Hope Downs 2 Proposal
Fauna Survey
March 2019

Prepared for
Rio Tinto



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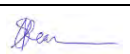
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Abbreviations

Abbreviation	Definition
ARU	Autonomous Recording Unit
Astron	Astron Environmental Services
BC Act	*Biodiversity Conservation Act 2016*
BHT	Bedded Hilltop
COI	Cytochrome c oxidase subunit I
CR	Critically Endangered
DBCA	Department of Biodiversity, Conservation and Attractions
DD	Data Deficient
DNA	Deoxyribonucleic acid
EN	Endangered
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Area
GDA94	Geocentric Datum of Australia 1994
ha	Hectares
HD1	Hope Downs 1
HD2	Hope Downs 2
IA	International Agreement (Migratory under the EPBC Act and Schedule 5 under the BC Act)
IBRA	Interim Biogeographic Regionalisation for Australia
km	Kilometres
m	Metres
MGA	Map Grid of Australia
mm	Millimetres
MNES	Matters of National Environmental Significance
P	Priority
PEC	Priority Ecological Community
sp.	Species
SRE	Short Range Endemic
Survey area	Hope Downs 2 Development Envelope, which includes two deposits: Hope Downs 2 and Bedded Hilltop (10,817.7 ha)
TEC	Threatened Ecological Community
VU	Vulnerable
WAM	Western Australian Museum
WM	Wonmunna

Executive Summary

Rio Tinto is evaluating the potential development of additional iron ore deposits at Hope Downs 2 (HD2) in the Pilbara region of Western Australia. Astron Environmental Services was commissioned to undertake a Level 2 fauna and Short Range Endemic assessment of the HD2 Development Envelope (the survey area, which is 10,817.7 hectares) over three separate phases of fauna surveying.

Vertebrate Fauna

Eight broad fauna habitat types were recorded in the survey area: Minor Drainage, Gorge/Gully, Breakaway, Rocky Hill, Low Hill and Slopes, Alluvial Plain, Mulga Woodland and Stony Plain. Areas of cleared habitat were present within the HD2 and Bedded Hilltop areas where exploration drilling had occurred in the form of drill pads and drill access tracks. The Gorge/Gully and Breakaway habitats in the survey area were considered important for fauna due to the microhabitats they provide such as caves and the potential for semi-permanent water pools. These areas contained a high diversity of microhabitats representing important sites of refuge and habitat for conservation listed fauna, such as the Northern Quoll, Pilbara Leaf-nosed Bat and Ghost Bat.

There were 174 vertebrate fauna species recorded within the survey area, comprising two amphibians, 55 reptiles, 84 birds and 33 mammals (including seven introduced mammal species). The fauna species assemblage recorded during the survey is considered typical of the Hamersley subregion.

Seven vertebrate species of conservation significance were recorded during the survey: Northern Quoll (*Dasyurus hallucatus*) (EN; EN); Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) (VU; VU); Ghost Bat (*Macroderma gigas*) (VU; VU); Oriental Plover (*Charadrius veredus*) (IA; IA); *Lerista macropisthopus remota* (P2); Letter-winged Kite (*Elanus scriptus*) (P4); and Western Pebble-mound Mouse (*Pseudomys chapmani*) (P4). Three of these species (Northern Quoll, Pilbara Leaf-nosed Bat and Ghost Bat) are classified under the *Environment Protection and Biodiversity Conservation Act 1999* as Matters of National Environmental Significance.

The Northern Quoll was recorded 14 times in the form of motion camera detection images (10 records), scat recordings (three records) and a solitary individual captured during the Phase 2 fauna survey. The seemingly large number of recordings, relative to the local vicinity and the micro-niches found in the preferred fauna habitats at Bedded Hilltop, suggests a resident population exists within the survey area.

The Pilbara Leaf-nosed Bat was recorded at three of the 23 bat detector locations. Recordings at all three locations were deemed to indicate low activity levels. The Pilbara Leaf-nosed Bat records were from foraging individuals in Gorge/Gully and Breakaway fauna habitats with all calls at least three hours after dusk and not consistent with the presence of a permanent roost cave nearby.

