matsu deposit.
ecologia Environment	2005	Flora and Fauna Assessment, Argyle Iron Ore Project (now RIOP)	Approximately 10 km north west of the Matsu deposit.

3.7.2 VEGETATION

The APM (2013) Level 1 survey covered 1,712 ha, with this large area intended to capture the Project surrounds and a number of active options for the Access Track. Due to the difficult access, the majority of areas were accessed by helicopter. Fourteen vegetation associations were recorded across the survey area.

The 2014 Level 2 survey (2014a) identified 26 vegetation associations from a smaller survey area of 256 ha limited to the Project area. Areas at the Matsu deposit were accessed by helicopter. The access track and process areas were accessed on quadbike and on foot.

The 2021 update report (APM 2021) describes 27 vegetation types with the Project area. These are presented in Table 3-3, Figure 3-1 and Figure 3-2.

Table 3-3: Vegetation Types

Vegetation Unit	Description	Landscape	Soil
CcSS1	*Corymbia collina, Corymbia dichromophloia* sparse to mid-dense trees over *Cochlospermum fraseri* very sparse shrubs over *Triodia bitextura, Schizachyrium* fragile closed tussock grasses	Rocky ironstone plains	Mostly metamorphosed sandstone, dark brown
CcSS2	*Corymbia collina* mid-dense trees over *Cochlospermum fraseri*, *Erythrophleum chlorostachys* sparse shrubs over *Petalostigma quadriloculare* very sparse heath shrubs over *Triodia* aff. *bitextura*, tussock grasses.	East facing slopes	Light/dark brown skeletal
CcSS3	*Corymbia collina* open trees over *Heteropogon contortus* and *Eulalia aurea* dense tussock grasses.	Cliff edges and steep west facing slopes	Light brown skeletal sandy
CdDL1	*Corymbia disjuncta* very sparse trees over *Cochlospermum fraseri* (*Acacia plectocarpa*) sparse shrubs over *Ischaemum australe* var. *australe* closed tussock grasses.	Incised drainage lines	Dark brown alluvial gravels
CdDL2	*Corymbia disjuncta* (*Corymbia cadophora* subsp. *Polychroma)* (P1) sparse trees over *Petalostigma quadriloculare* very sparse heath shrubs with *Triodia cremnophila* (P1) very sparse hummock grass.	Minor drainage	Dark brown alluvial gravels and stones
CdLGH1	*Corymbia dichromophloia* isolated trees over *Terminalia canescens* sparse shrubs over very sparse *Triodia* aff. *bitextura* sparse tussock grass.	Granite breakaways and rock piles	Yellow-brown skeletal loam in gravel matrix and Light grey-brown skeletal loam
CdSS1	*Corymbia dichromophloia* sparse trees over *Cochlospermum fraseri* (*Erythrophleum chlorostachys*) sparse shrubs over *Triodia schinzii* (*Triodia* aff. *bitextura*) mid-dense tussock grasses	East facing slopes	Light brown skeletal sandy loam
CdSS2	*Corymbia dichromophloia* and *Erythrophleum chlorostachys* mid dense trees over *Grevillea velutinella* sparse shrubs over *Triodia bitextura* mid-dense tussock grass with *Petalostigma quadriloculare* very sparse heath shrubs.	Cliff edges and steep west facing slopes	Skeletal orange brown
CfDL1	*Chochlospermum fraseri* very sparse shrubs over *Heteropogon contortus* mid-dense tussock grass and *Triodia cremnophila* mid-dense hummock grass	Minor drainage	Dark brown, patches of skeletal soil with translocated materials
CL	*Eucalytpus ordiana (P2)* scattered trees over *Triodia cremnophila (P1)* scattered tussock grass (P1 PEC Plant Assemblages on Vertical Sandstone Surfaces).	Vertical sandstone surfaces	Sandstone
DhUP4	*Dolichandrone occidentalis* emergent shrubs over *Triodia* aff. *bitextura* and *Chrysopogon fallax* mid-dense grasses.	Flood plain	Light brown sandy loam
EbFP3	*Eucalyptus brevifolia* and *Syzygium? eucalyptoides* subsp. *bleeseri* very sparse trees over *Triodia* aff. b*itextura, Eriachne glauca, Eragrostis cumingii* mid dense tussock grasses.	Flood plain	Beige grey sandy loam

Vegetation Unit	Description	Landscape	Soil
EbLSH3	*Eucalyptus brevifolia* sparse trees over *Triodia* aff. *bitextura*, *Sorghum plumosum* and *Heteropogon contortus* closed tussock grasses.	Steep rocky south west facing slopes	Pink-brown skeletal loam
EbLSH4	*Eucalyptus brevifolia* sparse trees over *Triodia schinzii* sparse hummock grass, with *Sorghum plumosum* open tussock grass.	Low rolling hills	Metamorphosed sandstone, reddish light brown skeletal loam
EbMSS1	*Eucalyptus brevifolia* sparse to mid dense trees, over *Petalostigma quadriloculare* very sparse heath shrubs over *Triodia* aff. *Bitextura, Sorghum plumosum* mid dense to closed tussock grasses.	East facing slopes	Light orange brown skeletal loam. Light brown skeletal clay.
EbUP1	*Eucalyptus brevifolia* mid-dense trees over *Triodia* aff. *bitextura*, *Sorghum plumosum* closed to open tussock grasses.	Undulating plains	Pink skeletal loam, and Beige -grey sandy loam
EbUP3	*Eucalyptus brevifolia* sparse trees over *Cochlospermum fraseri* very sparse shrubs over *Acacia translucens* sparse heath shrubs over *Triodia* aff. *bitextura* (*T. inutilis*) mid dense tussock grass	Rocky Plains	Light brown sandy loam in regolith matrix
EgFP4	*Eriachne glauca*, *Sorghum plumosum* and *Chrysopogon fallax* closed tussock grasses.	Flood plain	Dark brown sandy loam
EoC1	*Eucalyptus ordiana* (P2) *Corymbia dichromophloia* and *Corymbia collina* mid-dense trees over *Erythrophleum chlorostachys*, very sparse shrubs over *Triodia barbata* mid-dense hummock grasses with *Sorghum plumosum* and *Heteropogon contortus* tussock grasses.	Cliff edges and steep west facing slopes	Metamorphosed sandstone, light brown skeletal
EoLSH1	*Eucalyptus ordiana* (*Corymbia collina*) very sparse trees over *Cochlospermum fraseri* very sparse shrubs over *Triodia* aff. *bitextura* mid-dense tussock grass with (*T. cremnophila)* (P1) hummock grass.	Steep rocky south west facing slopes	Sandstone, dark red skeletal loam
EoLSH2	*Eucalyptus ordiana* (P2) (*Corymbia dichromophloia*) very sparse trees over *Terminalia canescens* very sparse shrubs over *Sorghum plumosum* and *Triodia* aff. *bitextura* closed tussock grasses.	Steep rocky south west facing slopes	Pink-red skeletal loam
EpFP1	*Eucalyputs pruinosa* subsp. *pruinosa* (*Eucalyptus brevifolia*) very sparse trees over *Carissa lanceolata* very sparse shrubs over *Sehima nervosum* (*Chrysopogon fallax*) closed tussock grasses	Flood plain	Orange/brown clay loam, light brown sandy clay
LgCDL1	*Lophostemon grandiflorus* subsp. *riparius*, *Andersonia gregorii* very sparse trees of *Arundinella nepalensis*, *Ischaemum australe* var. *arundinaceum* mid-dense tussock grasses.	Mid-sized creek lines	Light beige brown alluvial gravels and dark grey sandy clay
MmMSS1	*Melaeuca minutifolia* very sparse shrubs over *Chrysopogon fallax* (*Urochloa holosericea* subsp. *holosericea*) closed tussock grasses.	West facing slopes of metamorphosed sandstone	Light brown loam

Vegetation Unit	Description	Landscape	Soil
TcDL2	*Terminalia canescens* (*Bauhinia cunninghamii*) sparse shrubs, *Sorghum plumosum* and *Ischaemum australe* var. *arundinaceum*, *Cenchrus pedicellatus* ssp. *unispiculus*, closed tussock grass with *Aeschynomene indica*, *Indigofera hirsuta* herbs.	Deeply incised minor drainage lines	Dark brown sandy loam, and light brown alluvial gravel
TcUP2	*Terminalia canescens* mid-dense shrubs over *Triodia* aff. *bitextura* very sparse tussock grass.	Undulating plains	Light sandy brown loam with coarse gravel
TgDL3	*Terminalia grandiflora* (*Andersonia gregorii*) closed trees over *Ischaemum australe* var. *arundinaceum* and *Arundinella nepalensis* mid-dense grasses.	Mid-sized creek lines	Light sandy brown alluvial gravels.

Source: APM (2021)

No Threatened Ecological Communities (**TECs**) listed under the *Environmental Protection and Biodiversity Conservation Act* (**EPBC Act**) or *Biodiversity Conservation Act* (**BC Act**) were recorded within the survey areas. Database searches indicate no TECs occur within 50 km of the Project area (APM 2021).

The DWER Clearing Permit System Map Viewer did not identify any Environmentally Sensitive Areas in or near the Project area. The nearest Wetlands of International Importance are Lakes Argyle and Kununurra (10 and 20 km downstream) and the Ord River Floodplain 50 to 100 km downstream of the Matsu Project.

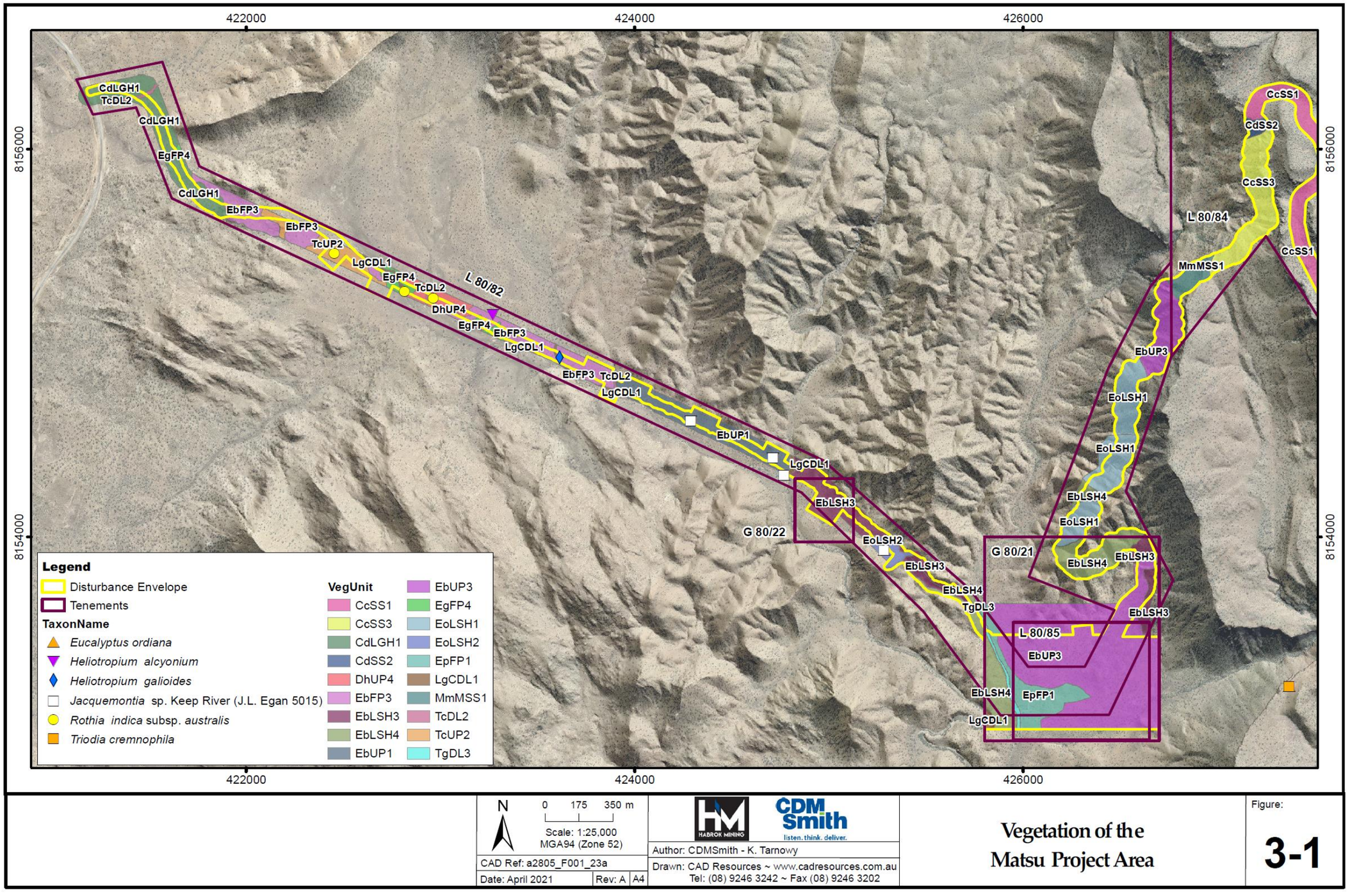

Figure 3-1: Vegetation Types and Conservation Significant Flora of the Matsu Access Road and Processing Plant Area

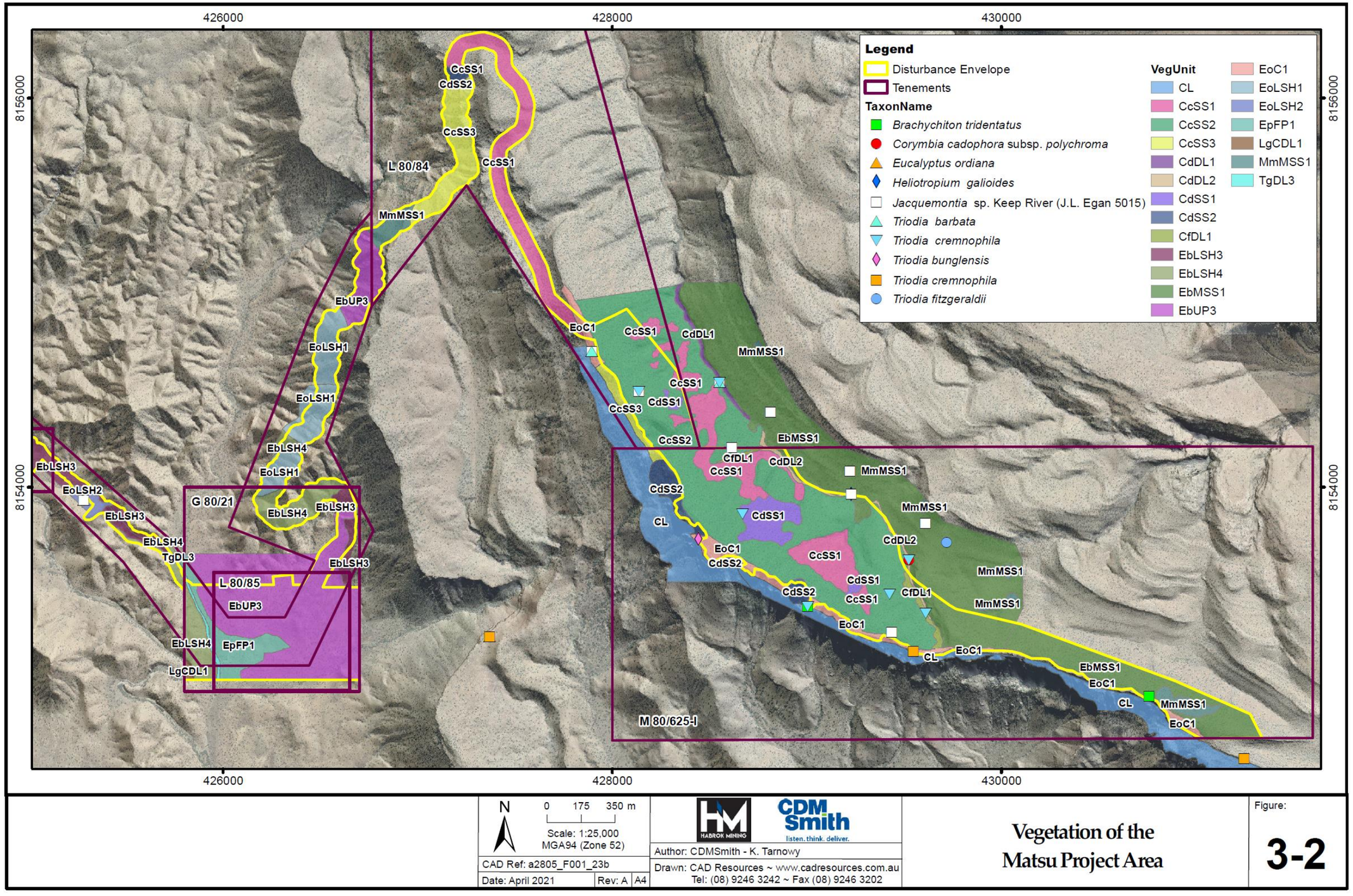

Figure 3-2: Vegetation Types and Conservation Significant Flora of the Matsu Pit, WRLs and Haul Road

3.7.3 CONSERVATION SIGNIFICANT COMMUNITIES

No Threatened Ecological Communities (TECs) listed under the EPBC Act or BC Act are known to occur within or near the Project area. No Environmentally Sensitive Areas (ESAs) occur in the Project area.

One Priority Ecological Community (**PEC**) was recorded. The vegetation community identified as the Priority 1 PEC 'Plant Assemblages on Vertical Sandstone Surfaces' was given the code CL in the Level 1 and Level 2 surveys.

