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Native Vegetation Clearing Permit – Supporting Report

Flora, Vegetation and Fauna Habitat Assessment for the Southern Fortescue Borefield Upgrade and WTS2 Pipeline Duplication

September 2020

RTIO-HSE-0343816

Hamersley Iron Pty Limited

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Document Status

				Approved for issue	
Rev	**Author**	**Reviewer/s**	**Date**	**Distributed to**	**Date**
A	[redacted]	[redacted]	22/09/2020	[redacted]	
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Executive Summary

Rio Tinto, on behalf of Hamersley Iron Pty Limited (the **Proponent**), is proposing to undertake drilling and replacement of a number of monitoring and production bores at the Southern Fortescue Borefield as well as duplicating the Southern Fortescue Pipeline from the filter plant at Marandoo booster station to Tom Price Town tanks (the **Proposal**). The study area is approximately 707 ha in size and comprises new amendments to CPS 4919/4. A summary of existing flora, vegetation and fauna assessments and a field reconnaissance survey of the CPS 4919/4 amendment (**study area**) was required to address the 10 clearing principles as part of the clearing permit application process. Approval for clearing of native vegetation associated with the Proposal is required via a Native Vegetation Clearing Permit under Section 51A of the *Environmental Protection Act 1986*

The landforms, vegetation and fauna habitats of the study area are well represented within the locality and the broader Hamersley sub-region. Twenty one vegetation units (including one mosaic) were identified across three major landforms within the study area. Seven vegetation units were described from low hills, slopes and breakaways, ten units from plains and floodplains and four units from drainage lines.

None of the vegetation units occurring within the study area are listed as threatened ecological communities under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* or under Western Australian listings. None of the vegetation units occurring within the study area represent communities listed as priority ecological communities.

A total of 92 taxa from 59 genera representing 25 families were recorded during the reconnaissance survey. No species of Threatened flora were recorded, or were expected to occur within the study area. One Priority 3 species, *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) and one Priority 4 species, *Lepidum catapycnon* have previously been recorded in the study area.

Four species, *Vittadinia* sp. Coondewanna Flats (S. van Leeuwen 4684) (P1), *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3), *Rostellularia adscendens* var. *latifolia* (P3) and *Goodenia nuda* (P4), were considered 'Likely' to occur within the study area based on desktop observations. Due to the small scale of the Proposal and existing disturbances in the area, it is unlikely the Proposal will negatively impact on the conservation status of any of these species on either a local or bioregional scale.

Five broad fauna habitat types were recorded within the study area: 'Creekline', 'Minor Drainage Line', 'Stony Plain', 'Mulga Plain', and 'Stony Hills and Slopes'. These fauna habitats are not considered to be restricted at a local or regional level.

No species of Threatened or Priority listed fauna have previously been recorded in the Study Area. Five fauna species were considered 'Likely' or 'Potential' to occur within the study area based on desktop observations. Whilst some of these species may use the area for foraging, it is unlikely the Proposal will negatively impact on the conservation status of any of these species on either a local or bioregional scale.

The Proposal was assessed against the 10 clearing principles as defined in Schedule 5 (Principles for Clearing Native Vegetation) of the *Environmental Protection Act 1986*. Assessment against the Principles concluded clearing within the study area is unlikely to be at variance with the clearing principles.

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1. Introduction

1.1 Project background and study area location

Rio Tinto, on behalf of Hamersley Iron Pty Limited (the **Proponent**), is proposing to undertake the drilling and replacement of a number of monitoring and production bores at the Southern Fortescue Borefield, as well as duplicating the Southern Fortescue pipeline from the filter plant at Marandoo booster station to Tom Price Town tanks (the **Proposal**). Approval for clearing of native vegetation associated with the Proposal is required via a Native Vegetation Clearing Permit (**NVCP**) under Section 51A of *the Environmental Protection Act 1986* (**EP Act**).

A review of the existing flora, vegetation and fauna assessments and a field reconnaissance survey for the borefield, pipeline corridor and associated works (the **study area**) was required to address the 10 Clearing Principles as part of the NVCP application process. This report summarises the biological values to support an amendment to CPS 4919/4.

The study area covers approximately 707 ha of disturbed and undisturbed ground, including intact native vegetation and extends from the Tom Price town site through to the Southern Fortescue Borefield, within the Pilbara region of Western Australia (WA) (Figure 1-1).

1.2 Scope of survey

This report describes the methodology employed for the flora, vegetation and fauna habitat assessment of the study area, and documents the results of relevant, previous surveys. In particular, this report identifies vegetation, flora and fauna habitats of conservation significance relevant to the study area.

This report is intended as a supporting document for an NVCP amendment application by Rio Tinto and has been prepared on the basis of a desktop review of existing information for the study area and reconnaissance survey where existing information was absent.

This report includes a description of the:

- Local environment of the study area including flora, vegetation, fauna habitats, geology, landforms, and hydrology;
- Locations and populations of conservation listed flora;
- Vegetation associations occurring in the study area, an assessment on their condition and conservation significance for the locality and sub-region, including mapping;
- Fauna habitats present, assessment of their significance for the locality and sub-region, including mapping; and
- Potential impacts of the Proposal on the local environment through application of the 10 clearing principles, as outlined in Schedule 5 of the EP Act.

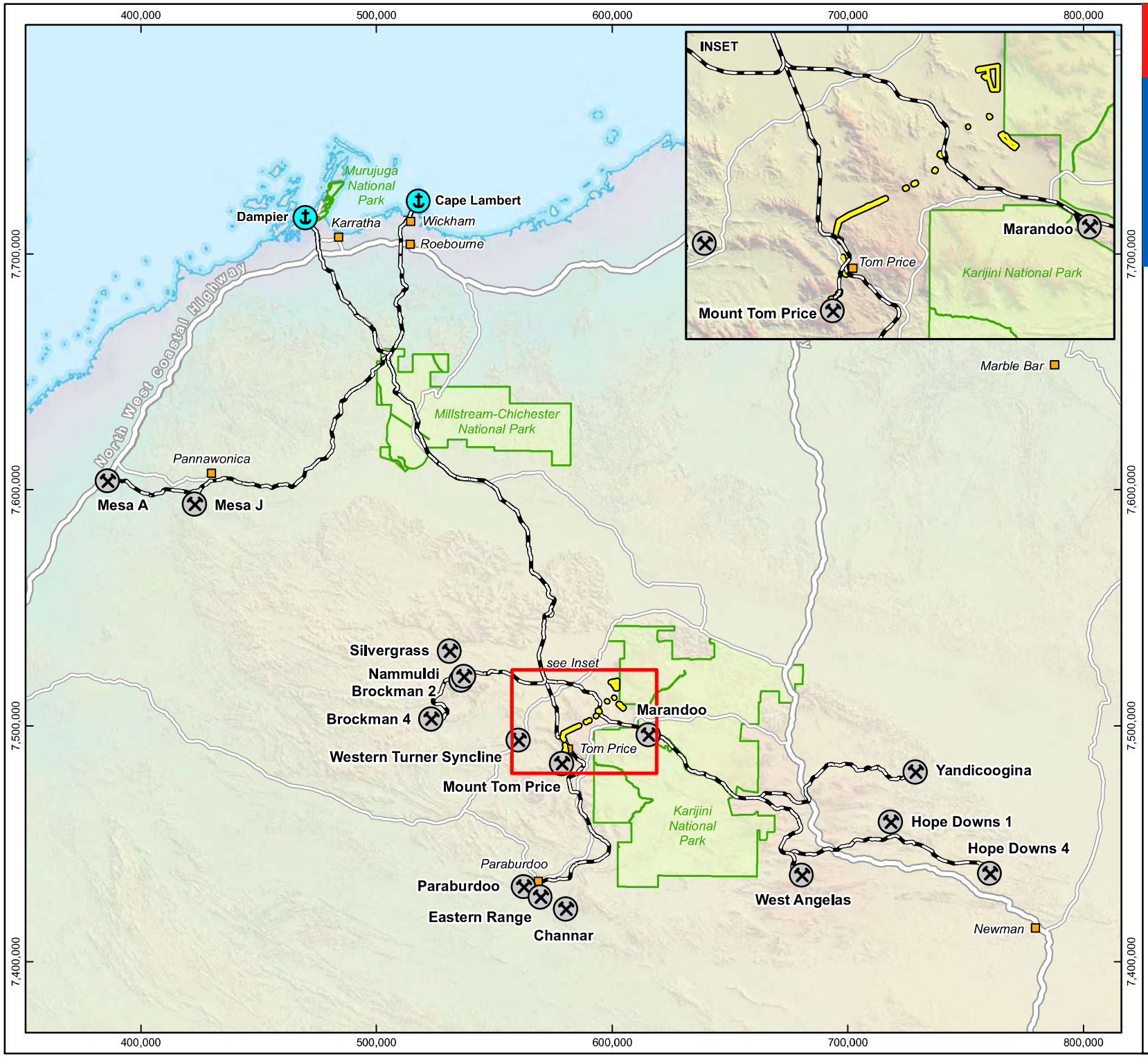

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Figure 1-1: Location of the Study area

Drawn: S.M.
Plan: PDE0172737v2
Date: September 2020
Proj: GDA 1994 M
Scale: 1:2,225,000

Legend

- Study Area
- Rio Tinto Mine
- Port
- Town
- National Park
- Rio Tinto Railway
- Highway
- Major Road

N

0 20 40 60 80 10

Kilometres

Map units in metres

1.3 Limitations

Limitations of the current survey of the study area are summarised in Table 1-1.

Table 1-1: Constraints and limitations of the current study

Constraint	Limitation
Sources of information	The Pilbara bioregion has been relatively well surveyed, with increasing biological survey work occurring due to the resource expansion in the region. Numerous flora and fauna surveys have been conducted in the wider Tom Price area. Therefore, a suitable number of survey reports were available for contextual information. Sources of information were not considered a limitation in this assessment.
Scope of works	The survey requirements of a reconnaissance level terrestrial flora, vegetation and fauna survey for a NVCP application were met. Results were derived and summarised from a combination of a reconnaissance survey and previous surveys relevant to the study area.
Completeness of survey	The majority of the study area was fully surveyed to the satisfaction of an equivalent reconnaissance assessment or had been previously surveyed to a higher standard. No additional surveys were deemed necessary for the purpose of this assessment. Fungi and non-vascular flora (algae, mosses and liverworts) were not sampled.
Intensity of survey	For the majority of the survey area, sources of information were derived and summarised from previous surveys relevant to the study area. Where it was considered inadequate information existed, a field reconnaissance survey was undertaken.
Timing, weather, season, cycle	The reconnaissance survey was conducted from the 30th April – 1st May 2019. Conditions encountered during the survey were regarded as below average conditions, with limited rainfall in the preceding three months. It is likely some annual species may have not been present at the time of survey; however none of these are classified as Threatened.
Disturbances	The study area was predominately disturbed with existing bores, infrastructure and cattle grazing. Majority of the study area had an old fire age.
Resources	The biologists undertaking the surveys and subsequent reports as part of the studies were suitably qualified to identify flora and fauna. Hayden Ajduk (field studies and reporting) has more than ten years of experience as a botanist/biologist in Western Australia, with significant experience working in the Pilbara. Natalie Murdock (field studies) has more than ten years of experience as a botanist/biologist in Western Australia, with significant experience working in the Pilbara. Steven Dillon, from the Western Australian Herbarium, completed the plant specimen identifications. There were no limitations noted in reports cited in the desktop assessment due to resourcing
Accessibility / remoteness	The Southern Fortescue section of the study area was accessed by vehicle and on foot as part of the reconnaissance survey. The Tom Price Pipeline Duplication area was based primarily on desktop results.

1.4 Climate

The closest Meteorological station providing long term data for rainfall and temperature is Wittenoom, located approximately 45 km to the west of the study area. Rainfall data from the Bureau of Meteorology (**BoM**) for Wittenoom is presented in Figure 1-2 (BoM 2018).

The regional climate is semi-arid to semi-tropical with a summer rainfall season and relatively dry winter season, which varies in frequency and volume from year to year. The summer wet months extend from November to April when temperatures can exceed 47°C. The remainder of the year is moderate to warm with a continental effect resulting in low minimum temperatures, below 10°C, in June and July. The closest data for Pan evaporation rates are in Port Hedland, which averages 3,500 mm per annum (Luke *et al*. 1987), exceeding annual rainfall averages.

Annual rainfall is variable with tropical lows producing large regional rainfall events (between 100 mm and 200 mm in a few days) to isolated thunderstorm events in the dry (winter) season. For Wittenoom, the mean annual rainfall for the period 1950 to 2019 is 461.8 mm, with most precipitation occurring between January and March, coinciding with the cyclone season (Figure 1-2). Wittenoom received no significant rainfall in the three months preceding the April-May 2019 survey (Figure 1-2), and 24 mm below average rainfall in January 2019.

Maximum temperatures reflected a warm summer to winter period (BoM 2018). Temperatures recorded preceding the survey were within expected ranges and generally followed mean maximum temperatures (Figure 1-2).

Due to the minimal rainfall recorded at Wittenoom in the months prior to the April-May 2019 survey, it is unlikely all annual species have been recorded for the study area.

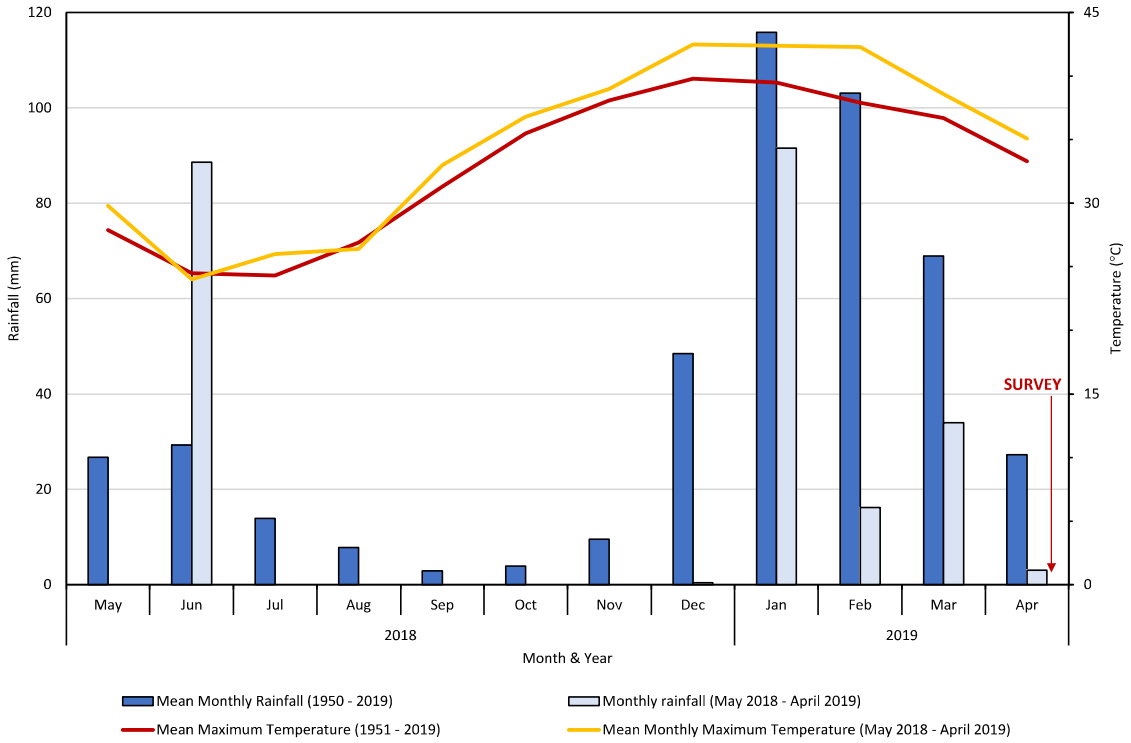

Figure 1-2: Rainfall and temperatures at Wittenoom, May 2018 – April 2019

1.5 Geology and soils

The study area was comprised of nine major geological units based on 1:250,000 scale map sheet series (Martin *et al.* 2014, Figure 1-2). These geological units were:

- Czc: Eluvium. Residual deposits of boulders and cobbled in clay; gilgais.
- Czd: Hematite - Hematite deposits, including canga, mostly residual on marra mamba iron formation and brockman iron formation. Contains Iron Ore.
- Ahm: Marra mamba iron - Chert, ferruginous chert and banded iron with minor shale; jaspilite with pronounced 'pinch and swell' structures, small occurrences of manganese.
- Qa: Quaternary alluvium - Alluvium - unconsolidated silt, sand, aeolian sand, red loamy sand in drifts and fixed shelf dunes and gravel.
- AFd: Dolerite, metadolerite and amphibolite dykes.
- AHd: wittenoom formation - Thin to medium-bedded grey crystalline dolomite, intercalations of chert, dolomitic shale, and metatuff in upper part.
- AFub: Bunjinah - Metabasaltic breccia, pelite and minor chert.
- AFj: Jeerinah - Pillowed and massive metabasalitic breccia.
- Qw: Cainozoic colluvium – Cainozoic – alluvium and colluvium – red brown sandy and clayey soil.

1.6 Surface hydrology

The study area lies within the Hardey River, Caves Creek and Southern Fortescue River catchments (Department of Water (**DoW**) 2016). The study area lies between Barnett Creek (to the west) and Joffre Creek (to the east) and just south of the Fortescue River South tributary, however no major rivers intersect the study area. The study area intersects Barnett Creek and two other unnamed major

creek lines, whilst several other small unnamed minor ephemeral drainage lines also occur in the study area.

1.7 Land systems

Land system (rangeland) mapping is based on regional patterns in topography, soils and vegetation (Christian and Stewart 1953). The most recent land system mapping of the Pilbara bioregion, in which the study area lies, was completed by van Vreeswyk *et al.* (2004). The mapping classifies the Pilbara region into 102 land systems. The study area is located within eight of these mapped Land Systems (Figure 1-3).

The Land Systems and their extent within the study area are presented below (Table1-2).

- Boolgeeda Land System consists of stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands or mulga shrublands.
- Jurrawarrina Land System consist of hardpan plains and alluvial tracts supporting mulga shrublands with tussock and spinifex grasses
- Marandoo Land System consists of basalt hills and restricted stony plains supporting grassy mulga shrublands.
- McKay Land System consists of hills, ridges, plateaux remnants and breakaways of meta sedimentary rocks supporting hard spinifex grasslands with acacias and occasional eucalypts.
- Newman Land System consists of rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands (van Vreeswyk *et al*. 2004).
- Paraburdoo Land System consists of basalt derived stony gilgai plains and stony plains supporting snakewood and mulga shrublands with spinifex, chenopods and tussock grasses.
- Platform Land System consists of dissected slopes and raised plains supporting shrubby hard spinifex grasslands.
- Rocklea Land System consists of Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex and occasionally soft spinifex grasslands with scattered shrubs.

Table 1-2: Land Systems occurring within the study area and their representation in the Pilbara bioregion

Land System (Map code)	Total area (ha) in Pilbara bioregion	Area (ha) in study area	Proportion (%) of study area	Study area proportion (%) of land system extent
Boolgeeda (BGD)	774, 800	466.7	66.0	0.06
Jurrawarrina (JUR)	66,400	106.6	15.1	0.16
Marandoo Land System (MDO)	45,900	47.4	6.7	0.10
McKay Land System (MCK)	4,202	2.1	0.3	0.05
Newman Land System (NEW)	1,458,000	7.0	1.0	0.0005
Paraburdoo Land System (PAR)	56,500	69.1	9.8	0.12
Platform Land System (PLA)	157,000	3.1	0.4	0.002
Rocklea Land System (ROC)	22,993	5.7	0.8	0.02
Total	**n/a**	**707.7**	**100%**	**n/a**

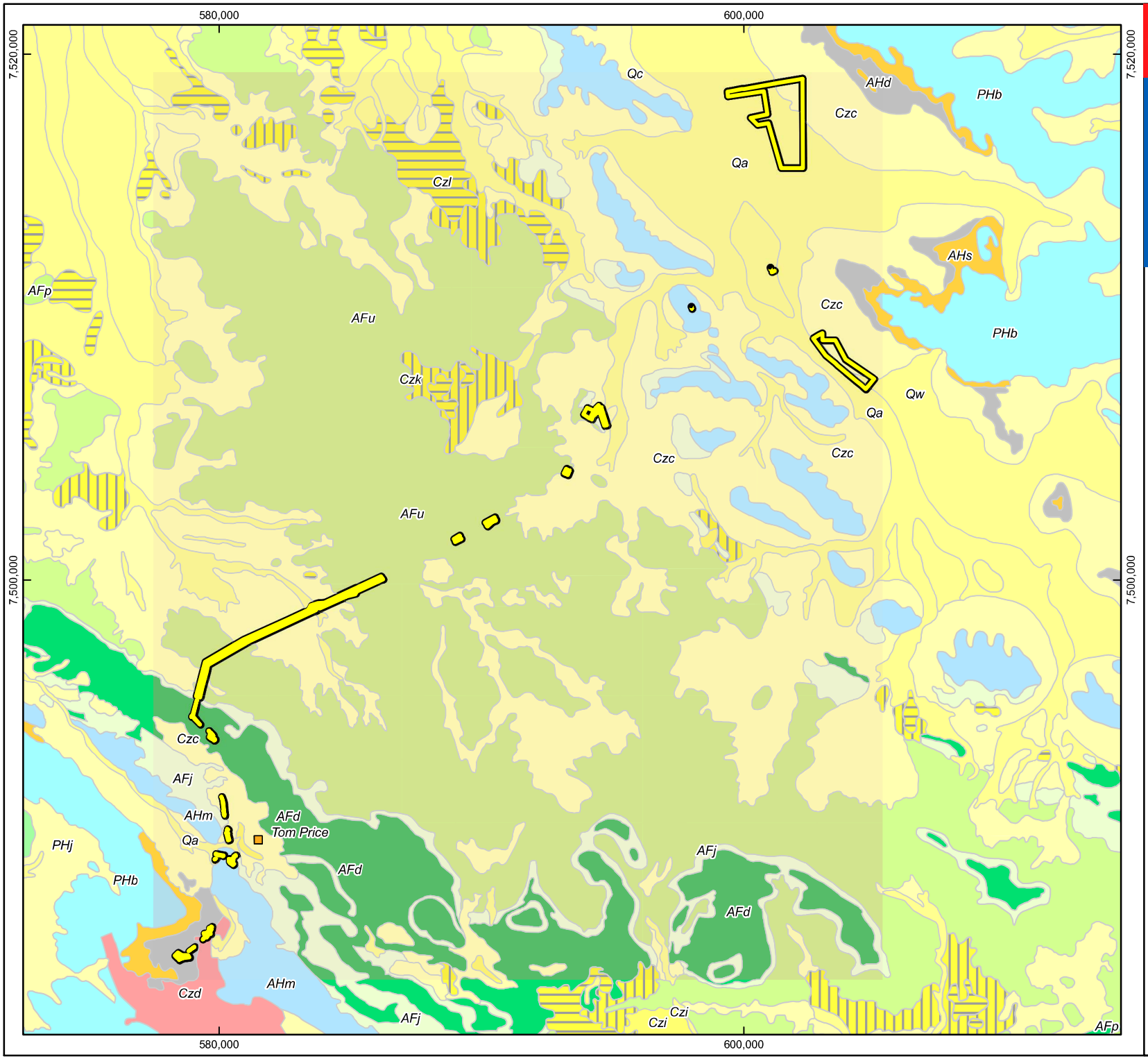

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Figure 1-2: Geology within the study area

