

# Clearing Permit Pilgangoora Mine Camp

Supporting Information for Native Vegetation Clearing  
(Purpose) Permit Application

18 July 2024

Native Vegetation Clearing Permit Application – Pilgangoora Lithium-Tantalum Project

Miscellaneous licence L45/760 - Shire of East Pilbara

## VERSION CONTROL

0	Submission to Regulator	TS	EA	IZ	22/7/2024
A	Prepared for Review	TS	MH	EA	4/7/2024
Rev	Description	Prepared	Checked	Authorised	Date

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ACRONYM	MEANING
AHD	Australian Height Datum
AER	Annual Environmental Report
BoM	Bureau of Meteorology
DMIRS	Department of Mines, Industry Regulation and Safety
EP Act	Environmental Protection Act 1986
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ESA	Environmentally Sensitive Area
GDE	Groundwater-Dependent Ecosystem
GDV	Groundwater Dependent Vegetation
ha	Hectare
IBRA	Interim Biogeographic Regionalisation for Australia
km	Kilometres
LoM	Life of Mine
m	Metres
mm	Millimetres
Mt	Million tonnes
Mtpa	Million tonnes per annum
PEC	Priority Ecological Community
P	Priority flora
PLS	Pilbara Minerals Ltd
POPL	Pilgangoora Operations Proprietary Limited
PMST	Protected Matters Search Tool
t	Tonnes
TEC	Threatened Ecological Community
TSF	Tailings Storage Facility

## 1 PERMIT APPLICATION DETAILS

### 1.1 BACKGROUND

Pilgangoora Operations Pty Ltd (POPL), is a 100% owned subsidiary of Pilbara Minerals Limited (PLS), that owns and operates the Pilgangoora Lithium-Tantalum Project (the Project). The Project is located approximately 80 km south-southeast of the town of Port Hedland and 30 km north-east of the Wodgina mine, in the Shire of East Pilbara (Figure 1-1).

The Project is located within Wallareenya Station pastoral lease, an active cattle grazing property, through which unsealed roads provide access from the Great Northern Highway.



**Figure 1-1: Regional location of the Pilgangoora Lithium-Tantalum Project**

## 1.2 PROPOSAL DETAILS AND OWNERSHIP

POPL proposed to develop mine camp infrastructure to support the mining operation situated approximately 7 kilometres to the east of the miscellaneous licence L45/760.

The proposed mine camp is under assessment in Mining Proposal Reg ID 126586, submitted in July 2024. Proposed activities include installation of accommodation and associated facilities to develop a 1,400-person village. A fly camp may be established to house construction workers while they build the permanent village.

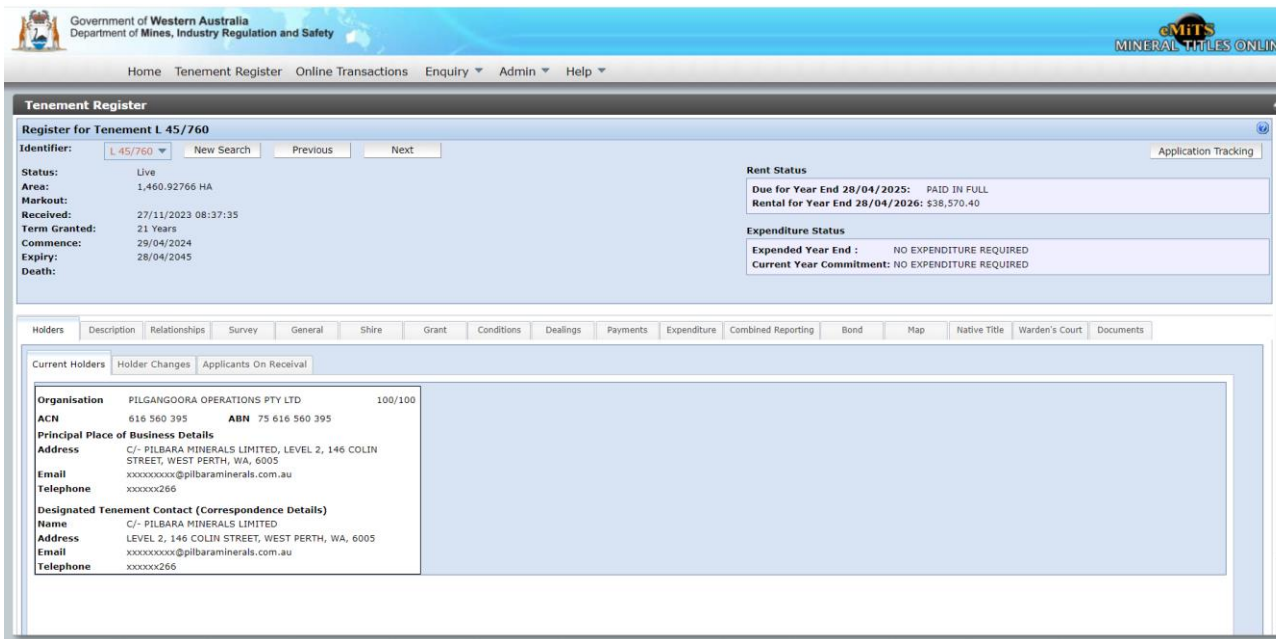
The accommodation village will comprise of the below:

- standard air-conditioned ensuite rooms;
- laundries;
- dry mess;, wet mess with outdoor garden;
- multi-sport courts, landscaping;
- Indoor gym;
- Gate house, Admin / Reception area, Paramedic facilities;
- Locker rooms;
- Bulk Linen and Chemical stores, Waste Handling and recycling;
- LV and Bus Parking including Bus shelter;
- Wastewater Treatment Plant and spray field;
- Potable water treatment plant, fire water pumps and tanks;
- Power Generation compound; and
- Communications tower and room.

The camp area will likely be fenced with buildings connected via concrete pathways, there will be swale drains to divert water as required. An adequately sized laydown will house modules as required prior to installation and areas of borrow may be sourced within the tenement for use on the tenement. Bores may be established on the tenement to provide a source of water to be treated at the camp location.

This Native Vegetation Clearing Permit (NVCP) (purpose permit) application is being made for clearing to support these activities.

Ownership details of L45/760 that underlies the proposed clearing permit area has been extracted from Government of Western Australia DEMIRS Mineral Titles Online and are presented below in Figure 1-2.



The screenshot shows the 'Tenement Register' interface for licence L45/760. The page includes a navigation menu at the top with options like 'Home', 'Tenement Register', 'Online Transactions', 'Enquiry', 'Admin', and 'Help'. The main content area is titled 'Register for Tenement L 45/760' and features a search bar with 'L 45/760' entered. Below the search bar, there are several sections: 'Status' (Live), 'Area' (1,460.92766 HA), 'Markout' (1,460.92766 HA), 'Received' (27/11/2023 08:37:35), 'Term Granted' (21 Years), 'Commence' (29/04/2024), 'Expiry' (28/04/2045), and 'Death'. To the right, there are sections for 'Rent Status' (Due for Year End 28/04/2025: PAID IN FULL, Rental for Year End 28/04/2026: \$38,570.40) and 'Expenditure Status' (Expended Year End: NO EXPENDITURE REQUIRED, Current Year Commitment: NO EXPENDITURE REQUIRED). Below these sections is a horizontal menu with various tabs like 'Holders', 'Description', 'Relationships', 'Survey', 'General', 'Shire', 'Grant', 'Conditions', 'Dealing', 'Payments', 'Expenditure', 'Combined Reporting', 'Bond', 'Map', 'Native Title', 'Warden's Court', and 'Documents'. The 'Current Holders' tab is selected, showing a table with one entry for 'PILGANGOORA OPERATIONS PTY LTD' with a 100/100 interest. A detailed information box for this holder is expanded, showing 'ACN 616 560 395', 'ABN 75 616 560 395', and contact details for 'PILBARA MINERALS LIMITED' at 'LEVEL 2, 146 COLIN STREET, WEST PERTH, WA, 6005'.

Figure 1-2: Ownership details of miscellaneous licence L45/760

### 1.3 PROPOSED CLEARING EXTENT

The application area for the purpose permit measures ~484 hectares. Within the application area, up to 140 hectares of vegetation is proposed for clearing.

The location of the permit application area appears as Figure 1-3.



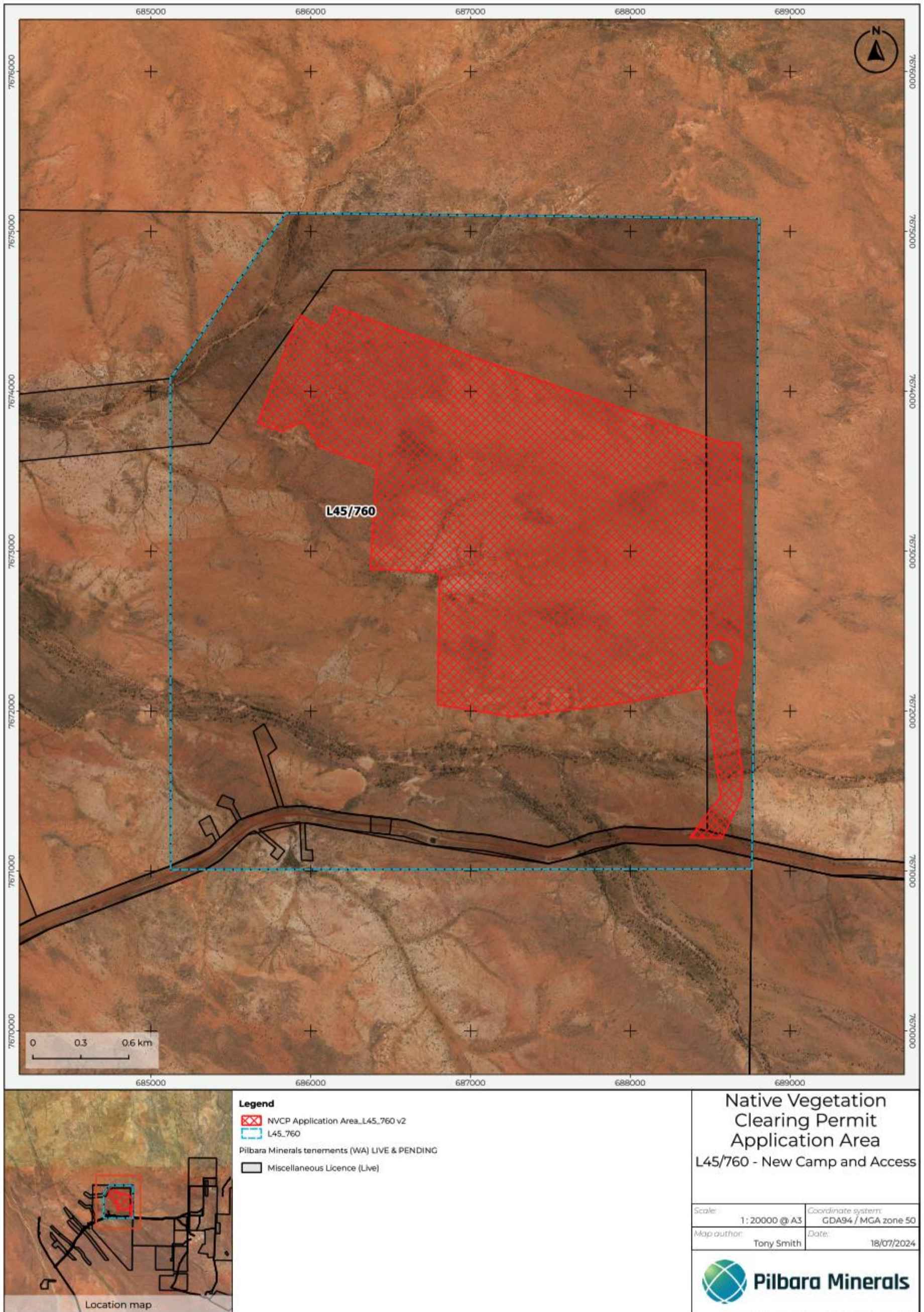


Figure 1-3: Clearing (Purpose) Permit Application Area



## 1.4 ALTERNATIVES CONSIDERED/ ACTIONS TO MINIMISE CLEARING AND IMPACTS

### 1.4.1 ALTERNATIVES

A range of alternative options were investigated to understand the environmental sensitivities of the project application area, whilst supporting mining infrastructure. The alternatives considered are outlined below:

- Investigation of alternative locations for key mine infrastructure.
  - Several options were assessed for location of a permanent Camp. The permit application area was further removed from conservation significant fauna habitat and records than other prospective sites closer to the existing mine.
  - Iterations of the permit application area were developed to exclude flora of conservation significance.
- Tenement conditions and constraints
  - The tenure was specifically sought to enable hosting of a Mine Camp at the selected location. This was to ensure that tenement conditions and purposes were suitable for hosting the Camp.
- The option of not applying for a Native Vegetation Clearing permit
  - It was identified as a risk to business continuity and ability to support operations if a new native vegetation clearing permit was not applied for. As future supporting infrastructure, the Mine Camp is vital for the future operation of the Project, as existing Camp areas are proposed to be subsumed by waste rock landforms in the future.

### 1.4.2 ACTIONS TO MINIMISE CLEARING

A thorough environmental assessment has been completed over the permit application area. The application area has been designed to avoid areas identified as critical habitat for conservation significant fauna for the northern quoll, and limit impacts on surrounding habitats and vegetation.

Actions to minimise impacts are outlined below.

- Vegetation clearing protocols and the potential impacts of unauthorised clearing are included in the site induction.
- A Land Use Certificate system is in place and requires sign off by the Environmental Advisor prior to clearing being undertaken.
- Survey control will be utilised to set out the limits of areas to be cleared using survey pegs and flagging tape.
- All site personnel will be made aware of the vegetation clearing procedure and permitting requirements.
- All topsoil stripped will be retained for use in rehabilitation activities.
- Progressively rehabilitate areas no longer required as soon as practicable.
- Where seed is required, only native plant species of local provenance will be used.
- To assist with ongoing review of the rehabilitation and impact assessment and environmental management at the site, the proponent will submit an annual environmental report to DEMIRS as required by tenement conditions.
- The NVCP application area envelope was modified to exclude locations with records of Priority flora and Mulgara.