The PEC was identified in the APM (2014b) survey from helicopter. Mapping was extrapolated from field notes using aerial imagery. The extent of CL is shown in Figure 3-1.

The Level 2 survey was a detailed survey and allowed refinement of the understanding of the distribution of the CL community. Mapping of the extent of CL is shown in Figure 3-2. Contrary to the lower scale Level 1 survey, no PEC is mapped as occurring within the Development Envelope. Areas within the Development Envelope that were previously allocated the CL code were revised to westerly facing slopes, often steep, and generally at the top of the cliffs on the south western edge of the plateau.

The VCP Envelope has been specifically allocated to exclude the Vertical Sandstone Surfaces. The alignment of the Access Track has been selected specifically to take advantage of the areas where there is a break in slope and a lack of vertical surfaces. The distribution of the PEC does not intersect with the Project area in any location. The PEC does occur adjacent to the Matsu deposit area to the south west. The disturbance area at the Matsu deposit has been allocated to allow retention of the PEC and associated habitats and the shallow mining activity is not expected to impact the PEC.

APM had previously advised that a Monsoon Vine Thicket community occurring in the Matsu area was a PEC (APM 2013). However, APM has now advised that the community present at Matsu has no specific conservation listing. This vegetation type is spatially restricted so is considered to have local conservation value, but occurs outside of the proposed Disturbance Envelope and is not expected to be impacted by development of the Project so is not considered further in this document.

3.7.4 VEGETATION CONDITION

Of the 46 ground survey sites (quadrats/relevés) observed in the 2014 Level 2 survey, 19 were classified as 'pristine', 26 were classified as 'excellent' and one was classified as 'very good' based on the Keighery (1994) vegetation condition scale.

3.7.5 FLORA

3.7.5.1 Summary

The 2014 Level 1 survey recorded 197 flora taxa (species, subspecies and varieties) from 53 families and 115 genera. Six Priority flora species were recorded and three specimens of taxonomic uncertainty. In comparison, the 2014 Level 2 field survey recorded 353 flora taxa, from 65 families and 173 genera. A species by site matrix and complete flora list is included in the APM (2014a) survey report (Appendix 5). Eleven Priority flora species were recorded from the Level 2 survey.

The 2021 update report (APM 2021) states that 12 Priority flora species are known or likely to occur in the Project area based on previous surveys conducted for the Matsu Project (Table 3-4**,** Figure 3-1 and Figure 3-2). In addition, this report identifies 16 species listed under the BC Act that have been recorded within 30 km of the Project area. Eight of these species have been assessed with a high likelihood of occurrence within the Project area. These species have been allocated a high likelihood of occurrence as they have been recorded within 10 km of the Project area and suitable habitat is known to be present (Table 3-4). These species comprise five P1, two P2 and one P3 species. However, database searches by APM (2021) returned no records of Threatened flora listed under the EPBC Act or BC Act within the Project area.

No Threatened Flora listed under the EPBC or BC Acts have been recorded in the Project area. Database searches from the region conducted in late 2020 did not identify any Threatened flora species as known to occur within 100 km of the Project (Appendix 6).

Table 3-4: Conservation Significant Flora Recorded or Potentially Occurring in the Project Area

Species	Conservation Code	Habitat	Distribution
Priority Flora			
Brachychiton tridentatus	P3	Sand, sandstone. Rocky hills and ridges.	Two records, on or near the Vertical Sandstone Surface. One inside the VCP Envelope.
Corymbia cadophora subsp. *polychroma*	P1	Sandstone, banded ironstone. Gentle slopes.	One record and one vegetation type with the species as the dominant species in the tree strata. All occurrences outside of the VCP Envelope.
Eucalyptus ordiana	P2	Skeletal soils over sandstone or quartzite. Steep rocky outcrops.	Four location all outside the VCP Envelope.
Grevillea minuata	P4	Forms scattered thickets throughout the *Eucalyptus* open woodland *Petalostigma* open shrubland *Triodia* grassland (EB-W) vegetation community	No specific locations recorded, but the vegetation type is well distributed throughout the locality with only a small fraction (4.5 ha 936 ha mapped), occurring within the VCP Envelope.
Heliotropium alcyonium	P1 Range extension	Flood plains on sandy soil.	Three occurrences. Two within the VCP Envelope.
Heliotropium galioides	P1 Range extension	Shallow skeletal soils on sandstone.	Two occurrences, one within the VCP Envelope.
Jacquemontia sp. Keep River (J.L. Egan 5015)	P1	Cliff faces and cliff margins of ironstone/sandstone geological formations.	Thirteen occurrences. Four within the VCP Envelope.
Rothia indica subsp. *australis*	P3 Range extension	Flood plains.	Four occurrences, three within the VCP Envelope.
Triodia barbata	P1	Cliff edges, rock faces and large boulders. Areas sheltered from fire.	Two occurrences, both outside of the VCP Envelope. Also known to occur within the P1 PEC Vertical Sandstone Surfaces which occurs adjacent to but outside of the VCP Envelope.
Triodia bunglensis	P2	Cliff edges, rock faces and large boulders. Areas sheltered from fire.	One occurrence outside of the VCP Envelope.
Triodia cremnophila	P1	Cliff faces and cliff margins of ironstone/sandstone geological formations. Drainage lines.	Ten occurrences, four within the VCP Envelope.
Triodia fitzgeraldii	P1	Rocky skeletal soils. Sandstone hills.	One occurrence outside of the VCP Envelope.

Taxonomic uncertainty			
Kunzea sp. Keep River	Conservation status under review	Occurs within the Priority 1 PEC Plant assemblages on vertical sandstone surfaces	Approximately 379 individuals in the suitable habitat which occurs adjacent to but outside of the VCP Envelope.
Acacia lycopodiifolia (prostrate form)	Under taxonomic review	Occurs within the Priority 1 PEC Plant assemblages on vertical sandstone surfaces	Suitable habitat occurs adjacent to but outside of the VCP Envelope.

T. barbarta, T. cremnophila, A. claviseta, T. bunglensis, G. minuata and *C. cadophora* subsp. *polychroma* prefer the sandstone cliffs located outside of the Matsu Disturbance Envelope. This habitat type is also the P1 PEC Plant Assemblages on Vertical Sandstone Surfaces that has been mapped at the Project area. The rocky slopes and outcrops represent good habitat for *A. smeringa* and *A. capillaris*. *Eucalyptus ordiana* and *T. racemigera* can potentially be found at both the rocky and sandstone habitat types.

Kunzea sp. Keep River is synonymous with the recently described *Kunzea petrophila* in the Northern Territory. The species has not yet been formally accepted in WA, but is expected to qualify as a Threatened species under the BC Act. As the species inhabits areas that are highly inaccessible, mining at Matsu is not expected to impact the microhabitats of the species on the cliffs. Mining is proposed to occur on the backslope, leaving the cliffs intact.

3.7.5.1.1 Priority Flora in the VCP Envelope

Six Priority flora occur within the VCP Envelope. The local and regional distribution of these species and the expected impact from the Project is discussed in the sections below.

Brachychiton tridentatus

Brachychiton tridentatus typically occurs as single individuals or small discreet populations in association with sandstone outcropping, a common formation throughout the central and eastern Kimberley (APM 2014a). The Matsu population represents the south easterly extent of the distribution of this species in the Kimberley region, but *B. tridentatus* does not appear to be restricted by habitat requirements as suitable habitat is commonly available in the area.

Forty-four records are available on the Atlas of Living Australia (**ALA**), including on islands of the north Kimberley. The distribution of the species in WA is shown in Figure 3-3. Due to the inaccessibility of the habitat type it is likely the species is under surveyed within the Kimberley.

The loss of one individual due to vegetation clearing at the Project is unlikely to lead to a decline in the sustainability of the species in the region. Locally, another specimen was recorded that will not be impacted. The recorded location of the individual within the VCP envelope was made as an opportunistic record during helicopter survey in the Level 1 survey and habitat was not recorded. The individual recorded during the Level 2 survey occurs in the Vertical Sandstone Surfaces community. It is possible that the record that falls within the VCP Envelope is actually downslope of the clearing area, but limited access in 2012 caused the location to be inaccurately recorded. It is probable that more individuals of the species occur within the Vertical Sandstone Surfaces community, but no clearing of this community is proposed. Suitable local habitat is shown in Figure 3-4.

Plate 1 shows the habitat of the *B. tridentatus* recorded in the Level 2 survey.

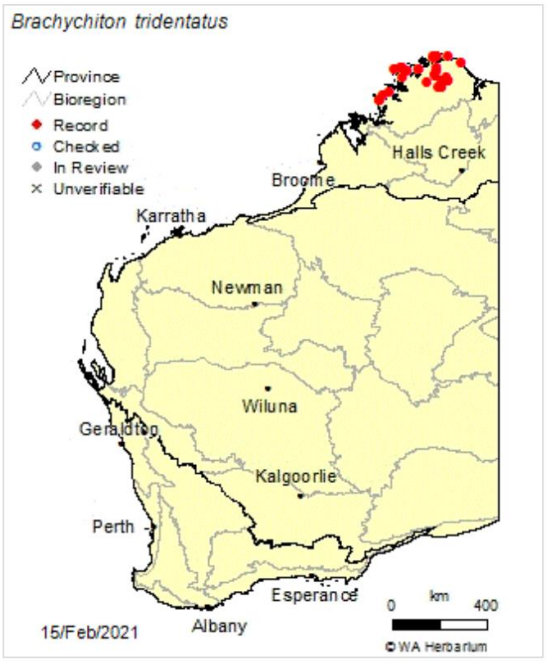

Figure 3-3: Distribution of *Brachychiton tridentatus* in WA

Plate 1. Habitat of *Brachychiton tridentatus* recorded in the Level 2 Survey

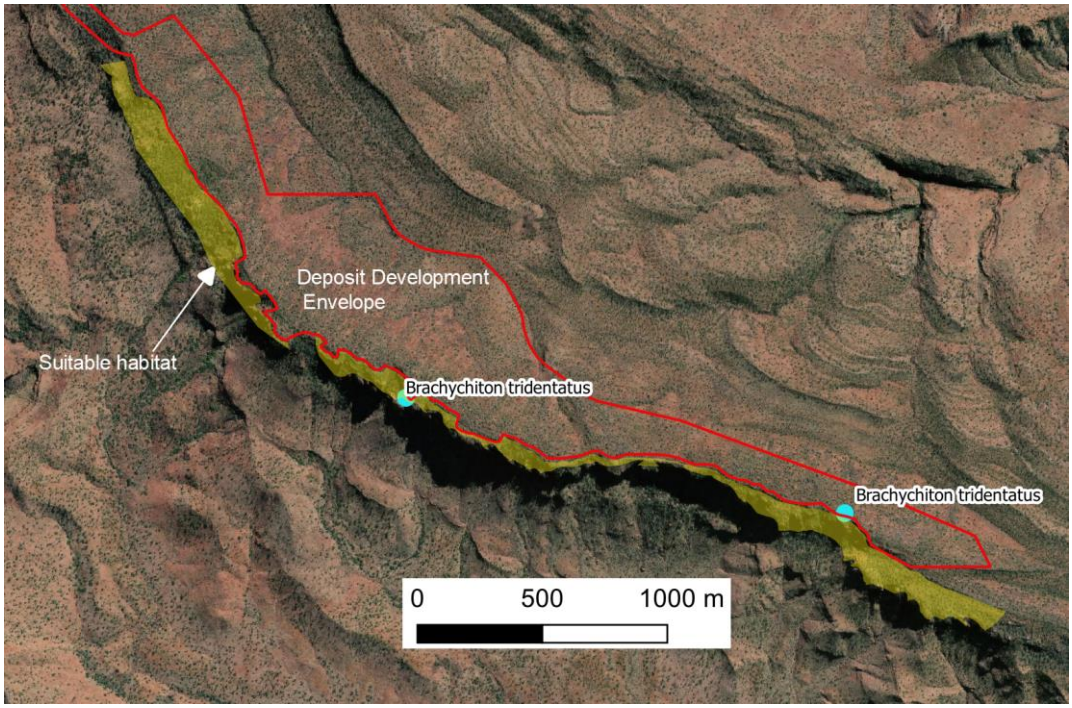

Figure 3-4: *Brachychiton tridentatus* Suitable Habitat in Relation to the Matsu Deposit

Heliotropium alcyonium

Figure 3-5 shows the known extent of *Heliotropium alcyonium* within WA, indicating the Matsu records are a range extension within the Kimberley region. *Heliotropium alcyonium* is common in the northern NT, but only one record is known from WA from slightly north of Kununurra (Figure 3-5). The collection at Matsu suggests this species may have a more southerly distribution boundary. The species occurs on sloping plains between low hills and flood plains. In the access track area, the species was recorded within the vegetation units EbFP3 and EbUP1, both commonly distributed in the study area (Figure 3-6).

It is likely that *Heliotropium alcyonium* is distributed in areas outside of the VCP Envelope within the locality as these habitat types are distributed throughout the Pompey Land System which occurs to the north and east of the access track (Figure 3-6). Plate 2 shows habitat for the species as recorded in the Level 2 survey.

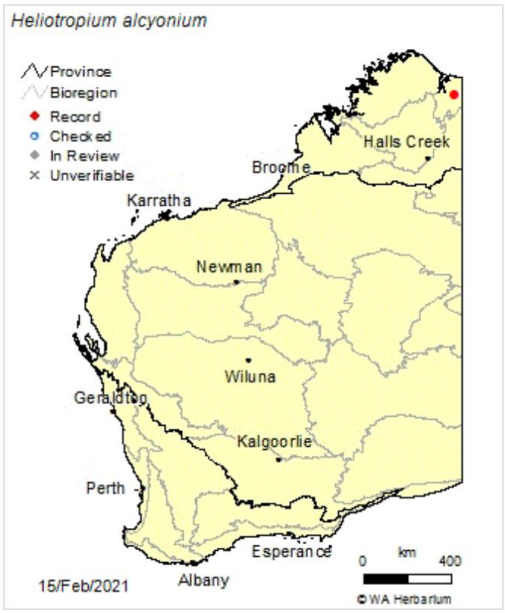

Figure 3-5: Distribution of *Heliotropium alcyonium* within WA

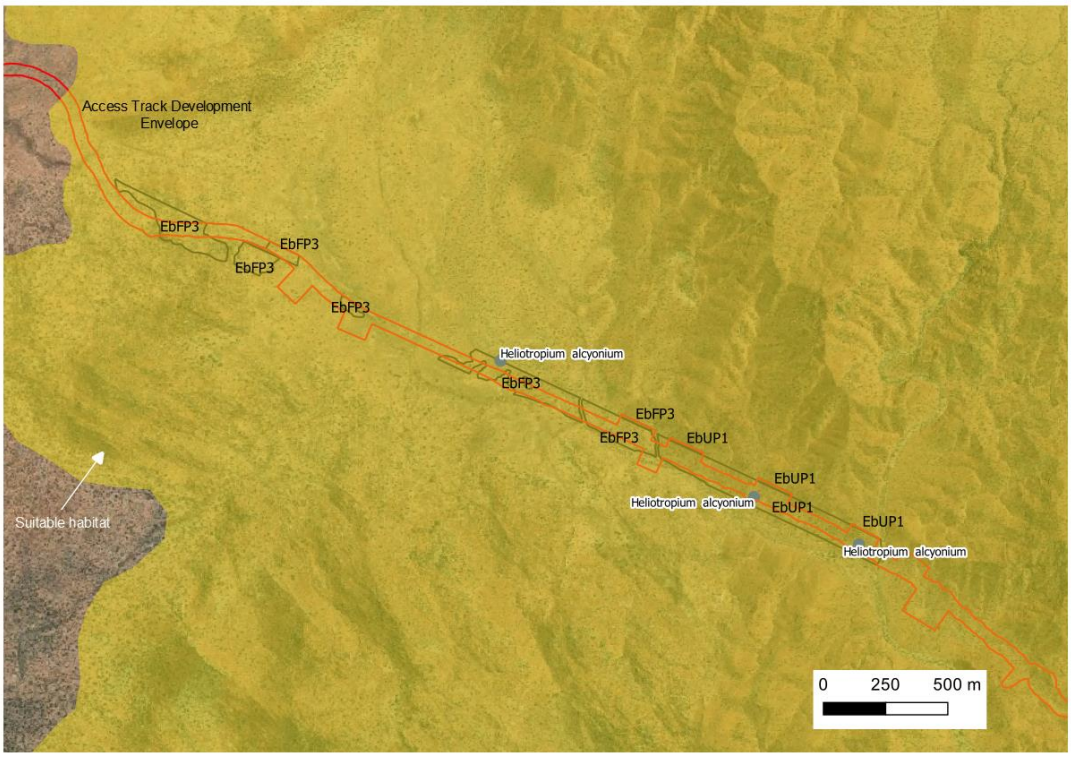

Figure 3-6: Suitable Habitat for *Heliotropium alcyonium* in the Local Area

Plate 2. *Heliotropium alcyonium* Habitat Recorded in the Level 2 Survey

Heliotropium galioides

Figure 3-7 shows the known extent of *Heliotropium galioides* in WA and indicates the Matsu record is a range extension within the Kimberley region. *Heliotropium galioides* is only known from four other records in the northern Kimberley. The species occurs on sloping plains between low hills and flood plains. In the access track area the species was recorded within the vegetation unit EbFP3, commonly distributed in the study area (Figure

3-8). It is likely that it is distributed in areas outside of the VCP Envelope within the locality as this habitat type is distributed throughout the Pompey Land System which occurs to the north and east of the access track (Figure 3-8).