Drawn: S.M.
Plan: PDE0172738v3
Date: September 2020

Proj: GDA 1994 M
Scale: 1:200,000 @ [redacted]

Legend

- Study Area
- Town

Geology 250k

AFd	Czi
AFj	Czk
AFp	Czl
AFu	PHb
AHd	PHj
AHm	Qa
AHs	Qc
Czc	Qw
Czd	

N

0 2 4 6 8 1

Kilometres

Map units in metres

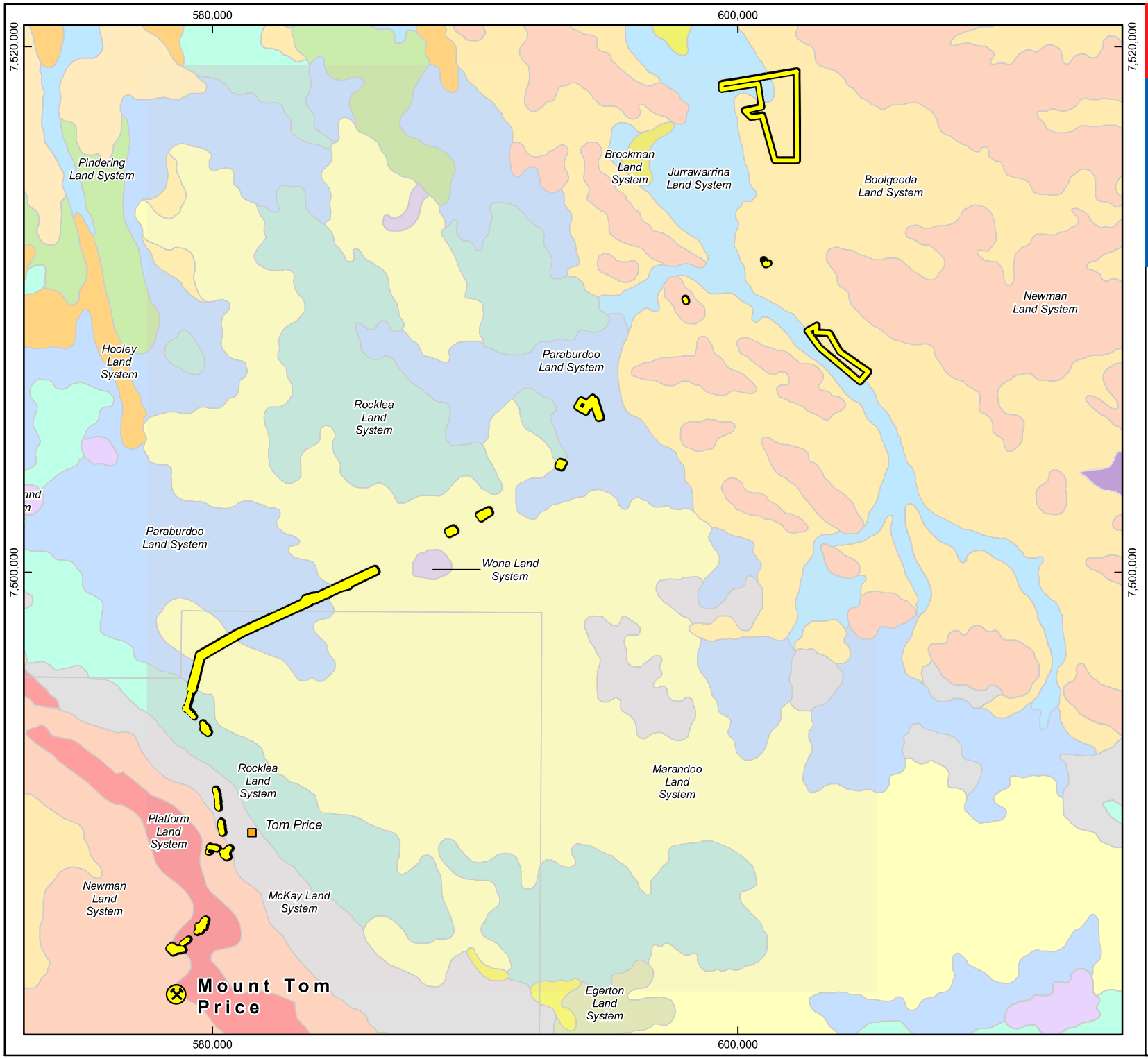

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Figure 1-3: Land systems within the study area

Drawn: S.M.
Plan: PDE0172739v3
Date: September 2020
Proj: GDA 1994 M
Scale: 1:200,000 @ [redacted]

Legend

- Study Area
- Mine Location
- Town

Landsystems

- Boolgeeda Land System
- Brockman Land System
- Egerton Land System
- Hooley Land System
- Jurrawarrina Land System
- Marandoo Land System
- McKay Land System
- Newman Land System
- Nooingn System
- Paraburd Land Sy
- Pinderin System
- Platform System
- Robe La System
- Rocklea System
- Wannam Land Sy
- Wona La System

N

0 2 4 6 8

Kilometres

Map units in metres

1.8 Vegetation

1.8.1 IBRA bioregions and subregions

The Interim Biogeographic Regionalisation of Australia (**IBRA7**) recognises 89 bioregions (DotEE 2018a). The study area is located in the Pilbara (**PIL**) bioregion as defined by IBRA. The Pilbara bioregion has been further subdivided into four subregions: Chichester (**PIL1**); Fortescue Plains (**PIL2**); Hamersley (**PIL3**); and Roebourne (**PIL4**).

The study area falls within the Hamersley sub-region and is described by Kendrick (2001) as:

- *'Mountainous area of Proterozoic sedimentary ranges and plateaux, dissected by gorges (basalt, shale and dolerite). Mulga low woodland over bunch grasses on fine textured soils in valley floors, and Eucalyptus leucophloia over Triodia brizoides on skeletal soils of the ranges. The climate is Semi-desert tropical, average 300 mm rainfall, usually in summer cyclonic or thunderstorm events. Winter rain is not uncommon. Drainage into either the Fortescue (to the north), the Ashburton to the south, or the Robe to the west'.*

1.8.2 Beard's regional vegetation mapping

Vegetation type and extent has been mapped at a regional scale by Beard (1975) who categorised vegetation into broad vegetation associations. Based on this mapping at a scale of 1:1,000,000, the Department of Agriculture and Food WA (**DAFWA**) has compiled a list of vegetation extent and types across WA (Shepherd *et al*. 2002). The study area falls within six vegetation association:

- Hammerlsey 18 (a1Li) - Low woodland; mulga (*Acacia aneura*)
- Hammersley 29 (a1Lp) - Sparse low woodland; mulga, discontinuous in scattered groups
- Hammerlsey 82 (e16Lrt3Hi) - Hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*
- Hammersley157 (t3Hi) - Hummock grasslands, grass steppe; hard spinifex, *Triodia wiseana*
- Hammersley 175 (xGc) – Short bunch grassland – savanna/grass plain (Pilbara).
- Hammersley 567 (a1,2Sr t1,2Hi) - Hummock grasslands, shrub steppe; mulga & kanji over soft spinifex & *Triodia basedowi*

Given the broad nature of Beard's mapping; this vegetation association is only broadly applicable to the vegetation types occurring in the study area.

1.8.3 Pre-European vegetation extent

The pre-European and current extent of native vegetation associations in Western Australia has been interpreted by Shepherd *et al*. (2002) using data from Beard's (1975) regional vegetation mapping and other vegetation mapping, as well as satellite imagery and orthophoto interpretation.

Shepherd *et al*. (2002) identified the Pilbara bioregion as having largely intact native vegetation owing to the lack of intensive agricultural land use practices. Although the native vegetation remains widespread and largely intact, the floristic composition and structural characteristics have almost certainly changed since European settlement by grazing and altered fire regimes (Shepherd *et al*. 2002).

Table 1-3 and Figure 1-4 present the pre-European and current extent of the Beard mapping units across their range, as well as the extent in the study area.

Table 1-3: Beard's mapping unit occurring within the study area, its current and pre-European extent within the Pilbara bioregion and its extent across the study area

Beard's mapping unit (Shepherd vegetation association)	Pre-European extent (ha)^	Current extent (ha)^	Extent (ha) within study area / (Proportion of current extent)
18	676,556.7	671,843.4	403.5 / 0.060%
29	1,133,219.8	1,131,712.0	156.3 / 0.014%
82	2,563,583.2	2,550,888.1	4.9 / 0.0002%
157	199,832.2	198,409.2	16.0 / 0.008%
175	507,860.16	507,466.80	61.1 / 0.012%
567	776,823.9	774,213.0	66.2 / 0.009%

^Government of Western Australia (2019)

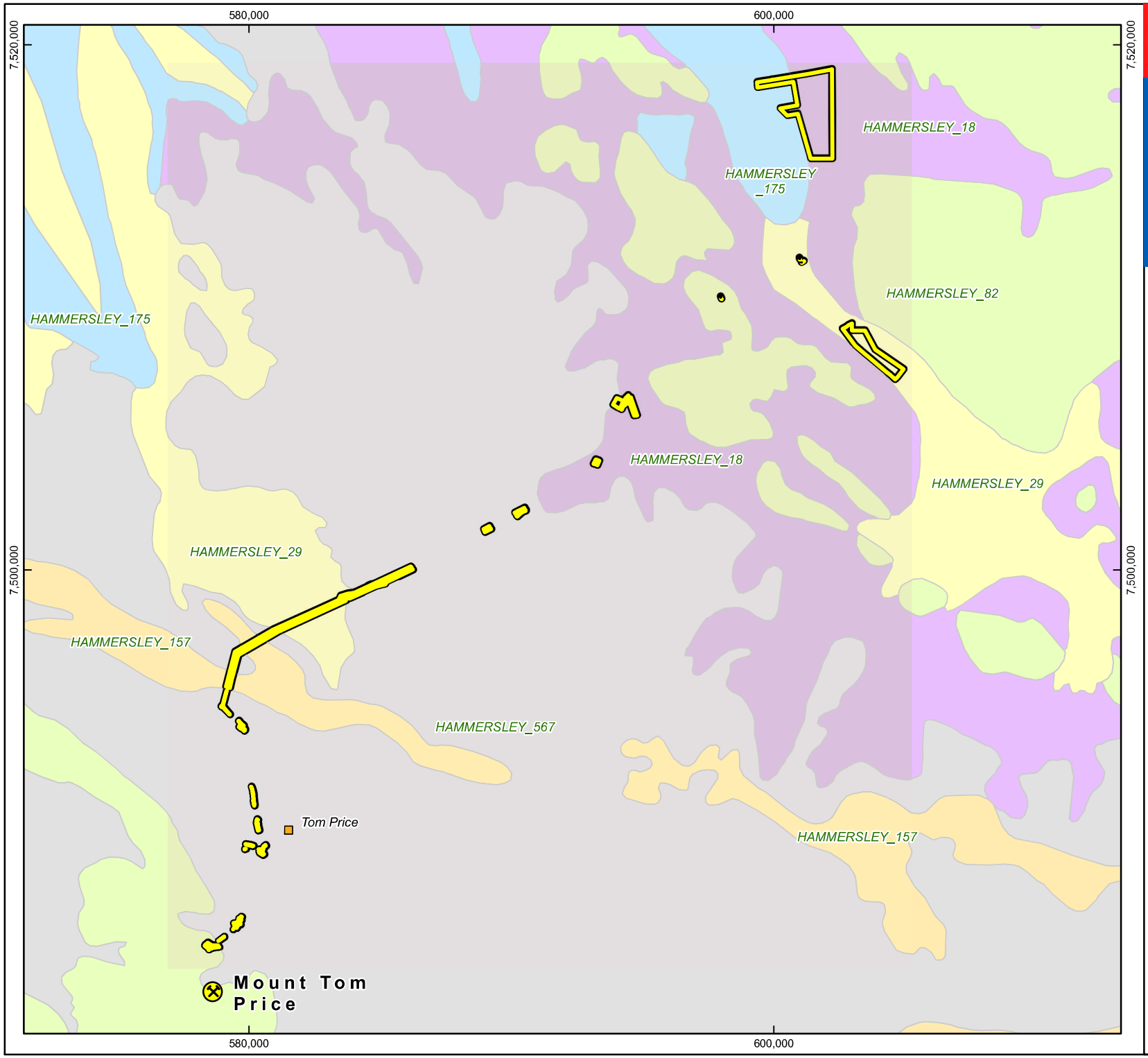

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Figure 1-4: Beard's / Shepherd's vegetation associations within the study area

Drawn: S.M.
Plan: PDE0172740v3
Date: September 2020
Proj: GDA 1994 M
Scale: 1:200,000 @ [redacted]

Legend

- Study Area
- Mine Location
- Town

Beard's / Shepherd's vegetation associations

- HAMMERSLEY_157
- HAMMERSLEY_162
- HAMMERSLEY_175
- HAMMERSLEY_18
- HAMMERSLEY_29
- HAMMERSLEY_567
- HAMMERSLEY_82

N

0 2 4 6 8 1

Kilometres

Map units in metres

1.9 Conservation areas and environmentally sensitive areas

Environmentally Sensitive Areas (**ESAs**) are defined in the *Environmental Protection (Environmentally Sensitive Areas) Notice 2005* under section 51B of the WA State EP Act. ESAs include areas declared as: World Heritage; included on the Register of the National Estate; defined wetlands; vegetation containing rare (Threatened) flora; Threatened Ecological Communities (**TEC**); and Bush Forever sites.

The western boundary of Karijini National Park lies less than a kilometre to the east of the study area. This area was listed on the Register of National Estate for its natural heritage values, and forms part of the Hamersley Range National Park 1997 boundary (DotEE 2018b). While this is no longer the current name for the existing Karijini National Park, it is still classified as an ESA, as are all items that were on the Register of National Estate at the time the current ESA notice was gazetted on 8 April 2005 (DotEE 2018b). The proposal is not expected to impact the environmental values of the ESA (or Karijini National Park).

One TEC has been recorded within 20 km of the study area: '*Themeda grasslands on cracking clays (Hamersley Station, Pilbara)*'. The Proposal is not expected to impact the environmental values of any TECs.

1.10 Priority ecological communities

Priority ecological communities (**PECs**) are possible TECs that do not meet survey criteria or are not adequately defined for listing under the BC Act as Threatened (DBCA 2019b), and are ranked as Priorities 1, 2 and 3 (1 being the highest).

The nearest PEC to the study area is the '*Brockman Iron cracking clay communities of the Hamersley Range'*. The boundary of the buffer for this Priority 3 Ecological Community is located less than 1 km to the west of the study area (Figure 1-6). The proposal is not expected to impact the environmental values of this PEC, or any others.

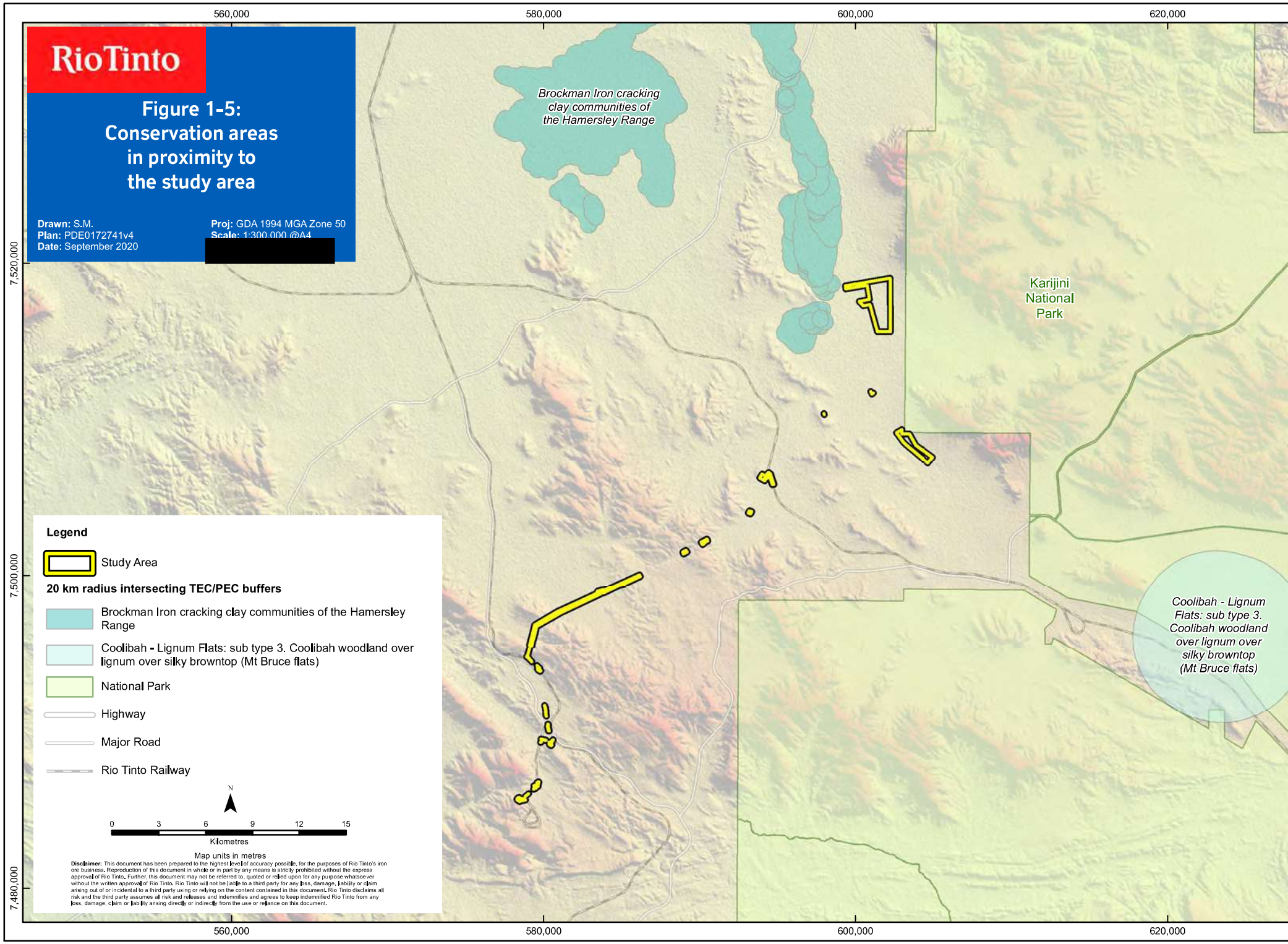
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Figure 1-5:
Conservation areas
in proximity to
the study area
Drawn: S.M.
Plan: PDE0172741v4
Date: September 2020
Proj: GDA 1994 MGA Zone 50
Scale: 1:300,000 @A4
[redacted]
560,000
580,000
600,000
620,000
7,520,000
7,500,000
7,480,000
Brockman Iron cracking clay communities of the Hamersley Range
Karijini National Park
Coolibah - Lignum Flats: sub type 3. Coolibah woodland over lignum over silky browntop (Mt Bruce flats)
Legend
Study Area
20 km radius intersecting TEC/PEC buffers
Brockman Iron cracking clay communities of the Hamersley Range
Coolibah - Lignum Flats: sub type 3. Coolibah woodland over lignum over silky browntop (Mt Bruce flats)
National Park
Highway
Major Road
Rio Tinto Railway
N
0 3 6 9 12 15
Kilometres
Map units in metres
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2. Methodology

2.1 Literature review

Early systematic flora survey work in the Pilbara bioregion was undertaken by Burbidge (1959) and Beard (1975). These surveys involved the mapping of broad floristic formations and vegetation associations across the bioregion. More recently, DAFWA conducted a regional inventory of flora, vegetation, vegetation condition, and land resources of the bioregion (van Vreeswyk *et al.* 2004). In addition, Parks and Wildlife undertook a comprehensive regional survey of the Pilbara (DEC 2011) which included counting, sampling, documenting, and mapping the way plant communities are distributed in relation to soil, climate, landforms and geology within the Pilbara.

Over recent decades there has been an expansion of resource development projects occurring within the Pilbara. As a result, there has been an increase in site-specific ecological surveys to fulfil the statutory requirements of the State EP Act and the *Biodiversity Conservation Act 2016*[1] (**BC Act**), and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (**EPBC Act**).

Numerous flora, vegetation and fauna surveys have previously been conducted within and surrounding the study area (Figure 2-1 and Figure 2-2). The findings of these surveys, in addition to the database searches, form the desktop study to determine conservation significant species that are known to, or may occur within the study area, as well as the flora, vegetation associations, ecosystems and fauna habitats.

Five previous flora and vegetation survey has been utilised as the basis of this flora and vegetation desktop assessment, Biota (2008), Mattiske (2008), Pilbara Flora (2011) Rio Tinto (2011) and Rio Tinto (2018). A summary of their findings is presented in Table 2-2.

Furthermore, numerous flora and vegetation surveys have been conducted in the surrounding area, including: multi-phase detailed surveys, single-phase detailed surveys and targeted surveys. The results of these survey were used in the desktop assessment of conservation significant flora and vegetation

Four previous fauna surveys have been utilised as part of this desktop assessment: Biota (2009), Biota (2011), Pilbara Flora (2011) and Rio Tinto (2018). These reports were reviewed as part of the literature review to determine conservation significant species that may occur within the study area and fauna habitats. A summary of the findings is presented in Table 2-2.

[1] The *Biodiversity Conservation Act 2016* replaced the *Wildlife Conservation Act 1950* on the 1st January 2019.