## 2 EXISTING ENVIRONMENT

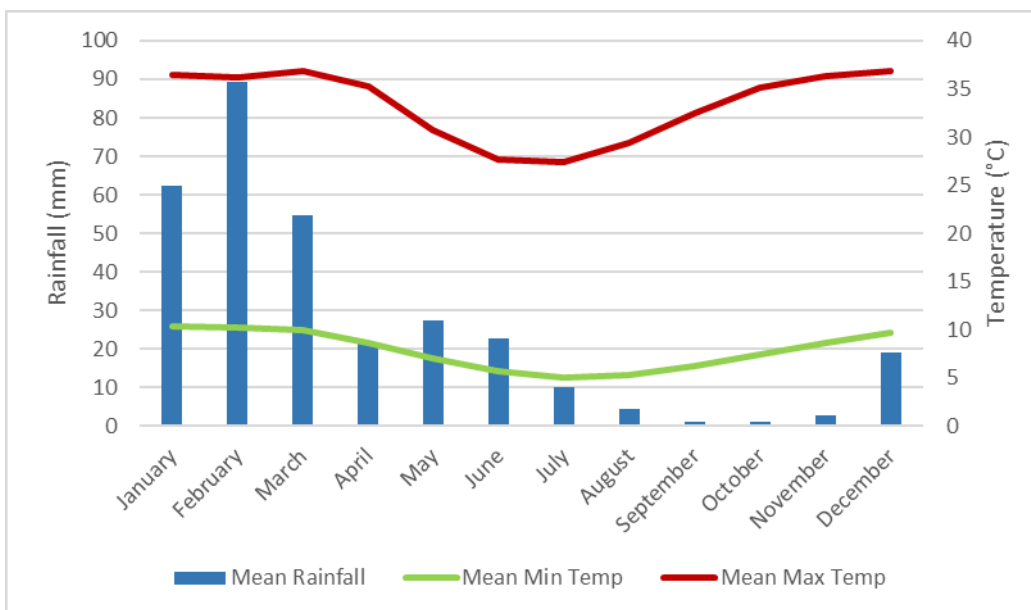
### 2.1 REGIONAL SETTING

The topography of the permit application area is relatively flat on the plain between the range of hills that is located to the east of the mine site (7 km) and Turner River to the west (12 km) to which ephemeral water courses of the Project area report. These hills provide in the order of 90 m local relief with ground elevations rising from about 170 metres Australian Height Datum (m AHD) on the plains, to about 260 m AHD in the vicinity of the hills.

### 2.2 CLIMATE

The Pilbara has very hot summers, mild winters and low and variable rainfall. It is classified as hot desert in northern and inland areas and hot grasslands in the north-west. The climate of the Chichester subregion of the Pilbara is described as semi-desert-tropical, receiving 300 millimetres (mm) of rainfall annually (Kendrick and McKenzie, 2001).

The nearest Bureau of Meteorology (BoM) weather station with a long historical record is at Port Hedland Airport (BoM Site Number: 004032), approximately 75 km northeast of the Survey Area. Port Hedland Airport has recorded rainfall from 1942 (80 years), and temperature from 1948 (74 years). The average climate data recorded for the region over these periods is shown in Figure 2 1. Monthly mean maximum temperature ranges from 36.8°C in March and December to 27.4°C in July. Monthly mean rainfall ranges from 89.3 mm in February to 0.9 mm in October, with a mean annual rainfall of 318.5 mm (BoM 2023).



**Figure 2-1: Temperature and rainfall averages for Port Hedland Airport weather station (No. 004032) (BOM 2023)**

### 2.3 BIOGEOGRAPHIC REGIONALISATION

The Interim Biogeographic Regionalisation for Australia (IBRA, version 7) classifies the Australian continent into regions (bioregions) of similar geology, landform, vegetation, fauna, and climate characteristics (Thackway

and Cresswell 1995). The mapping completed by Beard (1975) provides the basis for the IBRA bioregions. IBRA mapping (Version 7), places the Project within the Pilbara Bioregion.

The Pilbara Bioregion is characterised by vast coastal plains and inland mountain ranges with cliffs and deep gorges. Vegetation is predominantly mulga low woodlands or snappy gum over bunch and hummock grasses.

The Pilbara Bioregion is further subdivided into the Chichester (PIL1), Fortescue (PIL2), Hamersley (PIL3) and Roebourne (PIL4) Sub-regions. The Project lies entirely within the Chichester Sub-region of the Pilbara Bioregion.

The Chichester Sub-region comprises the northern section of the Pilbara Craton and is comprised of undulating Archaean granite and basalt plains and includes significant areas of basaltic ranges. Plains support a shrub steppe characterised by *Acacia inaequilatera* over *Triodia wiseana* hummock grasslands, while *Eucalyptus leucophloia* tree steppes occur on ranges (Kendrick and McKenzie, 2001).

## 2.4 LAND SYSTEMS

Land Systems of the Pilbara region are described by van Vreeswyk et al. (2004). Mapping of Land Systems is available from Department of Primary Industry and Regional Development (DPIRD, 2019a). The Survey Area falls within one soil landscape system, Macroy, as listed in Table 2-1 and illustrated in Figure 2-2.

**Table 2-1: Land systems**

LAND SYSTEM	GEOLOGY	DESCRIPTION
Macroy	Level to gently undulating stony and gritty surfaced plains with occasional granite tor field and domes and closely to moderately spaced dendritic tributary drainage floors, relief up to 25 metres	Stony plains and occasional tor fields based on granite supporting hard and soft spinifex grasslands

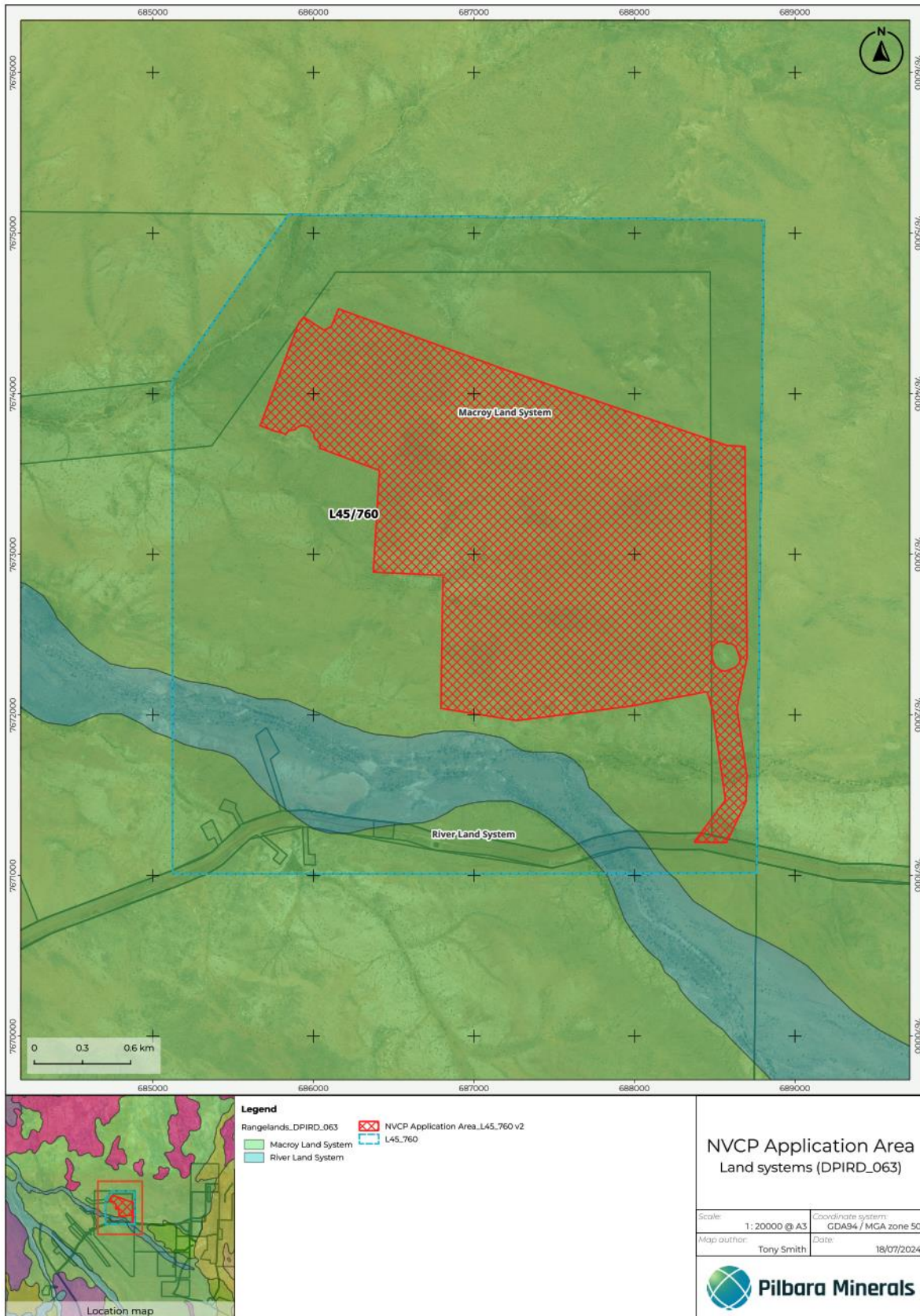


Figure 2-2: Land systems

## 2.5 GEOLOGY

The Pilbara 2014 Geological Information Series dataset (Geological Survey of Western Australia 2014) features a 1:100 000 scale surface geology compilation. The digital layers are based on published maps from the 1994-2005 Pilbara Craton Mapping Project, carried out by the Geological Survey of Western Australia and Geoscience Australia under the North Pilbara National Geoscience Mapping Accord. The Survey Area is within the Wodgina (2655) map area.

The permit application area contains the following six geological formations:

- \_A1c; Alluvial unit; Sand, silt, and gravel in active drainage channels; includes clay, silt, and sand in poorly defined drainage courses on floodplains; unconsolidated.
- \_A2-d-k; Alluvial unit; Partly consolidated alluvial gravel, sand, and silt; local carbonate cement; dissected by present-day drainage.
- \_A2-k; Alluvial unit; Alluvial or lacustrine calcrete; massive, nodular, and cavernous limestone; variably silicified; dissected by present-day drainage.
- \_R1-g-pg; Residual or relict unit; Residual quartzofeldspathic sand, with quartz and rock fragments; overlying and derived from mass-wasting of granitic rocks; unconsolidated.
- A-CLmo-xmgm-mgg; Motherin Monzogranite; Interleaved metamonzogranite, metagranodiorite, gneiss, and pegmatite; moderately to strongly foliated; intruded by abundant sheets of massive to weakly foliated muscovite-bearing metamonzogranite and pegmatite.
- A-PI-mats; Pilbara Supergroup; Strongly sheared serpentine schist derived from intrusive ultramafic rocks.

The surface geology of the Survey Area is shown in Figure 2-3.



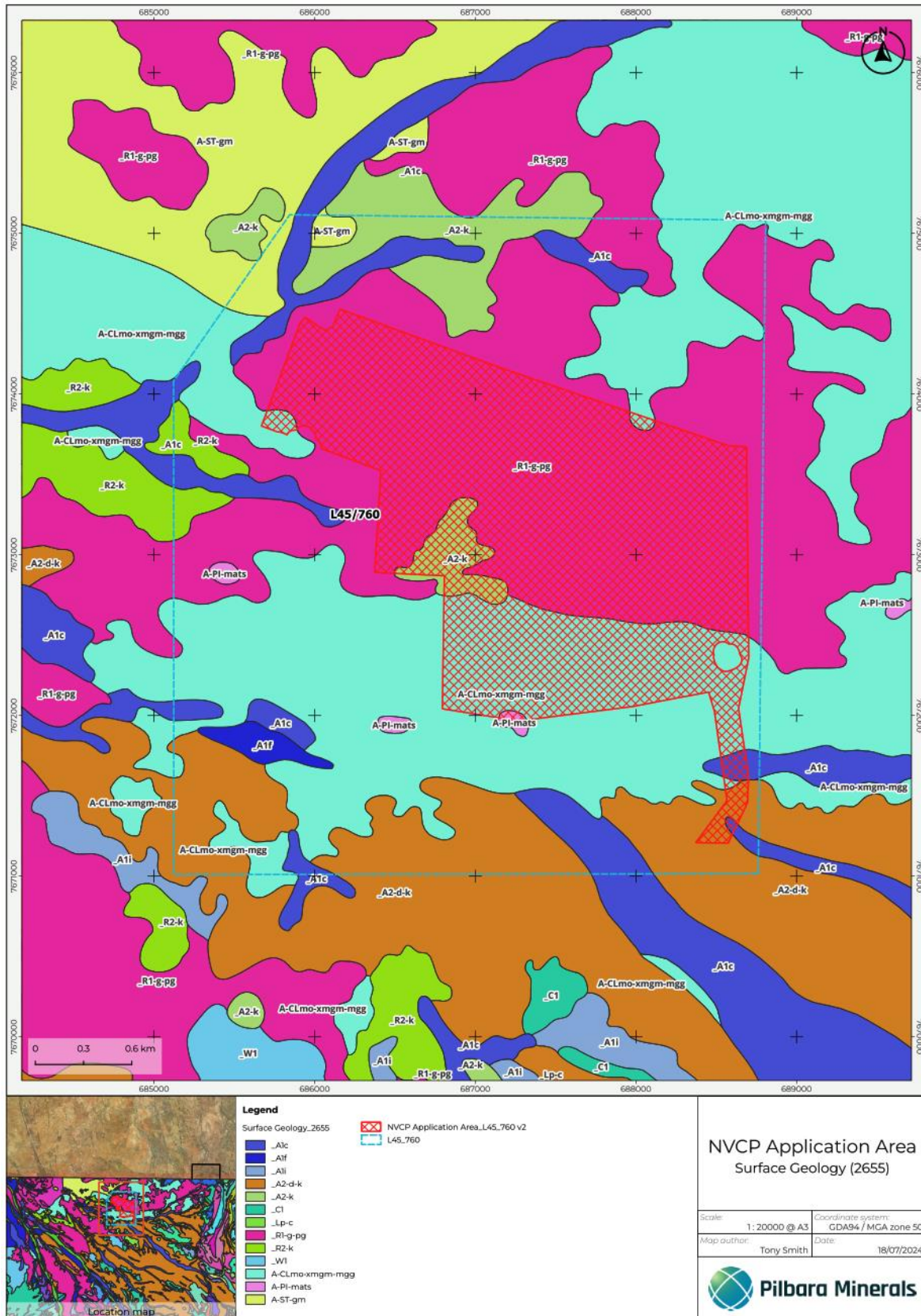


Figure 2-3: Surface geology of the permit application area

## 2.6 SURFACE WATER

The permit application area is located entirely within the Turner River catchment to the west of the regional watershed divide with the Strelley River (Figure 2-4).

The Turner River is a regionally significant river system, draining a catchment area of some 4,800 km<sup>2</sup>. The Turner River catchment forms the eastern-most part of the Department of Water's designated Port Hedland Coast Basin (No. 709).