The Ghost Bat was recorded on nine occasions within the survey area through acoustic recordings (calls), scats recorded in nocturnal feed caves and an individual sighted during spotlighting within the HD2 area. Seven caves (two Category 3 roost caves with occasional occupancy and five Category 4 nocturnal roost caves) were recorded within the survey area. Based on regional records, this species has a strong presence in the vicinity of the survey area. The survey results are consistent with the Ghost Bat foraging in low numbers on the HD2 and Bedded Hilltop ridges.

Short Range Endemic Invertebrate Fauna

Five habitats were considered more conducive to relictual Short Range Endemic invertebrates: Breakaway, Mulga Woodland, Minor Drainage, Gorge/Gully and Rocky Hill. Most of these latter habitats are associated with an isolated ridge running in an east-west direction, so most of the breakaways and rocky slopes are south-facing and therefore conducive to Short Range Endemic invertebrates.

The field surveys generated a total of 202 samples (comprising 358 individuals) from Short Range Endemic target taxa representing 66 different taxa. Seventeen of these species were known to be widespread, 48 were potential Short Range Endemics and one was a confirmed Short Range Endemic, *Karaops banyjima*. Of these Short Range Endemic category taxa, 32 were identified to the level of species or morphospecies:

- seven spiders: *Karaops banyjima*, *Karaops* sp. 'ARA001', *Aurecocrypta* 'MYG315', *Aurecocrypta* 'sp. indet. (AESHD1)', *Synothele* 'MYG309', *Synothele* 'MYG311' and *Yilgarnia* 'MYG197'
- nine pseudoscorpions: *Tyrannochthonius* 'sp. indet. (AESHD1)', *Tyrannochthonius* 'sp. indet. (AESHD2)', *Austrohorus* 'sp. indet. (AESHD5)', *Beierolpium* 'sp. indet. (AESHD1)', *Beierolpium* 'sp. indet. (AESHD2)', *Euryolpium* 'sp. indet. (AESHD6)', *Euryolpium* 'sp. indet. (AESHD7)', 'Genus 7/4 PSE118' and '*PSEAAA* sp. indet. (AESHD4)'
- four scorpions: *Lychas* 'bituberculatus complex', *Lychas* 'hairy tail complex', *Lychas* 'multipunctatus complex' and *Urodacus* 'HD1'
- seven centipedes: *Sepedonophilus* 'HD1', *Sepedonophilus* 'HD2', *Mecistocephalus* 'HD1', *Mecistocephalus* 'HD2', *Mecistocephalus* 'HD3', *Cryptops* 'HD1' and *Orphnaeus* 'HD1'
- three millipedes: *Antichiropus* 'wonmunna', *Austrostrophus* 'Clade A' and *Austrostrophus* 'Clade E'
- two isopods: *Buddelundia* '10ma' and *Buddelundia* '77'.

Seventeen Short Range Endemic taxa sampled represented ambiguously identified groups:

- three spiders: *Synothele* sp., *Aname* sp. and Nemesiidae sp.
- five pseudoscorpions: *Anatemnus* sp., *Sundochernes* sp., *Euryolpium* sp., *Indolpium* sp. and Olpiidae sp.
- two centipedes: *Sepedonophilus* sp. and Geophilomorpha sp.
- two millipedes: *Antichiropus* sp. and *Austrostrophus* sp.
- five isopods: *Buddelundia* sp., Buddelundiinae sp., *Pseudodiploexochus* sp., *Troglarmadillo* sp. and Philosciidae sp.

Several Short Range Endemic category invertebrates were found in multiple habitat types, suggesting that they may be less specialised with respect to their habitat preferences:

- *Lychas* 'bituberculatus complex', from Stony Plain, Alluvial Plain and Low Hills and Slopes
- *Sepedenophilus* 'HD1', from Gorge/Gully and Mulga Woodland
- *Mecistocephalus* 'HD1', from Rocky Hills, Gorge/Gully and Mulga Woodland
- *Austrostrophus* 'Clade E', from Stony Plain, Alluvial Plain and Mulga Woodland

- *Antichiropus* 'wonmunna', from Mulga Woodland in the survey area, but from gully slopes and riparian vegetation outside of the survey area.