Table 2-1: Summary of previous flora and vegetation reports utilised for the desktop assessment

Report and level of survey	Size (ha)	Number of taxa	Conservation listed flora	Weeds	Vegetation of significance
Biota (2008) *Marandoo Mine Phase 2 Project – Vegetation and Flora Survey*	2,540	537	*Goodenia lyrata* (P3) *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3) *Indigofera ixocarpa* (P2) *Eremophila magnifica subsp. magnifica* (P4)	**Bidens bipinnata* **Sigesbeckia orientalis* **Sonchus oleraceus* **Bassia scoparia* **Euphorbia hirta* **Euphorbia peplus* **Malvastrum americanum* **Vachellia farnesiana* **Bougainvillea* sp. **Cenchrus ciliaris* **Cenchrus setiger* **Chloris virgata* **Cynodon dactylon* **Echinochloa colona* **Setaria verticillata* * *Rumex vesicaria* **Datura leichhardtii* **Solanum nigrum*	No TECs or PECs
Mattiske (2008) *Flora and Vegetation on the Pipeline Corridor from the Fortescue Borefield to Tom Price*	-	139	None recorded	**Aerva javanica* **Argemone ochroleuca* **Bidens bipinnata* **Cenchrus ciliaris* **Rumex vesicaria* **Sonchus oleraceus* **Vachellia farnesiana*	No TECs or PECs

Report and level of survey	Size (ha)	Number of taxa	Conservation listed flora	Weeds	Vegetation of significance
Pilbara Flora (2011) *Flora and Vegetation Surveys for the Paraburdoo Magazine and the Tom Price Powerline Infrastructure Areas*	697.80	174	None recorded	**Aerva javanica* **Cenchrus ciliaris* **Cenchrus setiger* **Malvastrum americanum* **Melia azedarach* **Rumex vesicaria* **Vachellia farnesiana* **Washingtonia filifera*	No TECs or PECs
Rio Tinto (2011) *Flora and Vegetation Assessment of the Southern Fortescue Borefields*	132	185	*Goodenia nuda* (P4)	**Bidens bipinnata* **Cenchrus ciliaris* **Cenchrus setiger* **Citrullus lanatus* **Datura leichhardtii* **Echinochloa colona* **Flaveria trinervia* **Malvastrum americanum* **Sigesbeckia orientalis* **Solanum nigrum* **Vachellia farnesiana*	No TECs or PECs

Report and level of survey	Size (ha)	Number of taxa	Conservation listed flora	Weeds	Vegetation of significance
Rio Tinto (2018) *Flora, Vegetation and Fauna Habitat Assessment at Southern Fortescue Borefield*	751	245	*Aristida jerichoensis* subsp. *subspinulifera* (P3) *Goodenia nuda* (P4)	**Bidens bipinnata* **Cenchrus ciliaris* **Cenchrus setiger* **Chloris virgata* **Citrullus lanatus* **Datura leichhardtii* **Echinochloa colona* **Flaveria trinervia* **Malvastrum americanum* **Portulaca pilosa,* **Rumex vesicarius* **Setaria verticillata* **Sonchus oleraceus* **Vachellia farnesiana*	No TECs or PECs

Table 2-2: Summary of previous fauna habitat reports utilised for the desktop assessment

Report and level of survey	Size (ha)	Number of taxa	Conservation listed fauna	Fauna habitat of significance
Biota (2009) *Tom Price Power Line West Detritals: Two- Phase Fauna Survey*	813	52 Avifauna 11 Mammals 44 Herpetofauna	*Pseudomys chapmani* (Western Pebble-mound Mouse) (P4)	None recorded
Biota (2011) *Hamersley Agriculture Project Interim Report: Level 2 Fauna Survey*	3,018	130	Western Pebble-Mound Mouse	N/A
Pilbara Flora (2011) *Flora and Vegetation Surveys for the Paraburdoo Magazine and the Tom Price Powerline Infrastructure Areas*	697.80	-	None recorded	None recorded
Rio Tinto (2018) *Flora, Vegetation and Fauna Habitat Assessment at Southern Fortescue Borefield*	751	N/A	N/A	Mulga plain Stony plain Low hill and slope Minor drainage line Creek line Gully

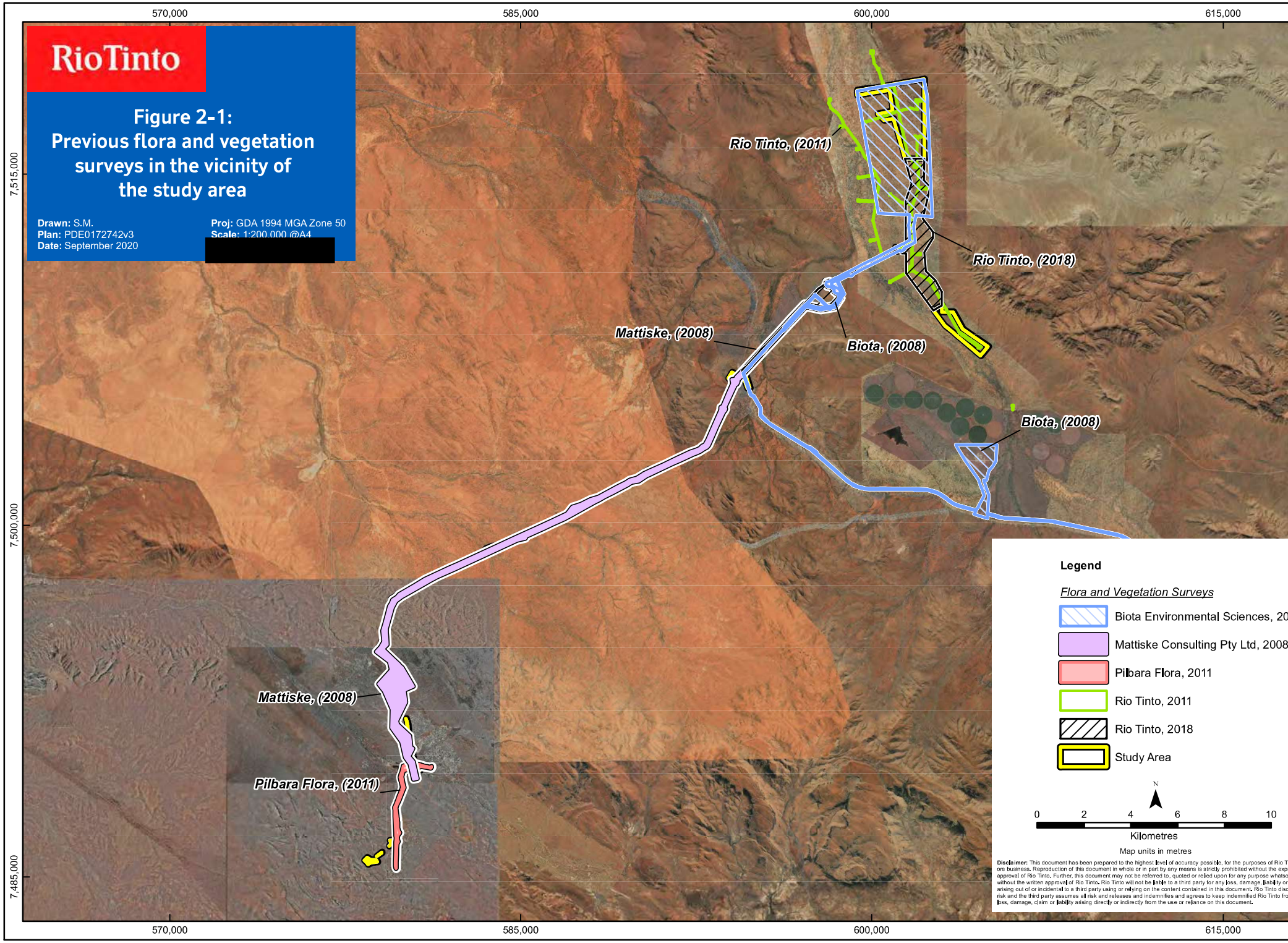
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Figure 2-1:
Previous flora and vegetation surveys in the vicinity of the study area
Drawn: S.M.
Plan: PDE0172742v3
Date: September 2020
Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A4
570,000
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7,515,000
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Rio Tinto, (2011)
Rio Tinto, (2018)
Mattiske, (2008)
Biota, (2008)
Biota, (2008)
Mattiske, (2008)
Pilbara Flora, (2011)
Legend
Flora and Vegetation Surveys
Biota Environmental Sciences, 20
Mattiske Consulting Pty Ltd, 2008
Pilbara Flora, 2011
Rio Tinto, 2011
Rio Tinto, 2018
Study Area
N
0 2 4 6 8 10
Kilometres
Map units in metres
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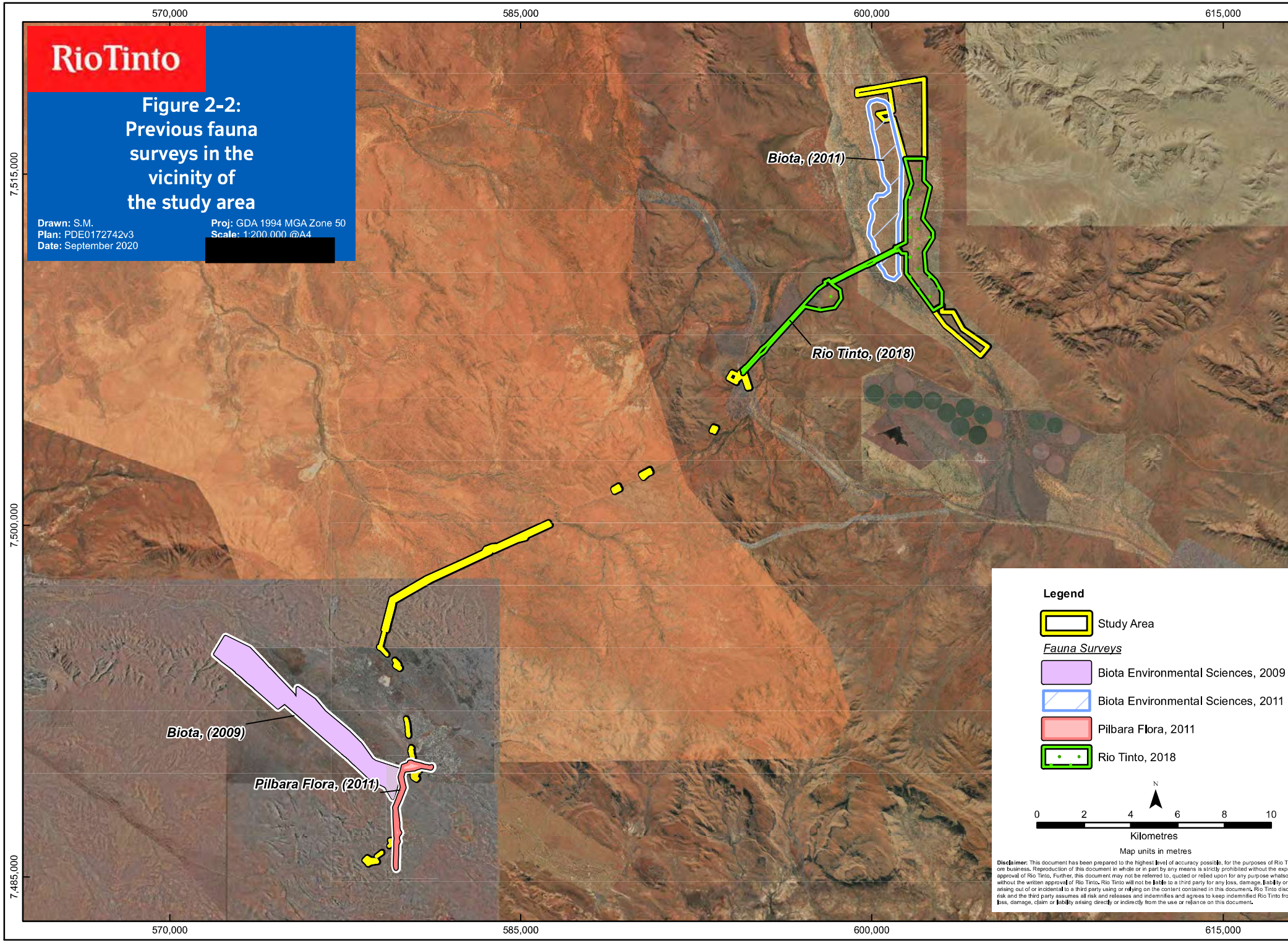
RioTinto
Figure 2-2:
Previous fauna surveys in the vicinity of the study area
Drawn: S.M.
Plan: PDE0172742v3
Date: September 2020
Proj: GDA 1994 MGA Zone 50
Scale: 1:200,000 @A4
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Biota, (2011)
Rio Tinto, (2018)
Biota, (2009)
Pilbara Flora, (2011)
Legend
Study Area
Fauna Surveys
Biota Environmental Sciences, 2009
Biota Environmental Sciences, 2011
Pilbara Flora, 2011
Rio Tinto, 2018
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0 2 4 6 8 10
Kilometres
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2.2 Database searches

A desktop assessment was undertaken in December 2019, in order to identify known or potential environmental constraints within or pertaining to the study area and surrounds.

The Parks and Wildlife and WA Museum's (**WAM**) NatureMap database (DBCA 2007-) were searched for Threatened and Priority flora and fauna that have the potential to utilise the habitats present within the study area. The Commonwealth Department of the Environment and Energy (**DotEE**) administered EPBC Act Protected Matters Search Tool was also searched for Matters of National Environmental Significance (**MNES**) listed under the EPBC Act including Threatened flora and fauna and TECs (Department of the Environment, Water, Heritage and the Arts 2013; DotEE 2019b).

Spatial data for conservation significant flora and fauna held and maintained by Rio Tinto was also searched as part of the desktop study. Any ESAs, Reserves and/or conservation areas within or surrounding the study area were also identified using relevant GIS layers held by Rio Tinto. The search coordinates used (22˚ 36' 12" S, 117˚ 50' 24" E and 117˚ 59' 37" E, 22 ˚ 29' 14" S) were at a two different central points within the study areas. A buffer of 20 km was used for NatureMap and Rio Tinto database searches, and 10 km for the Protected Matters Search Tool. Results of NatureMap and Protected Matters searches undertaken are presented in Appendix 1.

2.3 Likelihood of occurrence assessment

The results of the database searches were used to create a list of flora and fauna of conservation significance recorded, or with the potential to occur, within the study area. The likelihood of a flora or fauna species occurring within the study area was assessed through consideration of available habitats in the study area and each species' ecology. The fauna list will invariably include some species that do not occur in the study area, as some fauna have a limited or patchy distribution, high level of habitat specificity for habitat types not located in the study area, are locally extinct or were erroneously identified in previous surveys. These fauna were excluded from the list where relevant.

The likelihood of occurrence criteria for flora and fauna species is detailed in Appendix 2.

2.4 Vegetation assessment

Five previous flora and vegetation surveys; Biota (2008), Mattiske (2008), Pilbara Flora (2011) Rio Tinto (2011), and Rio Tinto (2018), have been conducted in the locality and were utilised as part of this flora and vegetation assessment. The existing vegetation mapping from these surveys formed the basis for the mapping in this report. The presence of these unit in the Southern Fortescue section were confirmed and ground truthed during the reconnaissance survey. Vegetation condition was assessed according to the Trudgen (1998) vegetation scale (Appendix 3).

2.5 Flora and vegetation field survey

The Southern Fortescue section of the study area were surveyed by Rio Tinto botanists [redacted] on the 30th April and 1st May 2019.

The study area was assessed in accordance with the relevant Factor Guidelines (EPA 2016a and 2016b) and Technical Guidance (EPA 2016c and 2016d). Habitats with potential to support species of conservation significance, identified by the database search, were targeted searched.

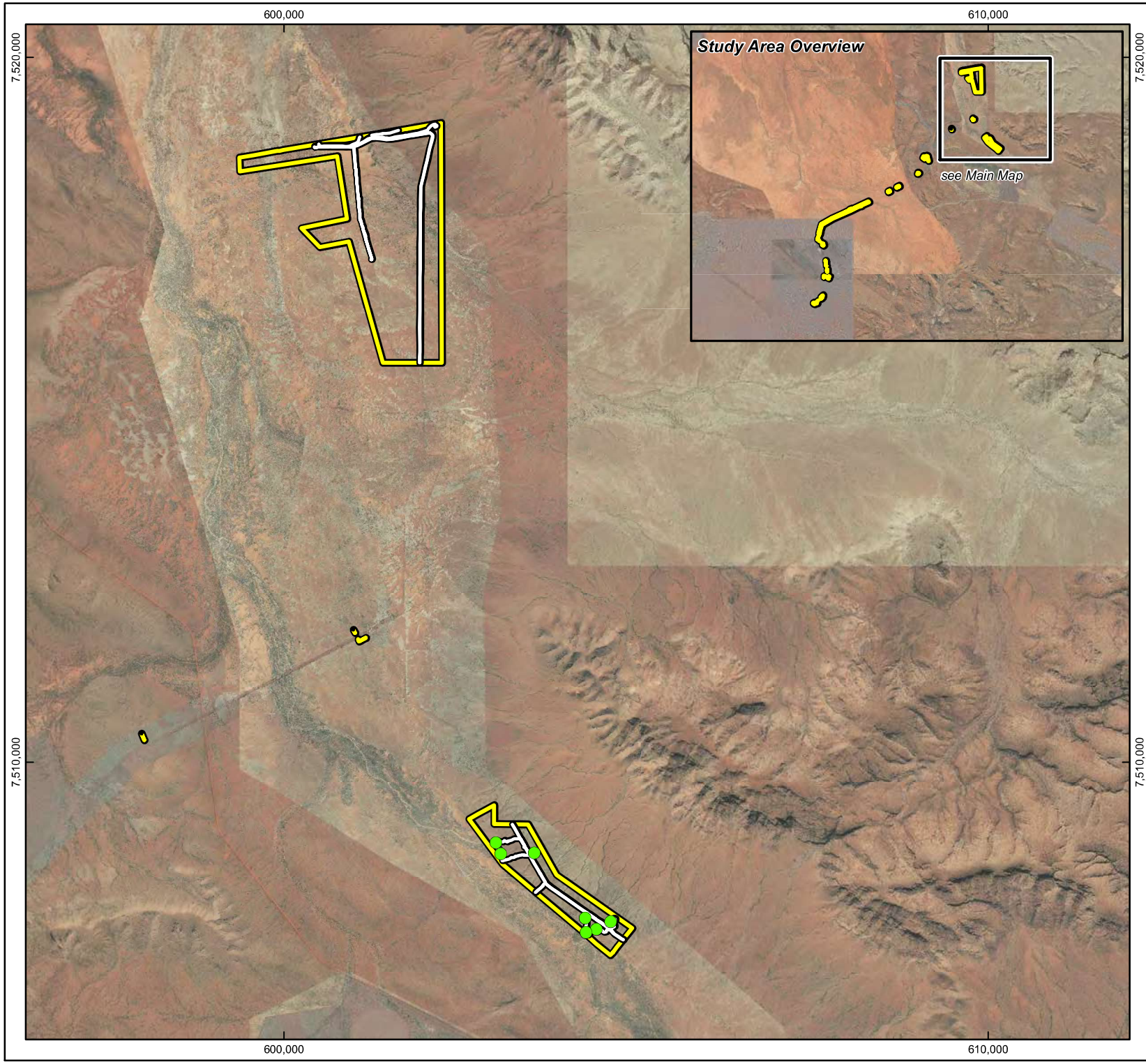
Relevé (unpegged) survey sites, typically 50 x 50 m in size (to represent an approximate 2,500 m^2) were established in representative areas of all vegetation associations within the study area. A botanical relevé is described as a vegetation sample that describes the structure and floristics, and associated physical attributes, flora and opportunistic fauna sightings.

A total of seven relevés were surveyed in representative vegetation associations. The layout and co-ordinates of each relevé from the study are presented in Figure 2-3 and Appendix 4, and track logs presented in Figure 2-3.

At each relevé site, a location was recorded with a handheld GPS and photographs were taken. Data was collected on the flora species present, including: percentage cover; average height of each vegetation stratum; site slope; aspect; topography; soil texture and colour; and landform type and habitat features.

Recent orthorectified aerial photography covering the study area was reviewed whilst in the field to determine boundaries of vegetation communities. The location of each site where a vegetation record was taken was determined based on interpretation of aerial photography and a visit to the site for ground truthing. Determination of boundaries between vegetation associations was also undertaken using aerial photography and ground truthing whilst in the field. The mapping data gathered in the field was used to prepare a draft map of vegetation, utilising rectified 1:5,000 scale colour digital air photography as the background. The vegetation boundaries were digitised on-screen using MapInfo 11.0.

Locations of flora of conservation significance, flora of special interest, unknown flora, weeds and other observations including opportunistic fauna sightings were recorded using a hand-held GPS (WGS 84 datum). Where populations of conservation significant flora were encountered; estimates of density or numbers of individuals, habitats and associated flora were recorded. Density or numbers of individuals of introduced flora species were also recorded.



RioTinto

Figure 2-3:
Releves within study area a
tracklogs from current surv

Drawn: S.M.
Plan: PDE0174611v3
Date: September 2020

Proj: GDA 1994 M
Scale: 1:75,000 @

[redacted]

Legend

- Study Area
- Releve
- Tracklog

N

0 1 2 3

Kilometres

Map units in metres

2.6 Fauna habitat assessment

Four previous fauna surveys; Biota (2009), Biota (2011), Pilbara Flora (2011), and Rio Tinto (2018), have been conducted in the locality and was utilised as part of this desktop fauna and fauna habitat assessment. This report (and others) were consulted as part of the literature review to determine conservation significant fauna species that may occur within the study area, as well as fauna habitats.

2.7 Other vegetation of significance

Vegetation not legally protected or classified as part of regulatory ratings may still be regarded as being of significance. Vegetation that may fall under this category includes (but is not limited to) vegetation supporting elevated floristic diversity, habitats supporting numerous conservation listed species, ecosystems at risk (Kendrick 2001), novel floristic associations, groundwater dependant ecosystems, uncommon vegetation and associations on novel landforms.

Vegetation associations or biological features assigned a significance classification are, for the purpose of this document, considered to be of elevated significance when compared to all other identified associations or features that are common or widespread and therefore well represented.

2.8 Environmentally significant areas

Rio Tinto manages all work, including clearing, through the Approvals Request Coordination System which ensures biological and heritage surveys are completed and all government regulatory approvals are in place prior to the commencement of works.

Environmentally significant features are uploaded into Rio Tinto's GIS database which includes a description highlighting the significance of these areas. Small populations or individuals are protected as buffered point locations, while larger spatial populations and significant habitat are protected as 'significant areas'. The GIS database is used as part of the Approvals Request Coordination System when reviewing the Proposal, thereby ensuring appropriate management conditions are in place.