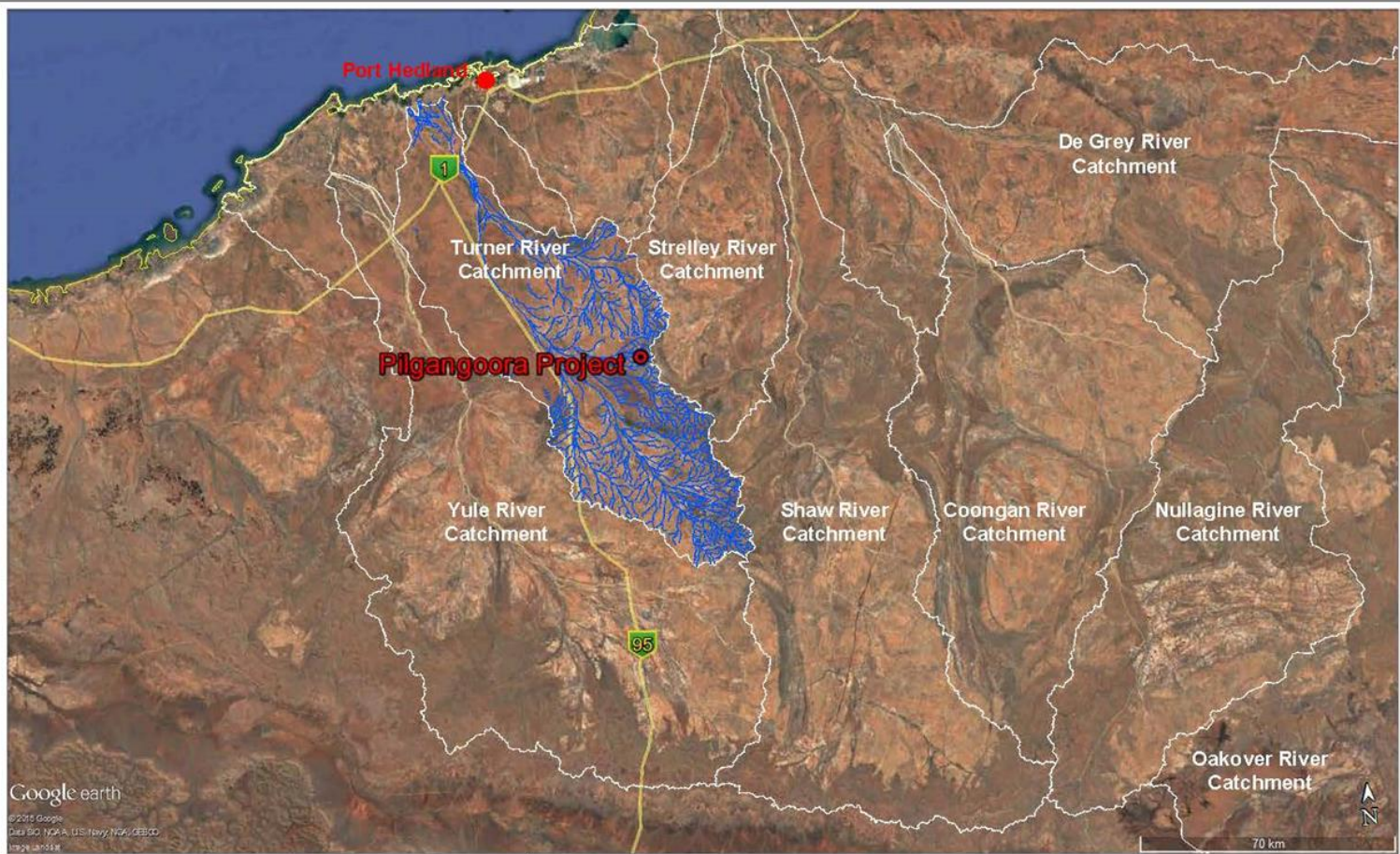
Northern Creek, Houston Creek, Pilgangoora Creek and Southern Creek drain in a roughly east to west direction across the Project site. All these creeks report to the Chinnamon Creek directly to the south of the permit application area. Confluence of the Chinnamon Creek and Turner River West occurs approximately 12 km downstream of the permit application area. The catchment areas for these creeks are shown on Figure 2-5.


All creeks and drainages in the vicinity of the Project site are typical of watercourses in the Pilbara in that they are ephemeral and highly variable with flows that can increase from zero to hundreds of cubic metres per second in a matter of hours as a result of precipitation from tropical cyclones and low-pressure weather systems. Although none of the on-site creeks are gauged, it is understood that the majority of annual stream flow occurs during January, February and March, after which they usually recede and dry up by June or July.

The permit application area intersects only with the Chinnamon Creek catchment which is approximately 287 km<sup>2</sup> and intersects with the Southern and Northern Creek catchments just upstream of their confluence with Chinnamon Creek. The access route to the Camp area will traverse Southern and Northern Creeks and the road will be culverted to enable continuity of flows.

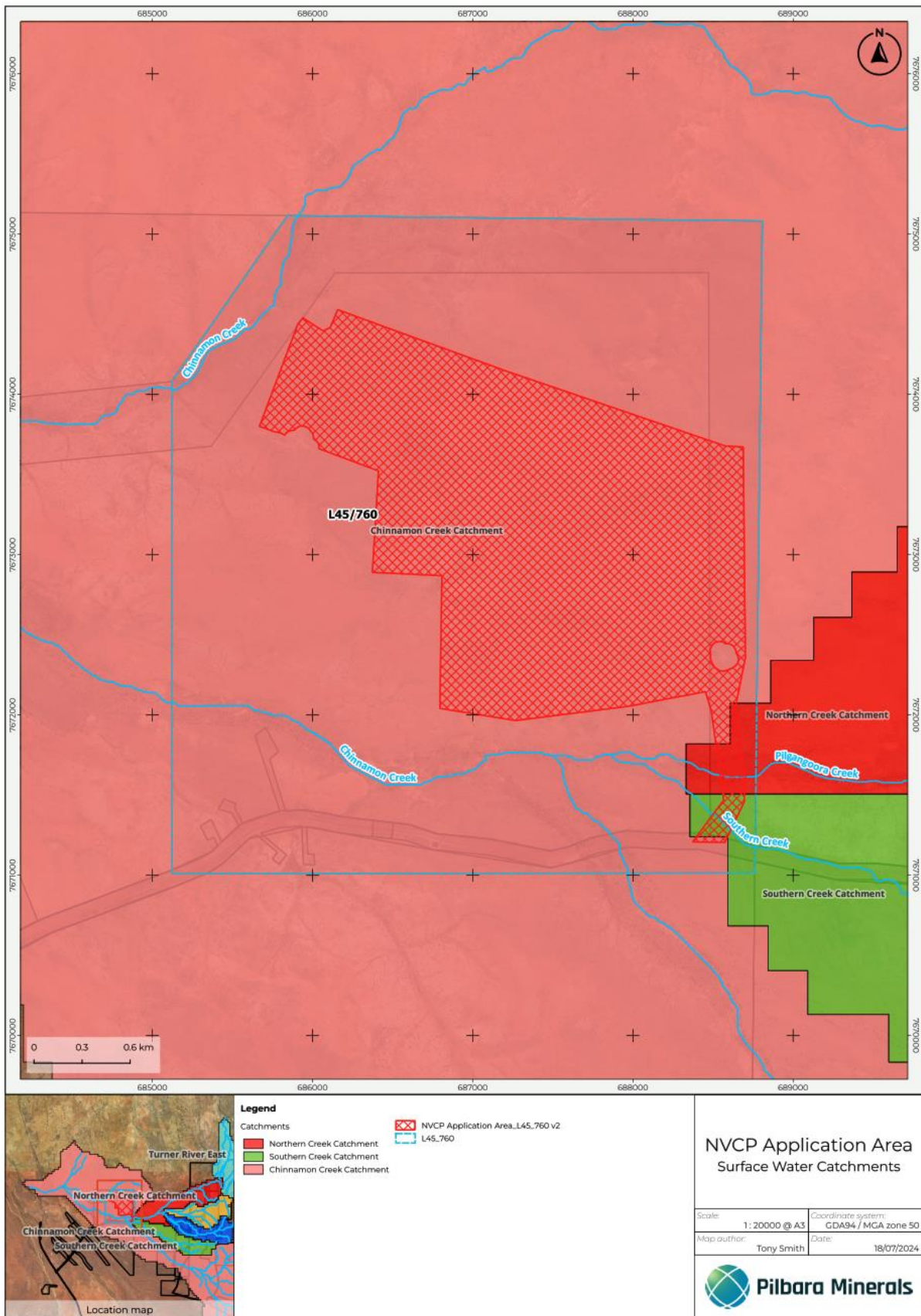
Where catchments are subject to changes in surface water hydrology associated with construction of infrastructure, these will be assessed under a *Rights in Water and Irrigation Act 1914*, section 11/17/21A permit to interfere with bed and banks.





<p><b>NOTES:</b></p> <ol style="list-style-type: none"> <li>Figure not to scale (70 km scale bar provided).</li> <li>Imagery from Google Earth.</li> <li>Catchment Boundaries from Department of Water &amp; Environmental Reregulation (DWER).</li> </ol>	<p>J1723R01 – Pilgangoora Project</p> <p>Pilbara Minerals Ltd</p>	<p><b>Pilgangoora Project Location &amp; DWER Regional Catchment Boundaries</b></p>	<p><b>GROUNDWATER</b></p>  <p>RESOURCE MANAGEMENT</p>
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**Figure 2-4: Regional surface water catchment**



**Figure 2-5: Local surface water catchments**



## 2.7 GROUNDWATER

The Pilgangoora project lies within the East Pilbara Granite Greenstone Terrane. There are no highly productive aquifers in this province although fractured rock aquifers are associated with greenstones and occasional quartz veining.

Data from the broader Pilgangoora project indicates that there is an east to west hydraulic gradient across the site, with a typical depth to groundwater of between 23 mbgl and 53 mbgl.

Previous field investigations have found relatively low permeability in bedrock. Regions of higher permeability occur in alluvium and in some fracture zones in the bedrock, which tend to underlie some of the alluvial waterways.

Groundwater is recharged by direct rainfall or by stream flow during episodic rainfall events. Recharge is predominantly from surface water runoff and flooding events along the upper reaches of the ephemeral creeks in the vicinity of the permit application area (Northern Creek, Pilgangoora Creek, Houston Creek, Southern Creek, Chinnamon Creek and tributaries). Recharge occurs mainly on or adjacent to the groundwater divide and along drainage lines.

The hydrogeology of the Pilgangoora project area is characterised by an east to west draining system, with the groundwater divide coincident with the catchment divide (GRM, 2018). In the permit application area there is westerly trending creeklines; these likely feature a greater depth of weathering into the underlying basement, and are anticipated to act as preferential pathways for groundwater flow.

## 2.8 FLORA AND VEGETATION

A flora, vegetation and fauna survey was completed over the permit application area in 2023. The survey report is attached as Appendix 1.

### 2.8.1 FLORA AND VEGETATION DESKTOP REVIEW

No T or P Flora listed under the *BC Act* and/or *EPBC Act* have been previously recorded within the Survey Area.

One T flora species has been recorded within 30 km, *Quoya zonalis* (formerly *Pityrodia* sp. Marble Bar, listed as Endangered under the EPBC Act and BC Act). One P1, twelve P3, and two P4 species have records within 30 km of the Survey Area.

A likelihood of occurrence assessment was conducted with results appearing in Table 4-1 of the attached Appendix 1.

There are no TECs listed under the BC Act or EPBC Act known to occur within the Survey Area. One P3 Ecological Community is located approximately 23 km west of the Survey Area; the Gregory Land System.

### 2.8.2 FLORA

A total of 61 species of flora were recorded within the Survey Area, comprising 59 native species and two introduced species. All specimens were identified to species level.

The Fabaceae (pea family, 18 native species), Poaceae (grass family, 15 native species, two introduced) and Amaranthaceae (five native species) were the most species-rich families recorded. Fifteen families represented by 37 genera were recorded across the Survey Area.

The complete list of plant species recorded within the Survey Area is presented in Appendix F. The mean species richness was 15.3 species per quadrat. This is lower than other local surveys including the MMWC Environmental (2016a) Pilgangoora baseline survey which included 49 detailed sites with an average species richness of 25, the Infill Biological Survey (APM 2023b) with 17 detailed sites and an average richness of 32, TSF Option 2 and 5 Survey (APM 2022b) with 19 detailed sites and an average species richness of 23, and the Lynas Find Survey (APM 2022a) with 23 detailed sites and an average species richness of 20. The low species richness is likely a consequence of survey season and seasonal conditions.

A species accumulation curve was performed, returning a modelled Michaelis-Menton species richness of 90, indicating that the floristic survey was approximately 68% complete.

The survey recorded ten species not previously encountered at the Pilgangoora Project and bring the total richness for the Pilgangoora Project area to 298 including subspecies, and varieties.

### 2.8.3 VEGETATION TYPES

Four vegetation types are described for the Survey Area, as summarised in Table 2-2 below.

Vegetation types are described below and are compared to those previously recorded for the Pilbara Minerals Pilgangoora Project using structural comparison and common species assemblages. Where communities share a high level of similarity, the vegetation code previously applied has been used here and a discussion of similarity presented. The cluster analysis grouped the sites occurring in drainage features. They have been described below as separate vegetation types to better reflect the differences in habitat availability and the previously described vegetation types across the Pilgangoora Project.