These species are likely to be found outside of the limits of the survey area.

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1 Introduction

1.1 Project Background

Rio Tinto is evaluating the potential development of additional iron ore deposits at Hope Downs 2 (HD2) in the Pilbara region of Western Australia, approximately 68 km north-west of Newman. Astron Environmental Services (Astron) was commissioned to undertake a multiple-phase Level 2 fauna survey of the 10,817.7 ha HD2 Development Envelope, which includes two deposits: HD2 and Bedded Hilltop, and herein is referred to as the survey area (Figure 1). This report presents the findings of the Level 2 surveys completed in November/December 2017, May 2018 and March 2019 as an overarching assessment.

1.2 Scope and Objectives

The objective was to undertake a terrestrial Level 2 vertebrate fauna and Short Range Endemic (SRE) invertebrate fauna assessment through a desktop assessment and field survey, and to incorporate data from previous biological surveys conducted in the vicinity of the survey area. The resultant data have been utilised to produce this report, which is intended to support and inform the environmental assessment process in accordance with the requirements of the Environmental Protection Authority. The scope of works was to undertake a:

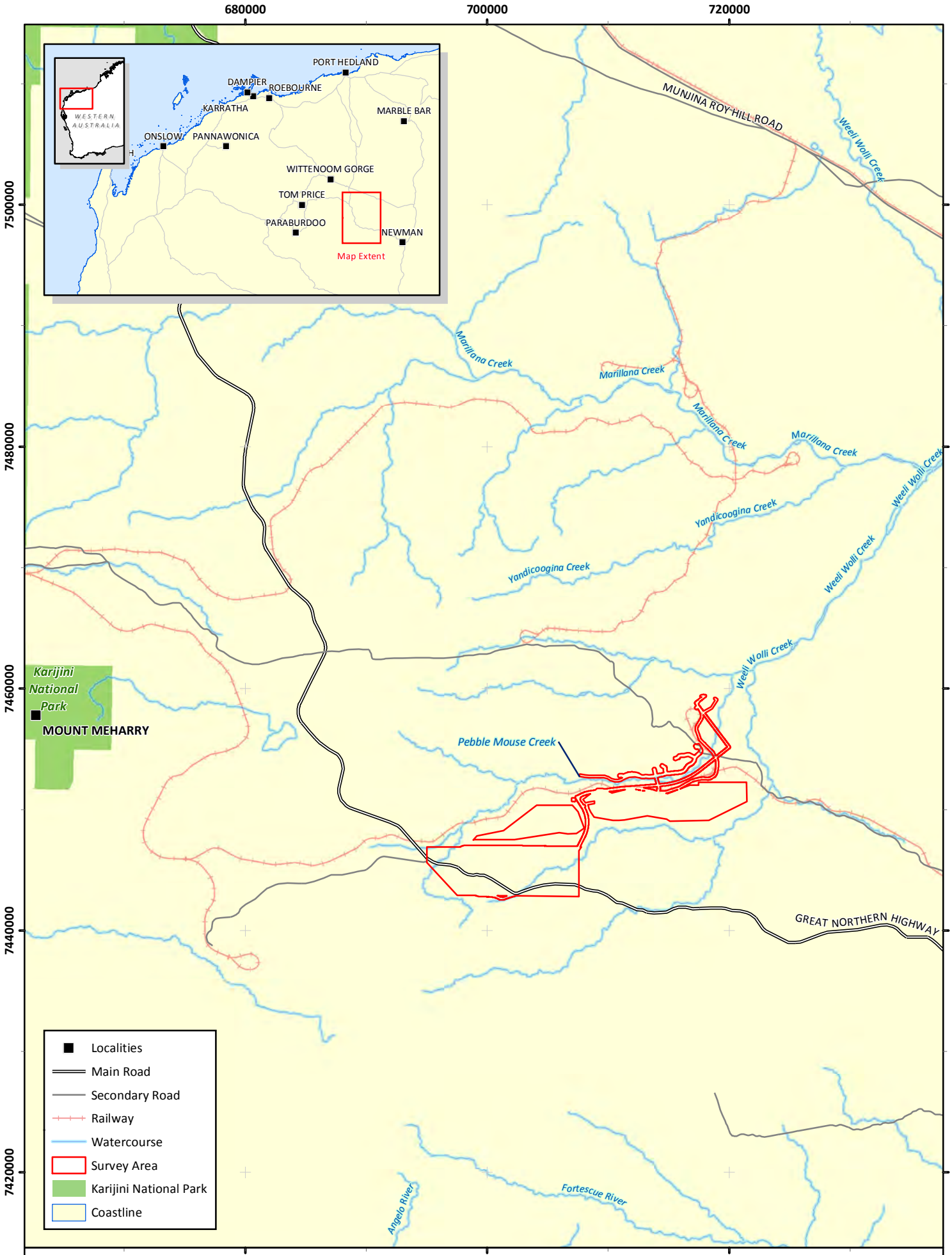
- desktop assessment, including database searches and literature review of available resources
- terrestrial vertebrate fauna field survey, including:
  - systematic fauna sampling
  - targeted Matters of National Environmental Significance (MNES) species sampling and searches
  - fauna habitat mapping.
- targeted SRE field survey, including:
  - targeted survey and searches
  - dry pitfall trap sampling
  - SRE fauna habitat mapping.