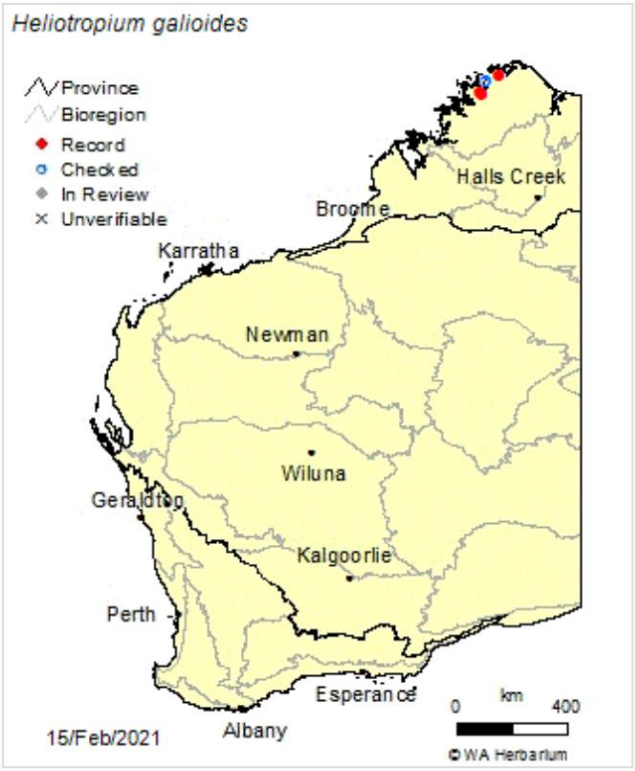

Figure 3-7: Distribution of *Heliotropium galioides* within WA

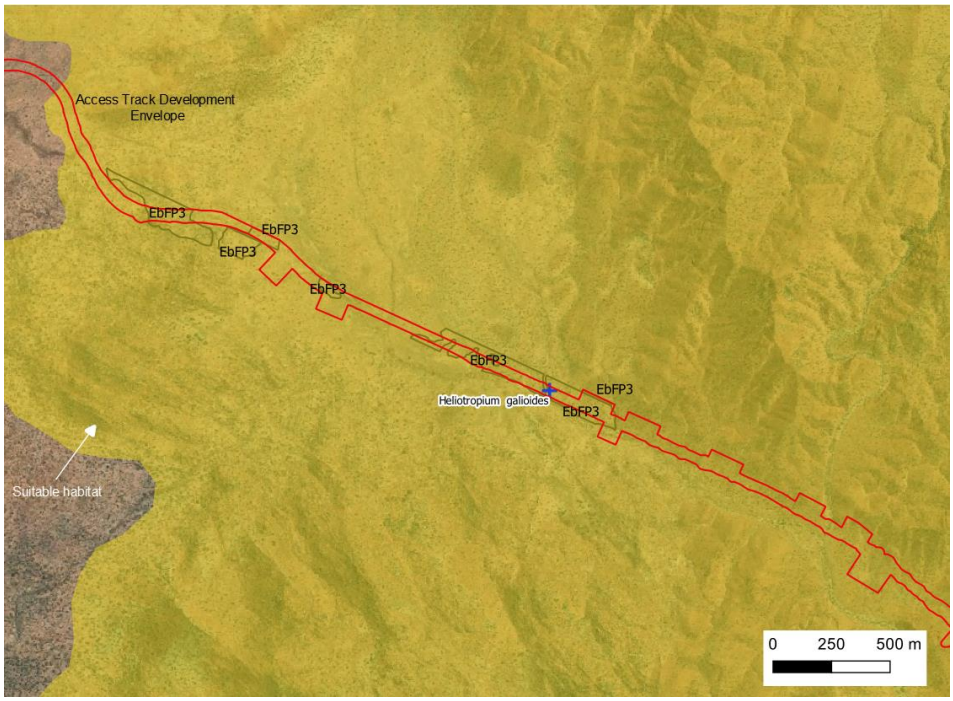

Figure 3-8: Suitable Habitat for *Heliotropium galioides* in the Local Area

Jacquemontia sp. Keep River

Jacquemontia sp. Keep River has a scattered, but broad, range in the Kimberley from the Ragged Ranges through to the Knox Creek area north east of Kununurra (Figure 3-9). The taxon is not yet formally described and requires taxonomic review. Plate 3 shows the specimen type as collected at Matsu.

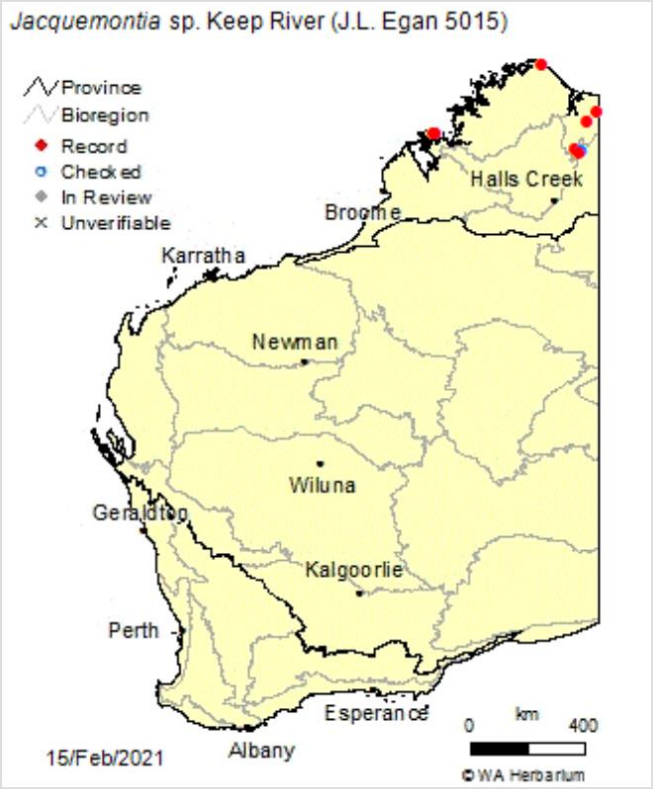

Figure 3-9: Distribution of *Jacquemontia* sp. Keep River in WA

Plate 3. Specimen Type of *Jacquemontia* sp. Keep River Collected at the Matsu Project

The taxa was recorded in 13 locations across six vegetation associations (CcSS2, CcSS3, CdDL1, EbMSS1, EbUP1, EoLSH2 [APM 2014a]) occurring across large areas outside of the VCP Envelope (Figure 3-10). The Project is unlikely to reduce the sustainability of the local or regional populations.

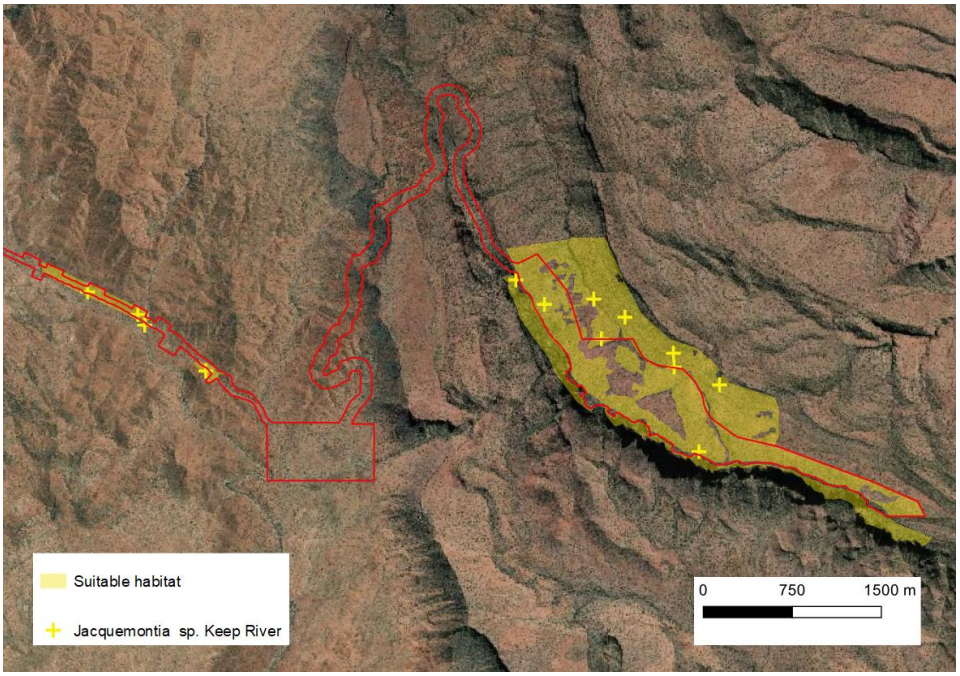

Figure 3-10: Suitable habitat for *Jacquemontia* sp. Keep River in the local area

Rothia indica subsp. *australis*

Rothia indica subsp. *australis* is widely distributed across WA (Figure 3-11) in small and scattered occurrences. This species occurs within flood plain areas in association with minor drainage channels. In the Matsu field surveys, it was recorded in vegetation types TcUP2, DhUP4, EGFP4 and EB-W. These habitat types are broadly distributed outside of the VCP Envelope (Figure 3-12). It is likely that the species occurs in areas outside of the Matsu Project area within the locality due to the presence of these habitat types throughout the Pompey Land System which occurs to the north and east of the access track. The Project is unlikely to have an impact on the sustainability of the local or regional population.

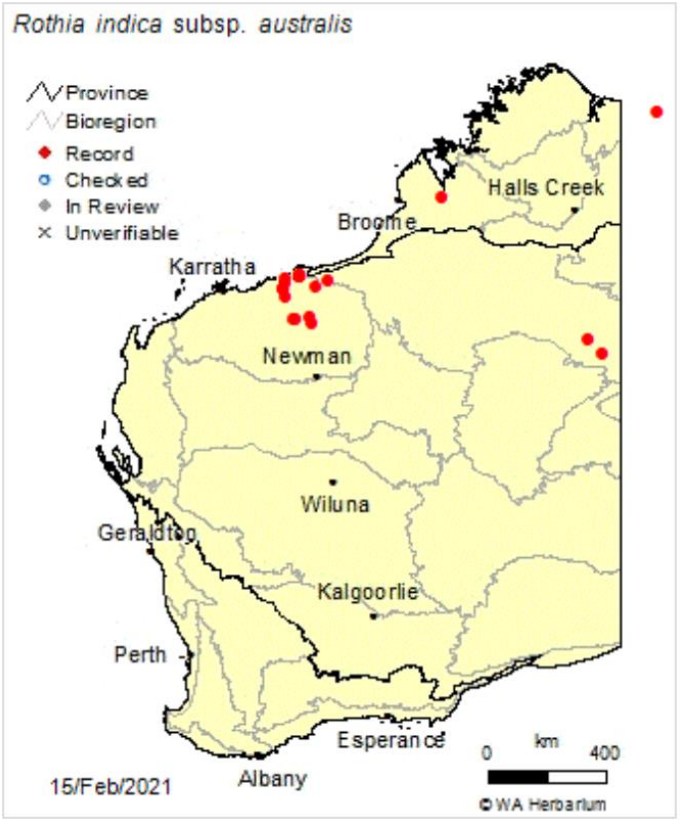

Figure 3-11: Distribution of *Rothia indica* subsp. *australis* in WA

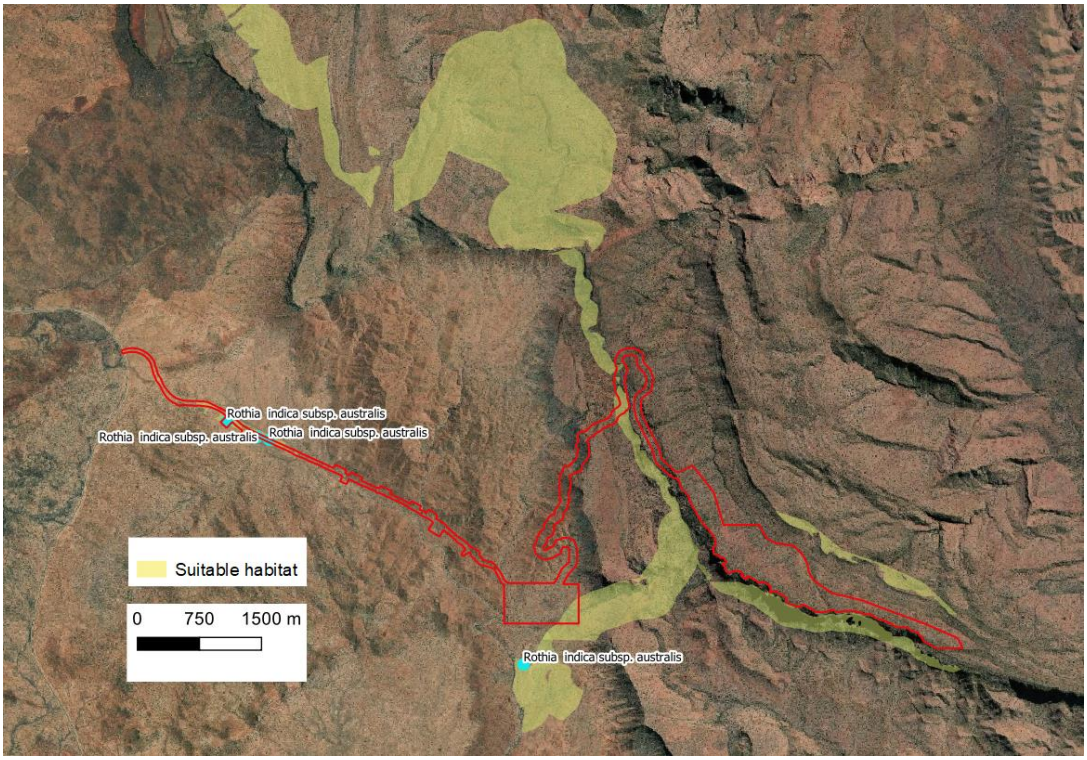

Figure 3-12: Suitable Habitat for *Rothia indica* subsp. *australis* in the Local Area

Triodia cremnophila

Triodia cremnophila has few records in WA (Figure 3-13) and is known only from the Ragged Range. The *T. cremnophila* recorded from Matsu field surveys are a northward extension to the previously known distribution of the species within the Ragged Range. Previously recorded on upper ranges of the southern end of the Ragged Range (75-25 km to the south of Matsu), occurring on slopes and crests of the lower hills. The species is now known to occur on 3 upland segments of the range.

Four of the 10 recorded occurrences of the species in the Matsu area occur within the area of the Matsu deposit. The species shows a diverse habitat suitability on the upper range area. In the Matsu field surveys it was recorded in the CdDL1 CdSS1, CcSS1, CcSS2, CcSS3, CfDL1 and CdDL2 vegetation types. Impacts to *T. cremnophila* are not anticipated to be significant as there will be no disturbance of the Vertical Sandstone Surfaces community and other suitable habitats that are well distributed locally (Figure 3-14).