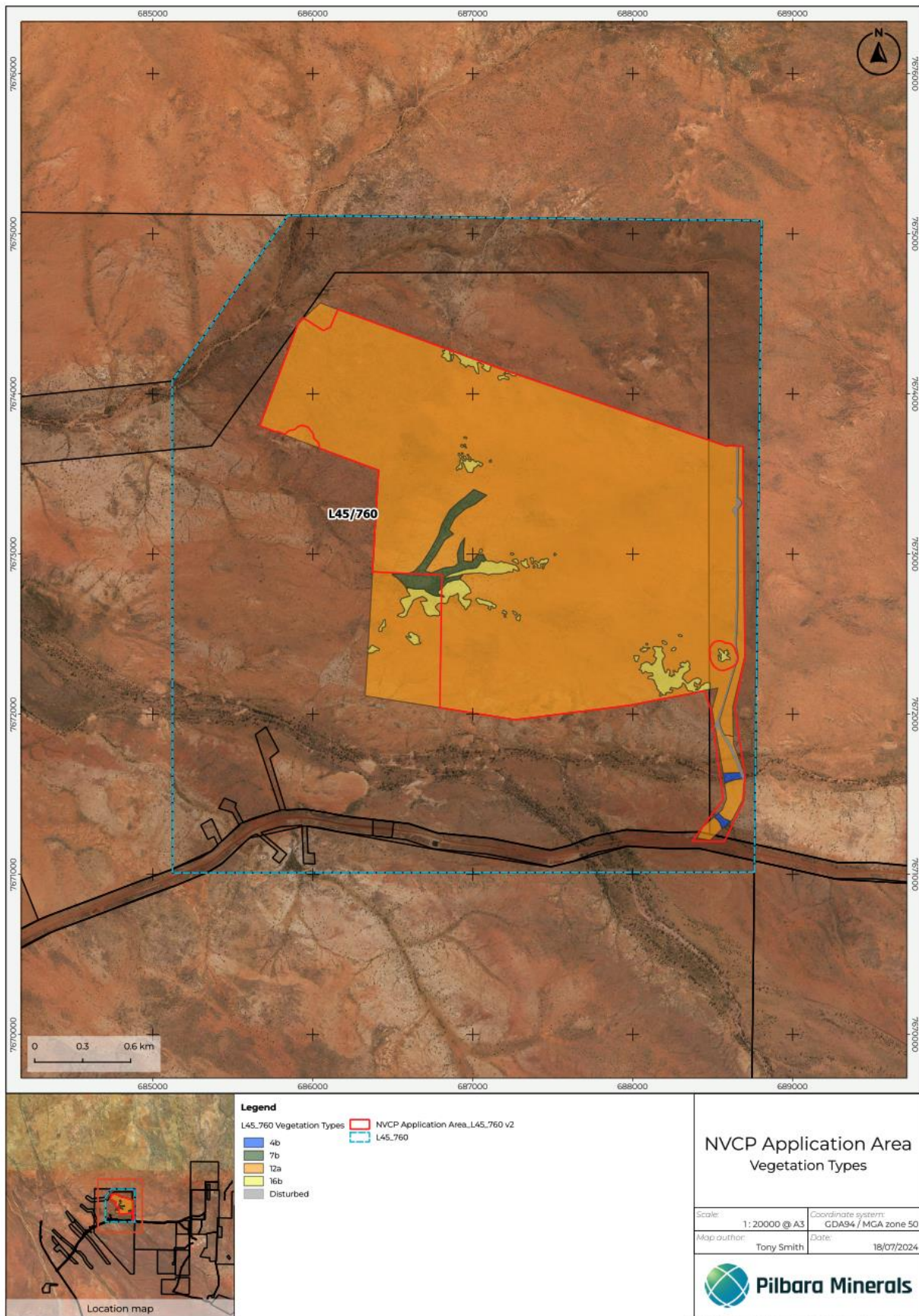
The DBCA fire history database indicates that approximately 80% of the Survey Area was burned in 2014, and the north-western corner (approximately 20%) is long unburned. On-ground observations supported these remotely recorded fire records. Post fire-regeneration has occurred in all areas and time since fire was considered in the assessment of vegetation condition.

Distribution of vegetation types at a scale of 1: 20,000 is shown in Figure 2-6.

Detailed descriptions of vegetation types appear in Section 4.2.2 of Appendix 1.

**Table 2-2: Vegetation types**

CODE	LANDFORM	VEGETATION DESCRIPTION	HA	%
4b	Sandy Creek	Low open woodland of <i>Eucalyptus victrix</i> over <i>Acacia bivenosa</i> , <i>Acacia trachycarpa</i> and <i>Acacia stellaticeps</i> tall open shrubland with <i>Triodia epactia</i> , <i>Triodia wiseana</i> and <i>Triodia secunda</i> hummock grassland.	0.95	0.2
7b	Drainage Depression	Low open woodland of <i>Corymbia hamersleyana</i> over <i>Acacia bivenosa</i> , <i>Acacia acedenia</i> and <i>Acacia inaequilatera</i> tall sparse shrubland with <i>Triodia wiseana</i> , <i>Triodia epactia</i> and <i>Triodia secunda</i> hummock grassland.	8.90	1.7
12a	Undulating plains	Isolated low <i>Corymbia hamersleyana</i> and <i>Corymbia zygomphylla</i> over <i>Acacia stellaticeps</i> , <i>Acacia inaequilatera</i> and <i>Acacia adsurgens</i> sparse mid shrubland with mid hummock grassland of <i>Triodia lanigera</i> , <i>Triodia wiseana</i> and <i>Triodia epactia</i> .	493.16	94.6
16b	Sandy basin	Hummock grassland of <i>Triodia secunda</i> and <i>Triodia epactia</i> with open herffield of <i>Pluchea tetranthera</i> , <i>Fimbristylis dichotoma</i> and <i>Eriachne ciliata</i> .	15.93	3.1
D	-	Disturbed – clear of vegetation	2.45	0.5



**Figure 2-6: Vegetation types**



## 2.8.4 VEGETATION CONDITION

Vegetation condition across the Survey Area was within the categories Very Good, Good and Completely Degraded, with most of the Survey Area in Very Good condition (Table 2-3).

**Table 2-3: Vegetation Condition**

VEGETATION CONDITION	AREA (HA)	AREA (%)
Very Good	517.91	99.3
Good	0.95	0.2
Completely Degraded	2.45	0.5

The primary sources of disturbance on-site are low to moderate grazing impact from cattle and occasional tracks that support pastoralism activities. Additional tracks are present in support of the nearby mining and exploration activities.

Areas receiving a condition rating of Very Good had a low level of grazing activity and occasional tracks may be present.

Areas receiving a condition rating of Good had weeds present, a moderate level of grazing activity and occasional vehicle tracks. This was limited to the sandy creek areas in the southern extent of the Survey Area.

Areas classified as Completely Degraded are cleared of vegetation and maintained in a vegetation free state. This was limited to an existing track on the eastern side of the Survey Area.

## 2.8.5 CONSERVATION SIGNIFICANT FLORA

No species listed as T under the *EPBC Act* or *BC Act* were recorded during the survey.

Two P3 species *Triodia chichesterensis* and *Euploca mutica* were recorded during the survey. **All locations where these taxa were recorded have been excluded from the permit application area with at least a 50 metre buffer.**

### ***Triodia chichesterensis* (P3)**

*Triodia chichesterensis* is characterised by being a short-leaved species, distinguished by the combination of diminutive stature, glabrous leaf sheaths, relatively unbranched inflorescence, often short pedicels, and pubescent lemma midlobe. The short pedicels and pubescent lemma midlobe contrast with the typically longer pedicels and glabrous lemma midlobes of other short-leaved species in the complex (*T. nana*, *T. scintillans*, *T. vanleeuwenii*).

The species has a limited distribution and has been found only in a narrow area in the central Chichester region of the Pilbara of WA. The areas immediately to the west and east of its known distribution are poorly explored, but it is likely to be restricted to an area <100 km beyond current collections, given intensive collecting efforts in the Pilbara (Anderson et al. 2017).

The Survey Area is in the central part of the range of this species, which is significant from the perspective of determining it from the closely related *Triodia lanigera* (Anderson et al. 2017). Where the two co-occur in the south it can be difficult to determine them based on morphological and distributional parameters. Where the two co-occur in the north, there is a subtle but consistent substrate change that marks the shift in species, with *T. lanigera* occurring on sandier soils and *T. chichesterensis* on rockier soils with quartzite pieces. In the

northern species range, it can usually be morphologically distinguished from *T. lanigera* by its shorter and less hairy leaves and less branched inflorescences.

The species has been previously recorded from studies conducted for the Pilgangoora Project and appears to be locally common on rocky soils with quartzite (APM, 2022a,b, APM, 2023). The species was recorded at one location in the northwestern corner of the survey area within sandy red soils where a patch of quartzite was present. This habitat extended further to the west outside of the survey area. This location was excluded from the permit application area.

***Euploca mutica* (P3)**

*Euploca mutica* is a small, perennial herb/shrub that grows to approximately 0.3 m. Collection records for the species (Atlas of Living Australia [ALA] 2023) identify that flowering specimens are often collected in August, and that habitat includes sandy or calcareous plains, often on granite geology, with a sandy or loamy surface often with ironstone and quartz.

The species was first recorded in the local area during surveys undertaken by MMWC Environmental in 2016a. At the time of the MMWC Environmental (2016) survey the species was known as *Heliotropium muticum* and was considered to be a Priority 1 species. Taxonomic revision for the species has led to the revision of the name to *Euploca mutica* (Frohlich et al. 2020) and targeted searches resulting in increased known population size has led to a revision of the status to Priority 3.

The species has previously been recorded at six locations during studies conducted for the Pilgangoora Project (MMWC Environmental 2016, APM (2023b)). In the P1000 Camp survey it was recorded at two locations, P05 and P08. These quadrats are in sandplain habitat, known to be potentially suitable habitat for the species. The species was recorded at low densities in both locations at 0.1% cover. These locations have been excluded from the permit application area and buffered by 50 metres.

**2.8.6 INTRODUCED FLORA**

Two introduced flora species were recorded in the Survey Area and are listed in Table 4 5. No Declared Weeds or WONS were recorded.

**Table 2-4: Introduced flora recorded within the Survey Area**

SPECIES	COMMON NAME	DESCRIPTION BAM ACT S11 - PERMITTED
<i>Cenchrus ciliaris</i>	Buffel grass	Tufted or sometimes stoloniferous perennial, grass-like or herb. 0.2 - 1.5 m high. Flowers purple from February to October. Grows on white, red, or brown sand, stony red loam, or black cracking clay.
<i>Cenchrus setiger</i>	Birdwood Grass	Erect, tussocky, stoloniferous perennial, herb or grass-like, to 0.5 m high. Flowers cream to purple from April to May. Grown in brown sands, red loam and pindan soils on sand dunes, plains, rangelands, stony hillsides or floodplains.

The agricultural weeds *Cenchrus ciliaris* and *Cenchrus setiger* was recorded in drainage lines, occurring only occasionally and in generally low abundance. Where found, these weeds were heavily grazed.

## 2.9 FAUNA

A fauna, flora and vegetation survey was completed over the permit application area in 2023. The survey report is attached as Appendix 1.

### 2.9.1 FAUNA DESKTOP REVIEW

The survey included a desktop review. The DBCA database search returned 16 species of significant fauna that have previously been recorded within 30 km of the Survey Area. Of these, six are T, six are P, three are migratory bird species (MI) and one is Other Specifically Protected (OS). The database does not contain any records for fauna within the Survey Area.

The PMST returned 12 additional species, five T, six MI and one that is both T and MI. These are species that do not have records within 30 km but where modelling has identified that suitable habitat is known to occur or may occur.

The literature review returned additional information about the locations and abundance of Northern Quoll, Pilbara leaf-nosed Bat, Ghost Bat, Pilbara Olive Python and Pebble-mound Mouse records.

Database search results of T, P and MI fauna within 30 km of the Survey Area are listed in Table 2-5 with the outcome of the likelihood of occurrence assessment. The complete assessment including the preferred habitat relative to those available in the Survey Area and a summary of records in the local area is included in Appendix G of Appendix 1.



**Table 2-5: Significant fauna database records and likelihood of occurrence**

SPECIES	COMMON NAME	CONSERVATION CODE		ASSESSMENT OF OCCURRENCE	
		BC ACT	EPBC ACT		
<i>Actitis hypoleucos</i>	Common sandpiper	MI	MI		
<i>Calidris acuminata</i>	Sharp-tailed sandpiper	MI	MI		
<i>Calidris ferruginea</i>	Curlew sandpiper	CR	CR, MI		
<i>Calidris melanotos</i>	Pectoral sandpiper	-	MI	Unlikely. No saline or coastal habitats available. Freshwater habitats are likely to be seasonally present in the major drainage line however there are no permanent or semi-permanent pools evident. Substrates are sandy, meaning infiltration is likely to be rapid and surface water very limited. No vegetation known to inhabit seasonally inundated environments was recorded.	
<i>Numenius madagascariensis</i>	Eastern curlew	CR	CR, MI		
<i>Glareola maldivarum</i>	Oriental pranticole	MI	MI		
<i>Hirundo rustica</i>	Barn swallow	MI	MI		
<i>Motacilla cinerea</i>	Grey wagtail	MI	MI		
<i>Motacilla flava</i>	Yellow wagtail	MI	MI		
<i>Apus pacificus</i>	Fork-tailed swift	MI	MI		Possible. Utilises a broad array of habitats.
<i>Charadrius veredus</i>	Oriental plover	MI	MI		Likely. Suitable habitat in the open plains.
<i>Polytelis alexandrae</i>	Princess parrot	-	VU		Unlikely, preferred feeding species are not present in high densities along the major drainage.
<i>Erythrotriorchis radiatus</i>	Red goshawk	VU	VU		Unlikely. Not within the known range of the species distribution.
<i>Falco hypoleucos</i>	Grey falcon	VU	VU	Likely. All areas are suitable for foraging. No suitable nesting habitat.	
<i>Falco peregrinus</i>	Peregrine falcon	OS	-	Possible. All areas are suitable for foraging. No suitable nesting habitat.	
<i>Pezoporus occidentalis</i>	Night parrot	CR	EN	Possible. No local records. Habitat modelling includes the Survey Area at the extremity of the species potential extent. Foraging resources are limited.	
<i>Rostratula australis</i>	Australian painted-snipe	EN	EN	Unlikely. No habitat occurs in the Survey Area. Vegetation too open to provide well vegetated shallows.	
<i>Dasyercus blythi</i>	Brush-tailed mulgara	P4	-	Present. Sandy basin habitat is suitable.	
<i>Dasyurus hallucatus</i>	Northern quoll	EN	EN	Likely. Dispersal and foraging habitat, denning habitat in the granite overhangs and tree hollows in the creek vegetation.	

SPECIES	COMMON NAME	CONSERVATION CODE		ASSESSMENT OF OCCURRENCE
		BC ACT	EPBC ACT	
<i>Hipposideros stenotis</i>	Northern leaf-nosed bat	P2		Unlikely. No suitable habitat. Nearby records may be erroneous.
<i>Lagorchestes conspicillatus leichardti</i>	Spectacled hare-wallaby	P4	-	Likely. Suitable habitat is present in the Spinifex Open Plains habitat.
<i>Macroderma gigas</i>	Ghost bat	VU	VU	Likely. Foraging habitat available. No roosting habitat available.
<i>Macrotis lagotis</i>	Greater bilby	VU	VU	Possible. All habitats are suitable.
<i>Pseudomys chapmani</i>	Western pebble-mound mouse	P4	-	Unlikely. No suitable habitat. Stony rises absent.
<i>Rhinonicteris aurantia</i>	Pilbara leaf-nosed bat	VU	VU	Likely. No roosting habitat available, foraging habitats present.
<i>Sminthopsis longicaudata</i>	Long-tailed dunnart	P4	-	Unlikely. No suitable habitat.
<i>Anilius ganei</i>	Gane's blind snake (Pilbara)	P1	-	Unlikely. No suitable habitat.
<i>Liasis olivaceus</i> subsp. <i>baronni</i>	Pilbara olive python	VU	VU	Present. Recorded on camera using a termite mound.
<i>Liopholis kintorei</i>	Great desert skink	VU	VU	Unlikely. No records in the local area. May occur 10 km to the east.