Astron conducted the fauna survey in accordance with the regulatory guidance detailed in Table 1 and Rio Tinto Data Standards (Rio Tinto 2019).

The scope and key limitations of the survey are outlined in Table 1. Section 3.7 of this report provides more detail on the limitations of the survey.

Table 1: Summary of Astron's vertebrate fauna and SRE invertebrate fauna assessment.

Level of survey	Survey area size	Survey timing	Relevant regulatory guidance documents	Key survey limitations
Level 2 terrestrial vertebrate and SRE fauna survey	10,817.7 ha	21 November to 2 December 2017 (Phase 1) 18 to 27 May 2018 (Phase 2) 8 to 18 March 2019 (Phase 3)	• Position Statement No. 3 (Environmental Protection Authority 2002) • Technical Guidance - Sampling Methods for Terrestrial Fauna (Environmental Protection Authority 2016a) • Technical Guidance – Sampling of Short Range Endemic Invertebrate Fauna (Environmental Protection Authority 2016b) • Technical Guidance - Terrestrial Fauna Surveys (Environmental Protection Authority 2016c) • *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) referral guideline for the Endangered Northern Quoll *Dasyurus hallucatus* (Department of the Environment and Energy 2016) • Survey Guidelines for Australia's Threatened Reptiles, Birds, Mammals and Bats (Department of Sustainability Environment Water Population and Communities 2011b; Department of the Environment 2010b; Department of Sustainability Environment Water Population and Communities 2011a; Department of the Environment 2010a) • Interim Guidelines for Preliminary Surveys of the Night Parrot (*Pezoporus occidentalis*) in Western Australia (Department of Parks and Wildlife 2017)	• Rainfall in the three months preceding Phase 2 and Phase 3 was below average, this led to potentially dry unfavorable conditions for SRE and vertebrate fauna sampling. However the rainfall received during the Phase 3 survey itself enabled a good sampling opportunity for vertebrate fauna and SRE species. • Only one SRE taxa could be assigned a species name and 17 of the 49 SRE invertebrate taxa could not be identified. • These are classified as minor limitations for vertebrate and SRE fauna as they are not expected to have a major impact on survey outcomes.