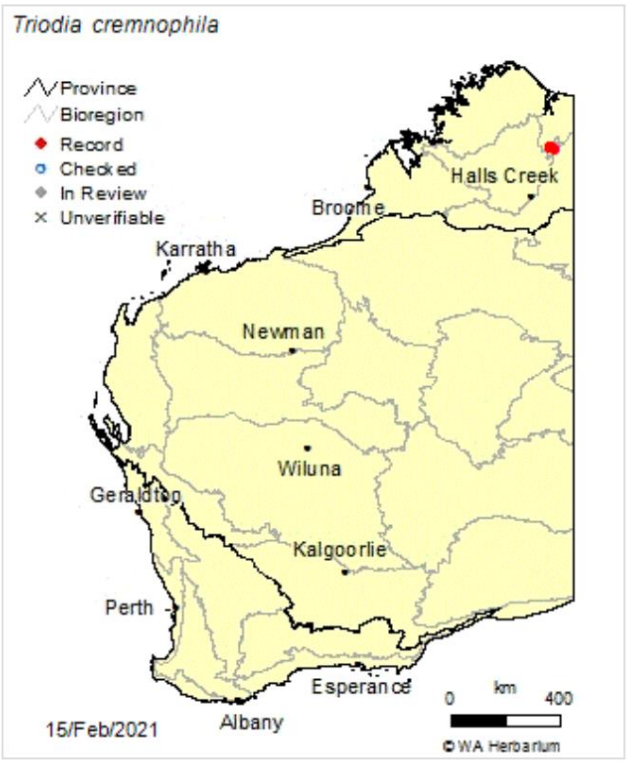

Figure 3-13: Distribution of *Triodia cremnophila* in WA

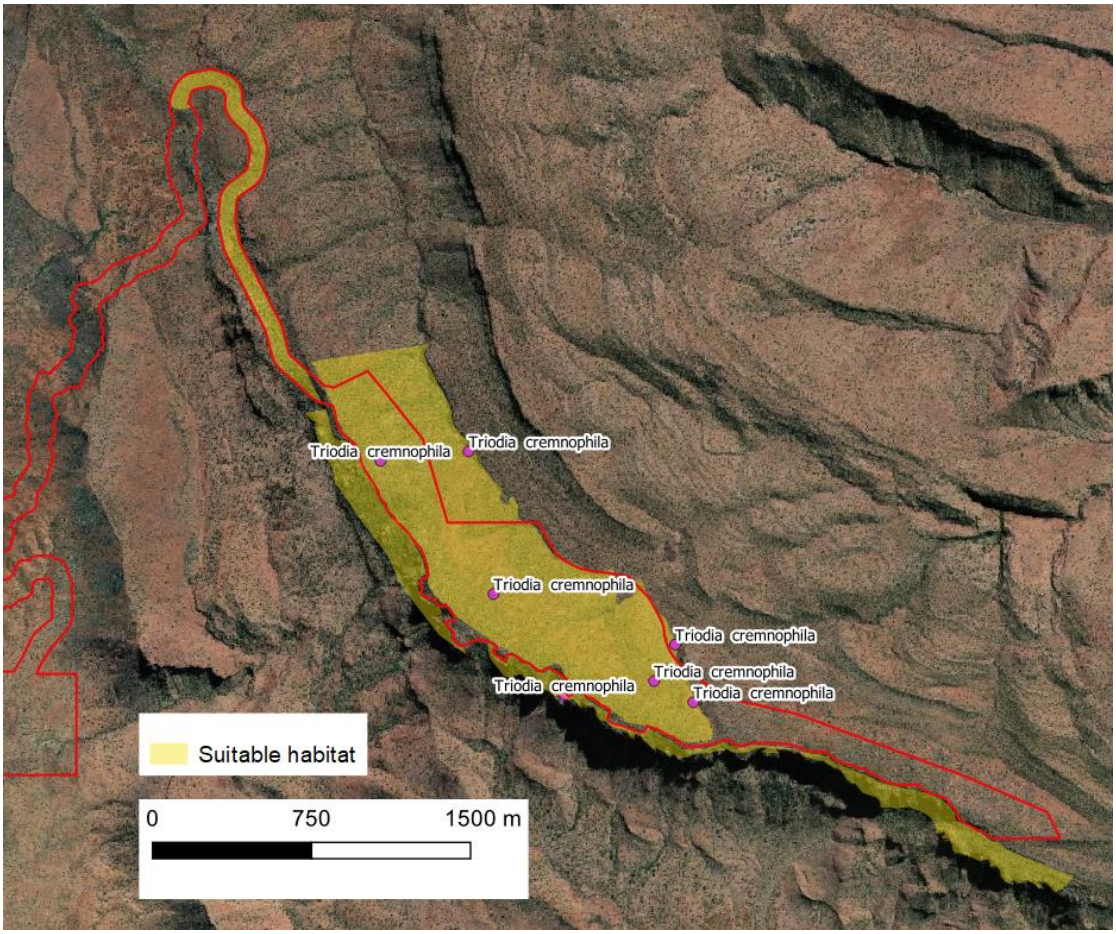

Figure 3-14: Suitable Habitat for *Triodia cremnophila* in the Local Area

3.7.5.2 Priority Flora Likely to Occur

Likelihood of occurrence assessments for Priority flora known to occur within 30 km of the Project are were conducted (APM 2021; Appendix 4). In addition to the flora known to be present, six species were determined to have a high or moderate likelihood of occurring within the Matsu area due to the presence of suitable habitat as mapped by APM (2014a; 2014b), and are listed in Table 3-5.

The local and regional distribution of these species and the expected impact from the Project is discussed in the sections below.

Table 3-5: Priority Flora with a High or Moderate Likelihood of Occurring in the Project Area

Taxa	Conservation Code	Habitat	Likelihood of occurrence
Acacia camptocarpa	P1	On sandy loam over sandstone, gentle slopes	**Moderate**. Recorded 7 km away. Suitable habitat may occur.
Acacia smeringa	P1	Shallow rock soils	**High**. Recorded 5.5 km away. Suitable habitat is known to occur.
Micraira sp. Purnululu (M.D. Barrett & R.L. Barrett 1507)	P1	On banded ironstone pavement	**Moderate**. Recorded 4.5 km away. Suitable habitat may occur.
Triodia racemigera	P1	Steep rocky slopes, crevices, cliffs and ridges.	**High**. Recorded 4.7 km away. Suitable habitat is known to occur.
Acacia capillaris	P2	Along creek, steep rocky slope.	**High**. Recorded 5.5 km away. Suitable habitat is known to be present.
Acacia claviseta	P3	On sandstone ridge crest	**High**. Recorded 8 km away. Suitable habitat is present.

Acacia camptocarpa

Acacia camptocarpa is known from three localities in the Kimberley (Figure 3-15). One of those locations is from a specimen collected from the RIOP baseline flora and vegetation survey (APM 2010) under the preliminary name of *Acacia thomsonii* (lignotuberous shrub form (Voucher: RLB 6620)) where it was found around a single point on the edge of the RIOP development area.

The specimen was then examined and determined to be taxonomically distinct by Maslin *et al.* (2013) and given the name *Acacia camptocarpa*. The species was assigned a conservation level of P1.

It is a lignotuberous multistemmed shrub less than 0.6 to 1 m tall. In the RIOP it was recorded as six plants from the vegetation type W4 with *Acacia* sp. (RLB 7509), *Erythrophleum chlorostachys, Eucalyptus brevifolia, Corymbia cadophora* subsp. *polychroma*, *Triodia* cf. *bitextura, Schizachirium fragile, Evolvulus alsinoides*, *Hybanthus enneaspermus* and *Petalostigma quadriloculare*. The vegetation community was mapped as being widespread (Figure 3-16), however only the one occurrence of the species was recorded, possibly due to the low accessibility of the area.

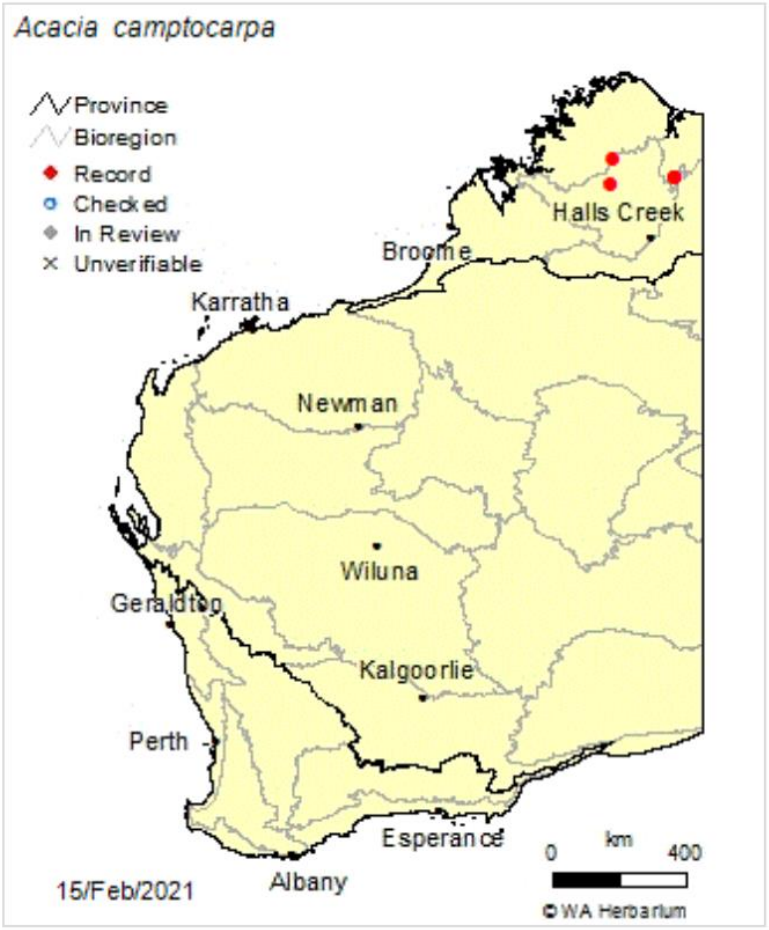

Figure 3-15: Distribution of *Acacia camptocarpa* in WA

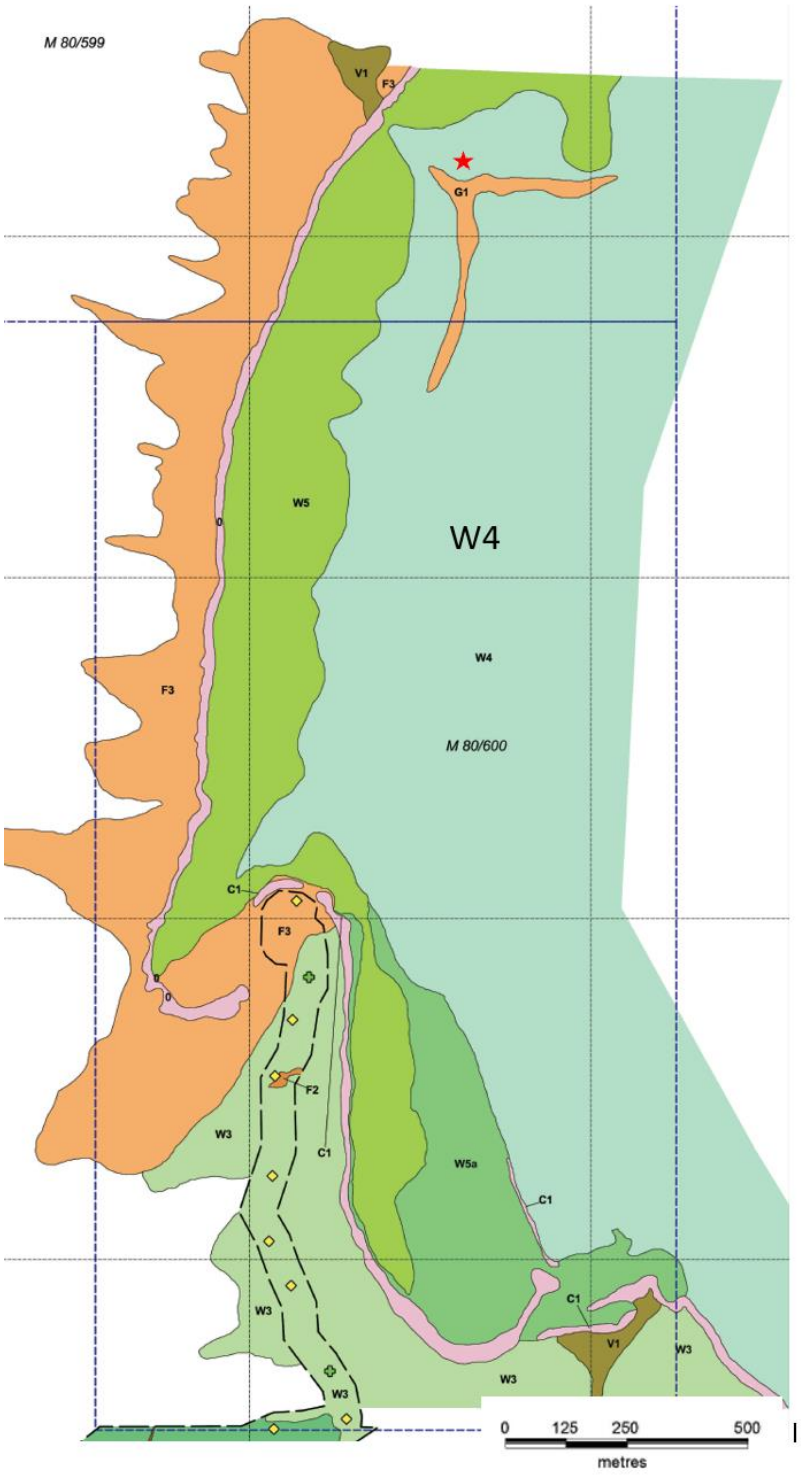

Figure 3-16: Approximate Location of *Acacia camptocarpa* (red star) at the RIOP and the Distribution of the W4 Community it was Recorded From. Reproduced from APM (2010)

An overlap in the vegetation mapping for the Matsu project occurred at the RIOP for the Level 1 survey as one of the investigated road alignments originated at the RIOP. In the Level 1 survey the name for the W4 vegetation type was retained. The distribution of that vegetation type is outside of the VCP Envelope as shown in Figure 3-17.

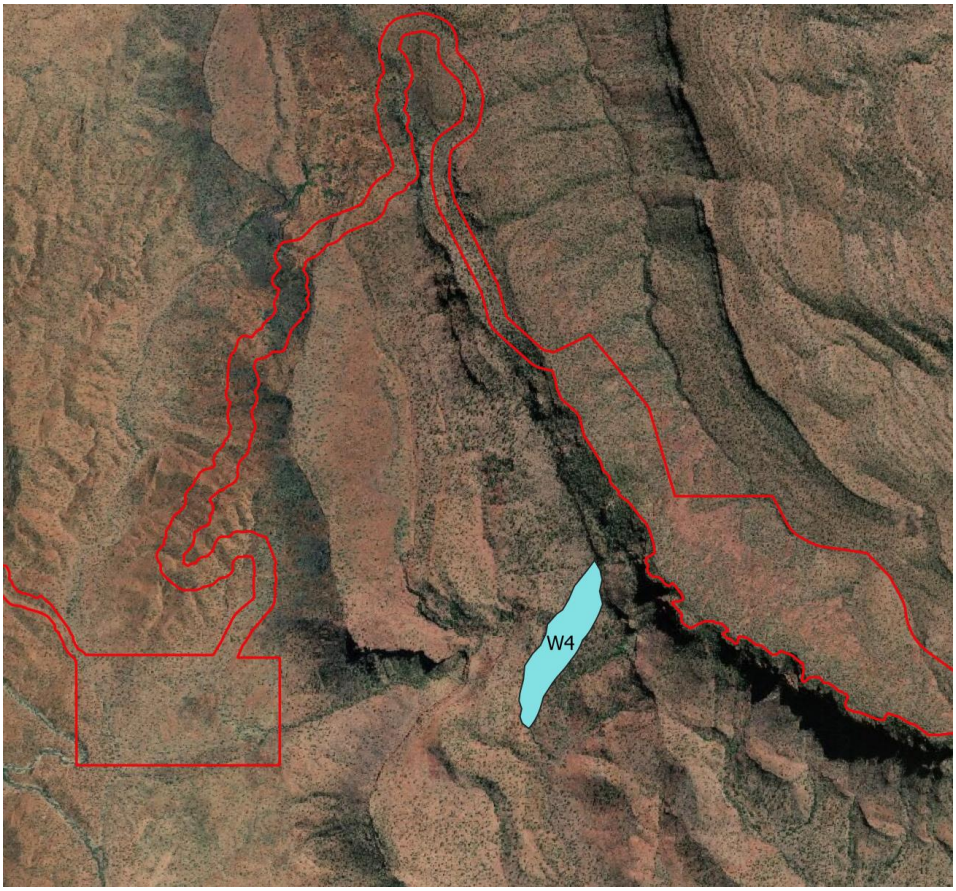

Figure 3-17: Distribution of the W4 Vegetation Community in Relation to the VCP Envelope

Acacia smeringa

Acacia smeringa is known from three localities in WA (Figure 3-18). The closest record is reportedly at Manning Gorge. Grows in shallow rocky soil, in woodland dominated by *Eucalyptus argillacea* with *Triodia* common in the understorey (George 1998).

The species is poorly known and habitat type known only from one location, however *Eucalyptus argillacea* was not recorded in the Matsu area but occurs predominantly along watercourses and plains. These habitats are infrequent in the VCP Envelope. The Project is unlikely to impact the sustainability of this species.

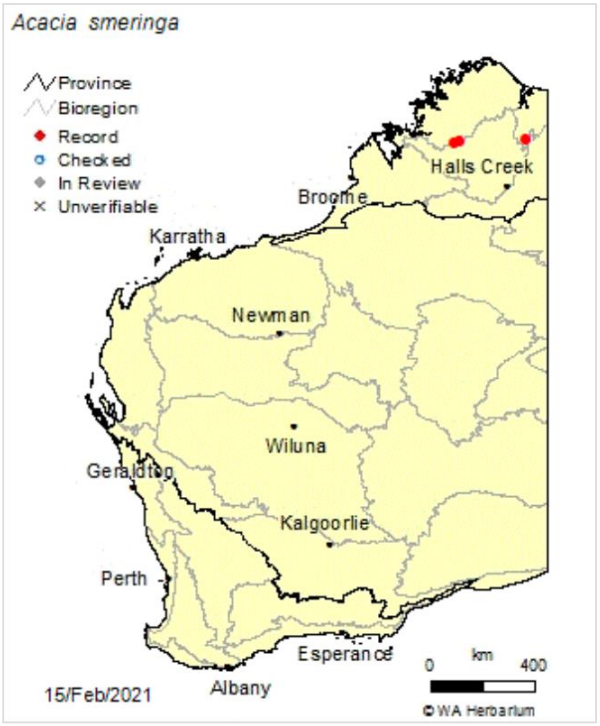

Figure 3-18: Distribution of *Acacia smeringa* in WA

Micraira sp. Purnululu (M.D. Barrett & R.L. Barrett 1507)

Micraira sp. Purnululu is known from three localities in Western Australia, from the RIOP, the Parker Range and Osmond Plateau (Figure 3-19). There is a location known from the Spirit Hills area in the NT (Figure 3-19).

A number of locations at the RIOP occurred within the mining area and are likely to have been cleared. Searches were conducted for suitable habitat outside of the RIOP mining area. Several large sandstone and ironstone rock pavements to the south of the RIOP mine site were visually assessed for suitability of habitat for *Micraira* sp. Purnululu. These pavements were assessed as relatively poor habitat due to their slope and the low quantity of soil present at the base of the slopes. These same slopes prevented landing of the helicopter nearby to check for the presence of Micraira and the small size of the plants made it impossible to determine presence or absence from the air. It was considered that some small populations may be present despite the relatively poor habitat (APM 2010).

Each of these populations exhibit subtle morphological differences and there may be multiple taxa included in this concept. The taxa has not been formally described.