3. Results

3.1 Vegetation of the study area

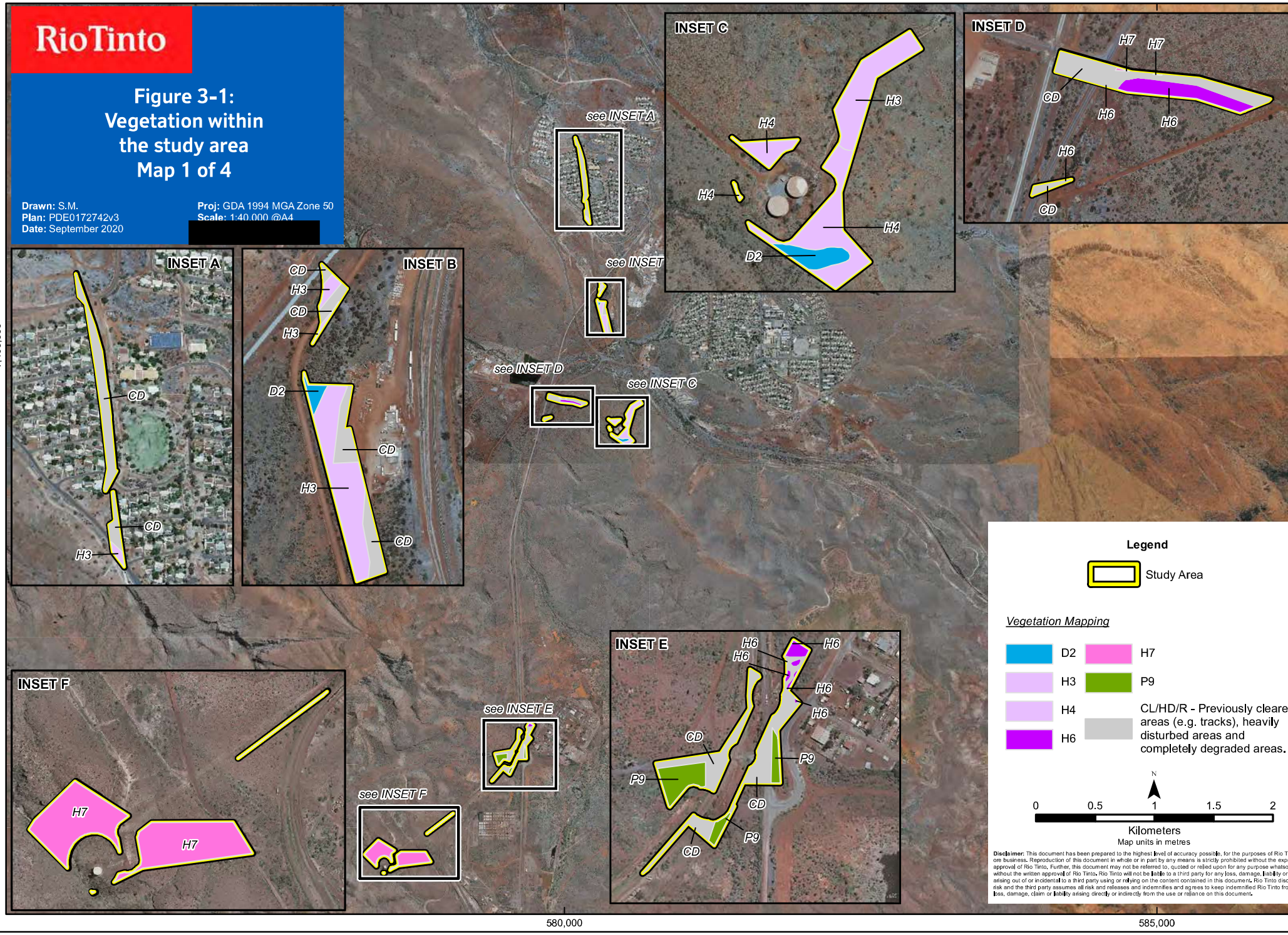
Twenty one vegetation units were identified across three major landforms over the study area. The vegetation units are summarised in Table 3-1 and are spatially represented in Figure 3-1. Seven vegetation units were described from hills, nine units from floodplains and plains and four from drainage lines. The most widespread vegetation unit was P6 (228.1 ha covering 32.2% of the study area).

Table 3-1: Vegetation associations of the study area

Unit	Source (Report and Unit code)	Vegetation description	Extent (ha) within study area	Proportion (%) within study area
		Vegetation of hills and breakaways		
H1	Mattiske (2008), B2	Low Open Woodland of *Acacia aneura* var. *aneura, Corymbia hamersleyana* and *Acacia pruinocarpa* over *Eremophila latrobei* subsp. *latrobei, Eremophila galeata, Themeda triandra, Triodia wiseana, Aristida* spp. and annual species	35.3	5.0
H2	Mattiske (2008), S1	Hummock Grassland of *Triodia pungens* and *Triodia wiseana* with emergent *Eucalyptus gamophylla, Eucalyptus leucophloia, Acacia aneura* var. *aneura, Acacia pruinocarpa, Acacia ancistrocarpa, Acacia bivenosa, Senna* spp. and a range of annual species	4.8	0.7
H3	Mattiske (2008), S2	Hummock Grassland of *Triodia wiseana, Triodia angusta, Triodia pungens* with emergent *Eucalyptus leucophloia* and *Eucalyptus gamophylla* over *Eremophila* spp., *Acacia bivenosa* and a range of annual species	1.6	0.2
H4	Mattiske (2008), S3	Hummock Grassland of *Triodia wiseana* with emergent *Eucalyptus leucophloia, Corymbia deserticola* subsp. *deserticola* over *Acacia bivenosa, Themeda triandra, Solanum lasiophyllum* and mixed *Senna* and *Ptilotus* species	10.3	1.5
H5	Mattiske (2008), S5	Hummock Grassland of *Triodia wiseana* with emergent *Acacia inaequilatera, Eucalyptus leucophloia, Acacia bivenosa* and mixed *Senna glutinosa* subsp. *glutinosa* and *Senna glutinosa* subsp. *pruinosa* and *Ptilotus* species	10.7	1.5
H6	Pilbara Flora (2011), 2	Low woodland of *Eucalyptus leucophloia, Acacia aptaneura and Acacia citrinoviridis* over mixed grassland	0.6	0.1
H7	Pilbara Flora (2011), 3	Low open woodland of *Eucalyptus leucophloia* over high shrubland of *Acacia* species over hummock grassland of *Triodia wiseana*	4.9	0.7
		Total	**68.2**	**9.7**
		Vegetation of floodplains and plains		
P1	Mattiske (2008), M1	Low Woodland to Low Open Forest of *Acacia aneura* var. *aneura, Acacia pruinocarpa, Grevillea berryana* over *Eremophila galeata*, *Acacia tetragonophylla, Eremophila forrestii* over *Triodia pungens* and a range of annual species	25.9	3.7
P2	Mattiske (2008), M3	Low Open Woodland of *Acacia aneura* var. *aneura, Acacia pruinocarpa* over *Acacia tetragonophylla*, *Eremophila forrestii* over *Triodia pungens* and a range of annual species	15.5	2.2

Unit	Source (Report and Unit code)	Vegetation description	Extent (ha) within study area	Proportion (%) within study area
P3	Rio Tinto (2018) P4	Tall open shrubland of *Acacia ancistrocarpa*, *Acacia pruinocarpa*, *A. aptaneura* and *A. atkinsiana* over open hummock grassland of *Triodia melvillei*.	85.2	12
P4	Rio Tinto (2018) P6	Low open woodland of *Acacia aptaneura*, *Acacia pruinocarpa* and *Corymbia deserticola* subsp. *deserticola* over scattered tall shrubs of *Acacia ancistrocarpa* over hummock grassland of *Triodia melvillei*.	12.1	1.7
P5	Biota (2008) 1a.	*Acacia aneura* woodland on broad flat alluvial and colluvial areas.	6.8	1.0
P6	Biota (2008) 1b.	Open grassland, Only occurs as a mosaic with P5 within the current study area.	228.2	32.2
P7	Biota (2008) 1c.	*Triodia melvillei* hummock grassland.	55.0	7.8
P8	Biota (2008) 4c.	*Acacia aneura* scattered low trees over open grassland.	146.9	20.8
P9	Pilbara Flora (2011), 10	Open forest of *Acacia aptaneura* over very open mixed hummock grassland (rehabilitation).	0.8	0.1
		Total	**576.4**	**81.5**
		Vegetation of drainage lines		
D1	Mattiske (2008), C2	Low Woodland of *Eucalyptus xerothermica* and *Corymbia hamersleyana* over *Acacia maitlandii, Acacia bivenosa, Petalostylis labicheoides, Rulingia luteiflora* over *Themeda triandra* and *Triodia pungens*.	10.1	1.4
D2	Mattiske (2008), C3	Tall Shrubland of *Acacia bivenosa*, *Acacia ancistrocarpa, Acacia maitlandii, Acacia monticola* with occasional emergent *Corymbia deserticola* subsp. *deserticola* and *Eucalyptus leucophloia* over *Gompholobium polyzygum, Rulingia luteiflora* and *Triodia pungens*.	4.0	0.6

Unit	Source (Report and Unit code)	Vegetation description	Extent (ha) within study area	Proportion (%) within study area
D3	Current Survey, CL1	Woodland of *Eucalyptus victrix* and *Acacia citrinoviridis* over closed grassland of **Cenchrus ciliaris* and **C. setiger*.	14.5	2.1
D4	Current Survey, MD1	Tall open scrub of *Acacia atkinsiana, Acacia monticola and Gossypium robinsonii* over open shrubland of *Acacia pruinocarpa* and *Acacia bivenosa* over open tussock grassland of *Themeda triandra* over very open hummock grassland of *Triodia melvillei.*	7.6	1.1
		Total	**36.2**	**5.2**
CD	Mattiske (2008) Pilbara Flora (2011), CL/HD/R	Previously cleared areas (e.g. tracks)		
		Total	**26.8**	**3.8**
		Grand Total	**707.5**	**100.0**


RioTinto
Figure 3-1:
Vegetation within
the study area
Map 1 of 4
Drawn: S.M.
Plan: PDE0172742v3
Date: September 2020
Proj: GDA 1994 MGA Zone 50
Scale: 1:40,000 @A4
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CL/HD/R - Previously cleare
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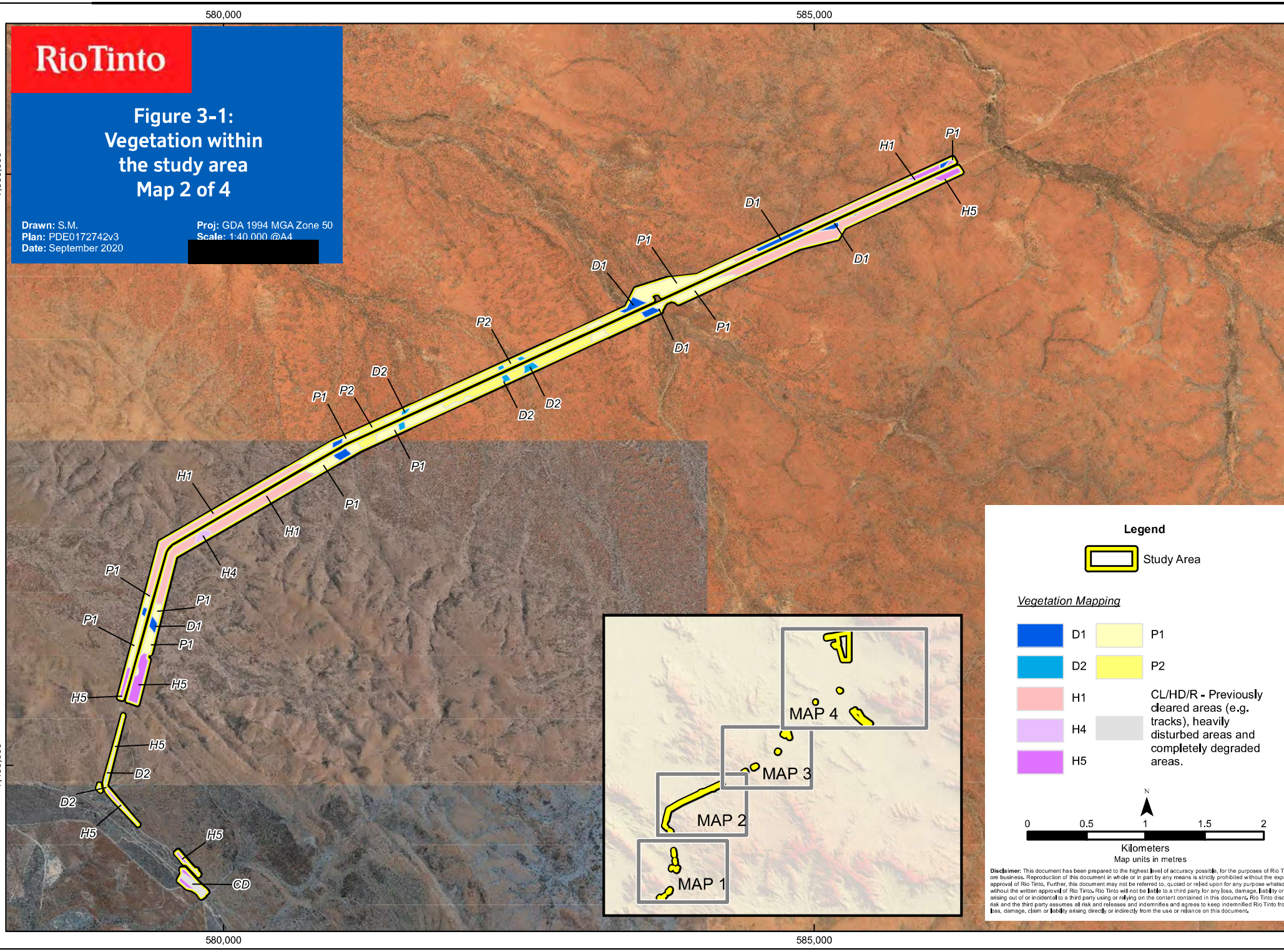
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Figure 3-1:
Vegetation within
the study area
Map 2 of 4
Drawn: S.M.
Plan: PDE0172742v3
Date: September 2020
Proj: GDA 1994 MGA Zone 50
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MAP 4
MAP 3
MAP 2
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Study Area
Vegetation Mapping
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CL/HD/R - Previously cleared areas (e.g. tracks), heavily disturbed areas and completely degraded areas.
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Map units in metres
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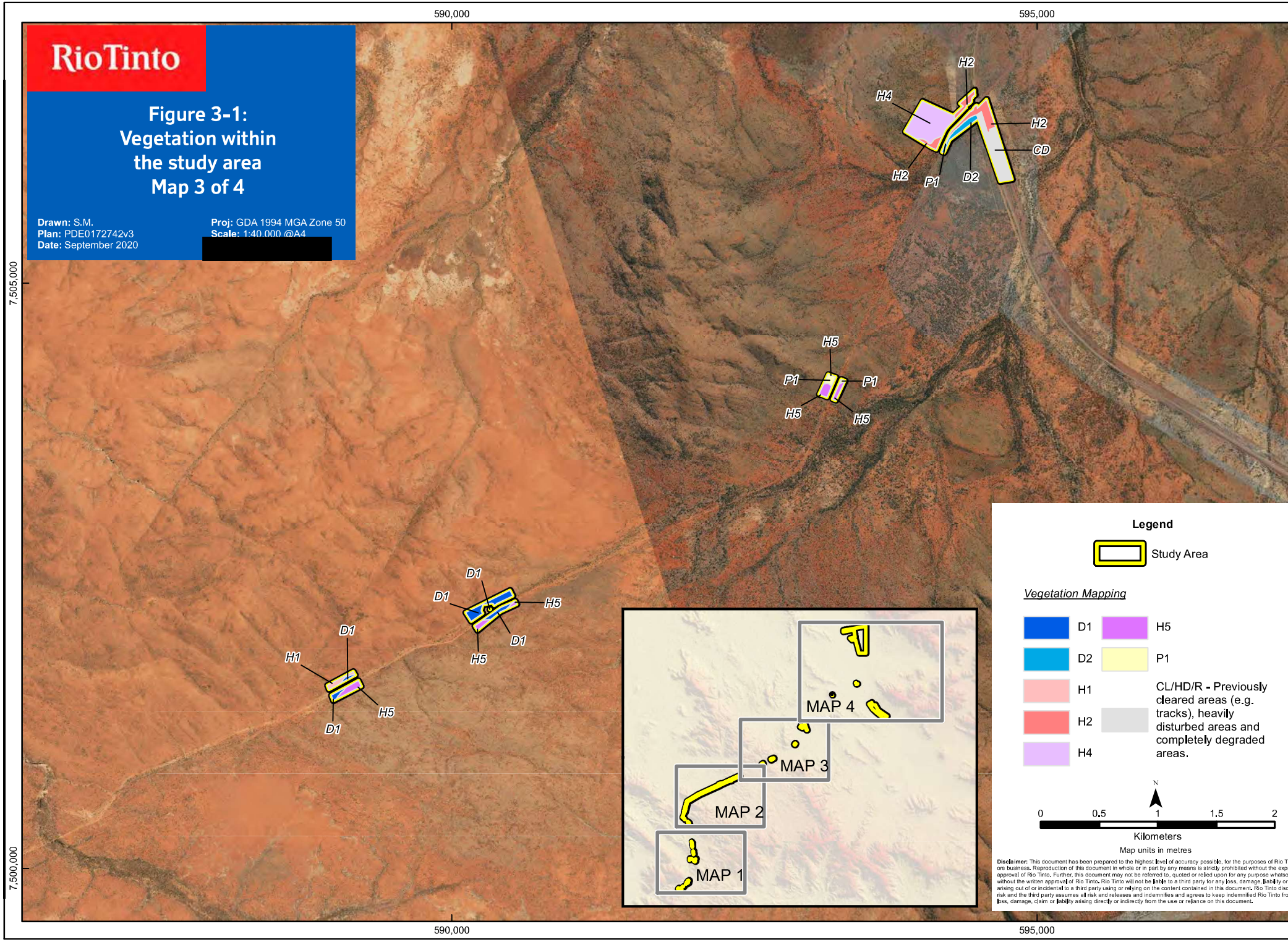

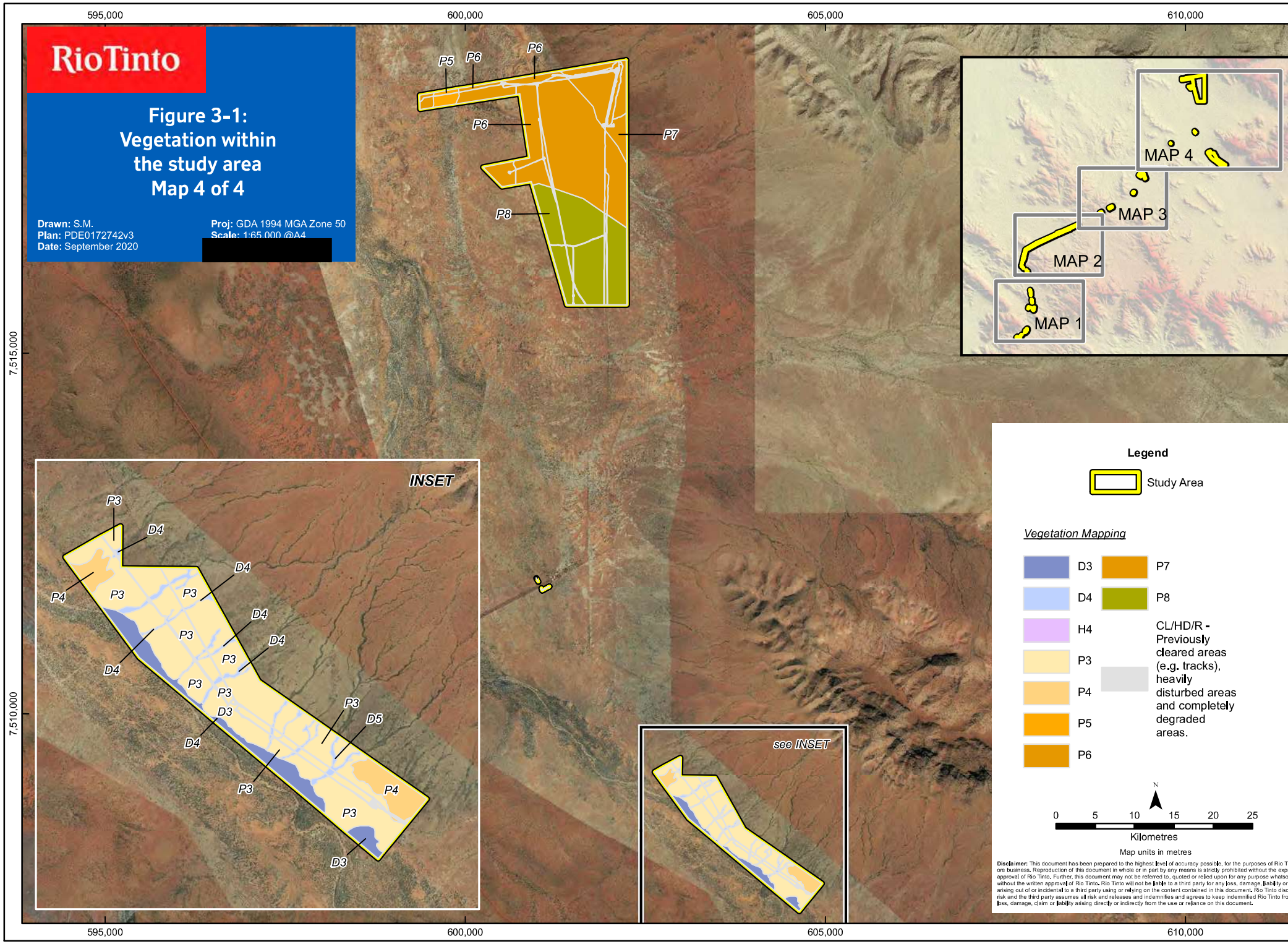

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3.2 Vegetation condition

The majority of vegetation within the study area was rated as Very Good to Good condition (based on the scale by Trudgen 1988). Figure 3-2 presents the condition mapping for the study area, whilst Table 3-2 presents the extent of condition of vegetation mapped within the study area.