Rio Tinto

Hope Downs 2 Proposal Fauna Survey

Figure 1: Survey area location

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Author: J. Johnston	Date: 12-11-2019
Drawn: C. Dyde	Figure Ref: 14292B-19-BIDR-3RevB_191112_Fig01_Locn

Datum: GDA 1994 - Projection: MGA Zone 50

0 5 10 15 20 Km

N

2 Environmental Context

2.1 Physical Environment

2.1.1 Climate

The climate of the Pilbara region of Western Australia is classified as arid tropical with two distinct seasons: a hot, wet summer (October – April) and a mild, dry winter (May – September) (Bureau of Meteorology 2019).

Based on long-term climatic data from the nearest Bureau of Meteorology weather station at Newman Aero (Station 007176) (approximately 90 km south-east of the survey area) the mean annual rainfall since 1971 is 329.5 mm. The mean maximum daily temperatures since 1996 range between 23.0°C and 39.2°C, and range above 30°C for much of the year (Bureau of Meteorology 2019) (Figure 2).

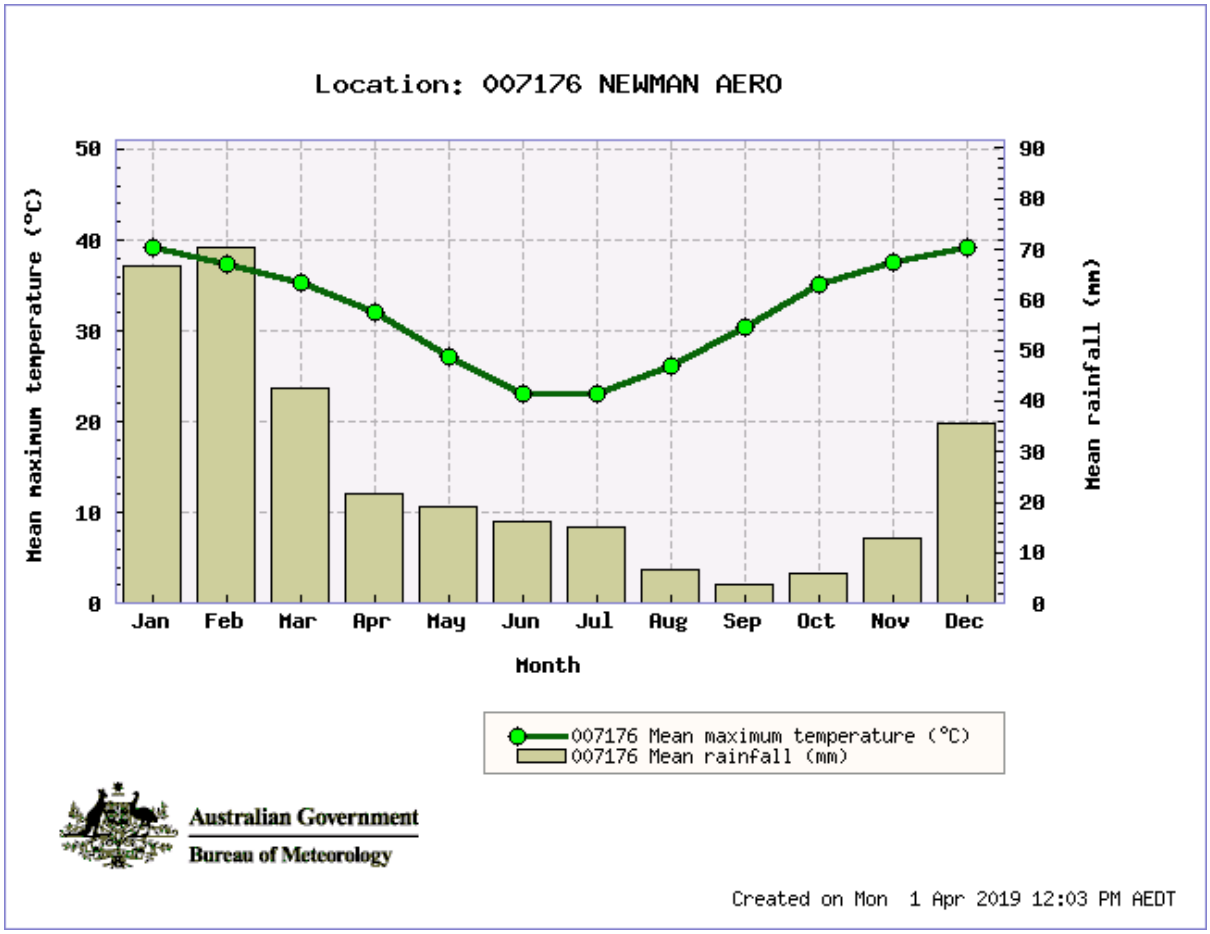


Figure 2: Climate data for Newman Aero Station (Station 007176). Mean annual rainfall data has been calculated from 1971 – 2019 and mean maximum temperature has been calculated from 1996 – 2019 (Bureau of Meteorology 2019).

2.1.2 Geology and Soils

The surface geology of the survey area is comprised of 10 units (Stewart et al. 2008), with Colluvium 3841 being the most dominant (Table 2). Geological mapping of the survey area and surrounds is presented in Figure A.1 (Appendix A).

Table 2: Geological units of the survey area (Stewart et al. 2008).

Geological name	Label	Area (ha)
Alluvium 38485: Channel and flood plain alluvium; gravel, sand, silt, clay, locally calcreted.	Qa	431.4
Brockman Iron Formation: banded iron-formation, chert, mudstone and siltstone.	Lchk	681.7
calcrete 38497 - Pisolitic, nodular or massive calcrete; ferruginous inclusions; calcareous cementing of bedrock and transported materials; locally with intercalated chalcedony; as low mounds, in playa lakes, or as valley calcrete; locally dissected and karstified	Czk	18.1
Colluvium 38491: Colluvium, sheetwash, talus; gravel piedmonts and aprons over and around bedrock; clay-silt-sand with sheet and nodular kankar; alluvial and aeolian sand-silt-gravel in depressions and broad valleys in Canning Basin; local calcrete, reworked laterite.	Qrc	2,587.8