At the RIOP the taxa was recorded from within the W5 vegetation community. The Matsu Level 1 survey also mapped the W5 community both at the RIOP and at the Matsu area. The distribution of the W5 community in the Matsu area is outside of the VCP Envelope (Figure 3-20).

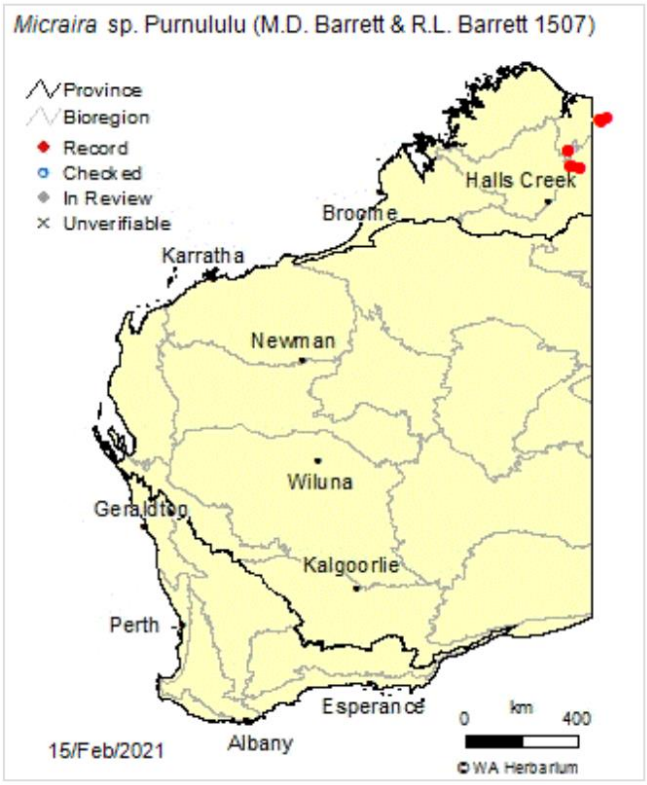

Figure 3-19: Distribution of *Micraira* sp. Purnululu in WA

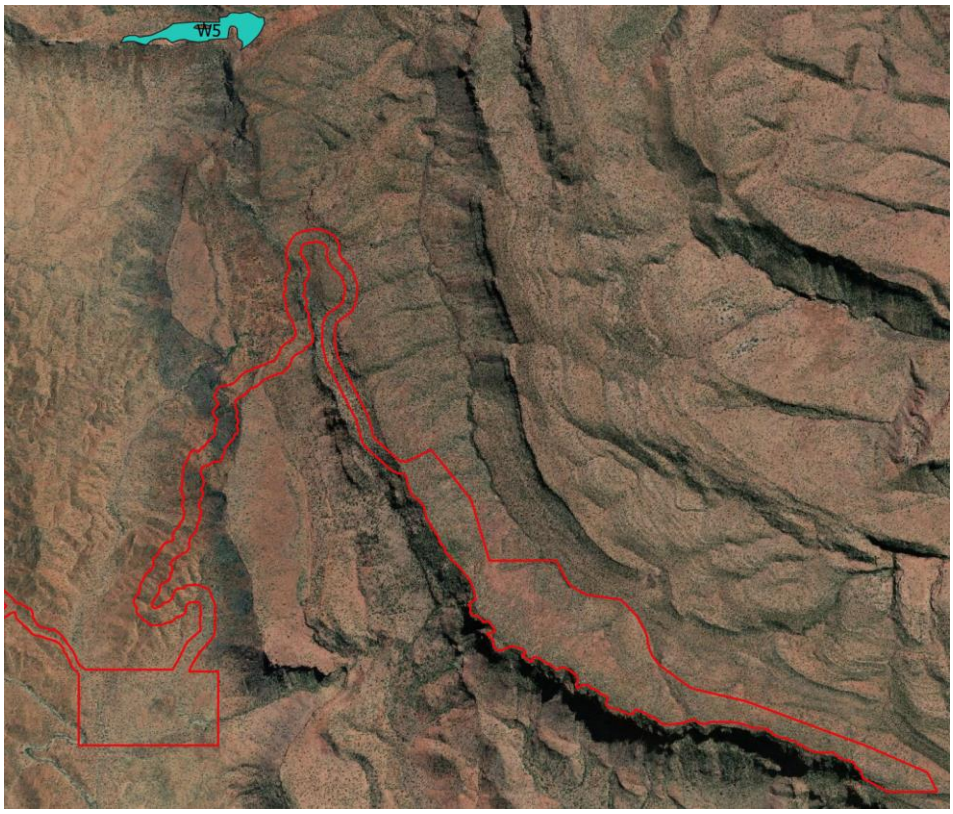

Figure 3-20: Distribution of the W5 Vegetation Community in Relation to the VCP Envelope

Triodia racemigera

Records for *Triodia racemigera* occur in the Central Kimberley, Ord Victoria Plain and Victoria Bonaparte bioregions as well as two localities in the NT (Figure 3-21). Records near to the Project are three clustered records from Lake Argyle area and from the RIOP. At the RIOP *T. racemigera* was recorded in several small (5 to 300 individuals) discrete populations, always occurring on broken rocky outcrops which naturally preclude fire (APM 2010). At the Matsu Project the suitable habitat is most likely the Vertical Sandstone Surfaces, which are outside of the VCP Envelope.

Clearing for the Project is unlikely to reduce the sustainability of the local or regional population.

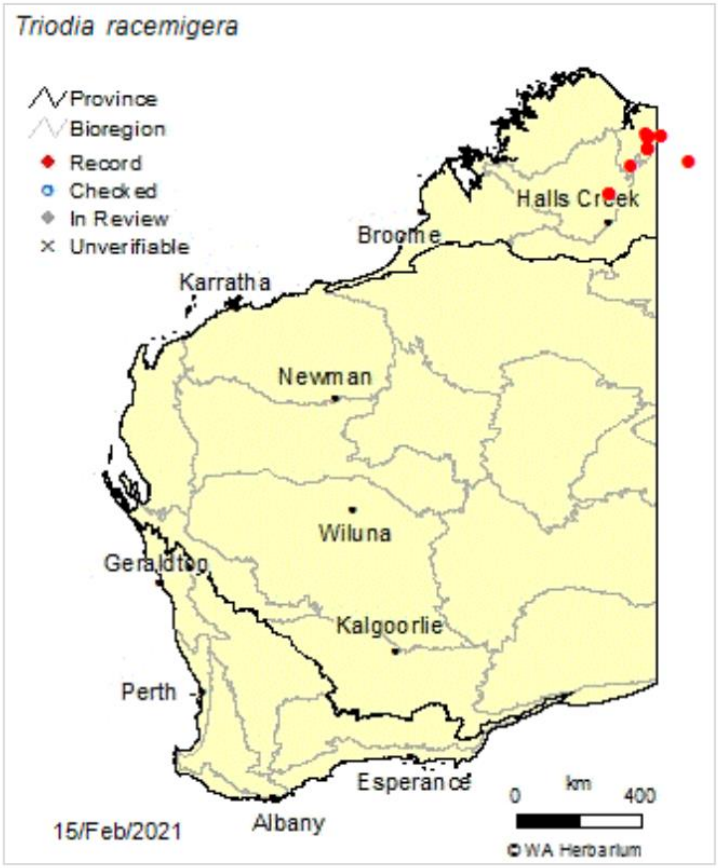

Figure 3-21: Distribution of *Triodia racemigera* in WA

Acacia capillaris

Records for *Acacia capillaris* occur predominantly in the Central Kimberley bioregion and one record in the Victoria Bonaparte bioregion (Figure 3-22). The record nearby to the Matsu area occurs in March Fly Creek, downstream of the RIOP.

Habitat associations are known from Mt Bell and Scott Gorge, west Kimberley, as red-brown clay over granite, under Livistona palms near creek and on rocky slopes in savannah–spinifex association. This habitat type is not present in the Matsu area. The presence of the species in March Fly Creek suggests a broader habitat association. The species may be present locally in lower creek lines, however these habitats are unlikely to be impacted by vegetation clearing. Indirect impacts to these habitats such as impacts to surface water quality and quantity may possibly occur as a result of the Project.

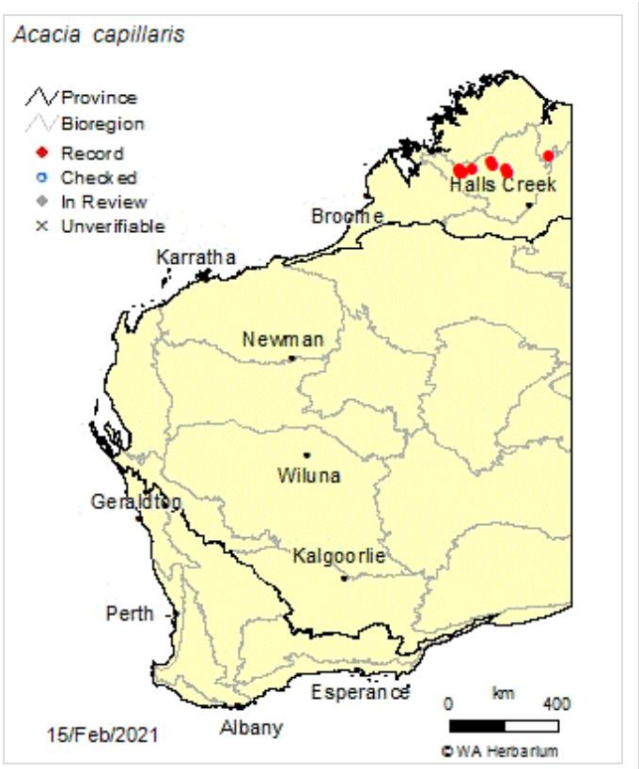

Figure 3-22: Distribution of *Acacia capillaris* in WA

Acacia claviseta

Records for *Acacia claviseta* occur predominantly in the Central Kimberley bioregion and Ord Victoria Plains bioregions and one record from the Keep River National Park in the NT (Figure 3-23). Grows on top of sandstone ridges, on sand flats and shallow sand lenses among sandstone boulders and on scree slopes (Maslin *et al.* 2013).

The species was collected from the RIOP as *Acacia* aff. *anasilla* within locations outside of the RIOP impact area. Further records exist on the sandstone cliffs north of the RIOP. If the species were to be present at the Matsu Project, it would most likely occur in the Vertical Sandstone Surfaces that occur outside of the VCP Envelope.

The Project is unlikely to reduce the sustainability of the local or regional populations of this species.

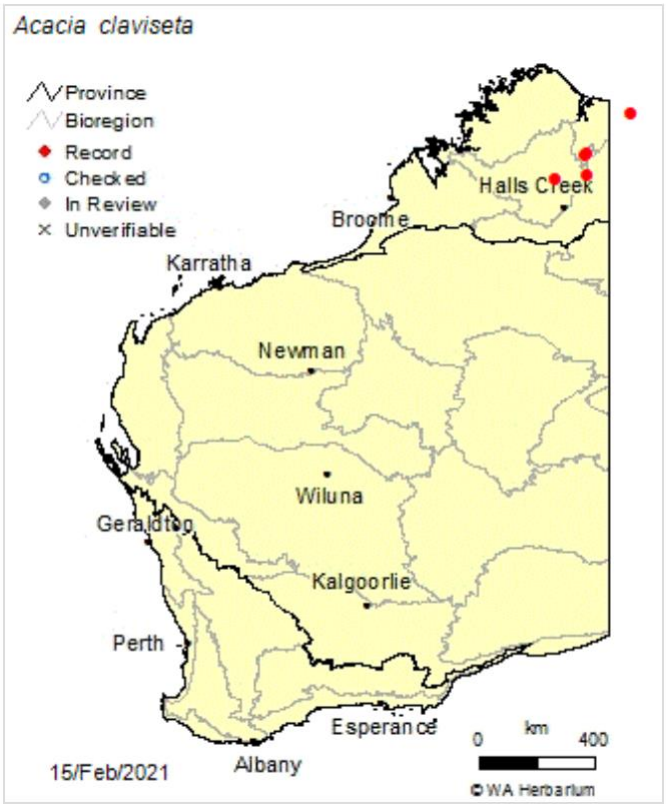

Figure 3-23: Distribution of *Acacia claviseta* in WA

3.7.6 INTRODUCED FLORA

Fourteen weed species were recorded during surveys and are listed in Table 3-6.

Table 3-6: Weed Species Recorded in the Project Area

Scientific name	Common Name
Aeschynomene villosa	
Alysicarpus vaginalis	
Bidens bipinnata	Bipinnate Beggartick
Calotropis procera (Aiton) W.T.Aiton	Calotrope
Cenchrus pedicellatus subsp. *unispiculus*	
Citrullus colocynthis	
Digitaria ciliaris	Summer Grass
Euphorbia hirta	Asthma Plant
Melinis repens	
Passiflora foetida var. *hispida*	
Sida acuta	
Sida acuta subsp. *acuta*	
Stylosanthes hamata	Verano Stylo
Tridax procumbens	Tridax

One weed species recorded is a declared weed on the Western Australian Organism List (DPIRD 2021). *Calotropis procera* (Aiton) W.T.Aiton is in the category S22(2) (exempt) under the WA *Biosecurity and Agricultural Management Act 2007.* The species was recorded from two locations on the top of the Vertical Sandstone Surfaces (

Figure **3-24**).

Whilst these locations are outside of the VCP Envelope, they are very close to the boundary and care will be taken while performing ground disturbance in this area so that weed seed is not transported to other areas or the weed species allowed to proliferate in the nearby disturbed land. The locations (in GDA 1994 MGA Zone 52) are:

- E: 429547, N: 8153153 (APM 2014b)
- E: 429005, N: 8153467 (APM 2014a).

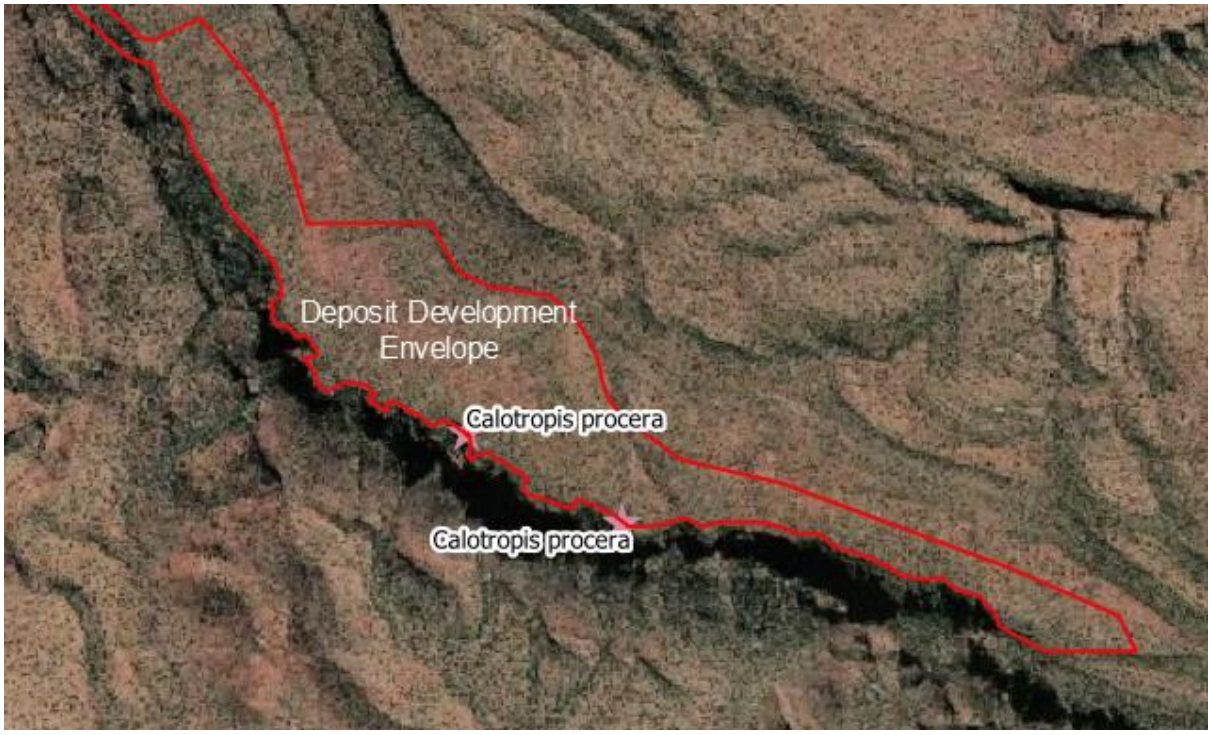

Figure 3-24: Locations of *Calotropis procera*

3.7.7 FAUNA HABITAT

Five vertebrate fauna habitat types were identified during the Level 1 Matsu Biological Survey (Appendix 8) and are described below. Surveys at the nearby Argyle Diamond Mine (2 km to the south east) and RIOP (3 km to the north of the access track) (Table 3-2) have been used to supplement the knowledge of expected fauna in the Matsu Project habitats. During the Level 1 fauna survey (APM 2014b), fauna habitats were mapped using the distribution and extent of vegetation and landform mapping. The Level 2 survey (APM 2014a) offered a more detailed account of the vegetation and landforms present within the areas to be developed at the Matsu Project and fauna habitats have been refined using this information and are shown in Figure 3-25.