Table 3-2: Vegetation condition of the study area

Condition	Area (ha)	Proportion (%) of study area
Very Good	633.7	89.6%
Good	29.4	4.2%
Poor	17.5	2.5%
Completely Degraded	26.8	3.9%
Total	**707.4**	**100%**

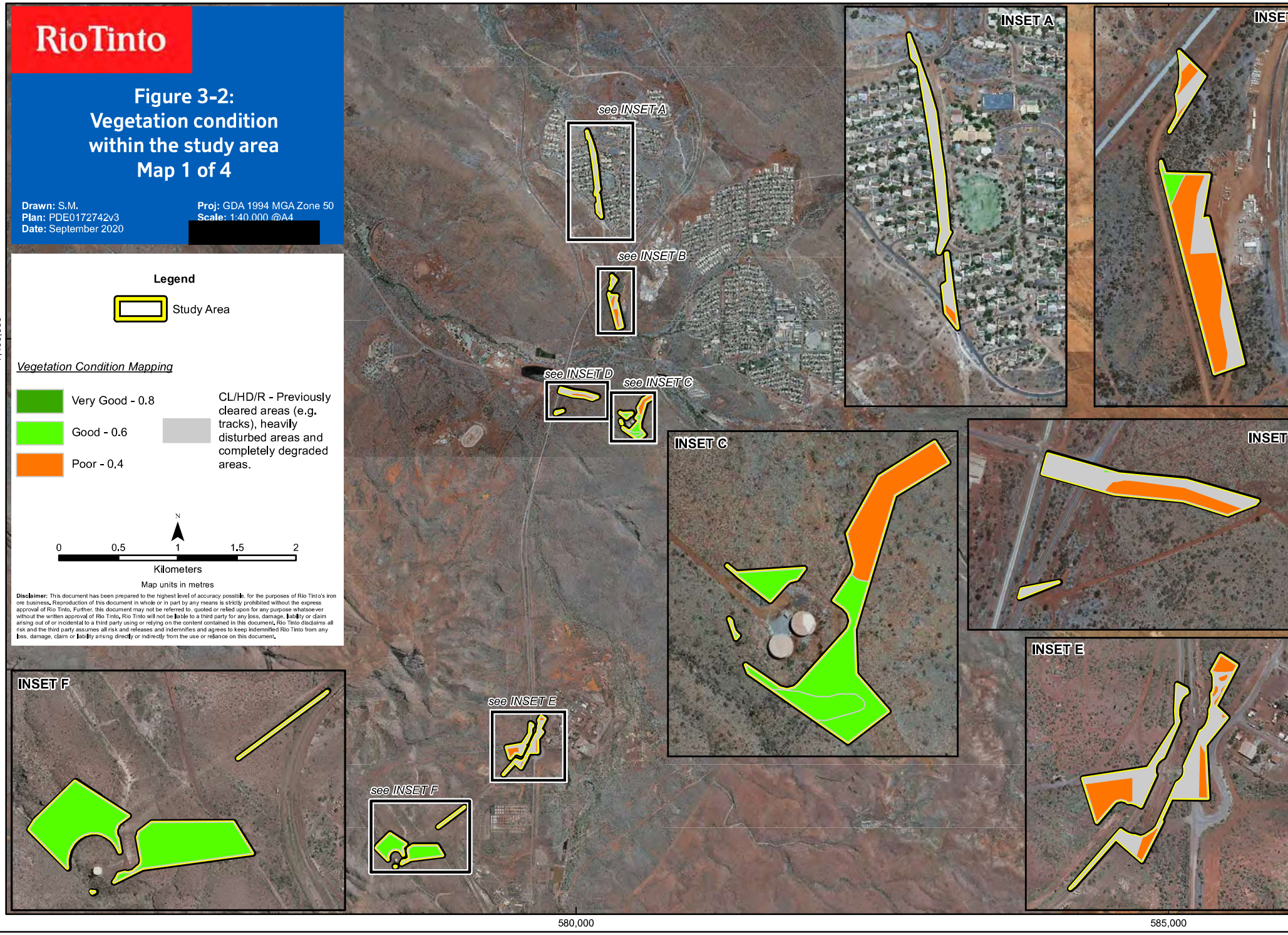
3.3 Vegetation of conservation significance

None of the vegetation associations occurring within the study area correspond to any ecosystems listed as Threatened under the EPBC Act (DotEE 2019c) and none are consistent with ecosystems listed as TECs under the BC Act (DBCA 2019).

None of the vegetation associations within the study area represent PECs as listed by the DBCA (2019b) and the Proposal is not expected to impact the environmental values of any PECs in the area.

3.4 Other vegetation of significance

None of the vegetation units encountered within the study area are of elevated significance.


RioTinto
Figure 3-2:
Vegetation condition
within the study area
Map 1 of 4
Drawn: S.M.
Plan: PDE0172742v3
Date: September 2020
Proj: GDA 1994 MGA Zone 50
Scale: 1:40,000 @A4
Legend
Study Area
Vegetation Condition Mapping
Very Good - 0.8
Good - 0.6
Poor - 0.4
CL/HD/R - Previously cleared areas (e.g. tracks), heavily disturbed areas and completely degraded areas.
N
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Kilometers
Map units in metres
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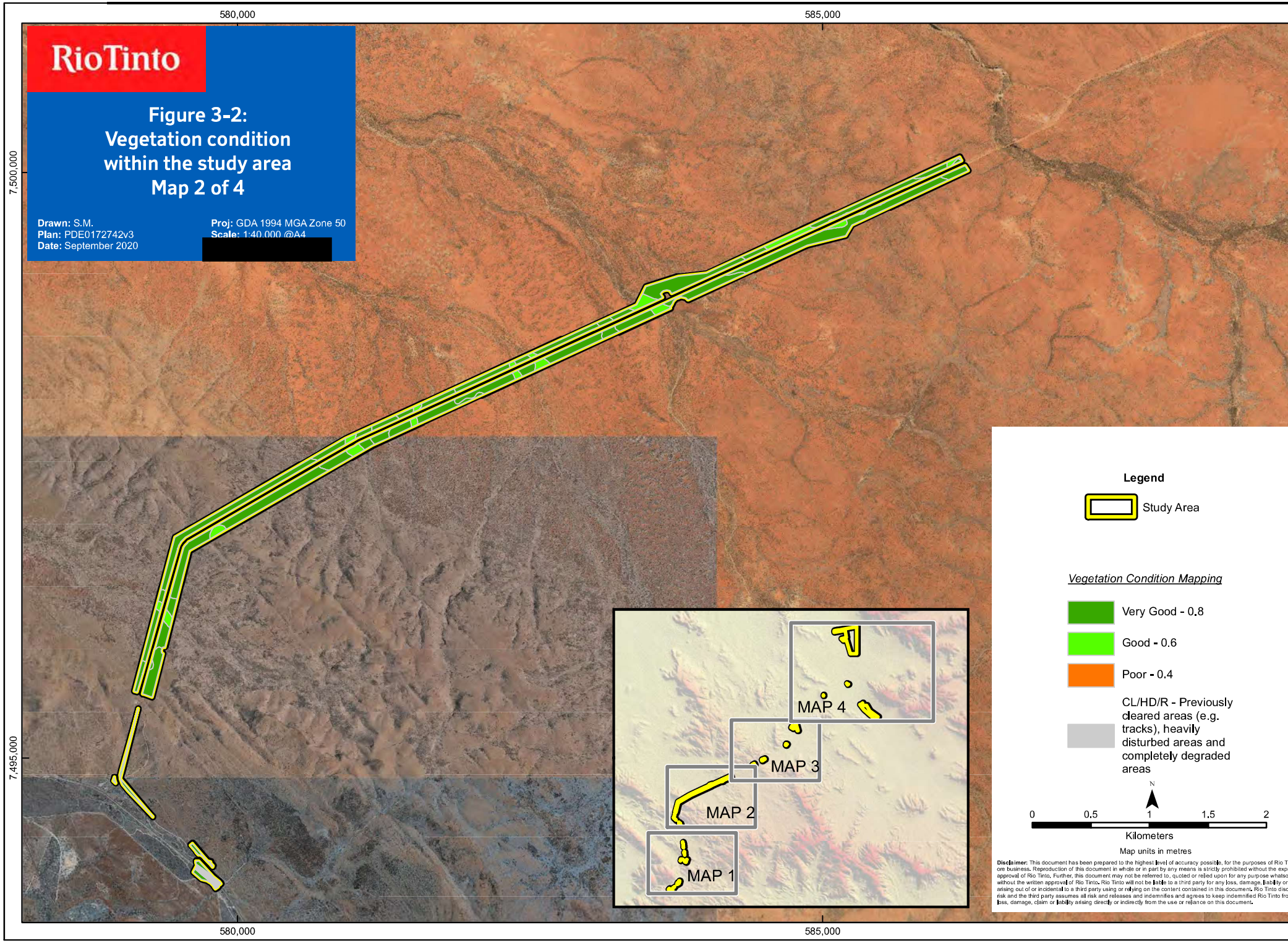
RioTinto
Figure 3-2:
Vegetation condition
within the study area
Map 2 of 4
Drawn: S.M.
Plan: PDE0172742v3
Date: September 2020
Proj: GDA 1994 MGA Zone 50
Scale: 1:40,000 @A4
[redacted]
580,000
585,000
7,500,000
7,495,000
MAP 4
MAP 3
MAP 2
MAP 1
Legend
Study Area
Vegetation Condition Mapping
Very Good - 0.8
Good - 0.6
Poor - 0.4
CL/HD/R - Previously cleared areas (e.g. tracks), heavily disturbed areas and completely degraded areas
N
0
0.5
1
1.5
2
Kilometers
Map units in metres
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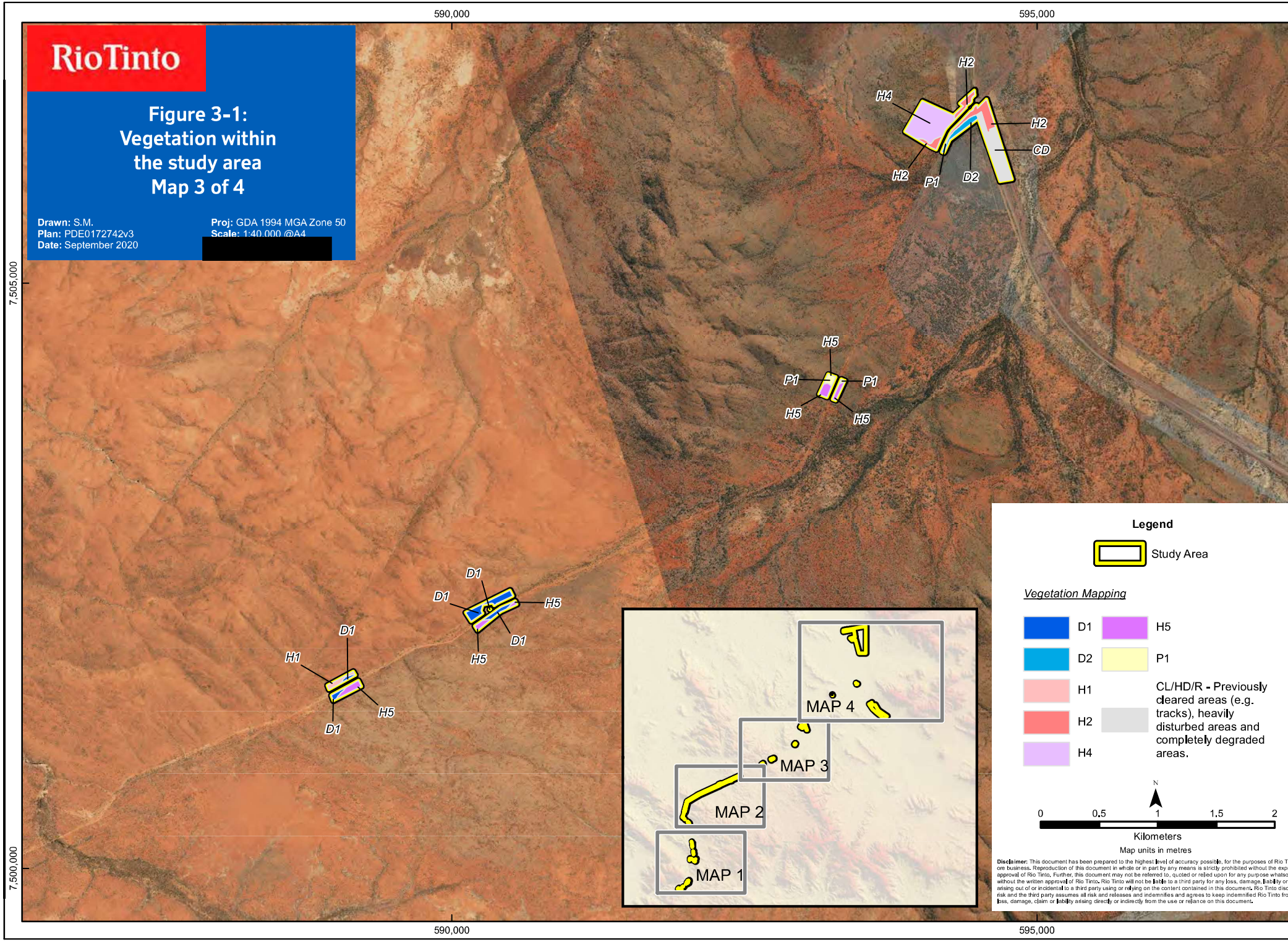

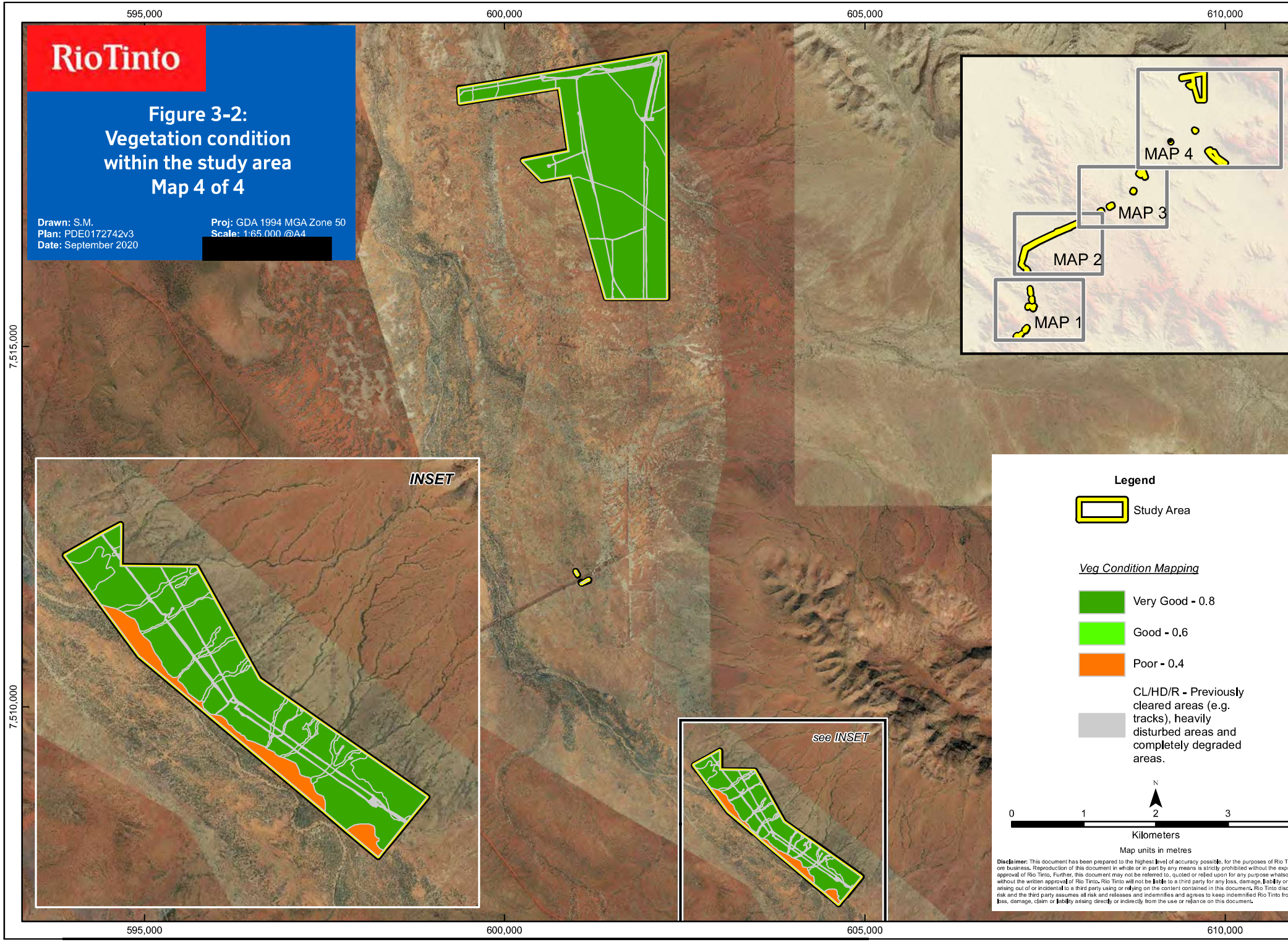
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RioTinto
Figure 3-2:
Vegetation condition
within the study area
Map 4 of 4
Drawn: S.M.
Plan: PDE0172742v3
Date: September 2020
Proj: GDA 1994 MGA Zone 50
Scale: 1:65,000 @A4
[redacted]
MAP 4
MAP 3
MAP 2
MAP 1
INSET
see INSET
Legend
Study Area
Veg Condition Mapping
Very Good - 0.8
Good - 0.6
Poor - 0.4
CL/HD/R - Previously cleared areas (e.g. tracks), heavily disturbed areas and completely degraded areas.
N
0
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Kilometers
Map units in metres
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3.5 Native flora

A total of 92 taxa from 59 genera representing 25 families were recorded during the reconnaissance survey (Table 3-3, Appendix 5).

The most taxon-rich families were: Poaceae (21 taxa) and Fabaceae (19 taxa). The most species rich genera was *Acacia* (13 taxa), followed by *Ptilotus* (5 taxa). The dominant plant groups are considered to be consisted with other surveys of the broader locality.

Table 3-3: Total recorded numbers of families, genera, species, taxa, priority species and weeds recorded during survey

Flora group	Number recorded
Families	25
Genera	59
Species	92
Priority species	0
Weeds	2

The number of taxa recorded by the current study appears less than what was expected when compared with smaller sized previous surveys of the Southern Fortescue Borefield localities. The Mattiske (2008) survey recorded 139 taxa while the Rio Tinto (2018) survey recorded 245 taxa.

3.6 Conservation listed flora recorded in study area

No Threatened or Priority flora species were recorded in the study area during the current field survey.

Two Priority species, *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) (P3) and *Lepidium catapycnon* (P4) have previously been recorded in the Study Area (Figure 3.3).

Themeda sp. Hamersley Station (M.E. Trudgen 11431) is a tall perennial grass to 1.8 m tall and is typically found growing in clay on clay plains and grasslands (WAH 2020). A total of 14 individuals from two locations have previously been recorded in the Study Area.

Lepidium catapycnon is an open, woody perennial to 0.3 m high and typically grows in skeletal soils on hillsides. A total of seven individuals from four records comprising a single population have previously been recorded in the Study Area.

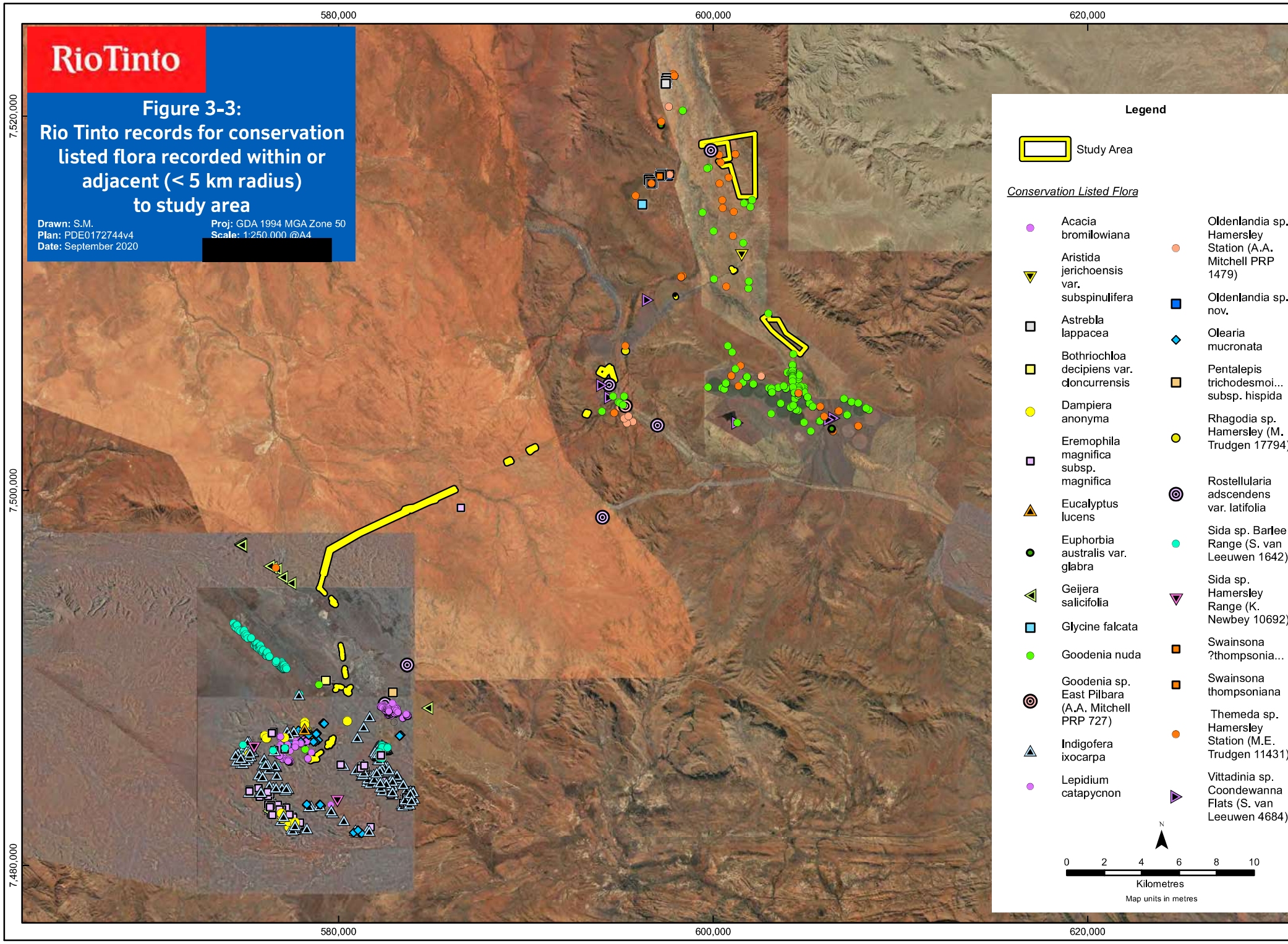
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Figure 3-3:
Rio Tinto records for conservation listed flora recorded within or adjacent (< 5 km radius) to study area
Drawn: S.M.
Plan: PDE0172744v4
Date: September 2020
Proj: GDA 1994 MGA Zone 50
Scale: 1:250,000 @A4
580,000
600,000
620,000
7,520,000
7,500,000
7,480,000
Legend
Study Area
Conservation Listed Flora
Acacia bromilowiana
Aristida jerichoensis var. subspinulifera
Astrebla lappacea
Bothriochloa decipiens var. cloncurrensis
Dampiera anonyma
Eremophila magnifica subsp. magnifica
Eucalyptus lucens
Euphorbia australis var. glabra
Geijera salicifolia
Glycine falcata
Goodenia nuda
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)
Indigofera ixocarpa
Lepidium catapycnon
Oldenlandia sp. Hamersley Station (A.A. Mitchell PRP 1479)
Oldenlandia sp. nov.
Olearia mucronata
Pentalepis trichodesmoi... subsp. hispida
Rhagodia sp. Hamersley (M. Trudgen 17794)
Rostellularia adscendens var. latifolia
Sida sp. Barlee Range (S. van Leeuwen 1642)
Sida sp. Hamersley Range (K. Newbey 10692)
Swainsona ?thompsonia...
Swainsona thompsoniana
Themeda sp. Hamersley Station (M.E. Trudgen 11431)
Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684)
N
0 2 4 6 8 10
Kilometres
Map units in metres

3.7 Potential conservation listed flora occurring in the study area

Three Threatened flora species are known to occur within the Pilbara region: *Aluta quadrata*, *Pityrodia* sp. Marble Bar (G. Woodman & D. Coultas GWDC Opp 4) and *Thryptomene wittweri*. None of these species would be expected to occur within the study area due to unsuitable habitat and significant separation to the nearest record.