## 2.9.2 FAUNA HABITATS

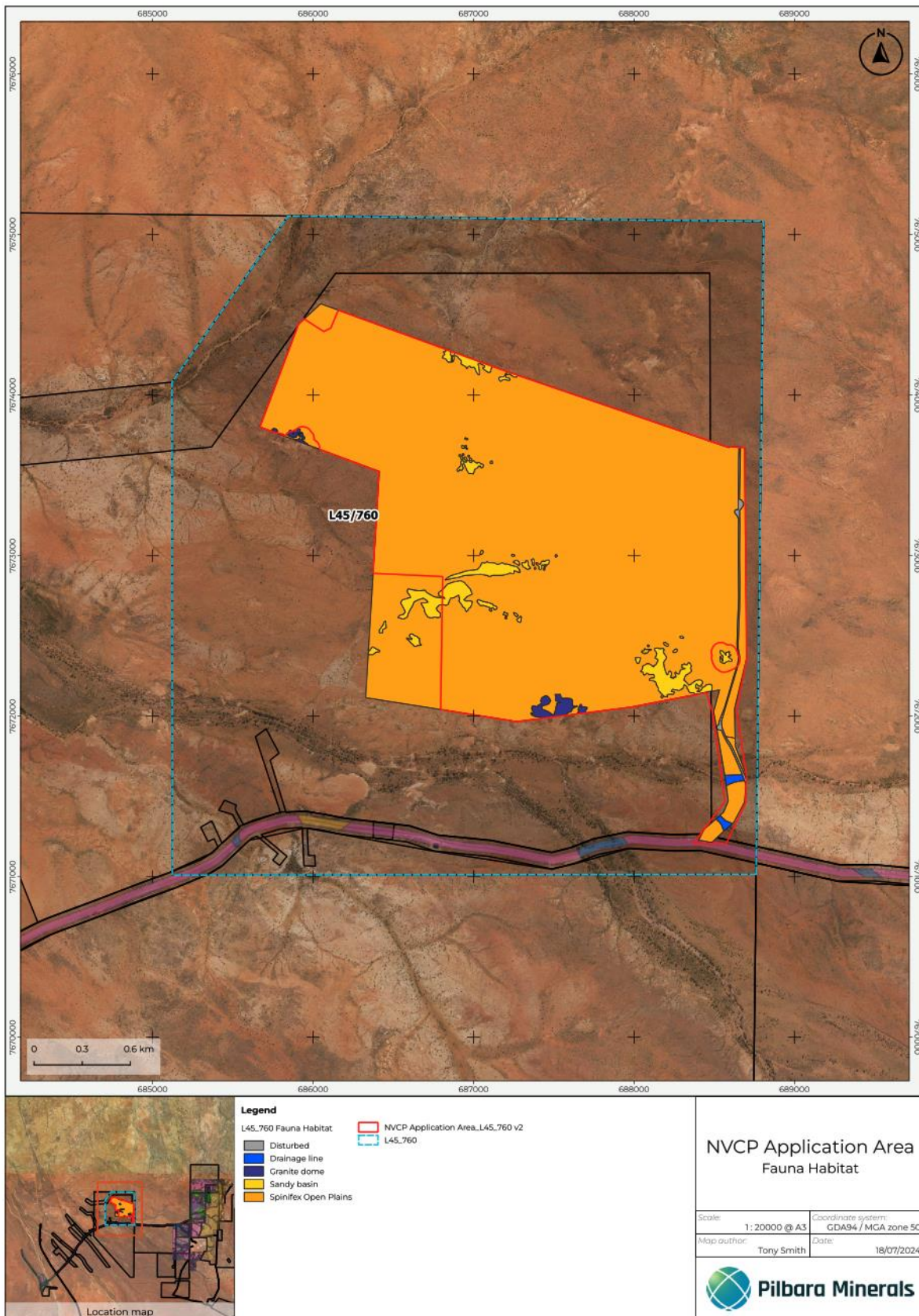
The Survey Area is characterised by sandy to stony plains with occasional first and second order ephemeral creeks and shallow sandy drainage basins. Granite domes occur scattered throughout the sandy plains, most emerging less than 1 m from the surrounding surface. There are higher ranges approximately 10 km to the east and water sheds from these into the Survey Area through the minor drainages that continue to the Turner River to the west. The presence of water is ephemeral, and no permanent or semi-permanent water is available. Seasonal inundation is not expected to occur as the shallow drainage basins are sandy and no evidence of inundation is present. Vegetation is predominantly open shrublands dominated by Acacia shrubs and Triodia hummock grasses, with the occasional low tree present. Denser and larger trees are present in the drainage features.

Recent fires recorded on the DBCA (2023b) database indicate approximately 400 ha burned in 2014, with 80% of the Survey Area being burned in the past 10 years. There are no records of fire in the north-west corner. No evidence of recent fire was present during field survey.

Four fauna habitats are described for the Survey Area and are summarised in Table 2-6. These are described in detail in Section 5.2.1 of Appendix 1. The distribution of fauna habitats is shown in Figure 2-7.

**Table 2-6: Fauna habitats within the Survey Area**

NAME	AREA (HA)	PROPORTION (%)
Drainage line	0.96	0.2
Granite dome	2.88	0.6
Sandy basin	15.93	3.1
Spinifex open plains	499.18	95.7
Disturbed	2.45	0.5



**Figure 2-7: Fauna habitats of the Survey Area**

### 2.9.3 CONSERVATION SIGNIFICANT FAUNA

#### ***Pilbara Olive Python***

The Pilbara Olive Python has been recorded frequently in the Pilgangoora area, most commonly in the rocky outcrops in the elevated ranges. Out of 56 records of the species within 100 km of Pilgangoora, only one has been recorded in a riparian environment – in the Turner River area.

The Pilbara Olive Python prefers deep gorges and water holes in the ranges of the Pilbara region (Pearson 1993). Radiotelemetry has shown that individuals spend the cooler winter months hiding in caves and rock crevices away from water sources. In the warmer summer months, the pythons were found to move around widely, usually in close proximity to water and rock outcrops (Swan 2007). Prey is captured by ambush on animal trails or by striking from a submerged position in water holes (Pearson 2006). The subspecies is adept at swimming, utilising water holes to hunt and its diet includes Rock wallabies, Fruit Bats, ducks, Spinifex Pigeons and Coucals (Threatened Species Scientific Committee [TSSC] 2008) Ellis and Johnstone (2016) and Ellis (2013) consider that birds, particularly waterbirds, are likely to make up a large portion of the diet of adult Pilbara Olive Python due to its frequent association with water bodies.

At the P1000 Camp area, the species was captured on camera exiting a large termite mound (Plate 2-1). During the camera survey period the mound was also used by a variety of bird and reptile species, the Fat-tailed Dunnart, and a cat.

Termite mounds are not recognised as important habitat for the Pilbara Olive Python and no reference to use of termite mounds was able to be found in the literature. The use of a termite mound by the Pilbara Olive Python on this occasion is considered a novel finding. It is possible that termite mound usage is a dispersal strategy, with the individual requiring refuge whilst moving between more suitable habitats.

Five termite mounds were recorded in the P1000 Camp Survey Area, in two locations. Termite mounds were recorded within the Spinifex Open Plains habitat. Additional termite mounds were noted as occurring past the northeast corner of the Survey Area.

Other habitat available in the Survey Area that is suitable for Pilbara Olive Python includes the Granite Dome overhang in the southern boundary of the Survey Area. The overhang would provide diurnal refuge to the Pilbara Olive Python in close proximity to the ephemeral or semi-permanent pools in Chinnamon Creek 0.7 to 1.8 km to the southwest. The overhang in the Survey Area is approximately 30 m long with multiple entrances. An additional Granite Dome overhang of similar size is available at Baldy Rock, 650 m south of the Survey Area southwest corner. These two granite domes provide the largest overhang/crevice type refuges in the local area. Other granite outcrops in the area have very small overhangs or crevices and overhangs are absent.





**Plate 2-1: Termite mound showing MSC033 setup (left) Pilbara and Olive Python leaving the termite mound (right)**

### ***Northern Quoll***

Northern quoll have been recorded on several occasions within the Pilgangoora Project Area (DBCA Database record, Ecologia Environmental 2018; Terrestrial Ecosystems 2020, APM 2022a, APM 2023b, APM unpublished data. Locally this species seems to be most encountered in the boulder hill tops habitat of the north/south tending ridgeline running along the eastern half of the Pilgangoora Project Area. This is the most rugged landform in the local area, at the highest elevation. Boulders on the ridge tops form a mosaic of cracks and crevices large enough to provide denning habitat for the quoll. Habitat critical to the survival of the Northern Quoll and populations important for the long-term survival of the Northern Quoll, as defined in CoA (2016), occur in the boulder hill tops habitats.

Within 30 km of the Survey Area, species records predominantly occur within rocky outcrop habitats, but also occur in the Turner River and larger tributaries of the Turner River, 11 km to the west of the Survey Area. Quoll have been recorded near to mine infrastructure of the Pilgangoora Project on three occasions.

No evidence of habitat usage within the Survey Area was recorded, and rocky boulder outcrop habitat critical to the survival of the species (CoA 2016) is absent. The granite outcrop in the southern part of the Survey Area contains overhangs suitable for denning and foraging opportunities, however no camera captures were made, or signs of recent usage recorded.

All habitats occurring within the Survey Area may be utilised by the species, at some time, to forage and or during dispersal activities; however, their significance to the species will vary depending on resource availability and connectivity. At the time of survey there is no evidence of consistent use of the Survey Area by Northern Quoll and the Survey Area is outside the 1 km buffer of critical habitats, indicating it is not important habitat for the sustainability of the local population, but may be used periodically.

### **Ghost Bat**

A recent review of Ghost Bat (Bat Call WA 2021a) updates the knowledge base on ecology, threats, and survey requirements for the species.

Ghost bats move between a number of caves seasonally or as dictated by weather conditions and/or foraging opportunities, so they require a range of cave sites (Richards et al. 2008). They disperse widely when not breeding but may concentrate in relatively few roost sites when breeding. In the Pilbara, except for the large, abandoned mine colonies, Ghost bats are often present either singly or in small groups (usually less than 15). These have been shown to move periodically, either seasonally or as dictated by prey availability. Their vagrant foraging strategy relates to patchy, locally unreliable rainfall events (and prey biomass) across much of its foraging habitat in the Pilbara and elsewhere in other semi-arid parts of its broader Australian range. Hence the relatively small groups that must move from roost to roost to access their ephemeral patchy food resource.

Extensive survey activity in the last decade has led to the proposal of four categories of roosting habitat used by Ghost bats in the Pilbara (Cramer et al 2022; Bullen 2021a):

- Category 1 permanent diurnal roost;
- Category 2 regular diurnal roost;
- Category 3 occasional diurnal roost; and
- Category 4 nocturnal feeding roosts.

Within the Survey Area there are no Category 1, 2, 3 or 4 roosts available to this species.

In the Pilbara, Ghost bats prefer to forage on productive plain areas with thin mature woodland over patchy or clumped tussock or hummock grass (*Triodia* spp.) on sand or stony ground. Isolated trees and trees on the edge of thin thickets on the plains, or trees along the edges of watercourse woodlands, appear to be preferred vantage points (Bullen unpublished data, reported in Bullen 2021). In the Survey Area there are scattered to clumped trees available for perching in all habitat types.

No Ghost bats were recorded during the acoustic survey, however acoustic recorders are not suited to Ghost bat detection during foraging as the species seldom uses its echolocation away from caves.

The Ghost Bat is listed in the PMST as known to occur within the local area and the DBCA database has records for the species within a 30 km radius. APM (2023b) recorded Ghost bat on camera in a location 10 km east northeast of the Survey Area in a Category 4 roost. Ghost bats are known to travel up to 15 km from a roost site for foraging and up to 30 km in one night to alternative roosting sites, indicating the Survey Area may be within range of Category 1, 2 or 3 roosts.

It is likely that the Survey Area offers foraging habitat to Ghost Bat across all habitat types.

### **Pilbara Leaf-Nosed Bat**

A recent review of Pilbara leaf-nosed Bat (Bat Call WA 2022b) updates the knowledge base on ecology, threats, and survey requirements for the species. It is generally encountered in rocky areas that provide opportunity for roosting, in particular the ironstone Hamersley Range, the ridgelines granite boulder piles and disused mines of the eastern Pilbara, and along medium and major drainage lines that radiate away from rocky uplands.

Pilbara leaf-nosed Bat roost during the day beyond the twilight zone in caves and underground mines with stable, warm and humid microclimates because of its poor ability to maintain its heat and water balance (Churchill et al. 1988; Jolly 1988; Churchill 1991; Baudinette et al. 2000; Armstrong 2001). The Pilbara leaf-nosed Bat does not roost in overhangs (shallow structures where the rear wall can be observed from the entrance), as these do not support warm, humid microclimates (TSSC, 2016). A suggestion that this species becomes 'forest dwelling' in the wet season of the monsoonal northern areas (Churchill 1991) has not been supported, and is very unlikely in the Pilbara region (Armstrong 2001).

Roosts have been categorised according to importance to the survival of the species into four categories (TSSC 2016):

- Category 1 - Permanent diurnal maternity roosts where seasonal presence of young is proven;
- Category 2 - Permanent diurnal roosts where presence of young is unproven;
- Category 3 - Semi-permanent diurnal roosts; and
- Category 4 - Nocturnal refuge.

The Pilbara leaf-nosed Bat was recorded locally during Targeted survey for individuals and roosts for the Pilgangoora Project (360 Environmental 2015, 2016). A Category 1 or 2 roost was located, and high-quality foraging habitat was identified at a major water body in an abandoned open cut pit. The roost site and confirmed foraging habitat are 13 km northeast of the Survey Area. An estimate of the number of Pilbara leaf-nosed bat at the roost based on ultrasonic calls and video counts ranged between 25-50. There are additional known permanent diurnal category 1 or 2 Pilbara leaf-nosed bat roosts within 40 km of the Survey Area (Bat Call WA 2022b), and Category 4 Roosts have been recorded to the east of the Pilgangoora Project (APM 2023c). The Survey Area does not contain any Category 1, 2, 3 or 4 roosts.

Generally, the Pilbara leaf-nosed Bat is most encountered within 20 km of its permanent diurnal roosts (Bullen 2013), but in the months where climatic conditions are least challenging for the species (April-May) they have been recorded further afield (Bat Call WA 2022b). Echolocation based records indicate that it can complete round trips of 50 km or longer in a night under favourable conditions (Bat Call WA 2022b).

No call sequences of the Pilbara leaf-nosed Bat were recorded within the Survey Area.

Foraging habitats used by the Pilbara leaf-nosed Bat are prioritised by EPBC Conservation Advice (TSSC 2016) as:

- Priority 1 - Gorges with pools;
- Priority 2 – Gullies;
- Priority 3 – Rocky Outcrop;
- Priority 4 – Major Watercourses; and
- Priority 5 – Open Grassland and Woodland.

Habitats in the Survey Area have been categorised using this Priority schedule and are shown in Appendix 1 where Priority 4 areas include the Drainage Lines and the remaining habitats are Priority 5.