Fortescue Group: Metadolerite, dolerite, gabbro; medium to coarse grained, massive grey-green rock, usually foliated.	Adf	763.6
Jeerinah Formation: Shale, sandstone, siltstone, mudstone, dolomite, local microbanded chert, jaspilite, conglomerate; fine-grained massive rhyolite; mafic tuff with local accretionary lapilli and agglomerate; thin basalt/dolerite and andesitic basalt flows.	Awfj	1,443.9
Marra Mamba Iron Formation: Chert, ferruginous chert, jaspilite, banded iron-formation, minor shale, siltstone, mudstone.	Achm	2,328.3
Mount McRae Shale and Mount Sylvia Formation: Interbedded shale, chert, banded iron-formation.	Ashm	1,212.5
Weeli Wolli Formation: Banded iron-formation (commonly jaspilitic), mudstone, siltstone; common interlayered metadoleritic sills.	Lchw	1,036.1
Wittenoom Formation: Calcitic dolomite, interbedded chert and shale in upper and lower parts, volcaniclastic sandstone.	Alhw	314.3

2.1.3 Surface Water and Hydrology

No Wetlands of International Importance (i.e. Ramsar wetlands) or Nationally Important Wetlands occur within the survey area (Department of the Environment and Energy 2017a, 2017b). The nearest Nationally Important Wetland is Fortescue Marshes, located 40 km north of the survey area, which has been nominated as a proposed Ramsar site. Pebble Mouse Creek passes through a large proportion of the survey area. One of the upper tributaries of Weeli Wolli Creek passes through the HD2 area.

2.2 Biological Environment

2.2.1 Interim Biogeographic Regionalisation of Australia

The Interim Biogeographic Regionalisation for Australia (IBRA version 7) divides the Australian continent into 89 bioregions and 419 subregions (Department of the Environment and Energy 2017c). The IBRA regions represent a landscape-based approach to classifying the land surface, including attributes of climate, geomorphology, landform, lithology, and characteristic flora and fauna. The survey area occurs in the Pilbara bioregion, of which 8.4% is represented in the national reserve system (Department of the Environment and Energy 2016b).