Forty six conservation listed flora species were returned by NatureMap and Rio Tinto database searches within 20 km of the study area (Appendix 1), including; six Priority 1 species; five Priority 2 species; 29 Priority 3 species; and five Priority 4 flora species (Table 3-3). One species has previously been recorded, four species are considered 'likely' to occur, while the remaining 41 species were considered either 'possible' or 'unlikely' to occur based on the criteria used to assess the pre-field likelihood of occurrence (Table 3-3, Appendix 2).

Table 3-4: Conservation listed flora species returned by database searches, including pre-field likelihood of occurrence assessment and potential presence via habitat preference and proximity of previous recordings

Species	Status	Database		Nearest known locality from study area	Habitat and discussion (pre-field)	Likelihood of occurrence
		NM	RT			
Acacia bromilowiana	P4	X	X	2.4 km	Grows in skeletal stony loam typically high in the landscape. The Hamersley Range populations occur on steep slopes, ridge tops and breakaways (often in gullies and sheltered places) that comprises a substrate of banded ironstone or massive basalts.	Unlikely
Acacia daweana	P3	x		10 km	Low spreading shrub. Recorded from rocky red skeletal loam in spinifex on lower scree slopes and bajada outwash fans of banded rocky ironstone ranges and ridges (Rio Tinto & DPaW 2014).	Unlikely
Acacia effusa	P3	x		13.4 km	Low spreading shrub. Recorded from rocky red loam with surface strew of rocks in spinifex on low scree slopes of low rocky ranges or on bajada alluvial plain at the base of large banded ironstone mountains and ranges (Rio Tinto & DPaW 2014).	Unlikely
Astrebla lappacea	P3	X	X	12 km	Recorded as occurring mainly on gilgais, depressions on cracking clays soils and crabholed plains.	Unlikely
Amaranthus centralis	P3		X	8 km	Recorded as growing in red sand in ephemeral watercourses, sandy to clayey loam on river banks and edges of permanent pools in eucalypt lined channels or Acacia shrubland.	Unlikely
Aristida jerichoensis var. *subspinulifera*	P3		X	3 km	Recorded from hardpan plains with deep soil with open Acacia woodland over Triodia and other grasses	Possible
Astrebla lappacea	P3		x	3.4 km	Tufted perennial grass. Recorded as occurring mainly on gilgais, depressions on cracking clay soils and crab holed plains (Rio Tinto & DPaW 2014).	Unlikely
Bothriochloa decipiens var. *cloncurrensis*	P1	X	X	>1 km	Associated with floodplains, clays and seasonally wet grasslands.	Unlikely
Calotis squamigera	P1	X	X	7.5 km	In the Pilbara, it is only known from a poorly defined flow line on a plain with pebbly red/brown loam. Elsewhere in central Australia, it is common in grassland and sclerophyll forest.	Unlikely

Species	Status	Database		Nearest known locality from study area	Habitat and discussion (pre-field)	Likelihood of occurrence
		NM	RT			
Dampiera anonyma	P3	X	X	1.5 km	Recorded from hummock grassland on hill slopes and summits above 1000 m in skeletal red brown soil over massive banded ironstone.	Unlikely
Eremophila magnifica subsp. *magnifica*	P4	X	X	<1km	Recorded from rocky-red brown loams on hill slopes and along ephemeral drainage lines.	Unlikely
Eremophila magnifica subsp. *velutina*	P3		X	13 km	Recorded as common and growing in rocky red-brown loams in amongst Triodia and Acacia species on hill slopes and along ephemeral drainage lines	Unlikely
Eucalyptus lucens	P1	X	X	1 km	Occupies higher altitude shallow soils on quartzite but also occurs on ironstone in the Pilbara.	Unlikely
Euphorbia australis var. *glabra*	P3		X	2.3 km	Recorded from heavy cracking clays.	Unlikely
Euphorbia inappendiculata var. *inappendiculata*	P2	x		5 km	A prostrate, much-branched diffuse herb. In the Pilbara it is recorded from hummock grassland of *Triodia epactia* over very open grassland of **Cenchrus ciliaris* on red loamy depressions interspersed with quartzite on plain (Rio Tinto & DPaW 2014).	Unlikely
Geijera salicifolia	P3	X	X	2 km	Recorded from scree slopes and gorges in the Pilbara.	Unlikely
Glycine falcata	P3	X	X	10 km	Recorded as growing on stony loam or cracking clays, typically in grassland in low-lying areas.	Unlikely
Goodenia nuda	P4	X	X	1.5 km	Mostly recorded from seasonally inundated clay soils and drainage lines, often in mulga.	Likely
Goodenia pedicellata	P1		X	17 km	Shows a strong association with calcrete soils.	Unlikely
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)	P3		X	1.6 km	Shows a strong association with calcrete soils.	Unlikely
Grevillea saxicola	P3	X	X	<1 km	Grows in orange-brown to red-brown loam soils on the upper scree/breakaway slopes and crests often associated with banded iron formation outcropping.	Unlikely
Gymnanthera cunninghamii	P3		X	16 km	Recorded as growing in the surrounding areas of permanent or semi-permanent water courses in sandy soils.	Unlikely

Species	Status	Database		Nearest known locality from study area	Habitat and discussion (pre-field)	Likelihood of occurrence
		NM	RT			
Hibiscus sp. Mt Brockman (E. Thoma ET 1354)			X	5 km	Grows in sheltered or rocky drainage lines below associated cliff-lines or rocky ridges.	Unlikely
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)	P2	X		3 km	Grows in sheltered or rocky drainage lines below associated cliff-lines or rocky ridges.	Unlikely
Indigofera ixocarpa	P2	X	X	<1 km	Recorded growing on hills and drainage lines, usually skeletal soils over massive ironstones but also on granite.	Unlikely
Indigofera sp. Bungaroo Creek (S. van Leeuwen 4301)	P3		X	14 km	Recorded as growing in coarse alluvium in high energy creek lines or along steep slopes in skeletal soils overlaying coarse breccias from the brockman ironstone formation.	Unlikely
Iotasperma sessilifolium	P3	X	X	18 km	Recorded from gilgai, cracking clays and crabhole country in periodically flooded areas.	Unlikely
Lepidium catapycnon	P4	X	X	Previously Recorded	Occurs on skeletal soils in open woodland in unusually hilly areas, more frequent on south facing slopes. It appears to be extirpated by *Triodia* sp. As the vegetation matures, re-appearing after fires.	Previously Recorded
Oldenlandia sp. Hamersley Station (A.A. Mitchell PRP 1479)	P3	X	X	8 km	Occurs on cracking clays.	Unlikely
Olearia mucronata	P3	X	X	1.5 km	Recorded from mesic areas amongst ironstone boulders and along creek lines sometimes locally abundant on the margins of dry creek lines.	Possible
Pentalepis trichodesmoides subsp. *hispida*	P2	X	X	< 1km	Often found in *Triodia* hummock grassland and on summits and slopes of low hills and basaltic soils.	Possible
Pentalepis trichodesmoides subsp. *incana*	P1	X		13 km	Found in in *Triodia* grassland and *Eucalyptus* woodland on skeletal soils on volcanic rock types.	Unlikely
Ptilotus mollis	P4	X	X	9 km	Recorded from steep rocky sites, usually in full sun on massive ironstone formations.	Unlikely
Ptilotus subspinescens	P3		X	15 km	Recorded from hummock grassland between mesas of ironstone, mainly on rocky and scree slopes.	Unlikely

Species	Status	Database		Nearest known locality from study area	Habitat and discussion (pre-field)	Likelihood of occurrence
		NM	RT			
Rhagodia sp. Hamersley (M. Trudgen 17794)	P3		X	<1 km	Recorded from mulga on cracking clays.	Likely
Rostellularia adscendens var. *latifolia*	P3	X	X	<1 km	Recorded from protected areas near watercourses, or along shaded rocky ridges, often in dry gullies and gorges.	Likely
Scaevola sp. Hamersley Range basalts (S. van Leeuwen 3675)	P2	X	X	2 km	Known to be very habitat specific, occurring on slopes and hilltops on skeletal brown soils over mostly basaltic volcanic rock.	Unlikely
Sida sp. Barlee Range (S. van Leeuwen 1642)	P3	X	X	<1 km	Recorded as growing in skeletal soils in rocky areas especially scree slopes and rock piles in full sun to afternoon shade or in small chines and gullies.	Unlikely
Sida sp. Hamersley Range (K. Newbey 10692)	P3	X	X	3 km	Recorded as being associated with rocky outcrops and breakaways also sometimes found in flat areas between hills in shrubby grassland.	Unlikely
Solanum kentrocaule	P3	X	X	13 km	Occurs on hillsides and mountaintops or occasionally creek-beds, in skeletal red-brown soil over ironstone or on basalt scree.	Unlikely
Solanum sp. Red Hill (S. van Leeuwen et al. PBS 5415)	P3		x	7.4 km	Low spreading shrub. Recorded from footslopes of shale hills or ironstone hills and gorges (Western Australian Herbarium 1998-).	Unlikely
Stylidium weeliwolli	P3	X	X	5 km	Rosetted annual herb growing on gritty sandy soil along watercourses and at the edges of permanent pools or in gorges. Unlikely to occur within study area due to lack of suitable habitat	Unlikely
Swainsona thompsoniana	P3	X	X	18 km	Occurs on clay soils, usually in association with tussock grasses. Unlikely to occur within study area due to lack of suitable habitat.	Unlikely
Themeda sp. Hamersley Station (M.E. Trudgen 11431)	P3	X	X	Previously recorded	Recorded from drainage lines, clays flats, crabhole flats and dark, self-mulching clays (Rio Tinto & DPaW 2014).	Previously recorded
Triodia basitricha	P3	X		4.5 km	Plants often grow on crests and nearby slopes of rocky hills.	Possible
Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684)	P1		X	50 m	Recorded from clay-loams, clays cracking clays and gilgai usually in association with low open woodland and frequently with mulga	Likely

NM – NatureMap; **RT** – Rio Tinto Priority Flora Database.

3.8 Introduced flora occurring within the study area

The current and previous surveys, (Biota 2008, Mattiske (2008), Pilbara Flora (2011) Rio Tinto (2011) and Rio Tinto (2018) have recorded a combined 25 introduced (weed) species (Table 3-4) in the vicinity of the study area. The ranking of these weed species as per the Parks and Wildlife Weed Prioritisation process (Parks and Wildlife 2014) is shown in Table 3-4. None of these species were listed as a Declared Pests under the State *Biosecurity and Agriculture Management Act 2007*.

Strict weed hygiene protocols should be implemented during clearing of vegetation and subsequent earthworks to minimise the introduction and spread of weeds to or from the study area.

Table 3-5: Introduced species recorded in the study area and Parks and Wildlife weed prioritisation ranking

Species	Ecological Ranking[1]	Invasiveness Ranking[1]
**Aerva javanica*	High	Rapid
**Argemone ochroleuca*	Unknown	Rapid
**Bassia scoparia*	N/A	N/A
**Bidens bipinnata*	Unknown	Rapid
**Bougainvillea sp.*	N/A	N/A
**Cenchrus ciliaris*	High	Rapid
**Cenchrus setiger*	High	Rapid
**Chloris virgata*	High	Rapid
**Cynodon dactylon*	High	Rapid
**Citrullus lanatus*	Unknown	Rapid
**Datura leichhardtii*	Unknown	Unknown
**Echinochloa colona*	High	Rapid
**Euphorbia hirta*	Low	Slow
**Euphorbia peplus*	N/A	N/A
**Flaveria trinervia*	N/A	N/A
**Malvastrum americanum*	High	Rapid
**Melia azedarach*	N/A	N/A
**Portulaca pilosa*	N/A	N/A
**Rumex vesicarius*	High	Rapid
**Setaria verticillata*	High	Rapid
**Sonchus oleraceus*	Low	Rapid
**Sigesbeckia orientalis*	Unknown	Rapid
**Solanum nigrum*	Low	Rapid
**Vachellia farnesiana*	High	Rapid
**Washingtonia filifera*	High	Rapid

[1]Parks and Wildlife (2019)

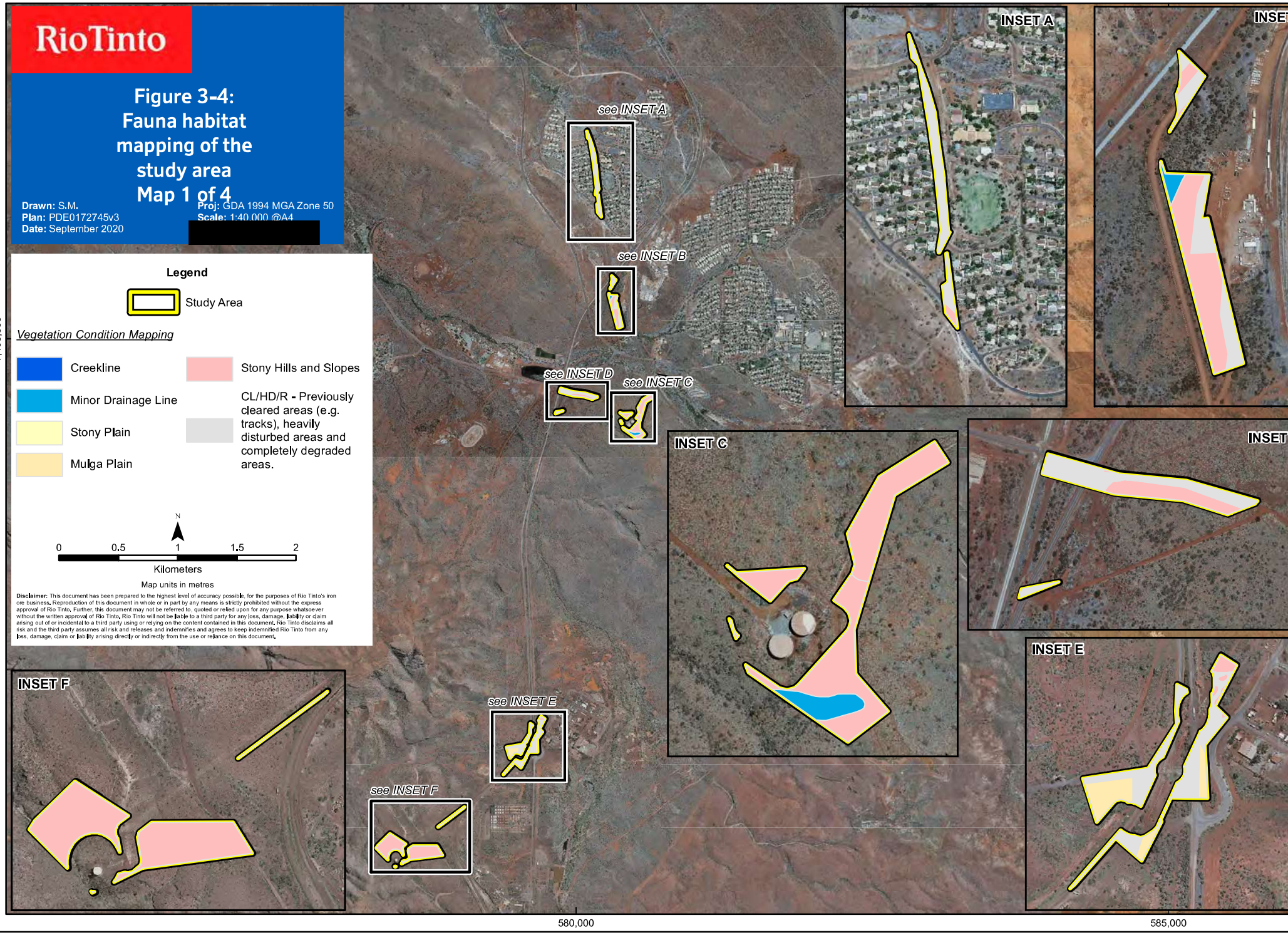
3.9 Fauna habitats

Four broad fauna habitat types were described from the study area, excluding disturbed habitat. The fauna habitat types recorded are described below, accompanied by mapping of the habitat types (Table 3-5, Figure 3-4).

The 'Mulga Plain' is the most widespread fauna habitat across the study area (454.1 ha, 55.6%), whilst 'creekline' is the least widespread fauna habitat recorded from the study area (16.0 ha, 2.0%).

Table 3-6: List of habitat types within the study area including microhabitats and extent

Habitat	Fauna habitat description	Significant microhabitat	Extent (ha) within study area	Proportion (%) within study area
Creekline	Open Woodland of *Eucalyptus victrix*, *Eucalyptus camaldulensis* var. *obtusa* over *Acacia citrinoviridis* over *Petalostylis labicheoides*, *Acacia pyrifolia* over *Tephrosia rosea* var. *clementii*, *Themeda triandra* and *Cleome viscosa* on coarse river sand with river stone. Associated with vegetation units D1, D3	Large tree hollows	16.0	2.0
Minor Drainage Line	Scattered tree of *Corymbia* spp. over tall shrubland of mixed *Acacia* spp. and *Androcalva luteiflora* over mixed open tussock grassland over open hummock grasslands of *Triodia* spp. on shallow red brown loams with mixed rocks on minor drainage lines. Associated with vegetation units D2, D3 and D4.	Leaf litter	45.9	5.6
Stony Plain	Shrublands of mixed *Acacia* spp. over hummock grasslands of *Triodia* spp. on red brown loams with ironstone pebbles and rocky plains and lower slopes. Associated with vegetation units P3 and P7	Leaf litter	140.2	17.2
Mulga Plain	Low Open Woodland of *Acacia aneura* (complex) over open shrubland over of mixed *Acacia* spp. and *Eremophila* spp. over open hummock grassland of *Triodia* spp. over tussock grasses and annual herbs on red brown loams. Associated with vegetation units P1, P2, P4, P5, P6, P5/P6, P8, P9	Leaf litter	454.1	55.6
Stony Hills and Slopes (HS)	Scattered low trees of *Eucalyptus leucophloia* subsp. *leucophloia* over open shrubland of mixed *Acacia* spp. and *Eremophila* spp. over hummock grassland of *Triodia* spp. over mixed annuals on shallow red brown loams with rock mantles and minor rock outcropping. Associated with vegetation units H1 – H7	Rock outcrops	134.6	16.5
Disturbed (HD)	Cleared areas from mining and pastoralism activities.		25.4	3.1
		Total	**816.2**	**100.00**