- ***Rocky Outcrops:*** Surface expressions of sandstone boulders are a common occurrence and provide complex refuges for saxacoline reptile species and small mammals. On lightly wooded stony slopes that have an established shrub layer and a ground cover of hummock grasses, the more woodland orientated skinks have been captured in abundance at nearby surveys. The rockier habitats (outcroppings) support a more unique fauna assemblage including the Spiny-tailed Monitor (*Varanus acanthurus)* and the Spotted Gecko (*Gehyra punctata)*.

- ***Open Eucalypt Woodland on Rocky Ridges***: This habitat represents an interzone between rocky outcrops, cliffs or drainage lines. The diverse woodland species and mid-dense grass layer create a good cover for the swift moving *Ctenotus* species. The interspersed shrubland provides habitat for dragons and the gecko (*Strophurus ciliaris)* that perches on shrub branches, relying on crypsis to escape predation during the day. Fossorial skink species are abundant in the dense litter and detrital layer.

  No amphibians are expected to occur in this habitat other than water holding species such as *Cyclorana* spp. which burrow deep within clay soils and emerge in the wet season. Bird species which favour the open woodland include the Weebil (*Smicrornis brevirostris)*, Brown Honeyeater (*Lichmera indistincta)* and Northern Rosella (*Platycercus venustus)*.

- ***Undulating Plains***: This habitat is similar in structure to the open eucalypt woodland on rocky ridges habitat but geographically distinct in that it is located off the escarpment and down on the undulating

plains, which tend to form broad valleys between ranges. The landform consists mainly of moderate slopes with scattered steep bouldery hills that are dissected by ephemeral drainages.

The vegetation generally comprises of open eucalypt woodland over tall mixed upland grasses. Due to the flatter nature of this habitat compared to the typically more rugged and steep terrain in the area, species that prefer the plains (such as the Australian Bustard and Bush Stone-curlew) are more likely to be found. The grasslands within this habitat provide a food source for seed eating birds and may provide useful feeding habitat for the conservation significant species the Gouldian Finch (*Erythrura gouldiae*).

- ***Gullies and Ephemeral Drainages:*** Minor, intermittent ephemeral drainage lines are present within the Project area, located primarily in the valley along the north-north eastern margin of the envelope at the bottom of the slope. Several minor ephemeral channels lead into this drainage line from the top of the escarpment. The base of many of these small gullies and ephemeral drainages sustain numerous small pools. Although mostly ephemeral, when present these pools provide an important water source for many species, notably numerous species of frog (including the invasive Cane Toad). In addition to the pools, the low-lying areas support a different suite of vegetation, being slightly denser than that of the surrounding woodland.

  The ephemeral drainages cross several different habitats and therefore serve as dispersal corridors for a variety of fauna particularly amphibians, including the invasive Cane Toad. These drainages may also hold water for longer time periods than the surrounds and can function as vital water sources for numerous species, including the larger macropods, bats and birds.

  Smaller mammals utilise the intermittent drainage lines where deposition of silt and sand promote the growth of very thick hummock and tussock grasses. The greatest bat species richness is typically recorded around wet areas, particularly where the water occurs in close association to rock outcrops and overhangs.

- ***Sandstone Cliffs:*** This habitat type occurs outside of the VCP Envelope but immediately adjacent to the south west of the Matsu deposit. Species likely to favour these environments are cliff dwelling reptiles such as (*Varanus glauerti)*, rock wallabies, bird species such as the White-quilled Rock-pigeon (*Petrophassa albipennis)* and bats such as the Northern Leaf-nosed-bat (*Hipposideros stenotis)*. If present the Peregrine Falcon (*Falco peregrinus)* will also nest on these vertical cliffs.

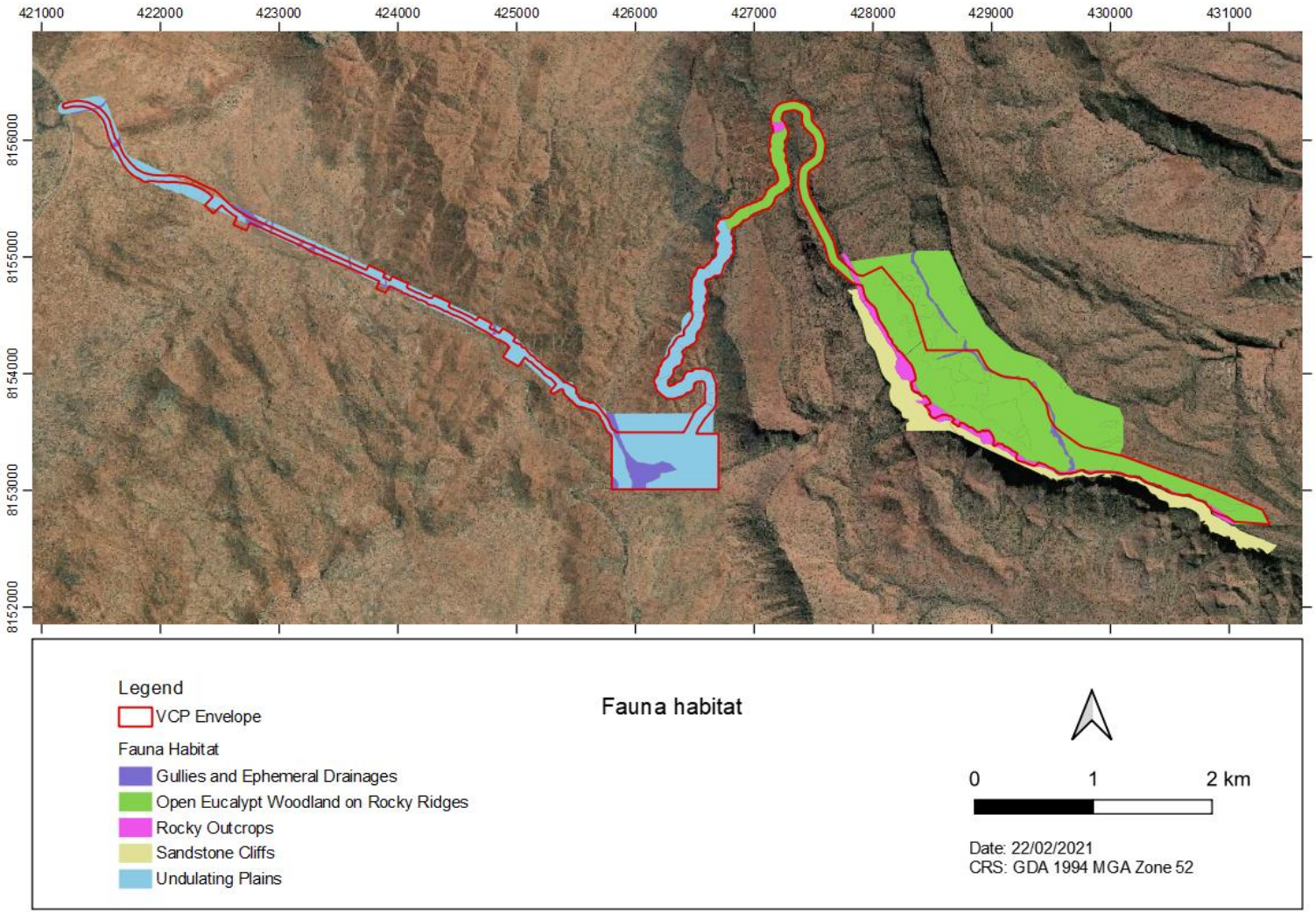

Figure 3-25: Fauna Habitat

3.7.8 FAUNA

3.7.8.1 Summary

The DBCA was consulted in 2012 (Nick Wolfrey and Murray Baker) and again in 2014 (Sandra Thomas) to confirm survey requirements for the Project. On both occasions, it was agreed that a targeted significant fauna survey was sufficient. Short Range Endemic surveys were not required as the fauna habitats of the Project area are continuous and show no potential for endemism.

Based on known distributions and habitat preferences, the expected fauna list comprised 118 bird, 34 mammal, 74 reptile and 18 amphibian species (Appendix 8).

The Level 1 fauna survey recorded 44 bird species, 10 bat species and four non-volant mammal species. Two species of conservation significance were recorded. These are the Ghost Bat and Orange Leaf-nosed Bat. See Table 3-7.

Table 3-7: Threatened and Priority Fauna Recorded in the Level 1 Field Survey

Scientific name	Common Name	Conservation Code		Number of records
		EPBC	WA	
Macroderma gigas	Ghost Bat	VU	VU	2*
Rhinonicteris aurantia	Orange Leaf-nosed Bat	-	P4	2*

*Echolocation audio recordings identified both these species across two nights

The Project occurs within the modelled distribution of the Northern Quoll. During the Level 1 Survey a reconnaissance survey was undertaken to assess the Matsu Project area for preferred habitat for Northern Quolls. Preferred habitat was located in the form of rocky outcrops. A targeted survey (using a trapping array for 467 trap nights) was conducted with no Northern Quolls recorded. No Northern Quolls have been recorded at the nearby RIOP Project or Argyle Diamond mine. Similarly, no records were returned from within 80 km of the Project area from the DBCA (2021) Threatened and Priority Fauna database search. This indicates the habitat is not critical to the survival of the Northern Quoll nor does it contain populations important for the long-term survival of the northern quoll. The Project is unlikely to have an impact upon the Northern Quoll.

Figure 3-26 shows the locations of Threatened and Priority fauna records and the Northern Quoll Targeted survey trapping array.

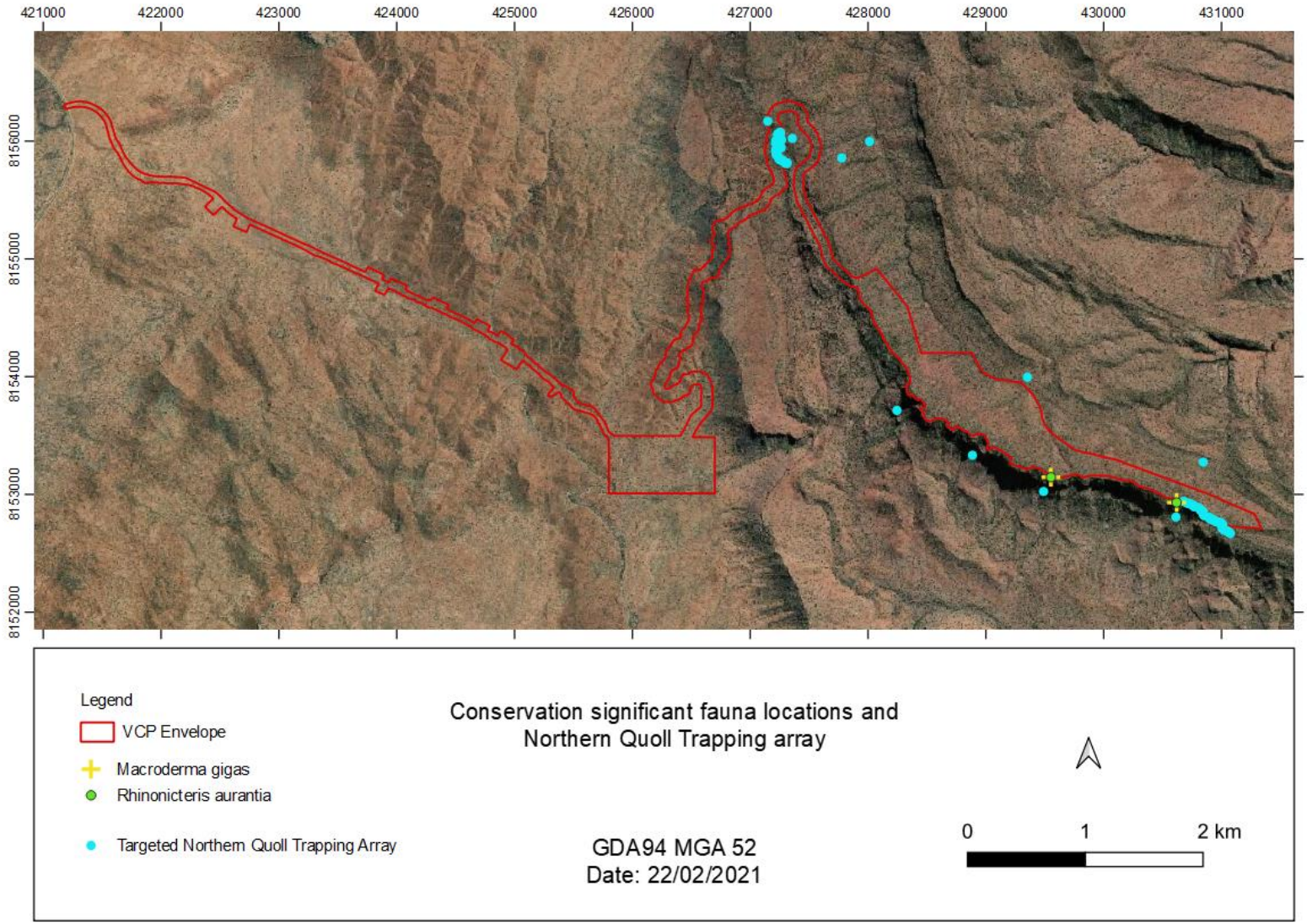

Figure 3-26: Conservation Significant Fauna Locations and Northern Quoll Trapping Array

A Desktop Study was performed in 2021 (Appendix 4) and database searches were conducted to identify new records of conservation significant fauna in the local and regional areas. Database searches returned no records of fauna species listed as Threatened under the EPBC Act or the BC Act within the Project area. Thirty-eight fauna species listed as Threatened or Migratory were returned from the database searches.

The closest records to the Project area are for the Gouldian Finch, Common Sandpiper and the Australian Little Bittern all approximately 3 km away. The majority of the database records were assessed as having a Low likelihood of occurring within the Project area due to a lack of suitable habitat.

Species that have been identified as having a High likelihood of occurrence in the Project area are presented Table 3-8.

Table 3-8: Likelihood of Occurrence of Conservation Significant Fauna in the Project Area

Species	Common name	Conservation code		Habitat	Likelihood of occurrence in the Project area
		EPBC Act	BC Act		
Apus pacificus	Fork-tailed Swift	MI	MI	This species flies over inland plains but also occasionally foothills or coastal areas, such as beaches and islands and well out to sea. They occur over dry or open habitats comprising of riparian woodland, low scrub, heathland or saltmarsh, also grasslands and sandplains with spinifex.	**Present.** Recorded 8 km away. This species is almost exclusively aerial. It occurs over cliffs, beaches, islands and settled areas (SEWPaC SPRAT 2013). This is a seasonal migrant and has been recorded in previous wet season surveys in the area.
Erythrura gouldiae	Gouldian Finch	EN	P4	These birds live in the tropical savannah, thickets, and woodlands with grassy plains usually near water.	**High**. Database records 3.4 km away. This species has been recorded nearby in previous surveys and a flock of 16 birds was also recorded at the RIOP camp during the 2012 survey. It is expected to occur in the Project area at various times of the year related to the seeding of food grass species.
Macroderma gigas	Ghost Bat	VU	VU	Inhabits arid spinifex hillsides, open savannah woodland, tall open forest etc. They roost in sandstone or limestone caves or under boulder piles and abandoned mines. They prefer to roost deep in the cave system and in a relatively open space in the cavity. This has to do with humidity and temperature in the microclimate that caves produce. Females roost with young preferentially in the large open cavity far from the cave entrance.	**Present**. Modelled to occur within 100 km. This species expands its foraging range in the wet season and contracts back to stable roost caves during the dry season. This species was recorded inside the Survey area in 2012 and in the RIOP Mine Site area.

Source: APM (2021)

3.7.8.2 Ghost Bat

Distribution

Fossil data show that the Ghost Bat was once distributed widely over much of Australia except Victoria and Tasmania, including the arid zone, but contracted northwards during the Holocene (Molnar *et al*. 1984; Churchill and Helman 1990). The present distribution of the Ghost Bat is widespread but intermittent throughout northern Australia (Figure 3-27). Availability of maternity roost sites is the limiting factor of the distribution of the Ghost Bat. Since European settlement its range has contracted, but the causal factors for the decline are still mostly unknown. Population sizes in Queensland in in the arid extents of distribution are at most risk of decline (Woniarski *et al.* 2014).

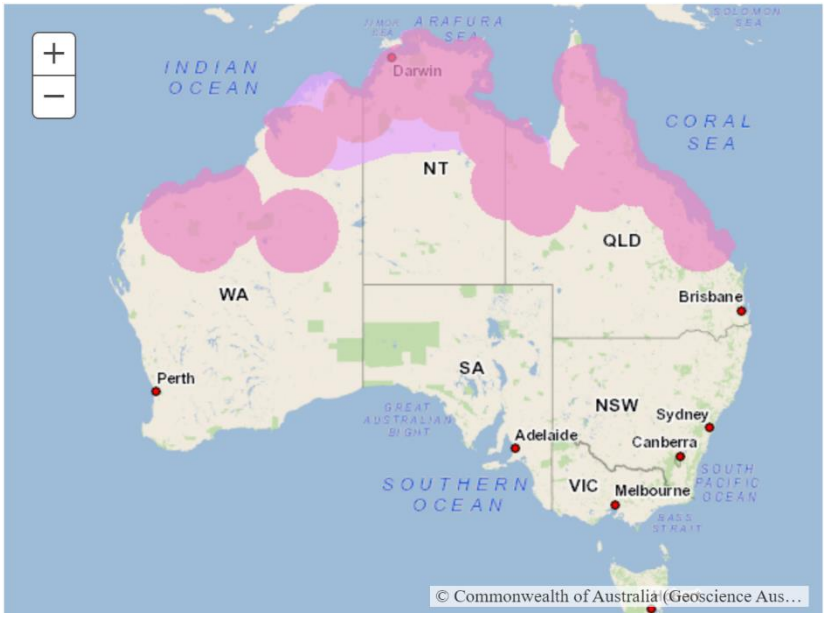

Figure 3-27: Distribution of *Macroderma gigas* in Australia. Source: DAWE (2020)

Habitat and Diet

The Ghost Bat occupies a diverse range of habitats from the arid Pilbara to lush northern rainforests. During the day, Ghost Bats generally roost in large, often complex cave systems with several entrances, deep rock fissures or mine adits. Individuals have been observed roosting in shallow rocky overhangs and sheds. The bats emerge from the roosts approximately one hour after sunset to forage (Douglas 1967).