Whilst the Pilbara Leaf-nosed Bat is known to occur in the local area, the Survey Area does not present habitat that is of high priority for conservation of the species.



### **Grey Falcon**

The Grey Falcon occurs in most of the drier parts of Australia (Schoenjahn 2018). Its distribution is centred on inland drainage systems where there is an average annual rainfall of less than 500 mm. Its main habitat is timbered lowland plains, particularly Acacia shrublands that are crossed by tree-lined watercourses. It generally occurs at low densities across inland Australia (BirdLife International 2019).

The Grey Falcon hunts far out into tussock grassland and open woodland. It nests in old nests made by other birds, usually nests in the tallest trees along watercourses, particularly river red gum (TSSC 2020). Prey species include doves, pigeons, small parrots and cockatoos, and finches, but a variety of other bird prey species has been recorded, as well as mammals and lizards (TSSC 2020).

Local records are centred on the Turner River and major tributaries. The closest record is 9 km from the Survey Area to the west. The Survey Area is suitable foraging habitat for this species, and within range of the population likely to be nesting in the Turner River riparian zone. No red gum trees were present in the Drainage Line fauna habitat within the Survey Area and no nests were observed. Larger trees including red gum, become frequent from the confluence of Pilgangoora Creek with Chinnamon Creek, to the west of the intersection of the Survey Area with the creek.

### **Night Parrot**

The Survey Area is within the area where Night Parrot is modelled as may occur. Very limited information is available on the Night Parrot, however some information on habitat characteristics where the species has persisted is available.

DBCA (2017) summarises habitat characteristics. Night parrot roosting and nesting sites are in clumps of dense vegetation, primarily old and large spinifex (*Triodia*) clumps, but sometimes other vegetation types. Often the vegetation in these habitats will be naturally fragmented and therefore well protected from fire. Little is known about foraging sites, but favoured sites are likely to vary across the range of the species. In Queensland, Night parrots have been shown to feed in areas rich in herbs including forbs, grasses and grass-like plants, and it is likely that such areas may also be important in WA. *Triodia* is likely also to provide a good food resource for Night Parrot, in times of mass flowering and seeding, but they also rely heavily on a range of other food species. *Sclerolaena* has been shown to be a source of food and moisture.

The species and growth pattern of the spinifex in some of the plains habitat in the Survey Area may be suitable for the Night Parrot, however there are no patterns of fragmentation and fire records (DBCA 2023b) and field observation show that burning is often landscape scale and at a moderate frequency. There are no samphire or chenopod habitats proximal to the Survey Area, however the drainage depressions may seasonally support a diversity of herbs and other potential forage species. Night parrots have been known to fly up to 40 km or more in a night during foraging expeditions, so foraging habitat is not necessarily within or adjacent to roosting areas.

An interim guideline for preliminary surveys of Night parrot in WA (DPAW 2017b) identifies when and where Night parrot surveys may be required. The Survey Area is on the north-western edge of the area classed as a high priority for survey. Due to the inclusion of the site in the high priority survey area and the presence of potentially suitable spinifex habitat, passive acoustic survey was conducted in three previous surveys (APM 2022a, APM 2022b and APM 2023b). No Night parrot calls were recorded and foot traverses have not encountered any signs or individuals of Night Parrot.

While the habitat is potentially suitable, there are no historic records of Night Parrot in the area and very few records of extant individuals. While it remains possible that the species could colonise in the future, there is no evidence that they are currently present.

#### Greater Bilby

Extant populations of bilby occur in a variety of habitats, usually on landforms with level to low slope topography and light to medium soils (typically sandy for burrow excavation). Bilby occupies three major vegetation types; open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas (Southgate 1990). Laterite and rock feature substrates are an important part of Greater bilby habitat, which support shrub species such as Acacia, and spinifex hummocks which are quite uniform and discrete, providing runways between hummocks, enabling easier movement and foraging (Southgate et al. 2007).

The species is identified by the PMST as known to occur within 30 km of the Survey Area. Database results returned 104 records within a 30 km radius of the Survey Area, the closest being one record to the east of Pilgangoora made in 1979. Recent records (2012-2016; 16 to 25 km west) are from surveys conducted for the rail and road corridors to the west. These records are surrounding the Turner River. The DBCA has a long-term bilby abundance monitoring program at the Turner River (DPAW 2017a).

All habitats in the Survey Area are suitable for Greater Bilby. Extensive foot transects were walked across all habitats. No burrows were located or scratching/diggings etc that may be attributable to bilby activity.

This species has the potential to occupy the Survey Area as bilbies can be relatively transient across their distribution. No burrows were observed suggesting any current use may be for foraging only and transitory in nature.

#### ***Brush-tailed Mulgara***

Brush-tailed Mulgara is widespread, but patchily distributed in sandy regions of arid central Australia and WA. It inhabits hummock grass plains, sand ridges, and mulga shrubland on loamy soils (Menkhorst and Knight, 2010). It uses the open space between vegetation, a microhabitat that is known to support important prey species and may forage in termite mounds (Molyneux et al. 2018).

The Brush-tailed mulgara constructs burrows or utilises those of other species. Burrows may provide access to prey items, protection from predators and have thermoregulation benefits (Molyneux et al. 2018).

Local database records are to the south and west of the Survey Area with the closest record 10 km to the south. Records originate from biological surveys assessing the impact of rail lines servicing the Pilbara region.

One burrow complex was recorded during traverses searching for signs of the species. Cameras were deployed and Mulgara were captured on 12 occasions over a 26-day period from three cameras that were clustered together around the burrow complex. Shallow digging and a suspected mulgara scat were recorded 100 m to the east and an abandoned burrow was recorded 460 m east northeast. ***The burrow complex was excluded from the permit application area.***

Suitable habitat occurs in the Sandy basin habitat. These areas have a deep sandy soil profile, large spinifex hummocks and are suitable for burrowing.



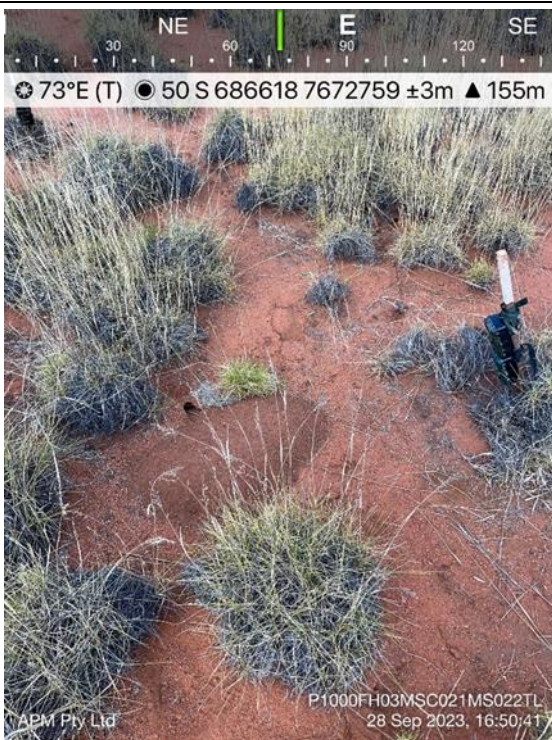
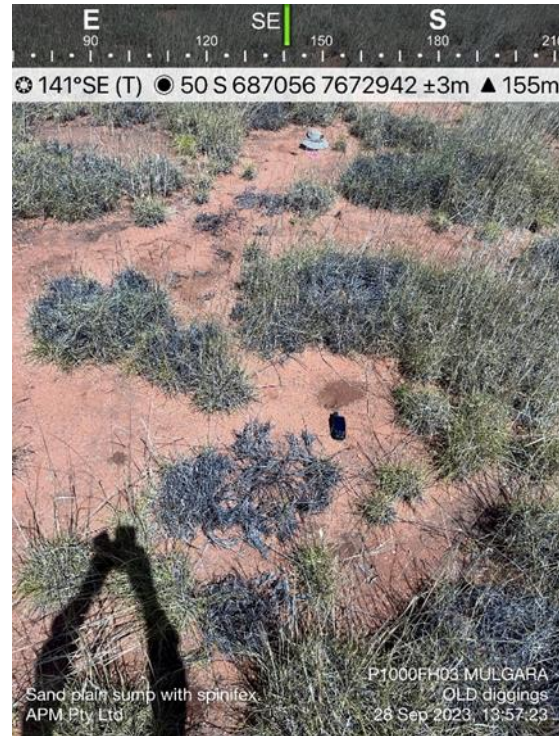


Plate 2-2: Mulgara signs





**Plate 2-3: Brush-tailed Mulgara camera capture**

### ***Spectacled Hare-wallaby (mainland)***

The Spectacled hare-wallaby inhabits tropical tussock or hummock grassland with mid-dense or sparse tree and shrub cover (Menkhorst and Knight, 2010). In the Pilbara this species has declined drastically, possibly due to fox predation and because frequent burning of spinifex grassland has prevented the development of the large hummocks required for shelter (Van Dyck and Strahan 2008).

There are many local records, in the surrounding foothills and plains habitats. These records are from the early 1990's.

The species was not recorded during the detailed and reconnaissance fauna surveys for the Pilgangoora Project with the absence of the species attributed to the broader regional decline. Scats recorded in two subsequent studies (APM 2022b, APM 2023d) were determined to be likely of belonging to the Spectacled hare-wallaby. The habitats available in the Survey Area, particularly in the Shallow Drainage Depressions and Creeks where the scats were recorded, offer a denser cover of vegetation that may be providing sufficient shelter from predation for the species to persist locally.

### **2.9.4 INTRODUCED FAUNA**

The field survey identified the presence of two introduced fauna species.

Eleven camera captures from two locations were of cattle, which is expected as the land is within a station and pastoralism is the active land use within all surveyed areas.

Fifty-nine camera captures of cat were from one camera, focused on a termite mound. Markings indicate this is one individual. The animal appears to be residing in the termite mound with several captures a day of the animal entering and exiting the mound. The mound is also the location where the Pilbara Olive Python was recorded and is 600 m north of the location where Mulgara were recorded. Note that the cat was caught and euthanased.

## 2.10 ENVIRONMENTALLY SIGNIFICANT AREAS

### 2.10.1 CONSERVATION ESTATE

The Western Australian Conservation Estate includes land and waters vested in the Conservation and Parks Commission under *the Conservation and Land Management Act 1984*. The Conservation Estate is managed by the Parks and Wildlife Service of DBCA to protect WA's biodiversity, and includes National Parks, Nature Reserves, Conservation Reserves, and other areas managed primarily for biodiversity conservation (DEE 2016).

A search of the Collaborative Australian Protected Area Database returned no conservation estates located within 50 km of the Survey Area. The nearest gazetted terrestrial conservation estate is Mungaroona Range, 60-80 km to the south-west of the Survey Area.

### 2.10.2 ENVIRONMENTALLY SENSITIVE AREAS

Environmentally Sensitive Areas (ESA) are areas that are defined by the Department of Water and Environment Regulation (DWER) (2019) as:

- A declared World Heritage property as defined in s.13 of the EPBC Act;
- An area that is included on the Register of the National Estate, because of its natural heritage value under the Australian Heritage Council Act 2003;
- A defined wetland and the area within 50 m of the wetland;
- The area covered by vegetation within 50 m of T flora, to the extent to which the vegetation is continuous with the vegetation in which the T flora is located;
- The area covered by a TEC;
- A Bush Forever site;
- Areas covered by the Gngara Mound Crown Land Policy and Western Swamp Tortoise Policy;
- Areas covered by lakes, wetlands, and fringing vegetation of the Swan Coastal Plain Lakes Policy, including Southwest Agricultural Zone Wetlands Policy and Swan and Canning Rivers Policy; and
- Protected wetlands as defined in the Environmental Protection (Southwest Agricultural Zone Wetlands) Policy 1998.

Environmentally Sensitive Areas can be viewed on the DWER clearing permit system map viewer. There are no ESAs within the Survey Area.

The Australian Wetlands Database includes nationally significant wetlands (as listed in the directory of important wetlands), wetlands listed under the Ramsar convention, wetlands that are representative, rare or unique, or wetlands that are considered of international importance (DEE 2019). The nearest wetlands listed

in the Directory of Important Wetlands within 150 km of the Survey Area are the Leslie (Port Hedland) Saltfields System, 80 km to the north, the De Grey River System, 85 km to the north-east, and the Fortescue Marshes, 130 km to the south-west.

### 3 ENVIRONMENTAL RISK MANAGEMENT

#### 3.1 IDENTIFYING ENVIRONMENTAL THREATS

Threats related to clearing of native vegetation at the Pilgangoora Project are summarised in Table 3-1.

**Table 3-1: Threats from clearing native vegetation**

ENVIRONMENTAL THREAT	POTENTIAL RISK
Clearing of native vegetation	Clearing beyond approved boundaries and/or exceeding approved disturbance areas.
Dust	Impacts to native flora caused by dust emanating from the site.
Impacts to surface water flows	Clearing of vegetation leading to changes to runoff or mobilisation of sediment resulting in adverse impacts to natural surface water flows, potentially impacting creek lines and downstream riparian vegetation.
Native fauna and habitat	Clearing of vegetation and activity associated with the project has potential to directly (vehicle strikes, habitat removal) and indirectly impact native fauna (changes to foraging or dispersion dynamics).
Introduced flora	Weeds competing with native species and impacting the success of rehabilitation.

#### 3.2 RISK ASSESSMENT

An Environmental Risk Assessment was undertaken for the threats identified above using the criteria adopted from the DEMIRS Statutory Guidelines for Mining Proposals (2020) – see Table 3-2 below.