RioTinto
Figure 3-4:
Fauna habitat mapping of the study area
Map 1 of 4
Drawn: S.M.
Plan: PDE0172745v3
Date: September 2020
Proj: GDA 1994 MGA Zone 50
Scale: 1:40,000 @A4
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Legend
Study Area
Vegetation Condition Mapping
Creekline
Minor Drainage Line
Stony Plain
Mulga Plain
Stony Hills and Slopes
CL/HD/R - Previously cleared areas (e.g. tracks), heavily disturbed areas and completely degraded areas.
N
0
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1
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Kilometers
Map units in metres
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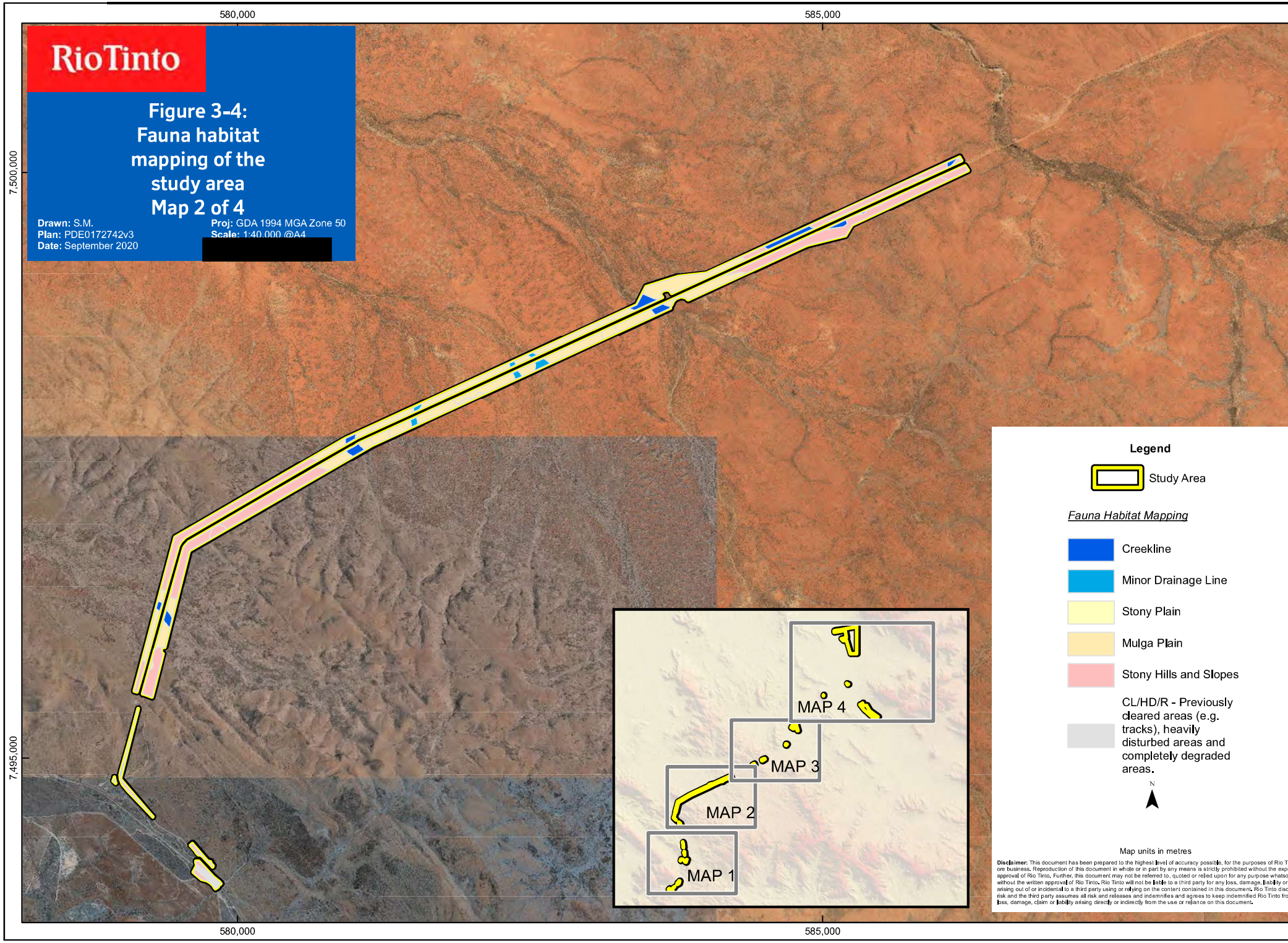
RioTinto
Figure 3-4:
Fauna habitat
mapping of the
study area
Map 2 of 4
Drawn: S.M.
Plan: PDE0172742v3
Date: September 2020
Proj: GDA 1994 MGA Zone 50
Scale: 1:40,000 @A4
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580,000
585,000
7,500,000
7,495,000
MAP 4
MAP 3
MAP 2
MAP 1
Legend
Study Area
Fauna Habitat Mapping
Creekline
Minor Drainage Line
Stony Plain
Mulga Plain
Stony Hills and Slopes
CL/HD/R - Previously cleared areas (e.g. tracks), heavily disturbed areas and completely degraded areas.
N
Map units in metres
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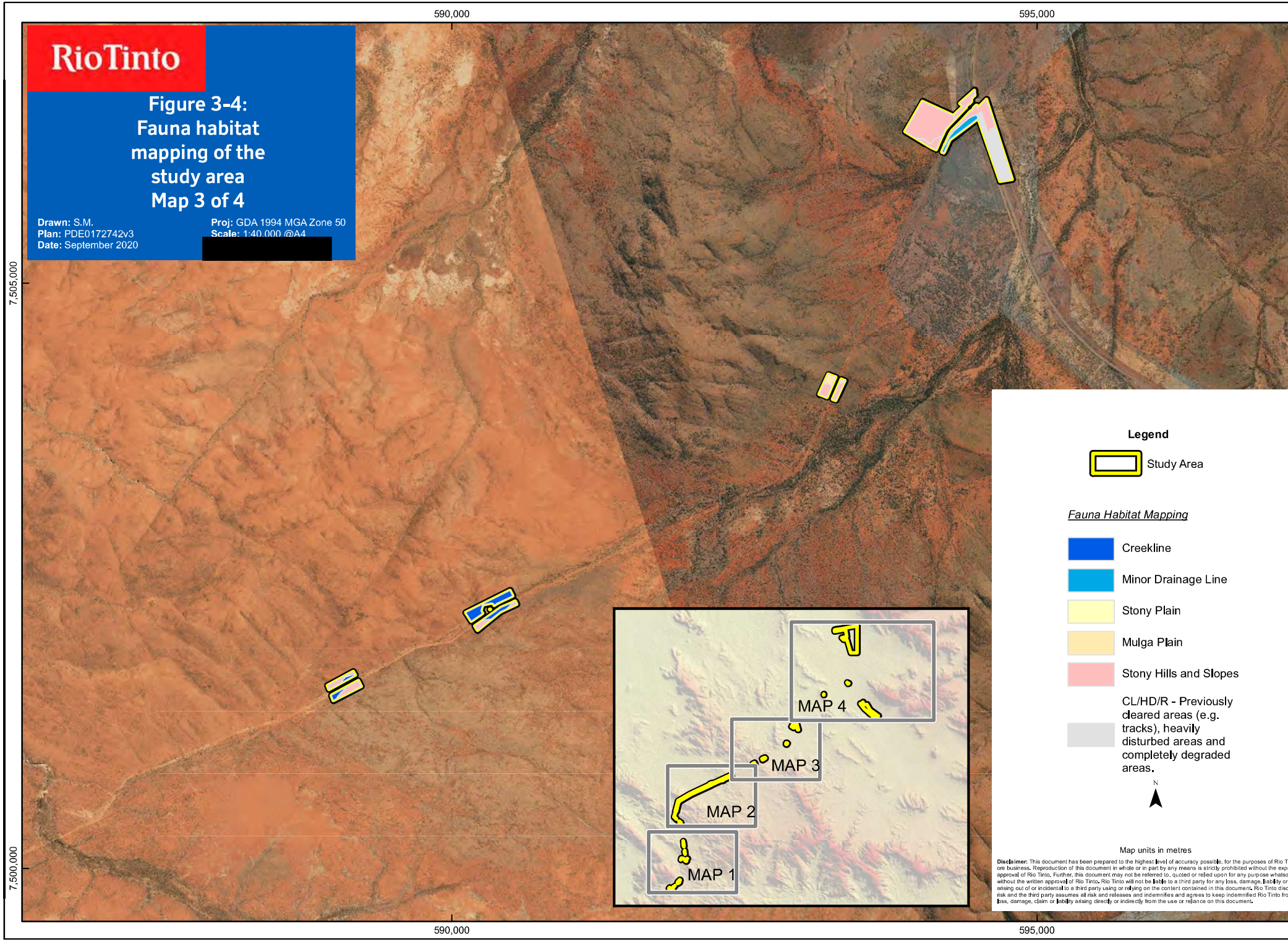
RioTinto
Figure 3-4:
Fauna habitat
mapping of the
study area
Map 3 of 4
Drawn: S.M.
Plan: PDE0172742v3
Date: September 2020
Proj: GDA 1994 MGA Zone 50
Scale: 1:40,000 @A4
[redacted]
590,000
595,000
7,505,000
7,500,000
MAP 4
MAP 3
MAP 2
MAP 1
Legend
Study Area
Fauna Habitat Mapping
Creekline
Minor Drainage Line
Stony Plain
Mulga Plain
Stony Hills and Slopes
CL/HD/R - Previously cleared areas (e.g. tracks), heavily disturbed areas and completely degraded areas.
N
Map units in metres
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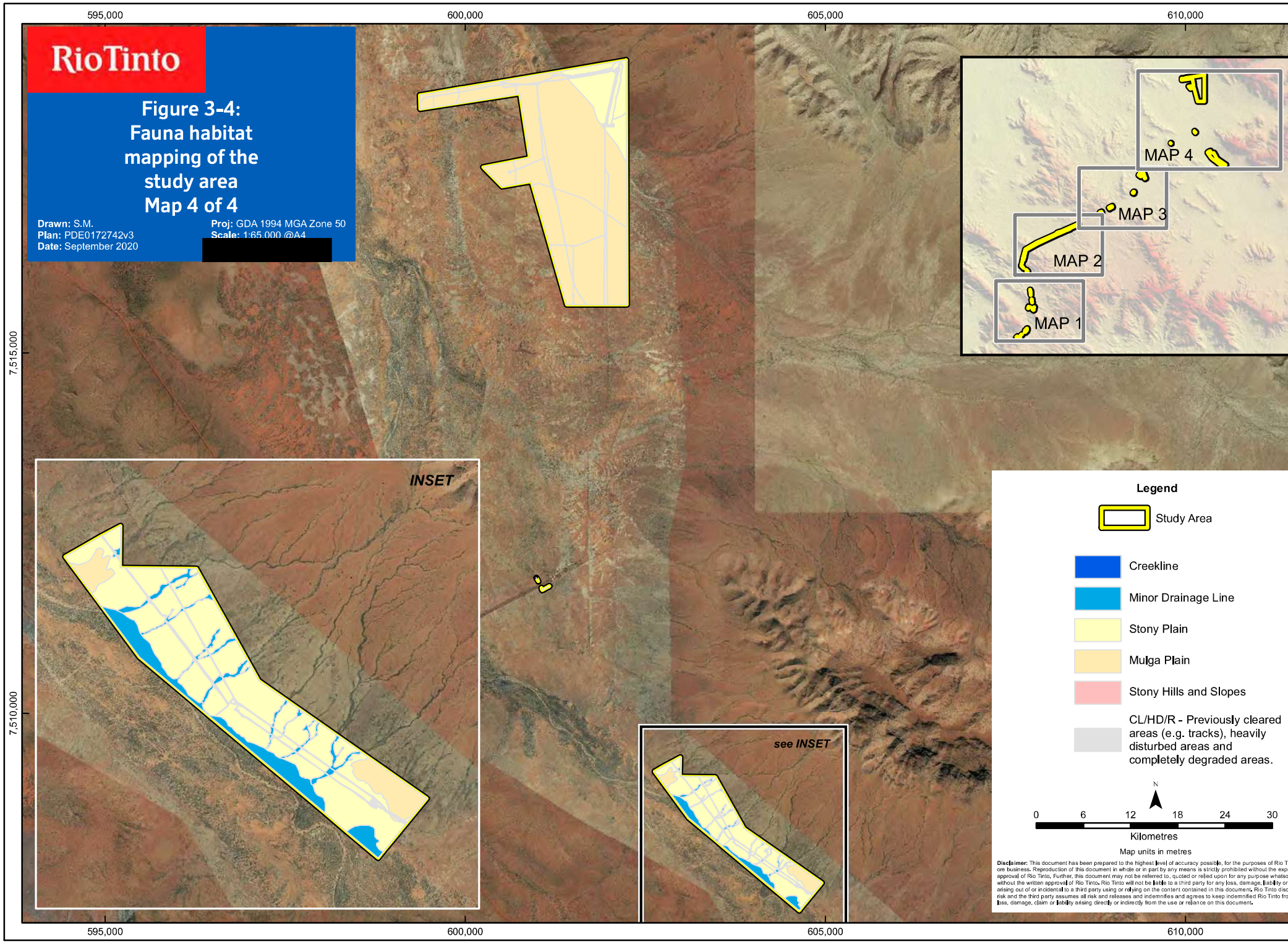
595,000
600,000
605,000
610,000
7,515,000
7,510,000
RioTinto
Figure 3-4:
Fauna habitat
mapping of the
study area
Map 4 of 4
Drawn: S.M.
Plan: PDE0172742v3
Date: September 2020
Proj: GDA 1994 MGA Zone 50
Scale: 1:65,000 @A4
[redacted]
MAP 4
MAP 3
MAP 2
MAP 1
INSET
see INSET
Legend
Study Area
Creekline
Minor Drainage Line
Stony Plain
Mulga Plain
Stony Hills and Slopes
CL/HD/R - Previously cleared areas (e.g. tracks), heavily disturbed areas and completely degraded areas.
N
0
6
12
18
24
30
Kilometres
Map units in metres
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3.10 Fauna habitats of significance

None of the fauna habitats occurring within the study area correspond to any ecosystems listed as Threatened under the EPBC Act and none are consistent with ecosystems listed as TECs by DBCA (2018).

None of the fauna habitats occurring within the study area are representative of listed PECs by DBCA (2019b).

3.11 Other habitats of significance

None of the fauna habitats occurring within the study area were deemed to hold elevated conserved significance.

All habitats within the study area have the potential to support a range of conservation listed fauna species passing through the site on an occasional basis, or utilising the site as foraging habitat. All habitats within the study area occur extensively in the local and broader Pilbara region.

3.12 Conservation listed fauna recorded in study area

No fauna species of conservation significance have previously been recorded within the study area.

3.13 Potential conservation listed fauna occurring in the study area

The desktop study, utilising previous survey results and various database searches identified 26 other conservation significant fauna species that may occur within the vicinity of the study area. The likelihood of their occurrence is presented in Table 3-6 and is based on a review of the available habitats within the study area and their suitability for each species.

Twenty two of the 26 conservation listed species identified by the database search were deemed unlikely to occur within the study area, due to the study area not supporting likely habitat (Table 3-6). One species, *Pseudomys chapmani* (Western pebble-mound mouse) was considered 'likely' to occur and a further three have the 'potential' to occur within the habitats available in the study area. Species that are likely or have the potential to occur within the study area are discussed below:

- ***Liasis olivaceus* subsp. *barroni* (Pilbara olive python) – Vulnerable (BC Act and EPBC Act)**

  Regarded as a Pilbara endemic, the Pilbara olive python has a known distribution that coincides roughly with the Pilbara bioregion (Environment Australia 2012). This species typically shelters in logs, flood debris, caves, tree hollows and thick vegetation close to water and rock outcrops (Burbidge 2004). While there are rocky habitats within the study area, none are associated with permanent water sources.

  While the Pilbara olive python may move through the study area at times, due to the lack of permanent water pools and the relatively small scale of the Proposal, it is considered unlikely the Proposal will negatively impact on the conservation status of this species on either a local or bioregional scale.

- ***Notoscincus butleri* (Lined Soil-crevice Skink) – Priority 4**

  The lined soil-crevice skink is endemic to Western Australia and restricted to the arid north-west of the Pilbara bioregion (Wilson & Swan 2008). This species has been associated with spinifex dominated areas near creek and river margins and suitable habitat for this species is therefore present in the study area. Due to the small size of the study area it is considered unlikely the Proposal will negatively impact on the conservation status of this species.

- ***Pseudomys chapmani* (Western pebble-mound mouse) – Priority 4**

  The western pebble-mound mouse is endemic to the Pilbara region of Western Australia and occurs west to the McKay Range and south to the Collier Range (Menkhorst and Knight 2001). The species is patchily distributed on gentle colluvial slopes of rocky, hummock grasslands with little or no soil and a sparse shrub layer.

  Records of this species have been made in the vicinity of the study area and a small amount of suitable habitat is present. The conservation status of this species is considered unlikely to be impacted by the Proposal.

- ***Sminthopsis longicaudata* (Long-tailed Dunnart) – Priority 4**

  The Long-tailed Dunnart occurs across the Gibson Desert,Pilbara and Murchison with a patchy distribution restricted to rocky scree and plateau areas, generally with little vegetation or in areas of spinifex hummock grassland, shrubs and open woodland. (Van Dyck and Strahan 2008).

  Due to the small size of the study area it is considered unlikely the Proposal will negatively impact on the conservation status of this species

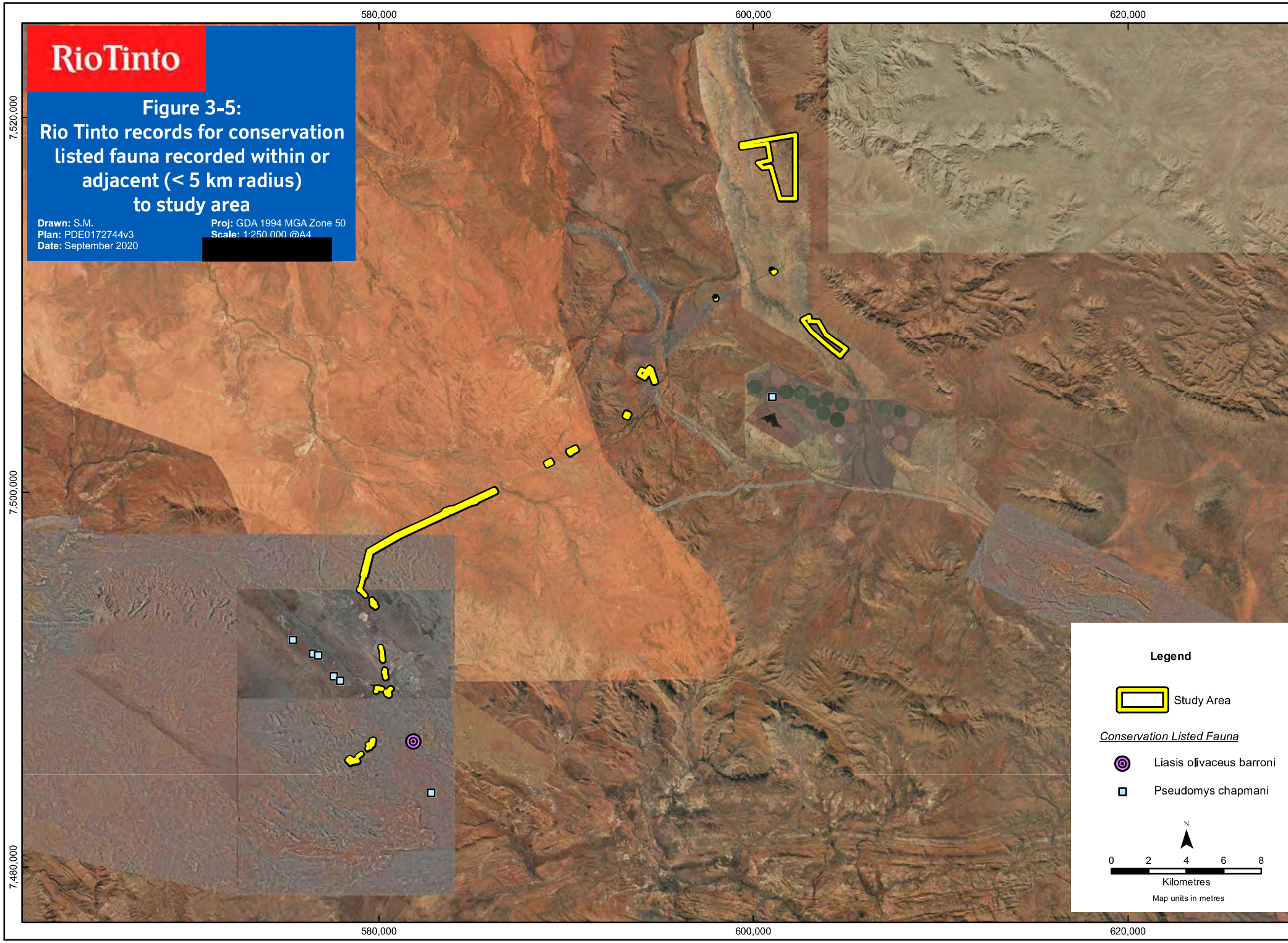
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Figure 3-5:
Rio Tinto records for conservation listed fauna recorded within or adjacent (< 5 km radius) to study area
Drawn: S.M.
Plan: PDE0172744v3
Date: September 2020
Proj: GDA 1994 MGA Zone 50
Scale: 1:250,000 @A4
580,000
600,000
620,000
7,520,000
7,500,000
7,480,000
Legend
Study Area
Conservation Listed Fauna
Liasis olivaceus barroni
Pseudomys chapmani
N
0 2 4 6 8
Kilometres
Map units in metres

Table 3-7: Conservation listed fauna species returned by database searches, including pre-field likelihood of occurrence assessment and potential presence via habitat preference and proximity of previous recordings

Species	Common name	BC Act	EPBC Act	NM	RT	EPBC	Distance to nearest record	Habitat and discussion	Likelihood of occurrence
Leggadina lakedownensis	Northern Short-tailed Mouse, Lakeland Downs Mouse	P4	-	X	-	-	3 km	Found in a variety of habitats including spinifex and tussock grasslands, samphire and sedgelands, *Acacia* shrublands, woodlands and stony ranges across much of tropical Australia. In the Pilbara, the species has been recorded from coastal and inland localities and appears to prefer cracking clay habitats, although has been recorded in rocky habitat. As there are no cracking clays within the study area, it is unlikely there is suitable habitat for this species.	Unlikely
Sminthopsis longicaudata	Long-tailed Dunnart	P4	-	X		-	2.5 km	Exposed rock and stony soils with hummock grasses and shrubs. Flat-topped hills, lateritic plateaus, sandstone ranges and breakaways. Sparse mulga over spinifex.	Potential
Dasyurus hallucatus	Northern Quoll	EN	EN			X	> 20 km	In the Pilbara region, the species tends to prefer the Rocklea, Macroy and Robe land systems and occurs within gorges, breakaways and major drainage lines with large Eucalyptus trees. This species has been recorded twice within 50 m and 190 m east of the study area, from breakaway habitats. This habitat continues into the study area, hence it is considered likely the Northern Quoll would utilise habitat found within the study area.	Unlikely
Macrotis lagotis	Greater Bilby	VU	VU	x	X		15 km	Remaining populations of the Greater Bilby occupy three major vegetation types, namely: open tussock grassland on uplands and hills, mulga woodland/shrubland growing on ridges and rises, and hummock grassland in plains and alluvial areas.	Unlikely
Macroderma gigas	Ghost bat	VU	VU	-	X	X	5 km	This species is known to occur in the Hamersley Range and wider Pilbara region. It roosts in natural caves, adits and mines, as well as granite rockpiles in the eastern Pilbara (Armstrong and Anstee 2000). This species has been recorded from calls surrounding the study area and may utilise habitat for foraging within the study area.	Unlikely

Species	Common name	BC Act	EPBC Act	NM	RT	EPBC	Distance to nearest record	Habitat and discussion	Likelihood of occurrence
Pseudomys chapmani	Western Pebble-mound Mouse	P4	-	X	X	-	6 km	The Western pebble-mound mouse is endemic to the Pilbara region of Western Australia and occurs west to the McKay Range and south to the Collier Range (Menkhorst and Knight 2001). The species is patchily distributed on gentle colluvial slopes of rocky, hummock grassland with little or no soil and sparse shrub layer. A small amount of habitat is present in the study area and an inactive mound was recorded in the wider area during the 2015 surveys.	Likely
Rhinonicteris aurantia (Pilbara form)	Pilbara Leaf-nosed Bat	VU	VU	X	X	X	9 km	This species inhabits abandoned mine shafts, granite rock pile terrain of the east Pilbara and caves formed in gorges that dissect sedimentary geology in the west Pilbara (van Dyck and Strahan 2008). This species is more influenced by the availability of suitable roost caves than by habitat type and high humidity is particularly important to this species (Churchill 1998).	Unlikely
Liasis olivaceus subsp. *barroni*	Pilbara Olive Python	VU	VU	X	X	X	<1 km	Regarded as a Pilbara endemic, the Pilbara olive python has a known distribution that coincides roughly with the Pilbara bioregion (Environment Australia 2012). This species typically shelters in logs, flood debris, caves, tree hollows and thick vegetation close to water and rock outcrops (Burbidge 2004).	Potential
Notoscincus butleri	Lined Soil-crevice Skink (Dampier)	P4	-	X	X	-	4.5 km	Found in spinifex dominated areas near creek and river margins. Suitable habitat is located within the study area.	Potential
Amytornis striatus subsp. *striatus*	Striated Grasswren (inland)	P4	-	X	-	-	<1 km	Occurs in spinifex country with sparsely scattered trees, on sand dunes or stocky ranges. The study area lies outside the known range of the *A. striatus* subsp. *striatus* with the nearby NatureMap record likely to be erroneous.	Unlikely
Malurus leucopterus subsp. *leucopterus*	Dirk Hartog black and white fairy-wren	VU	VU	X	-	-	< 1 km	The White-winged Fairy-wren (Dirk Hartog Island) occurs at a single location, Dirk Hartog Island, in Western Australia (Schodde & Mason 1999).	Unlikely
Plegadis falcinellus	Glossy Ibis	MI	MI	X			< 1km	Migratory wader bird, therefore unlikely to land as no permanent water in study area.	Unlikely

Species	Common name	BC Act	EPBC Act	NM	RT	EPBC	Distance to nearest record	Habitat and discussion	Likelihood of occurrence
Calidris ferruginea	Curlew Sandpiper	CR & MI	CR & MI	-	-	X	> 200 km	Small, slim sandpiper which occurs on intertidal mudflats and around non-tidal swamps, lakes and lagoons near the coast and ponds in saltworks and sewage farms. No suitable habitat for this species occurs in the study area.	Unlikely
Pezoporus occidentalis	Night Parrot	CR	EN	-	-	X	> 100 km	This species inhabits treeless or sparsely wooded spinifex near water. This cryptic species is unlikely to occur in the study area.	Unlikely
Rostratula australis	Australian Painted-snipe, Australian Painted Snipe	EN	EN	-	-	X	> 150 km	This species frequents shallow, freshwater wetlands with a thick cover of low vegetation (DEH 2003). No suitable habitat for this species occurs in the study area.	Unlikely
Apus pacificus	Fork-tailed Swift	MI	MI	-	-	X	45 km	The Fork-tailed Swift is almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher. Unlikely to be dependent on habitat in the study area.	Unlikely
Hirundo rustica	Barn Swallow	MI	MI	-	-	X	> 200 km	The Barn Swallow usually occurs in northern Australia, on Cocos-Keeling Island, Christmas Island (Stokes et al. 1984; Stokes 1988), Ashmore Reef (Higgins et al. 2006), and patchily along the north coast of the mainland from the Pilbara region, Western Australia, to Fraser Island in Queensland. The species has been recorded irregularly further south in Western Australia, in areas such as Derby and Carnarvon, and in South Australia near Koolunga, Roxby Downs, Nantawarra and south of Innamincka (Higgins et al. 2006).	Unlikely
Actitis hypoleucos	Common Sandpiper	MI	MI	X	X	X	<1km	Migratory wader bird, therefore unlikely to land as no permanent water in study area.	Unlikely
Motacilla cinerea	Grey Wagtail	MI	MI	-	-	X	140 km	This species inhabits fast-flowing mountain streams and rivers with riffles and exposed rocks or shoals, often in forested areas. It is also found in more lowland watercourses, even canals, where there are artificial waterfalls, weirs, millraces or lock gates. Outside of the breeding season it occupies a wider variety of habitats, including farmyards, sewage farms, forest tracks, tea estates and even town centres (Tyler 2016).	Unlikely

Species	Common name	BC Act	EPBC Act	NM	RT	EPBC	Distance to nearest record	Habitat and discussion	Likelihood of occurrence
Motacilla flava	Yellow Wagtail	MI	MI	-	-	X	>500 km	This species occupies a range of damp or wet habitats with low vegetation, from damp meadows, marshes, waterside pastures, sewage farms and bogs to damp steppe and grassy tundra. In the north of its range it is also found in large forest clearings.	Unlikely
Calidris subminuta	Long-toed Stint	MI	MI	X	-	-	< 1 km	Migratory wader bird, therefore unlikely to land as no permanent water in study area.	Unlikely
Calidris melanotos	Pectoral Sandpiper	MI	MI	-	-	X	> 200 km	Migratory wader bird, therefore unlikely to land as no permanent water in study area.	Unlikely
Falco peregrinus	Peregrine Falcon	OS	-	X	-	-	10 km	Occupies a variety of habitats, with nesting typically occurring on ledges, cliff faces or shallow tree hollows. Unlikely to be dependent on habitat in the study area.	Unlikely
Calidris acuminata	Sharp-tailed Sandpiper	MI	MI	-	-	X	55 km	Migratory wader bird, therefore unlikely to land as no permanent water in study area.	Unlikely
Charadrius veredus	Oriental Plover	MI	MI	-	-	X	45 km	Migratory wader bird, therefore unlikely to land as no permanent water in study area.	Unlikely
Tringa glareola	Wood Sandpiper	MI	MI	X	X	-	< 1 km	Migratory wader bird, therefore unlikely to land as no permanent water in study area.	Unlikely

NM – NatureMap; **RT** –Rio Tinto Priority Fauna Database; **EPBC** – EPBC Act Protected Matters Search Tool.