This species is Australia's only truly predatory bat, feeding on frogs, reptiles, small birds and mammals, including other bats (Jolly and Hand 1995). Much of the prey is captured on the ground and usually within 2 km of their roost site (Tideman *et al.* 1985). The species flies smoothly and directly with the head held high. Prey is located visually, as well as by echo location, captured by being enveloped in the wings of the Ghost Bat, and killed with powerful bites. The prey is then taken to an established feeding site, such as a rock overhang or small cave, which often have an accumulation of discarded parts of prey. An individual's foraging area is around 61 ha and each bat will take up a vantage point and observe before venturing to capture prey (Tideman *et al.* 1985). This vantage point is changed every 15 minutes to another one roughly 300 meters away (Tideman *et al.* 1985).

Breeding

Ghost Bats mate during July and August. Gestation takes three months with a single young being born between September and November each year. Females form maternity colonies separate from males while the young are being weaned. Maternity colonies may contain numerous individuals (Thomson 1991). Juveniles hunt with their mothers until they become completely independent. Colony sizes range from a few individuals to greater than 100, although colonies of this size are rare. In the Pilbara colony sizes in natural roosts are generally much smaller, often consisting of just a few animals. Population genetic studies indicate a high degree of female philopatry (remaining in, or returning to, an individual's birthplace) at natal roosts (Woinarski *et al*. 2014).

Significance of the Matsu Population

It is possible that the Vertical Sandstone Surfaces community contain significant habitat for the Ghost Bat. The large cliff faces may contain caves that are general and maternity cave habitat.

The species was recorded from two locations in close proximity on two nights using an echolocation call recorded in 2012.

Threatening Processes

Woinarski *et al.* (2014), estimate the population size of the Ghost Bat to be <10,000, with an estimated continuing decline of > 10% in 24 years (three generations). It is declining in Queensland and is projected to be declining in the Pilbara due to the anticipated loss of maternal roost sites. In the Kimberley, a population of around 3,000 to 4,000 individuals have been inferred (McKenzie and Hall 2008).

The species is quite sensitive to disturbance (Richards and Hand 1995). Roost disturbance affects 13 out of the 36 threatened species of bats in Australia. Disturbance is usually where human activity comes into close proximity of roosting caves. This disturbance is even more disruptive to the bat if it occurs at a sensitive period, such as during the breeding season.

Due to the high degree of female philopatry at natal roosts it is expected that losses of maternity sites containing breeding females have the potential to reduce the area of occupancy significantly.

Expected Impact

No impact is expected to the Vertical Sandstone Surfaces community where the suitable habitat for the Ghost Bat occurs. The Project has been specifically allocated to avoid impacts to this habitat type. Disturbance will occur on the back slope and to a shallow depth.

3.7.8.3 Gouldian Finch

Distribution

The Gouldian Finch is patchily distributed in tropical northern sub-coastal areas from Derby, Western Australia, to the Gulf of Carpentaria and thinly to central Cape York Peninsula but is locally common in the north and north-western parts of its range. Figure 3-28 shows the distribution from records on the Atlas of Living Australia (ALA 2021).

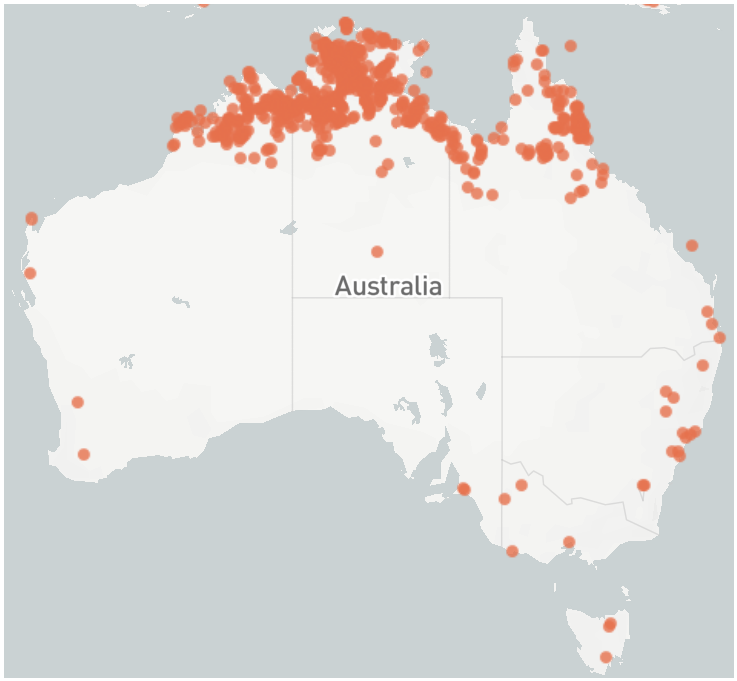

Figure 3-28: Distribution of Gouldian Finch (ALA 2021)

Habitat and Diet

Outside the breeding season the Gouldian Finch is partly migratory. Birds move in quite large flocks to more coastal areas and return back inland to breed when the rainy season arrives. In the breeding season they use hollows in *Eucalyptus brevifolia* trees near to suitable feeding grounds.

For most of the year Gouldian Finches feed mostly on ripe or half-ripe grass seeds. During the breeding season, however, the diet consists almost entirely of insects. Insects are rich in protein and help satisfy the demanding appetite of the young birds. Birds feed in small to large groups, and food may be taken on the ground or in flight (WAM 2021).

Perennial water sources are particularly valuable to Gouldian Finch. There are two perennial water sources located in the vicinity of the Project area that may be utilised by local Gouldian Finch populations. Neither of these water sources will be impacted by the Project as they are not located within the impact footprint and are located upstream of the VCP Envelope.

Breeding

The Gouldian Finch breeds in small social colonies. It is the only grassfinch that nests exclusively in tree hollows or holes in termite mounds. Several pairs may share a single hollow. (Rarely, birds will construct a dry grass nest in a bush or tree). Two or three broods may be reared in a season, with both parents sharing incubating and brooding duties.

- Breeding season: January to April.
- Clutch size: 4 to 8.
- Incubation: 13 days.
- Time in nest: 21 days.

Significance of the Matsu Population

No Gouldian Finch have been recorded within the Project area however they are considered likely to occur. The Project Area contains suitable breeding habitat however no breeding has been recorded as occurring. The

suitable breeding habitat may be Significant habitat and provision of artificial nest boxes has been proposed to mitigate the impact of habitat loss to the satisfaction of EPBC Referral Decision Notice 2014/7216 (DoE 2014).

Significant amounts of similar quality habitat occur in the area surrounding the project. In July 2014, two flocks of approximately 15, mostly juvenile, Gouldian Finches were observed near to the Project area by APM. Additionally, two individuals have been sighted by APM 11 km to the north-west of the Matsu Deposit in 2012 and 2014 and 16 km north north-west by Ecologia (2005). During the May 2014 annual monitoring program of artificial nest boxes at the RIOP, nine Gouldian Finch chicks were recorded. Additionally, 16 records of Gouldian Finches were made by APM during a 2010 survey at the Speewah Vanadium Project which is located approximately 50 km north-west of the Project. Populations of Gouldian Finch were regularly sighted at Argyle Diamond Mine by Frank O'Connor, though the exact numbers, location and timing of these observations are not available (O'Connor 2005 unpublished).

Threatening Processes

Key threats are detailed in the *National Recovery Plan for Gouldian Finch* (O'Malley 2006) and are summarised below.

The restricted diet of Gouldian Finches, combined with their essential annual lifecycle, makes them particularly vulnerable to the seed shortages that can occur at the onset of the wet season (November to January).

Vegetation change through inappropriate fire regimes and grazing impacts of stock and feral herbivores is the factor most likely to be contributing to ongoing declines, or absence of recovery, in Gouldian Finch populations.

Expected Impact

Suitable Gouldian Finch breeding habitat will be cleared in the access track. The Matsu Gouldian Finch Nest Hollow Assessment recommended nest boxes to be installed to mitigate the impact of habitat loss due to clearing for the Project. EPBC Referral Decision Notice 2014/7216 (DoE 2014) limits the clearing in potential Gouldian Finch Breeding Habitat to 45.6 ha and requires the installation of 86 nest boxes using the methods described in the Gouldian Finch Restoration and Management Plan, which must occur prior to the Gouldian Finch breeding season (1 February to 31 July) that immediately proceeds clearing of the access track.

Residual loss of habitat is unlikely to have a significant impact on the local or regional sustainability of the population.

3.7.8.4 Orange Leaf-nosed Bat

Distribution

The Orange Leaf-nosed Bat is found from the Pilbara region of WA, through the Kimberley and across northern Australia into north-western Queensland and is endemic to Australia (Churchill 1998) (Figure 3-29). Hall *et al.* (1997) concludes that their fragility in temperature regulation is the limiting factor in their range.

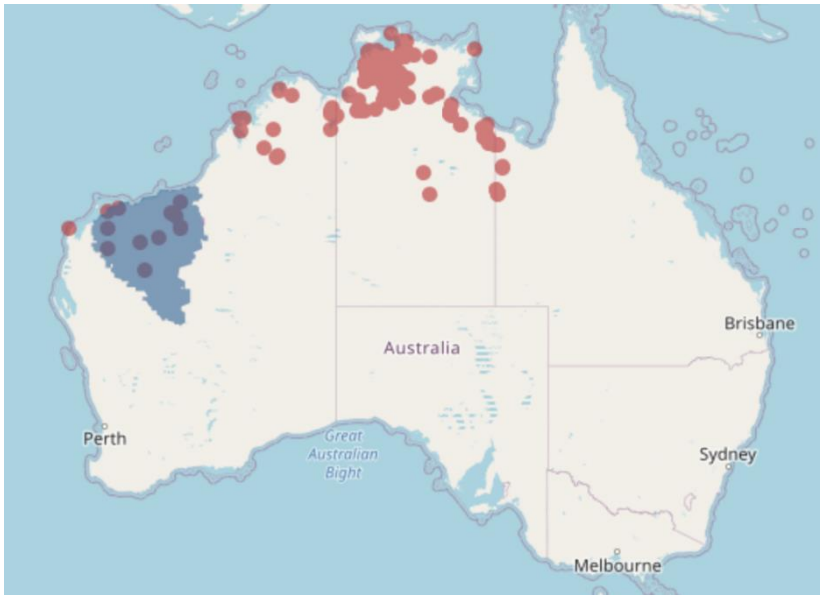

Figure 3-29: Distribution of *Rhinonicteris aurantia* in Australia. Blue shading is the Pilbara Population (Source: ALA 2020)

Habitat and Diet

The species uses a number of roosts; nocturnal and diurnal roosts that change with the seasonal conditions and maternity roosts (Churchill 1991; TSSC 2015). Maternity roosts and dry season diurnal roosts are restricted to deep, humid caves highly likely to be critical habitat (Armstrong 2001; Churchill 1991). High temperature and humidity caves are essential as this species is unable to maintain its body temperature when resting. Caves of this type are not abundant across the species range (Armstrong 2000; Jolly 1988; Churchill 1998). Orange Leaf-nosed Bats do not cluster for warmth, with individuals hanging from the roof with a separation distance of approximately 12 cm (Jolly and Hand 1995).

During the wet season when ambient temperature and humidity is suitable, bats become forest dwellers and may utilise hollow timber, rock overhangs, smaller, less complex caves and mines as roosts (Churchill 1998; Duncan *et al.* 1999). These wet season diurnal roosts are readily available.

At dusk, the Orange Leaf-nosed Bat emerges from its roosting site to feed (Hall 1989; Jolly and Hand 1995). It is an opportunistic, aerial insectivore, with no records of these bats landing on the ground or gleaning insects. Prey is typically captured in the tail membrane and passed to the mouth (Hall 1989). The diet of Orange Leaf-nosed Bats comprises of approximately 70% moths, 17% beetles and 8% termites (Churchill 1998). They are often seen flying along roads at night and their bright fur is very distinctive in the car headlights (Churchill 1998).

Breeding

The Orange Leaf-nosed Bat mates in July and the females give birth to a single young in late December or early January after a five month gestation. The young grow quickly and are almost indistinguishable from the adults when they are weaned in late February (Churchill 1998). The females are reproductively mature at seven months, but males do not mature until their second year at 18 months.

Significance of the Matsu Population

It is possible that the Vertical Sandstone Surfaces contain significant habitat for the Orange Leaf-nosed Bat. The large cliff faces may contain caves that are general and maternity cave habitat.

The species was recorded from two locations in close proximity on two nights using an echolocation call recorded in 2012.

Threatening Processes

Roost disturbance affects 13 out of the 36 threatened species of bats in Australia. This species is particularly sensitive to human interference and quickly takes to the wing at the slightest disturbance (Jolly and Hand 1995). Disturbance is usually where human activity comes into close proximity of roosting caves. This disturbance is even more disruptive to the bat if it occurs at a sensitive period, such as during the breeding season.

Vehicles can strike low flying, foraging individuals and this species, in particular, is often seen flying along roads at night (Churchill 1998).

Expected Impact

No impact is expected to the Vertical Sandstone Surfaces community where the suitable habitat for the Orange Leaf-nosed Bat occurs. The Project has been specifically allocated to avoid impacts to this habitat type. Disturbance will occur on the back slope and to a shallow depth.

3.7.9 INTRODUCED FAUNA

The introduced Cane Toad (*Rhinella marina*) was recorded in the Project area. A creek at the bottom of the slope in the mining area. contained high numbers of Cane Toads at various stages of development. The Cane Toad is an invasive poisonous species that has caused the population decline of many native predators and is listed as a Declared Pest on the Western Australian Organism List (DPIRD 2021).

4 IMPACTS

4.1 CONSERVATION SIGNIFICANT FLORA

Six Priority listed flora species (listed under the BC Act) are known to occur within the VCP Envelope. Most species are known from elsewhere in the region and locally are not restricted to the VCP Envelope. All suitable habitats are well distributed in the local and regional area.

Kunzea sp. Keep River is synonymous with the recently described *Kunzea petrophila* in the NT. While the species has not yet been formally accepted into WA, it is likely to qualify as a Threatened species under the BC Act. The species inhabits areas that are highly inaccessible, the Matsu population represents the only known population to be near any form of threat from disturbance and populations have been recorded within the reserve system. The Matsu Project is not expected to impact the microhabitats of the species on the Vertical Sandstone Surfaces community, as mining is proposed to occur on the backslope, leaving the cliffs intact (APM 2021).

Although the proposed clearing is not expected to have a detrimental impact on conservation significant flora, the management measures listed in Section 5 will be implemented.

4.2 SIGNIFICANT VEGETATION AND ECOLOGICAL SYSTEMS

No TECs occur within or near the Project. The Priority 1 PEC 'Plant Assemblages on Vertical Sandstone Surfaces' occurs outside of the Matsu deposit to the south west.

4.3 INTRODUCED FLORA

The vegetation in the vicinity of the Matsu Project is in pristine to excellent condition. Generally, the weed presence is of low abundance and in few locations. The species currently present are not considered likely to have a significant impact on rehabilitation efforts with the exception of *Calotropis procera*, a declared weed. There are two known locations that are outside of but very close to the boundary of the VCP Envelope. The locations (in GDA 1994 MGA Zone 52) are:

- E: 429547, N: 8153153 (APM 2010); and
- E: 429005, N: 8153467 (APM 2014a).

Where declared pests are found to be present, the landowner/occupiers are to adhere to requirements under the *Biosecurity and Agriculture Management Act 2007* and its subsidiary legislation (exempt). These requirements include reporting the presence of this pest, implementing control measures to destroy, prevent or eradicate it and ensure any person conducting an activity on the land is aware that measures are required to be taken to control the declared pest.

An infested area must be managed in such a way that alleviates the impact, reduces the number or distribution or prevents or contains the spread of the declared pest in the area (DPIRD 2020). Recommended control measures for *Calotropis procera* require the application of appropriate herbicides either as a foliar spray, or cut stump or basal bark on larger trees (DPIRD 2016). However, given the location on top of the ridge, access for treatment is limited. Therefore, whilst the recorded locations are outside of the disturbance envelope, care should be taken while performing ground disturbance in this area so that weed seed is not transported to other areas or the weed species allowed to proliferate in the nearby disturbed land.

New weeds can be introduced to site via machinery and equipment that has come from weed infested areas without being cleaned.

To minimise the potential for the introduction and spread of new weed species to the site, Habrok will implement the management strategies outlined in Section 5.

4.4 CONSERVATION SIGNIFICANT FAUNA

The construction and operations of the Matsu Project is unlikely to interfere with the Ghost Bat and Orange Leaf-nosed Bat habitats as mining will occur on the back slope of the ridge, not in the Vertical Sandstone Surfaces. The shallow nature of the mining and the allocation of the disturbance away from the edge of the cliff reduces the likelihood of impacts through noise and vibration.