**Table 3-2: Clearing risk assessment**

ENVIRONMENTAL THREAT	CAUSE	POTENTIAL IMPACT	BEFORE MANAGEMENT			MANAGEMENT PRACTICES TO BE IMPLEMENTED	AFTER MANAGEMENT		
			Consequence	Likelihood	Inherent Risk		Consequence	Likelihood	Residual risk
Clearing of vegetation	Clearing works undertaken for project development	Clearing of vegetation in unapproved areas and/or outside the tenement boundary.  Environmental factor: • Biodiversity/Flora/Fauna/ Ecosystem	Moderate	Possible	Moderate (B3)	<ul style="list-style-type: none"> <li>Survey undertaken prior to clearing.</li> <li>Induction training highlights the procedure for clearing and the consequences of unauthorised clearing.</li> <li>Land Use Certificate permitting system and procedure is in place.</li> <li>Survey control of areas to be cleared.</li> <li>Post clearing checks to ensure clearing has been undertaken in accordance with approval.</li> </ul>	Moderate	Unlikely	Moderate (C4)
		Clearing of vegetation resulting in loss of conservation significant species or habitat.  Environmental factor: • Biodiversity/Flora/Fauna/ Ecosystem	Moderate	Likely	High(C2)	<ul style="list-style-type: none"> <li>Survey undertaken prior to clearing.</li> <li>Induction training highlights the procedure for clearing and the consequences of unauthorised clearing.</li> <li>Land Use Certificate permitting system and procedure is in place.</li> <li>Survey control of areas to be cleared.</li> <li>Understand and record Priority Flora locations. Maintain GIS records and record impacts to Priority Flora if they are subject to clearing.</li> </ul>	Moderate	Possible	Moderate (B3)
Dust	Vehicle and machinery movement	Dust resulting from movement of vehicles and operation of machinery settles on adjacent vegetation and causes plant death.  Environmental factor: • Biodiversity/Flora/Fauna/ Ecosystem	Minor	Likely	Moderate (B2)	<ul style="list-style-type: none"> <li>Regular dust suppression of vehicle access roads, hardstand areas using water carts.</li> <li>Stripping and movement of topsoil not to be undertaken in windy conditions where practical.</li> </ul>	Minor	Unlikely	Low (B4)
	Wind	Dust generated by wind blowing across cleared areas and stockpiles settles on adjacent vegetation and causes plant death.  Environmental factor: • Biodiversity/Flora/Fauna/ Ecosystem	Minor	Likely	Moderate (B2)	<ul style="list-style-type: none"> <li>Regular dust suppression of vehicle access roads, hardstands using water carts.</li> <li>Dust suppression of stockpiles as required.</li> <li>Clearing of vegetation to be undertaken progressively.</li> </ul>	Minor	Possible	Moderate (B3)
Surface water flows	Interruption of natural surface water flows	Surface water flows are captured or redirected away from the natural drainage channels resulting in impact to riparian vegetation.  Environmental factor: • Biodiversity/Flora/Fauna/ Ecosystem • Water resources	Major	Possible	High (D3)	<ul style="list-style-type: none"> <li>Surface water flows to be redirected away from operational areas in an effort to minimise disruption of surface flow.</li> <li>Surface Water Management Plan to implemented.</li> </ul>	Major	Unlikely	Moderate (D4)
	Uncontrolled surface water movement	Surface water flows carry sediment into surrounding vegetation causing vegetation death.  Environmental factor: • Biodiversity/Flora/Fauna/ Ecosystem • Water resources	Moderate	Likely	High (C2)	<ul style="list-style-type: none"> <li>Drainage and containment structures to direct flows to sediment traps for removal of sediment before discharge to the environment.</li> </ul>	Moderate	Unlikely	Moderate (C4)
Native fauna and habitat	Clearing of Vegetation	Clearing results in loss of conservation-significant fauna or suitable habitat  Environmental factor: • Biodiversity/Flora/Fauna/ Ecosystem	Moderate	Possible	Moderate (C3)	<ul style="list-style-type: none"> <li>Survey undertaken prior to clearing.</li> <li>Clearing managed with the Land Use Certificate process.</li> </ul>	Moderate	Unlikely	Moderate (C4)
	Interaction with fauna	Interaction with native fauna causes detriment to significant species.  Environmental factor: • Biodiversity/Flora/Fauna/ Ecosystem	Moderate	Possible	Moderate (C3)	<ul style="list-style-type: none"> <li>Induction and site rules relating to avoiding interaction with fauna.</li> <li>Appropriate management of waste.</li> <li>Speed limits imposed on Project roads.</li> <li>Management of site landfill in accordance with DWER licence conditions.</li> </ul>	Moderate	Unlikely	Moderate (C4)



ENVIRONMENTAL THREAT	CAUSE	POTENTIAL IMPACT	BEFORE MANAGEMENT			MANAGEMENT PRACTICES TO BE IMPLEMENTED	AFTER MANAGEMENT		
			Consequence	Likelihood	Inherent Risk		Consequence	Likelihood	Residual risk
Introduced flora	New weed species introduced to site	Machinery and equipment brought to site carrying seeds of weed species not currently found in the project area. Environmental factor: <ul style="list-style-type: none"> <li>Biodiversity/Flora/Fauna/Ecosystem</li> </ul>	Minor	Possible	Moderate (B3)	<ul style="list-style-type: none"> <li>Weed hygiene procedure.</li> <li>Machinery and equipment to be cleaned prior to being mobilised to site.</li> <li>Inspection of machinery on arrival, not permitted to work until appropriately cleaned.</li> <li>Weed surveys to be undertaken.</li> </ul>	Minor	Unlikely	Low (B4)

## 4 ADDRESSING THE TEN CLEARING PRINCIPLES

Under section 51-O of the EP Act, the CEO must have regard to the clearing principles, outlined in Schedule 5 of the EP Act, when deciding to grant, or refuse, a permit. Table 11 below addresses the ten clearing principles in relation to the permit application area.

**Table 4-1: Addressing the Ten Clearing Principles**

THE TEN PRINCIPLES OF CLEARING NATIVE VEGETATION	
<b>Principle (a)</b>	<b>Native vegetation should not be cleared if it comprises a high level of biological diversity</b>
<p>The flora and vegetation surveys within the Permit Application Area recorded a total of:</p> <ul style="list-style-type: none"> <li>59 native taxa (37 genera from 15 families) recorded by APM (2023)</li> </ul> <p>The level of flora diversity in the permit application area is not high, relative to other surveys in the local and regional area.</p> <p>Fauna habitats recorded are like those recorded in the surrounding areas and are not unique to the permit application area. On a regional level, Burbidge et al. (2010) find that habitats that support significantly higher biodiversity for avian fauna in the Pilbara are riverine levees, riverine beds, or clay pans with River Gums and/or paperbark trees.</p> <p>Whilst the survey areas contain drainage lines, the location where the Survey Area crosses the creek is of lower habitat value than the areas downstream of the confluence of adjacent creeks and is not as well developed as described by Burbidge et al. (2010). On a National and International level there are no Key Biodiversity Areas in the survey areas, with the closest being the Fortescue Marsh, 140 km to the south.</p> <p>Thereby the proposed clearing is unlikely to have a significant impact on biological diversity and it is unlikely to be considered to be at variance with clearing principle (a).</p>	
<b>Principle (b)</b>	<b>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</b>
<p>Fauna habitats within the Permit Application Area are typical of the local and regional area and are not unique to the area. The survey areas are typical of the Land Systems within which they occur (Department of Primary Industries and Regional Development, 2019).</p> <p>The Land Systems comprising the Permit Application Area predominately contains the Macroy system, with the distribution of the Macroy system described as very common.</p> <p>The Permit Application Area has been developed to avoid higher value habitats where conservation significant fauna were recorded, including sandy basin habitat containing Brush tailed Mulgara. While one record of Pilbara Olive Python was made within the permit application area, its location within the termite mound was considered <i>novel</i>, and likely to be a transitional refuge as it traversed the area.</p> <p>Whilst not recorded during the P1000 Camp survey, the Northern Quoll is known to occur in the local area and critical habitat has previously been identified in the ridgeline 10 km to the east of the Survey Area. The permit application area contains habitat that is of value to the Northern Quoll for denning, foraging and dispersal. While all habitats may be utilised at some time, the Granite Dome and Drainage Line habitats are of greatest value. Whilst of value to the Northern Quoll, these habitats are not critical to the survival of the species as described in (CoA 2016), or within 1 km of habitat that is critical to the survival of the Northern Quoll.</p>	

**THE TEN PRINCIPLES OF CLEARING NATIVE VEGETATION**

The Pilbara leaf-nosed Bat is known to occur in the local area and diurnal roosts occur within the range of the Survey Area. There are no roosts suitable for the Pilbara leaf-nosed Bat in the Survey Area and the species was not recorded during acoustic survey. The conservation ranking of foraging habitat in the Survey Area is limited to small areas of Priority 4 foraging habitat with the majority being Priority 5. For the majority of the site, the species may occasionally use the habitats for foraging or in transit to other more productive areas.

The Ghost Bat is known to occur in the local area and diurnal roosts are known to occur within range of the Survey Area. The Survey Area is suitable foraging habitat for the Ghost Bat. The Ghost Bat was not recorded during the acoustic survey, however, the method has limitation with detection of the species. The species is likely to occur within the Survey Area at some time, for foraging purposes only.

Clearing is not likely to be at variance with clearing principle (b).

<b>Principle (c)</b>	<b>Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.</b>
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No rare (Threatened) flora has been recorded from the permit application area and the vegetation in the assessment area is unlikely to include, or be necessary for the continued existence of rare flora.

Vegetation was determined as unsuitable habitat (or suitable land system) for the Endangered *Quoya zonalis* (formerly *Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4)).

The permit application area has been designed to avoid locations of Priority (P3) flora *Triodia chichesterensis* and *Euploca mutica*. While recorded locally in the survey (APM 2023) areas have been excluded from the permit application area.

The proposed clearing is not likely to be at variance with clearing principle (c).

<b>Principle (d)</b>	<b>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.</b>
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The vegetation of permit application area is not consistent with the description of any threatened ecological community.

The closest Priority Ecological Community to the permit application area is the Gregory Landsystem, over 30 km away. Given the distance from the PEC the clearing will not impact the community.

Therefore, the clearing is not likely to be at variance with clearing principle (d).

<b>Principle (e)</b>	<b>Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.</b>
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Regional Vegetation Associations within the permit application area as described by Beard have over 99% pre-European Vegetation extent remaining. Conservation significance ranking of vegetation associations occurring within the permit application area are of 'Least Concern'.

The proposed clearing is not likely to be at variance with clearing principle (e).

<b>Principle (f)</b>	<b>Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.</b>
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The permit application area intersects a creek line and drainage depressions. The ephemeral creeks flow periodically during high rainfall events associated with cyclonic events and tropical lows. Being ephemeral creeks, the associated vegetation is adapted to long periods with no stream-flows.

Two vegetation types were mapped within the drainage features of the permit application area, including vegetation types: 4b and 7b.

**THE TEN PRINCIPLES OF CLEARING NATIVE VEGETATION**

Major drainage lines and creek lines will be avoided during clearing to the maximum extent possible. Where clearing is for a road and it intersects with a creek line the road will be designed to maintain water flows through construction at grade or with adequate sized culverts. If any activity is expected to cause diversion or pooling of water flows, a permit under the Rights in Water and Irrigation Act 1917 will be applied for as required.

The connectivity of streams within the permit application area will be preserved and vegetation within those streams retained.

Proposed clearing within the clearing envelope is not likely to be at variance with clearing principle (f)

<b>Principle (g)</b>	<b>Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.</b>
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Clearing within the permit application area is for the development of infrastructure supporting a mining operation. The infrastructure will be constructed in accordance with appropriate guidelines and standards to prevent appreciable land degradation.

The clearing will be undertaken to minimise potential erosion, sediment movement, dust impacts and water contamination in accordance with management actions outlined in the risk assessment above. Weed impacts will be managed by undertaking the activities outlined in Table 3-2.

The proposed clearing is not likely to be at variance with clearing principle (g).

<b>Principle (h)</b>	<b>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.</b>
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The nearest conservation area to the assessment is the DBCA-managed Mungaroona Range Nature Reserve, which is approximately 80 km south-west of the assessment area.

Millstream-Chichester National Park is 120 km west-south-west while Karijini National Park is 140 km south.

The proposed clearing is not likely to be at variance with clearing principle (h).

<b>Principle (i)</b>	<b>Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.</b>
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Clearing native vegetation may temporarily cause runoff and sedimentation. However with appropriate management actions, impacts on hydrology and drainage should be manageable, particularly as the soils of the Macroy land system has low erodibility.

Any proposed clearing is not likely to intersect groundwater resources of the area as the reported groundwater is >15 metres below ground level.

Clearing will be undertaken in accordance with a Land Use Certificate permitting system. Controls outlined in the Land Use Certificate permitting system reduce potential clearing during wet periods or inappropriate conditions that would lead to surface water quality deterioration.

Clearing is to be undertaken shortly before commencement of infrastructure construction (< 3 months), limiting the period during which cleared land is subject to erosion that would lead to surface water quality decline.

The proposed clearing is not likely to be at variance with clearing principle (i).

<b>Principle (j)</b>	<b>Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.</b>
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### THE TEN PRINCIPLES OF CLEARING NATIVE VEGETATION

The Permit Application Area does intersect multiple ephemeral creek lines. The substrate is predominantly sandy, indicating that rainfall is likely to infiltrate and surface flow is likely only during high magnitude (i.e. prolonged) or high intensity rainfall events so potential for causing or exacerbating the incidence or intensity of flooding is minimal.

The proposed clearing is not likely to be at variance with clearing principle (j).

## 5 REFERENCES

- 360 Environmental (2015) Pilbara Leaf-nosed Bat Survey, Pilgangoora Prepared for Pilbara Minerals November 2015
- 360 Environmental (2016a) Baseline Vertebrate Fauna Survey, Pilgangoora. Prepared on behalf of Pilbara Minerals Limited. Publication date: May 2016.
- 360 Environmental (2016b) Pilbara Leaf-nosed Bat Roost Survey, Pilgangoora Prepared for Pilbara Minerals February 2016
- Anderson B, Thiele K and Barrett M (2017) A revision of the *Triodia basedowii* species complex and close relatives (Poaceae: Chloridoideae). *Australian Systematic Botany* 30, 197-229
- APM (2022a) Lynas Find Biological Survey - Prepared for Pilbara Minerals Limited by APM, October 2022
- APM (2022b) TSF Option 2 and Option 5 Biological Survey - Prepared for Pilbara Minerals Limited by APM, November 2022
- APM (2023a) Pilgangoora Project – Targeted Searches for Northern quoll. Memo report prepared for Pilbara Minerals Pilgangoora Project March 2023.
- APM (2023b) E45/2287 Infill Biological Survey, Pilgangoora Project, WA. Technical Report prepared for Pilbara Minerals Limited May 2023.
- APM (2023c) Pilgangoora Project – Targeted Searches for Conservation Significant Bat Roosts. Memo report prepared for Pilbara Minerals Pilgangoora Project August 2023.
- APM (2023d) Pilgangoora Project Biological Survey- Prepared for Pilbara Minerals Limited Pilgangoora Project, October 2023.
- Armstrong K (2001) The roost habitat and distribution of the orange leaf-nosed bat, *Rhinonicteris aurantius*, in the Pilbara region of Western Australia. *Wildlife Research*. 28:95–104.
- Armstrong K and Anstee S (2000) The ghost bat in the Pilbara: 100 years on. *Australian Mammalogy*. 22:93–101.
- ALA (2023) Atlas of Living Australia. Online database. Accessed December 2023.
- Bat Call WA (2021a) A review of ghost bat ecology, threats and survey requirements, report prepared for the Department of Agriculture, Water and the Environment, Canberra. CC BY-NC-ND 4.0.
- Bat Call WA (2022b) A review of Pilbara leaf-nosed bat ecology, threats and survey requirements, report prepared for the Department of Agriculture, Water and the Environment, Canberra, November.
- Baudinette R, Churchill S, Christian K, Nelson J and Hudson P (2000) Energy, water balance and the roost microenvironment in three Australian cave-dwelling bats (Microchiroptera). *Journal of Comparative Physiology*. B 170:439–446.
- Beard J (1975) Vegetation Survey of WA, 1:1,000,000 series, Pilbara Sheet and Explanatory Notes. University of Western Australia Press.
- BirdLife International (2019) Species factsheet: *Falco hypoleucos*. Accessed July 2022 <http://www.birdlife.org>
- BirdLife International (2022) Species factsheet: *Erythrotriorchis radiatus*. Downloaded from <http://www.birdlife.org> on 01/11/2022.
- Bullen R (2013) Pilbara leaf-nosed bat, *Rhinonicteris aurantia*: Summary of current data on distribution, energetics and threats. Presentation made to Western Australian Department of Environment and Conservation workshop on Pilbara leaf-nosed bats, 25 June 2013

Bullen R (2021) Ghost bats in the Pilbara, *Macroderma gigas*: Summary of current data on distribution, energetics and threats. Presentation made to Curtin University workshop, 2 March 2021.