4. Statement addressing the 10 clearing principles

Rio Tinto is proposing to undertake the drilling and replacement of a number of monitoring and production bores at the Southern Fortescue Borefield as well as duplicating the Southern Fortescue pipeline from the filter plant at Marandoo booster station to Tom Price Town. The study area is approximately 707 ha in size and comprises amendments to CPS 4919/4.

Based on specialist assessment of the study area and discussion below, it is deemed that the Proposal is unlikely to be at variance with any of the 10 clearing principles under Schedule 5 of the EP Act.

4.1 Comprises high level of biological diversity

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

The Pilbara is one of Australia's 15 National Biodiversity Hotspots (DotEE 2019d) and is a secondary centre of endemism and species richness for *Acacia*, *Triodia*, *Corymbia* and *Sida* in Western Australia (Maslin 2001, Kendrick 2001 and Maslin and van Leeuwen 2008). The Hamersley sub-region of the Pilbara has been identified by the Threatened Species Scientific Committee for the Australian Government Biodiversity Hotspots as it provides habitat for a number of threatened, endemic and fire-sensitive species and communities.

The study area occurs within the Hamersley sub-region of the Pilbara bioregion. The Hamersley sub-region is described as: 'Mountainous area of Proterozoic sedimentary ranges and plateaux, supporting Mulga (*Acacia aneura*) low woodland over bunch grasses on fine textured soils, and *Eucalyptus leucophloia* woodlands over *Triodia brizoides* hummock grasslands on skeletal sandy soils' (Kendrick 2001).

Special features of the Hamersley sub-region include rare features such as gorges, centres of endemism including calcrete deposits, refugia and the *Themeda* grasslands TEC (Kendrick 2001). The buffer boundary for the '*Themeda* grasslands on cracking clays (Hamersley Station, Pilbara)' TEC is located approximately 26 km north of the study area, and due to the separation, will not be impacted by the Proposal.

Twenty one vegetation units were described from the study area. Seven vegetation units were described from hills, nine units from floodplains and plains and four from drainage lines. None of the vegetation units occurring within the study area are listed as TECs under either the EPBC Act or under the State BC Act.

None of the vegetation units represent PECs under the State listing maintained by DBCA. The vegetation units identified within the study area are considered to be widely distributed both locally and throughout the Hamersley sub-region.

Five broad fauna habitat types were recorded within the study area: 'Creekline', 'Minor Drainage Line', 'Mulga Plain', and 'Stony Plains', 'Stony Hills and Slopes'. These fauna habitats are not considered to be restricted at a local or regional level.

The Proposal is considered unlikely to be at variance with this Principle.

4.2 Potential impact to any significant habitat for fauna indigenous to Western Australia

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

No species of Threatened or Priority listed fauna have previously been recorded in the Study Area. A further five fauna species were considered 'Likely' or 'Potential' to occur within the study area based on desktop observations. Whilst some of these species may use the area for foraging, it is unlikely the Proposal will negatively impact on the conservation status of any of these species on either a local or bioregional scale

Four conservation significant fauna species were considered 'Likely' or 'Potential' to occur within the habitats available in the study area. These species were: *Liasis olivaceus* subsp. *barroni* (Pilbara olive python; *Notoscincus butleri* (Lined soil-crevice skink), *Pseudomys chapmani* (Western Pebble-mound Mouse) and *Sminthopsis longicaudata* (Long-tailed Dunnart).

These species may move through the study area to forage, however, due to the small size of the study area, it is considered unlikely the Proposal will negatively impact on the conservation status of any of these species, on either a local or regional scale. The Proposal is considered unlikely to be at variance with this Principle.

4.3 Potential impact to any rare flora

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

No Declared Rare / Threatened flora species were recorded, nor were any EPBC Act listed Threatened flora observed. None of the Pilbara region Threatened flora species would be expected to occur in the study area due to unsuitable habitat and distance to nearest record. The Proposal is not considered to be at variance with this Principle.

4.4 Presence of any threatened ecological communities

Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of a threatened ecological community (TEC).

There are no State or Commonwealth listed TECs within or adjacent to the study area. The Proposal is not considered to be at variance with this Principle.

4.5 Significance as a remnant of native vegetation in the area that has been extensively cleared

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

The majority of the Pilbara region has not been extensively cleared. However grazing, inappropriate fire regimes and weed invasion have greatly altered the vegetation in some areas. The study area lies within six of Beard's mapping units – Hammersley 18, Hammersley 29, Hammersley 81, Hammersley 157, Hammersley 175 and Hammersley 567.

The current extent of all the mapped Beard (1975 units in the study has been estimated to be over 99% of their pre-European extent remaining and is considered to be of 'least concern'. Vegetation types within the study area would not represent remnant stands of extensively cleared vegetation. The Proposal is not considered to be at variance with this Principle.

4.6 Impact on any watercourse and / or wetlands

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

Minor ephemeral (creeklines that flow after significant rainfall events) and one moderate creekline (C1) intersects the study area. These flow lines are not considered to be significant watercourses or wetlands and therefore the Proposal is not at variance with this Principle.

4.7 Potential to cause appreciable land degradation

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

The study area lies mostly within the Marandoo Land System, as well as the Paraburdoo Land System, and to a lesser extent, the Boolgeeda, Jurrawarrina, Rocklea, Newman, McKay and Platform Land Systems. These Land Systems are generally not prone to degradation and not susceptible to erosion. The Proposal is not expected to result in soil erosion, nutrient export, water-logging/flooding, acidification, salinization or deep subsoil compaction. The Proposal is not considered to be at variance with this Principle.

4.8 Potential to impact on the environmental values of adjacent or nearby conservation areas

Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

Give the small scale of the proposal the clearing of native vegetation is not considered likely to impact the nearby Karijini National Park. The Proposal is not considered to be at variance with this Principle.

4.9 Potential deterioration in the quality of surface or underground water

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

No permanent water features occur in the study area. Given the small scale of Proposal, there is no reason to expect that the Proposal would affect surface or groundwater quality in the region.

The Proposal is unlikely to be at variance with this Principle.

4.10 Potential of clearing to cause, or exacerbate, the incidence or intensity of flooding

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

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

The Proposal is not considered to be at variance with this Principle.

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6. Appendices

Appendix 1: Results of NatureMap and EPBC Protected Matters and Parks Searches

NatureMap

NatureMap Species Report

Created By Guest user on 20/02/2020

Conservation Status Conservation Taxon (T, X, IA, S, P1-P5)
Current Names Only Yes
Core Datasets Only Yes
Method 'By Circle'
Centre 117° 50' 34" E,22° 35' 1" S
Buffer 20km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	30071	*Acacia bromilowiana*		P4	
2.	41323	*Actitis hypoleucos* (Common Sandpiper)		IA	
3.	24538	*Amytornis striatus* subsp. *striatus* (Striated Grasswren (inland))		P4	
4.	228	*Astrebla lappacea* (Curly Mitchell Grass, Wheat Mitchell)		P3	
5.	18395	*Bothriochloa decipiens* var. *cloncurrensis*		P1	
6.	24783	*Calidris subminuta* (Long-toed Stint)		IA	
7.	13231	*Calotis squamigera*		P1	
8.	20381	*Dampiera anonyma*		P3	
9.	14093	*Eremophila magnifica* subsp. *magnifica*		P4	
10.	20825	*Eucalyptus lucens*		P1	
11.	25624	*Falco peregrinus* (Peregrine Falcon)		S	
12.	4483	*Geijera salicifolia*		P3	
13.	5346	*Glycine falcata*		P3	
14.	7550	*Goodenia nuda*		P4	
15.	44441	*Grevillea saxicola*		P3	
16.	40960	*Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708)		P2	
17.	14329	*Indigofera ixocarpa*		P2	
18.	15584	*Isotropis parviflora*		P3	
19.	24217	*Leggadina lakedownensis* (Northern Short-tailed Mouse, Lakeland Downs Mouse, Kerakenga)		P4	
20.	3022	*Lepidium catapycnon* (Hamersley Lepidium)		P4	
21.	25225	*Liasis olivaceus* subsp. *barroni* (Pilbara Olive Python)		T	
22.	24548	*Malurus leucopterus* subsp. *leucopterus* (Dirk Hartog black and white fairy-wren)		T	
23.	25198	*Notoscincus butleri* (Lined soil-crevice skink (Dampier))		P4	
24.	19640	*Oldenlandia* sp. Hamersley Station (A.A. Mitchell PRP 1479)		P3	
25.	13536	*Olearia mucronata*		P3	
26.	42006	*Pentalepis trichodesmoides* subsp. *hispida*		P3	
27.	42007	*Pentalepis trichodesmoides* subsp. *incana*		P1	
28.	24843	*Plegadis falcinellus* (Glossy Ibis)		IA	
29.	24233	*Pseudomys chapmani* (Western Pebble-mound Mouse, Ngadji)		P4	
30.	2744	*Ptilotus mollis*		P4	
31.	41368	*Rhinonicteris aurantia* (Orange Leaf-nosed Bat)		P4	
32.	11586	*Rostellularia adscendens* var. *latifolia*		P3	
33.	32587	*Scaevola* sp. Hamersley Range basalts (S. van Leeuwen 3675)		P2	
34.	18816	*Sida* sp. Barlee Range (S. van Leeuwen 1642)		P3	
35.	33887	*Sida* sp. Hamersley Range (K. Newbey 10692)		P3	
36.	24115	*Sminthopsis longicaudata* (Long-tailed Dunnart)		P4	
37.	42542	*Solanum kentrocaule*		P3	
38.	18123	*Stylidium weeliwolli*		P3	
39.	42147	*Swainsona thompsoniana*		P3	
40.	17820	*Themeda* sp. Hamersley Station (M.E. Trudgen 11431)		P3	
41.	24806	*Tringa glareola* (Wood Sandpiper)		IA	
42.	45169	*Triodia basitricha* (Pilbara Curly Spinifex)		P3	

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

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

NatureMap is a collaborative project of the Department of Biodiversity, Conservation and Attractions and the Western Australian Museum.

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Page 1

Australian Government
Department of the Environment and Energy

EPBC Act Protected Matters Report

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

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

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 02/01/20 18:43:14

This map may contain data which are ©Commonwealth of Australia (Geoscience Australia). ©PSMA 2010

Coordinates
Buffer: 10.0Km

Summary

Matters of National Environmental Significance

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

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	7
Listed Migratory Species:	9

Other Matters Protected by the EPBC Act

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

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

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

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	14
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	None

Extra Information

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

State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	10
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Pezoporus occidentalis Night Parrot [59350]	Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat likely to occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Rhinonicteris aurantia (Pilbara form) Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat may occur within area
Reptiles		
Liasis olivaceus barroni Olive Python (Pilbara subspecies) [66699]	Vulnerable	Species or species habitat known to occur within area

Listed Migratory Species		[Resource Information]
* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.		
Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus		
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba		
Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis		
Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Charadrius veredus		
Oriental Plover, Oriental Dotterel [882]		Species or species habitat may occur within area
Chrysococcyx osculans		
Black-eared Cuckoo [705]		Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Karijini	WA

Invasive Species [Resource Information]

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

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Mammals		
Camelus dromedarius Dromedary, Camel [7]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus asinus Donkey, Ass [4]		Species or species habitat likely to occur within area
Equus caballus Horse [5]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Vulpes vulpes		
Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Cenchrus ciliaris		
Buffel-grass, Black Buffel-grass [20213]		Species or species habitat likely to occur within area

Caveat

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

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

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

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

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

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

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

- migratory and
- marine

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

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

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

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

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

Coordinates

-22.60333 117.84

Acknowledgements

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

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

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

Please feel free to provide feedback via the Contact Us page

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Appendix 2: Likelihood of occurrence criteria for flora and fauna species

Likelihood of occurrence criteria for flora and fauna species:

- **Likelihood: Previously recorded**
  - The species has previously been recorded within study area from the Department of Biodiversity, Conservation and Attractions (DBCA) database search results and/or from previous surveys of the study area, and/or the species has been confirmed through a current vouchered specimen at the Western Australian Herbarium (WAH).
- **Likelihood: Likely**
  - The species has not previously been recorded from within the study area. However:

    The species has been recorded in proximity (<5 km) to the study area, and occurs in similar habitat to that which occurs within the study area.

    Core habitat and suitable landforms for the species occurs within the study area either year-round or seasonally. In relation to fauna species, this could be that a host plant is seasonally present on site, or habitat features such as caves are present that may be used during particular times during its life cycle e.g. for breeding. In relation to both flora and fauna species, it may be there are seasonal wetlands present.

    There is a medium to high probability that a species uses the study area.
- **Likelihood: Potential**
  - The species has not previously been recorded from within the study area. However:

    Targeted surveys may locate the species based on records occurring in proximity to the study area (5-15 km) and suitable habitat occurring in the study area.

    The study area has been assessed as having potentially suitable habitat through habitat modelling.

    The species is known to be cryptic and may not have been detected despite extensive surveys.

    The species is highly mobile and has an extensive foraging range so may not have been detected during previous surveys.
  - The species has been recorded in the study area by a previous consultant survey or there is historic evidence of species occurrence within the study area. However:

    Doubt remains over taxonomic identification, or the majority of habitat does not appear suitable (although presence cannot be ruled out due to factors such as species ecology or distribution).

    Coordinates are doubtful.
- **Likelihood: Unlikely**
  - The species has been recorded locally through DBCA database searches. However, it has not been recorded within the study area and:

    It is unlikely to occur due to the site lacking critical habitat, having at best marginally suitable habitat, and/or being severely degraded.

    It is unlikely to occur due to few historic record/s and no other current collections in the local area.

- The species has been recorded within the bioregion based on literature review but has not been recorded locally or within the study area through DBCA database searches.
- The species has not been recorded in the study area despite adequate survey efforts, such as a standardised methodology or targeted searching within potentially suitable habitat.

- **Likelihood: No**
  - The species is not known to occur within the IBRA bioregion based on current literature and distribution.
  - The study area lacks important habitat for a species that has highly selective habitat requirements.
  - The species has been historically recorded within study area or locally; however it is considered locally extinct due to significant habitat changes such as land clearing and/or introduced predators.

Appendix 3: Vegetation condition rating scale

Vegetation condition scale rating for use on Pilbara surveys^

Rating	Description
Excellent	Pristine or nearly so; no obvious signs of damage caused by human activities since European settlement.
Very Good	Some relatively slight signs of damage caused by human activities since European settlement. For example, some signs of damage to tree trunks caused by repeated fire, the presence of some relatively non-aggressive weeds, or occasional vehicle tracks.
Good	More obvious signs of damage caused by human activities since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
Poor	Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of activities of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
Degraded	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with a number of weed species present including very aggressive species.
Completely Degraded	Areas that are completely or almost completely without native species in the structure of their vegetation; i.e. areas that are cleared or 'parkland cleared' with their flora comprising weed or crop species with isolated native trees or shrubs.

^Based on Trudgen (1998) as presented in EPA Technical Guidance (EPA 2016c).

Appendix 4: Relevé Locations

Site	Type	Easting (mE)	Northing (mN)
SW01	Relevé	604641	7507733
SW02	Relevé	604435	7507629
SW03	Relevé	604291	7507584
SW04	Relevé	604281	7507784
SW05	Relevé	603556	7508709
SW06	Relevé	603082	7508700
SW07	Relevé	603011	7508860

Appendix 5: Flora species recorded within the study area

Family	Species	Status
Acanthaceae	*Dipteracanthus australasicus*	
Amaranthaceae	*Alternanthera nana*	
Amaranthaceae	*Gomphrena canescens*	
Amaranthaceae	*Ptilotus astrolasius*	
Amaranthaceae	*Ptilotus calostachyus*	
Amaranthaceae	*Ptilotus exaltatus*	
Amaranthaceae	*Ptilotus obovatus*	
Amaranthaceae	*Ptilotus* sp.	
Araliaceae	*Trachymene oleracea* subsp. *oleracea*	
Asteraceae	Asteraceae sp.	
Boraginaceae	*Trichodesma zeylanicum* var. *zeylanicum*	
Capparaceae	*Capparis spinosa*	
Caryophyllaceae	*Polycarpaea longiflora*	
Chenopodiaceae	*Maireana* sp.	
Chenopodiaceae	*Sclerolaena* sp.	
Cleomaceae	*Cleome viscosa*	
Convolvulaceae	*Duperreya commixta*	
Convolvulaceae	*Evolvulus alsinoides*	
Cyperaceae	*Cyperus vaginatus*	
Fabaceae	*Acacia ancistrocarpa*	
Fabaceae	*Acacia aptaneura*	
Fabaceae	*Acacia atkinsiana*	
Fabaceae	*Acacia bivenosa*	
Fabaceae	*Acacia bivenosa*	
Fabaceae	*Acacia citrinoviridis*	
Fabaceae	*Acacia inaequilatera*	
Fabaceae	*Acacia maitlandii*	
Fabaceae	*Acacia monticola*	
Fabaceae	*Acacia pruinocarpa*	
Fabaceae	*Acacia pruinocarpa*	
Fabaceae	*Acacia pteraneura*	
Fabaceae	*Acacia pyrifolia*	
Fabaceae	*Gompholobium canescens*	
Fabaceae	*Gompholobium oreophilum*	

Family	Species	Status
Fabaceae	*Indigofera monophylla*	
Fabaceae	*Rhynchosia minima*	
Fabaceae	*Senna artemisioides* subsp. *Helmsii*	
Fabaceae	*Senna glutinosa* var. *glutinosa*	
Goodeniaceae	Goodeniaceae sp.	
Malvaceae	*Abutilon otocarpum*	
Malvaceae	*Androcalva luteiflora*	
Malvaceae	*Gossypium robinsonii*	
Malvaceae	*Hibiscus coatesii*	
Malvaceae	*Hibiscus sturtii*	
Malvaceae	Malvaceae sp.	
Malvaceae	*Seringia velutina*	
Malvaceae	*Sida fibulifera*	
Malvaceae	*Sida platycalyx*	
Malvaceae	*Waltheria indica*	
Molluginaceae	*Glinus lotoides*	
Myrtaceae	*Calytrix carinata*	
Myrtaceae	*Corymbia deserticola*	
Myrtaceae	*Corymbia hamersleyana*	
Myrtaceae	*Eucalyptus camaldulensis*	
Myrtaceae	*Eucalyptus gamophylla*	
Myrtaceae	*Eucalyptus leucophloia* subsp. *Leucophloia*	
Myrtaceae	*Eucalyptus victrix*	
Phyllanthaceae	*Phyllanthus maderaspatensis*	
Plantaginaceae	*Stemodia viscosa*	
Poaceae	**Cenchrus ciliaris*	
Poaceae	*Amphipogon sericeus*	
Poaceae	*Aristida contorta*	
Poaceae	*Aristida latifolia*	
Poaceae	*Chrysopogon fallax*	
Poaceae	*Digitaria* sp.	
Poaceae	*Echinochloa colona*	
Poaceae	*Enneapogon caerulescens*	
Poaceae	*Enneapogon polyphyllus*	
Poaceae	*Eragrostis eriopoda*	

Family	Species	Status
Poaceae	*Eriachne mucronata*	
Poaceae	*Eriachne* sp.	
Poaceae	*Eulalia aurea*	
Poaceae	*Paraneurachne muelleri*	
Poaceae	*Perotis rara*	
Poaceae	Poaceae sp.	
Poaceae	*Schizachyrium fragile*	
Poaceae	*Themeda triandra*	
Poaceae	*Triodia melvillei*	
Poaceae	*Triodia wiseana*	
Poaceae	*Urochloa occidentalis var. ciliata*	
Proteaceae	*Grevillea berryana*	
Proteaceae	*Grevillea wickhamii*	
Proteaceae	*Hakea lorea* subsp. *lorea*	
Rubiaceae	*Psydrax suaveolens*	
Santalaceae	*Anthobolus leptomerioides*	
Santalaceae	*Santalum lanceolatum*	
Scrophulariaceae	*Eremophila forrestii* subsp. *forrestii*	
Scrophulariaceae	*Eremophila lanceolata*	
Scrophulariaceae	*Eremophila latrobei* subsp. *filiformis*	
Scrophulariaceae	*Eremophila longifolia*	
Solanaceae	*Solanum ferocissimum*	
Solanaceae	*Solanum lasiophyllum*	
Solanaceae	*Solanum morrisonii*	
Violaceae	*Hybanthus aurantiacus*	