The Gouldian Finch is distributed throughout the Kimberley and is generally classed as moderately common in the North, Central and East Kimberley and the lower Ord drainage area, while uncommon or scarce in most of the South Kimberley (Johnstone and Storr 2004). Two flocks of Gouldian Finch were observed in the vicinity of the Project area in July 2014.

A key threatening process for the Gouldian Finch is the destruction of potential nest sites. The species is an obligate cavity-nesting species and utilises smooth barked *Eucalyptus* and *Corymbia* species. The potential for impact on trees that bear hollows that may now, or in the future, provide nesting habitat for the Gouldian Finch is fully detailed in the Gouldian Finch Nest Hollow Assessment report (APM 2014c; Appendix 7).

The loss of hollow-bearing trees that may be used by Gouldian Finches for nesting at Matsu will be mitigated by the provision of artificial nest hollows, the success of which has been reported in Brazill-Boast *et al*. (2013). This has also been demonstrated at the RIOP with Gouldian Finches observed using at least two nest boxes for breeding (APM 2021). At least 86 nest boxes (DoE 2014) will be installed to mitigate the potential loss of breeding habitat as a result of the Matsu Project. Nest boxes will be monitored annually. The DAWE supports this approach to Gouldian Finch management (DAWE 2021).

The two perennial water sources located in the vicinity of the Project area may be utilised by local Gouldian Finch populations. Neither of these water sources will be impacted by the Project as they are not located within the impact footprint and are located upstream of the areas designated for clearing and construction.

There is no habitat critical to the survival of the Northern Quoll in the VCP Envelope nor does it contain populations important for the long-term survival of the Northern Quoll. The Project is unlikely to have an impact upon the Northern Quoll.

Although the proposed clearing is not expected to have a detrimental impact on fauna and fauna habitats, the management measures listed in Section 5 will be implemented.

4.5 INTRODUCED FAUNA

An animal sighting register will be implemented, and site personnel encouraged to report sightings of feral fauna (cats, dogs, cane toads). Feral fauna eradication programs will be undertaken using licensed service providers. Other management measures listed in Section 5 will be implemented.

4.6 LAND DEGRADATION

The physical and chemical properties of the surface soils and waste materials were studied at the RIOP by Soil Water Consultants (2010; Appendix 1). The conditions at the Matsu Project are expected to be the same as at the RIOP.

No appreciable land degradation is anticipated in response to clearing for the proposed activities due to the physical and chemical properties of the surface soils and waste materials.

Chemically, the surface soils are deficient in all nutrients, have low-moderate levels of organics, low base exchangeable cations and are non-saline and slightly to strongly acidic. These chemical properties reflect the extensive leaching that these soils have undergone (i.e., since the Cretaceous Period), the dominant iron oxide mineralogy and formation from the Hensman Sandstone. Therefore, none of the soils present in the escarpment

have properties that will limit their disturbance, handling, utilisation and/or storage and none, by themselves, have the potential to cause environmental harm if they are disturbed.

Waste material at the RIOP mine and the Matsu deposit is relatively homogeneous and, due to having the same geological characteristics, waste characterisation undertaken at the RIOP is reflective of the waste material associated with the Matsu deposit.

The characterisation shows that the waste materials are largely non-dispersive and non-erosive. Furthermore, the waste rock at the Matsu deposit does not contain potentially acid forming materials. Land degradation resulting from the handling and storage of waste materials is therefore not anticipated. However, the management actions listed in Section 5 will be implemented.

4.7 SURFACE WATER

Drainage systems in the Project area are ephemeral. The proposed mining area is situated on a localised high within the upper reaches of systems that drain away from the ridge, the access track and processing infrastructure are located on the plains. The Project area is subject to highly variable rainfall during the wet season resulting from monsoonal depressions and tropical cyclones. Potential surface water impacts that could result from the Project include localised modification of flow paths, ponding of water upstream of infrastructure, increased erosion and sedimentation or contamination.

Creeks and drainage lines will be avoided during the development of site infrastructure and the mining area where possible. Adequate culverts will be installed to avoid impeding natural drainage lines. Appropriate drainage and containment infrastructure will be constructed to control runoff from hardstand areas, roads and other cleared surfaces.

Surface water quality will be maintained through the careful management of hydrocarbons and hazardous materials, and through the management strategies described in Section 5.

4.8 GROUNDWATER

The proposed mining operations will not intercept the groundwater table and water requirements will be small. A 5C application for a licence to extract water will be submitted for an annual water entitlement of up to 1 ML per day, for the purposes of dust suppression, mineral ore processing and other mining requirements. No impacts on groundwater resources are expected as a result of the Project.

Although the proposed clearing is not expected to have a detrimental hydrological impact, the management measures outlined in Section 5 will be implemented.

5 ENVIRONMENTAL MANAGEMENT MEASURES

The environmental implications of the proposal have been considered throughout the various stages of Project development. Management measures have been developed for the Project and will be implemented throughout the life of the mine and until final closure and decommissioning is completed. Management strategies relevant to the current proposal are summarised in Table 5-1.

Table 5-1: Environmental Management Actions

Aspect	Management Actions
Clearing of native vegetation	• Clearing of vegetation will be undertaken progressively and only when required. • All required approvals and licences must be in place before clearing can commence. • Prior to clearing being conducted an internal ground disturbance permit will be completed. • Land clearing and handling of topsoil in windy conditions will be avoided as far as practical. • Areas to be cleared will be clearly delineated on maps and by using survey pegs and coloured flagging tape in the field. • Survey pegs/tape will remain in place once clearing has occurred so the recording ('pick up') of cleared areas on completion can occur and over clearing can be identified. • Clearing within the pit area will be restricted to the back slopes and at least 10 m from the escarpment to minimise disturbance to the cliff face and reduce the likelihood of overburden spilling over the edge. • Clearing will be conducted in a manner that facilitates the re-use of growth media (topsoil, subsoil and vegetation debris) for rehabilitation activities. • Vegetation shall be removed, transported, and stockpiled in a way that does not damage vegetation or disturb soil outside of the clearing limits. • Mature trees shall be avoided where practicable. • Burning of vegetation is prohibited. • Cleared areas and stockpiles will be surveyed, documented, and reported in the Annual Environmental Report. • Where practicable, topsoil will not be stripped when wet as this can lead to compaction and loss of soil structure when stockpiling. • Clearing beyond approved clearing boundary and/or limits shall be reported using an incident report form. Over-clearing shall be reported to DMIRS where the area has exceeded approved limits. • Cleared areas no longer required will be rehabilitated as soon as practicable. Bare, compacted soils and previously disturbed areas that are not required shall be ripped and re-contoured in order to promote seed germination. • Dust suppression techniques will be implemented to reduce erosion impacts from wind.
Storage and stockpiling	• Sites for stockpiling are to be clearly defined prior to clearing and will be located to avoid impeding on surface drainage lines. • Topsoil stockpiles will be no higher than 1.5 m in height and not compacted. • Stockpiles will be adequately signposted, and an inventory of stockpile volumes undertaken. • Where practicable, topsoil will be directly placed on rehabilitation areas. Where this is not possible, storage time will be minimised to prevent decline in soil structure as well as seed and nutrient viability. • Topsoil stockpiles will be monitored for weed germination and weed control undertaken as necessary. • Topsoil stockpiles will be monitored for erosion and mitigation measures such as stabilisation will be implemented where required. • Run-off from stockpiles will be contained or directed to appropriately constructed sediment traps prior to entering natural drainage lines.

Aspect	Management Actions
Introduced flora	• Machinery and equipment will be thoroughly cleaned prior to being mobilised to site. • Contractors will provide a weed hygiene certificate for each item of machinery brought to site. • Machinery and equipment that arrives on site will be inspected. Machinery that does not meet the hygiene requirements will require removal and additional cleaning in an appropriate location. • Regular monitoring of disturbed areas and road verges will be conducted to identify weeds. • Weed control programs will be implemented when necessary. • Stock will be prevented from accessing rehabilitated areas.
Fauna and fauna habitat	• Clearing of vegetation will be undertaken progressively and kept to the minimum required for the Project. • Feeding of animals (both native and introduced) will be prohibited. • Native fauna will not be captured or intentionally handled except by personnel or consultants qualified and required to do so. • Employees and contractors who are nominated to handle fauna, for example, the removal of snakes from work areas, will require suitable training and permits. • Firearms and pets will be prohibited on site. • Road mortality (kills) will be removed from the road to a minimum of 10 m into the vegetation to avoid further impacts on fauna feeding on carcasses and will be reported using an Incident Report Form. • Trenching operations will be undertaken over the shortest period possible to limit the entrapment of native fauna. Twice-daily inspections of open trenches will be undertaken. • Fauna egress ramps will be installed on all excavations i.e. sumps, turkey's nests, ponds and trenches etc. • Drill holes no longer required for immediate use will be capped once drilling has ceased to avoid trapping of native fauna.
Introduction of feral fauna	• Feeding of native or feral animals will be prohibited. • Domestic waste will be stored and disposed of appropriately. • An animal sighting register will be implemented, and site personnel encouraged to report sightings of feral fauna (cats, dogs, cane toads). • Feral fauna eradication programs will be undertaken as required using licensed service providers. • Rehabilitated areas will be monitored as per the monitoring program in the MCP.
Surface water	• Ensure placement of key mining activity (pit, waste dump, ROM) and other infrastructure does not result in significant impact to catchment areas or surface drainage lines. • Appropriate drainage and containment infrastructure to control runoff from hardstand areas, roads and other cleared surfaces will be constructed. • Adequately sized culverts will be installed where necessary, to avoid interruption of waterways. Culverts will be inspected at regular intervals during the wet season to ensure continuity of access and clear water passage.
Groundwater	• Appropriate licences will be obtained for water abstraction and extraction will not exceed the DWER approved allocation. • Groundwater monitoring, data and reporting will occur in accordance with Licence conditions. • Flow metres will be fitted to all production bores. • Water cart operators will be present and supervise refilling to prevent spillage due to overfilling.

Aspect	Management Actions
Erosion and Sedimentation	• WRLs will be progressively rehabilitated (where possible) to minimise the area of disturbed land that has the potential to alter surface water flows. • Bunding and drainage will be installed around hardstand areas to catch surface water runoff. • Water containment/management structures (contour ripping, back-sloped berms, perimeter bunding) will be installed on constructed landforms to prevent surface water runoff and subsequent transportation of sediment. • Surface water runoff will be directed to appropriately designed and located sedimentation ponds. • Appropriately designed sediment traps will be installed and monitored for siltation. • Visual inspections of the Project area will be carried out after rainfall events to identify erosion and sedimentation locations that have potential to become erosion and sediment control issues, and determine if remedial action is required. • Bare, compacted soils and previously disturbed areas that are not required shall be progressively ripped and re-contoured to promote seed germination.
Hydrocarbons and other chemicals	• All chemicals stored and transported in the mining area will be in accordance with Dangerous Goods Regulations. • Bunding, drainage and containment will be constructed to ensure potentially contaminated surface water does not reach the surrounding environment. • Waste oil and hydrocarbon contaminated wastes (filters, rags, hydrocarbon absorbent materials) will be stored in appropriate containers and removed from site by a licenced service provider for reprocessing or disposal at an appropriate facility. • Washdown from hardstand areas (e.g., workshop area floors and vehicle washdown pads) will be directed to an oil water separator for treatment. Sludge from the washdown pad will be removed from the settling sump for treatment in the bioremediation area. • Appropriate spill response kits and training for site personnel will be provided. • Spills will be immediately cleaned up and the material will be disposed of appropriately. Hydrocarbon contaminated soils will be excavated and transported to the bioremediation pad for treatment. • A register of stored substances and storage locations will be maintained.
Staff Training/Awareness	• All employees and contractors will be required to complete a site induction which will provide an awareness of environmental management and their responsibilities. • All personnel must drive to conditions and adhere to the speed restrictions applied to mine roads and tracks. • All vehicles, plant and equipment are restricted to within clearing limits.

6 ASSESSMENT AGAINST THE 10 CLEARING PRINCIPLES

Clearing Principle 1: Native vegetation should not be cleared if it comprises a high level of biological diversity.

The field survey in 2014 (APM 2014a), recorded 353 vascular plant taxa, from 65 families and 173 genera. 26 vegetation communities were identified. The biological diversity is similar to that expected in the region.

The P1 PECs 'Plant Assemblages on Vertical Sandstone Surfaces' occurs outside the VCP Envelope.

Clearing of native vegetation within the VCP Envelope is not considered to be at variance to this principle.

Clearing Principle 2: Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.

Although several species of conservation-significant fauna have been recorded within the Project area, and some may potentially utilise the area as part of a broader foraging habitat, the area is not considered to provide habitat necessary for the survival of these species. The fauna habitat to be impacted by the Project is well represented in the surrounding area and accounts for a very small proportion of available habitat.

Threatened and Priority fauna species that have been recorded in or near the Project area from previous surveys are the Ghost Bat, Orange Leaf-nosed Bat and the Gouldian Finch. The construction and operations of the Matsu Project should not interfere with the Ghost Bat and Orange Leaf-nosed Bat habitats as mining will occur on the back slope, leaving the potentially suitable habitat in the Vertical Sandstone Surfaces untouched. Due to the shallow mining on the back slope bats are unlikely to be impacts by noise and vibration.

Clearing of potential nesting sites for the Gouldian Finch will be offset by a Gouldian Finch Nest Box installation program. Artificial nest boxes are known to increase natural breeding densities and fledging success (Brazill-Boast *et al*. 2013). Therefore, the local population of Gouldian Finch is not expected to be negatively impacted as the artificial nest boxes offset the loss of natural hollows and potentially increases fecundity. There is not expected to be a significant residual impact.

The VCP Envelope does not contain habitat significant for the Northern Quoll.

Clearing of native vegetation within the area is not considered to be at variance to this principle.

Clearing Principle 3: Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.

The area does not coincide with any previously recorded Rare flora taxa, and no Rare flora species are known to occur within 80 km. Accordingly, the area is not considered necessary for the continued existence of Rare flora.

Priority flora that may be impacted are present in the surrounding locality and region.

Clearing of native vegetation within the area is not considered to be at variance to this principle.

Clearing Principle 4: Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.

The Project area does not contain any TECs listed under the EPBC Act or BC Act. No TECs are known to occur within 80 km of the Matsu Project. Accordingly, the area is not considered necessary for the maintenance of a TEC.

Clearing of native vegetation within the area is not considered to be at variance to this principle.

Clearing Principle 5: Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

The Project area does not comprise an isolated remnant of intact vegetation.

Clearing of native vegetation within the area is not considered to be at variance to this principle.

Clearing Principle 6: Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

The Project area does not contain native vegetation that is within or associated with any significant watercourse or wetland.

Several minor ephemeral drainage lines pass through the area. The Project has been designed to avoid these in the majority.

Drainage lines occur downstream of the Matsu Project. To ensure secondary impacts are minimised, management strategies will be implemented, including the construction of sediment trapping devices.

Clearing of native vegetation within the area is not considered to be at variance to this principle.

Clearing Principle 7: Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

None of the vegetation in the area is associated with land that is recognised as being particularly susceptible to land degradation. Appropriate surface water drainage and containment around cleared areas will minimise the potential for surface water erosion. Land degradation resulting from clearing of vegetation is considered unlikely.

Soil and rock types that will be exposed during clearing are not considered likely to cause land degradation.

Clearing of native vegetation within the area is not considered to be at variance to this principle.

Clearing Principle 8: 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 Project area is not located within or adjacent to any conservation reserves.

Clearing of native vegetation within the area is not considered to be at variance to this principle.

Clearing Principle 9: Native vegetation should not be cleared if the clearing of native vegetation is likely to cause deterioration in the quality of surface or underground water.

Clearing of vegetation is not anticipated to have any impact on the groundwater system. Drainage and containment structures incorporated into the development areas will ensure surface water runoff is controlled and minimise the potential for contaminants and sediment to enter the surface water system.

Upon cessation of mining the pit will be partially backfilled. The rehabilitated backfilled mine surface and post-mine landforms will be designed such that they do not impede or impact on surface water hydrology along the escarpment, and thus no impacts to surface water flows are expected to occur.

Mining will occur above the groundwater table, so dewatering will not be necessary. Additionally, the water requirements for the Project are expected to be relatively small.

Clearing of native vegetation within the area is not considered to be at variance to this principle.

Clearing Principle 10: Native vegetation should not be cleared if the clearing of native vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.

Land clearing is not expected to increase the incidence or intensity of flooding as the properties of the surface soils (i.e. high infiltration rates and gravelly and rocky surface cover materials) will promote vertical infiltration of rainfall and deep recharge of the soil profile. It is therefore not expected that land clearing will significantly increase surface water runoff and subsequent flooding of low-lying areas.

In addition, groundwater generally occurs at considerable depths below the surface and any increase in recharge in response to land clearing is not expected to cause an appreciable rise in groundwater levels.

Clearing of native vegetation within the area is not considered to be at variance to this principle.

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8 APPENDICES

Appendix 1: Ridges Iron Ore Deposit Soil Survey and Waste Characterisation (SWC 2010)

Appendix 2: Matsu Project Surface Water Risk Assessment (Golder 2014a)

Appendix 3: Matsu Project Hydrogeology Desktop Study (Golder 2014b)

Appendix 4: Matsu Desktop Biological Study (APM 2021)

Appendix 5: Level 2 Floristic Survey and Vegetation Mapping (APM 2014a)

Appendix 6: Matsu Access Track and Processing Development Envelope Fauna Desktop Assessment (APM 2015)

Appendix 7: Matsu Project Gouldian Finch Nest Hollow Assessment (APM 2014c)

Appendix 8: Matsu Level 1 Biological Survey (APM 2014b)