Bureau of Meteorology (2023) Climate Data Online. Available online: <http://www.bom.gov.au/climate/data/>

Churchill S (1991) Distribution, abundance and roost selection of the Orange Horseshoe-bat, *Rhinonycteris aurantius*, a tropical cave dweller. *Wildlife Research*. 18:343–353.

Churchill S, Helman P and Hall L (1988) Distribution, populations and status of the Orange Horseshoe Bat, *Rhinonycteris aurantius* (Chiroptera: Hipposideridae). *Australian Mammalogy*. 11(1):27–33.

Clarke K and Gorley R (2015) PRIMER v7: User Manual/Tutorial. PRIMER-E Plymouth.

Commonwealth of Australia (COA) (2016) EPBC Act referral guideline for the endangered northern quoll, Commonwealth of Australia 2016.

Cramer VA, Armstrong KN, Bullen RD, Cross SL, Gibson L, Hanrahan N, Knuckey CG, Ottewell K, Reiffer S, Ruykys L and Shaw RE (2022) Research priorities for the ghost bat (*Macroderma gigas*) in the Pilbara region of Western Australia. *Australian Mammalogy*. <https://doi.org/10.1071/AM21042>

Department of Agriculture, Water and the Environment (DAWE) (2020) National Established Weed Priorities – Towards A National Framework – Final Draft. Prepared by Wild Matters Pty. Ltd. for the Department of Agriculture, Water and the Environment July 2020.

Department of Biodiversity, Conservation and Attractions (DBCA) (2017) Night parrot. Published: 26 May 2017. Available at <https://www.dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/threatened-animals/night-parrot>

Department of Biodiversity, Conservation and Attractions (DBCA) (2023a) Dandjoo search accessed on the 14/03/2023. Available at <https://dandjoo.bio.wa.gov.au/>

Department of Biodiversity, Conservation and Attractions (DBCA) (2023b) DBCA Fire History (DBCA-060). Fire Management Services Branch. Last updated 01/07/2023. Available at <https://catalogue.data.wa.gov.au/dataset/dbca-fire-history>

Department of Biodiversity, Conservation and Attractions (DBCA) (2023c) List of threatened and priority flora. <https://www.dbca.wa.gov.au/wildlife-and-ecosystems/plants/list-threatened-and-priority-flora>. Accessed 12/01/2024.

Department of Climate Change, Energy, the Environment and Water (DCCEEW) (2023) Approved lists under the EPBC Act. Available at: <https://www.dcceew.gov.au/environment/epbc/what-is-protected/approved-lists#species>

Department of the Environment, Heritage, Water and the Arts (2010) Survey guidelines for Australia's threatened bats: Guidelines for detecting bats listed as threatened under the Environment Protection and Biodiversity Conservation Act 1999. Commonwealth of Australia.

Department of Parks and Wildlife (DPAW) (2017a) The conservation and management of the bilby (*Macrotis lagotis*) in the Pilbara: Progress Report 2017, Department of Parks and Wildlife, Perth.

Department of Parks and Wildlife (DPAW) (2017b) Interim guideline for preliminary surveys of night parrot (*Pezoporus occidentalis*) in Western Australia. Version 1 May 2017.

Department of Primary Industries and Regional Development (DPIRD) (2019a) Soil Landscape Mapping – Best Available DPIRD-027. Version 05.01. Data last updated 02-08-2019.

Department of Primary Industries and Regional Development (DPIRD) (2019b) Pre-European Vegetation (DPIRD-006). Available from Natural Resource Information (WA) ([agric.wa.gov.au](http://agric.wa.gov.au)). Accessed 2 August 2021.

Department of Primary Industries and Regional Development (DPIRD) (2023) Western Australian Organism List (WAOL). Available at: <https://www.agric.wa.gov.au/bam/western-australian-organism-list-waol> Accessed 15/09/2023.

Department of Primary Industries and Regional Development (DPIRD) (2023) Hard spinifex plain pastures in the Pilbara, Western Australia. Page last updated: Friday, 14 April 2023. Available at: <https://www.agric.wa.gov.au/rangelands/hard-spinifex-plain-pastures-pilbara-western-australia>

Department of Sustainability Environment Water Population and Communities (DSEWPAC) (2011a) Survey Guidelines for Australia's Threatened Mammals, Australian Government. Retrieved from <https://www.awe.gov.au/environment/epbc/publications/survey-guidelines-australias-threatened-mammals>

Department of the Environment (2015) Threat abatement plan for predation by feral cats. Canberra, ACT: Commonwealth of Australia. Available from: <http://www.environment.gov.au/biodiversity/threatened/publications/tap/threat-abatement-plan-feral-cats>. In effect under the EPBC Act from 23-Jul-2015.

Department of the Environment and Energy (DEE) (2016) Collaborative Australian Protected Areas Database -Terrestrial CAPAD 2016. Australian Government

Department of the Environment and Energy (DEE) (2018) Guidelines for biological survey and mapped data, Australian Government. Retrieved from <https://www.awe.gov.au/environment/environmental-information-data/information-policy/guidelines-for-biological-survey-mapped-data>

Department of Water and Environmental Regulation (DWER) (2019) Clearing Regulations - Environmentally Sensitive Areas. Government of Western Australia.

Ecologia Environmental (2018a) Pilgangoora Lithium Project – M45/1260 Level 1 Fauna and Reconnaissance Flora and Vegetation Assessment. Prepared on behalf of Altura Mining Limited. Publication date: 7 July 2018.

Ecologia Environmental (2018b) Pilgangoora Project – Stage 2 Expansion Desktop Environmental Assessment. Prepared on behalf of Pilbara Minerals Limited. Publication date: 26 October 2018.

Ecoscope (2020) Pippingarra and Wodgina Roads: Flora and Fauna Survey – Prepared for Iron Bridge Operations Pty Ltd 10/08/2020.

Ellis RJ and Johnstone RE (2016) *Liasis olivaceus barroni* (Pilbara olive Python) diet. Herpetol. Rev. 47, 685.

Ellis, RJ (2013) *Liasis olivaceus barroni* (Pilbara olive python) diet. Herpetol. Rev. 44, 693.

Environmental Protection Authority (EPA) (2016) Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment. Available online: <https://www.epa.wa.gov.au/policies-guidance/technical-guidance-flora-and-vegetation-surveys-environmental-impact-assessment>

Environmental Protection Authority (EPA) (2020) Technical Guidance - Terrestrial vertebrate fauna surveys for environmental impact assessment. Available online: <https://www.epa.wa.gov.au/policies-guidance/technical-guidance-terrestrial-vertebrate-fauna-surveys-environmental-impact>

Environmental Protection Authority (EPA) (2021) Instructions for the preparation of data packages for the Index of Biodiversity Surveys for Assessments (IBSA). 15 November 2021.

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

Frohlich MW, Thulin M and Chase MW (2020) Ninety-three new combinations in *Euploca* for species of *Heliotropium* section *Orthostachys* (Boraginaceae sensu APG). Phytotaxa 434 (1): 013–021.



Geological Survey of Western Australia (2014) 1:100 000 Geological Map – WODGINA (2655), second edition. Perth: Author.

Hill B and Ward S (2010) National Recovery Plan for the Northern Quoll *Dasyurus hallucatus*. Department of Natural Resources, Environment, The Arts and Sport, Darwin

Jolly S (1988) Five colonies of the Orange Horseshoe Bat, *Rhinonycteris aurantius* (Chiroptera: Hipposideridae), in the Northern Territory. *Australian Wildlife Research*. 15:41–49.

Kendrick P and McKenzie N (2001) Pilbara 1: PIL1 Chichester Supregion. Available online: [https://www.dpaw.wa.gov.au/images/documents/about/science/projects/waaudit/pilbara01\\_p547-558.pdf](https://www.dpaw.wa.gov.au/images/documents/about/science/projects/waaudit/pilbara01_p547-558.pdf)

Menkhorst P and Knight F (2010) *A Field Guide to the Mammals of Australia*. 3rd ed. CSIRO Publishing, Sydney

MMWC Environmental Pty Ltd (2016a) Pilgangoora Project Area – Flora, Vegetation and Fauna Assessment. Prepared on behalf of Pilbara Minerals Limited. Publication date: July 2016

MMWC Environmental Pty Ltd (2016b) Pilgangoora Access Road Borrow Pits - Flora and Vegetation Assessment. Prepared on behalf of Pilbara Minerals Limited. Publication date: July 2016.

Molyneux J, Pavey C, James A, Carthew S (2018) Habitat use by the brush-tailed mulgara (*Dasyercus blythi*). *Australian Journal of Zoology* 65(5) 335-345.

Natural Area Consulting (2014) Flora and Fauna Survey Report – Pilgangoora. Prepared on behalf of Altura Mining Limited, February 2014.

Natural Area Consulting Flora (2016) Vegetation and Fauna Survey Report – Pilgangoora Lithium Project. Prepared on behalf of Altura Mining Limited, June 2016.

Outback Ecology (2009) Wodgina DSO Project Flora and Vegetation Assessment. Unpublished report prepared for Atlas Iron Limited.

Pearson DJ (1993) Distribution, status and conservation of pythons in Western Australia In: Lunney, D and Ayers, D (Eds) *Herpetology in Australia: a Diverse Discipline*, pp. 383-395, Royal Zoological Society of NSW, Sydney.

Pearson DJ (2006) Giant Pythons of the Pilbara. *Landscape* 19: 32-39.

Pfautsch S, Dodson W, Madden S and Adams MA (2014) Assessing the impact of large-scale water table modifications on riparian trees: a case study from Australia. *Ecohydrology*, 8(4):642-51.

Richards G, Hand S, Armstrong K and Hall L (2008) Ghost bat *Macroderma gigas*. In *The Mammals of Australia*. Third Edition. (Eds S. Van Dyck and R. Strahan), pp. 449-450. Reed New Holland, Chatswood.

Schoenjahn J (2018) Adaptations of the rare endemic grey falcon *Falco hypoleucos* that enable its permanent residence in the arid zone of Australia. PhD Thesis. University of Queensland

Southgate R (1990) Habitats and diet of the Greater Bilby *Macrotis lagotis* Reid (Marsupialia: Permelidae) (pp.293-302). In 'Bandicoots and bilbies'. (Surrey Beaty and Sons: Sydney.)

Southgate R, Paltridge R, Masters P and Carthew S (2007) Bilby distribution and fire: a test of alternative models of habitat suitability in the Tanami Desert, Australia. *Ecography* 30, 759–776.

Specialised Zoological (2022) Acoustic analysis and bat call identification from Lynas Find, Western Australia. Unpublished report by Specialised Zoological for Animal Plant Mineral Pty Ltd, 23 November 2022, project reference SZ637.

Specialised Zoological (2024). Acoustic analysis and bat call identification from Pilgangoora, Western Australia: October 2023. Unpublished report by Specialised Zoological for Animal Plant Mineral Pty Ltd, 8 January 2024, project reference SZ690

Swan M (2007) Keeping and Breeding Australian Pythons, Mike Swan Herp Books, Lilydale.

Terrestrial Ecosystems (2020) Northern Quoll survey on mining tenement M45/1266. Memo prepared for Pilbara Minerals, January 2020.

Thackway R and Cresswell I (1995) An Interim Biogeographic Regionalisation for Australia. Available online: <https://www.environment.gov.au/system/files/resources/4263c26f-f2a7-4a07-9a29-b1a81ac85acc/files/ibra-framework-setting-priorities-nrs-cooperative-program.pdf>

Threatened Species Scientific Committee (TSSC) (2008) Approved Conservation Advice for *Liasis olivaceus barroni* (Olive Python - Pilbara subspecies). Canberra: Department of the Environment, Water, Heritage and the Arts. Available from: <http://www.environment.gov.au/biodiversity/threatened/species/pubs/66699-conservation-advice.pdf>. In effect under the EPBC Act from 03-Jul-2008.

Threatened Species Scientific Committee (TSSC) (2016) Conservation Advice: *Rhinonicteris aurantia* (Pilbara form), Pilbara Leaf-nosed Bat., Canberra, Australian Capital Territory

Threatened Species Scientific Committee (TSSC) (2020) Conservation Advice *Falco hypoleucos* grey falcon. Approved from 09/07/2020.

Tille P (2006) Soil-Landscape Zones of Western Australia's Rangelands and Interior. (Resource Management Technical Report 313). Western Australia: Department of Agriculture and Food.

Trudgen M (1988) A Report on the Flora and Vegetation of the Port Kennedy Area. Unpublished report prepared for Bowman Bishaw and Associates, West Perth.

van Dyck S and Strahan R (editors) (2008) The Mammals of Australia. 3rd ed. Reed New Holland, Sydney.

van Vreeswyk A, Payne A, Leighton K and Hennig P (2004) An inventory and condition survey of the Pilbara region, Western Australia. Available online: [https://researchlibrary.agric.wa.gov.au/cgi/viewcontent.cgi?article=1006&context=tech\\_bull](https://researchlibrary.agric.wa.gov.au/cgi/viewcontent.cgi?article=1006&context=tech_bull)

Western Australian Herbarium (1998-) Florabase. Descriptions by the Western Australian Herbarium, Department of Biodiversity, Conservation and Attractions. Text used with permission (<https://florabase.dpaw.wa.gov.au/help/copyright>). Accessed on 17 May 2023

Western Australian Museum (2023) Checklist of the Terrestrial Vertebrate Fauna of Western Australia. Available at <https://museum.wa.gov.au/research/departments/terrestrial-zoology/checklist-terrestrial-vertebrate-fauna-western-australia> May 2023.

Wilson S and Swan G (2013) A Complete Guide to Reptiles of Australia. New Holland Publishers, Sydney.

## **6 APPENDICES**

### **APPENDIX 1: P1000 CAMP BIOLOGICAL SURVEY (APM 2023)**

See IBSA Package Number: IBSA-2024-0044