The biodiversity of the 53 subregions recognised in Western Australia was documented as part of a national audit to provide priorities for conservation action (Department of Conservation and Land Management 2002). The survey area occurs within the Hamersley subregion of the Pilbara region and is described in the audit as:

- Hamersley PIL3 – dissected bold plateaux and ranges of flat lying, moderately folded sandstone and quartzite with vegetation described as Mulga low woodland over tussock grasses occurring on fine textured soils in valley floors, with scattered Snappy gum (*Eucalyptus leucophloia*) over *Triodia brizoides* on skeletal soils of the ranges (Kendrick 2001).

2.2.2 Land Systems

Land systems of the Western Australian rangelands have been mapped and described by the Department of Primary Industries and Regional Development (formerly the Department of Agriculture and Food) outlining the distributions and providing comprehensive descriptions of biophysical resources, including soil and vegetation condition. A total of 102 land systems occur in the Pilbara bioregion covering 181,723 km^2. Nine land systems occur in the survey area (Table 3). The layout of these land systems within the survey area is shown in Figure A.2 (Appendix A).

Table 3: Distribution of land systems within the survey area.

Land system	Total area within bioregion (ha)	Total area (ha) (proportion of survey area (%))
Boolgeeda - stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands and mulga shrublands.	961,847	1,486.0 (13.7)
Calcrete - Low calcrete platforms and plains supporting shrubby hard spinifex grasslands.	134,834	4.9 (<0.1)
Egerton - Highly dissected plains and slopes with sparse mulga shrublands or shrubby hard spinifex grasslands.	66,849	1.4 (<0.1)
McKay - Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands with acacias and occasional eucalypts.	426,124	326.7 (3.0)
Newman - rugged jaspilite plateaux, ridges and mountains with hard spinifex.	1,994,339	4,647.2 (43.0)
Pindering - Gravelly hardpan plains supporting groved mulga shrublands with hard and soft spinifex.	38,738	410.5 (3.8)
Platform - dissected slopes and raised plains supporting shrubby hard spinifex grasslands.	236,390	2,522.2 (23.3)
Rocklea - basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex and occasionally soft spinifex grasslands with scattered shrubs.	2,880,288	1,314.1 (12.1)
Wannamunna - Hardpan plains and internal drainage tracts supporting mulga shrublands and woodlands and occasionally eucalypt woodlands.	63,004	104.5 (1.0)

2.2.3 Pre-European Vegetation

Beard (1975) completed broad-scale (1:1,000,000) pre-European vegetation mapping at an association level. The Beard mapping was later used by the Department of Agriculture and Food (Shepherd, Beeston, and Hopkins 2002) to compile vegetation units that assisted with identifying pre-European and current extents of vegetation throughout Western Australia.

Three pre-European vegetation units, 82, 18 and 29 (Shepherd, Beeston, and Hopkins 2002), are associated with the survey area (Figure A.3, Appendix A). Table 4 summarises the current and pre-European extent of these three vegetation units in the Pilbara bioregion and the survey area.

Table 4: Extent of pre-European vegetation within the survey area (Government of Western Australia 2018).

Vegetation association	Mapping unit (Beard 1975)	Description	Total area (ha) (proportion of survey area (%))	Pre-European extent (ha)	Current extent in bioregion (ha)	Proportion of pre-European extent remaining (%)	Pre-European extent with formal protection (%)
82	e16Lr t3Hi	Hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*	5,452.2 (50.4)	2,168,702	2,156,558	99.4	13.7
18	a1Li	Low woodland, open low woodland or sparse woodland; mulga (*Acacia aneura*)	5,339.0 (49.4)	580,512	576,389	99.3	29.6
29	a1Lp	Mulga (*Acacia aneura*) and associated species.	26.5 (0.2)	172,083	171,975	99.9	12.8

2.3 State and Commonwealth Conservation Categories and Management

Commonwealth and State regulatory authorities maintain databases of the locations and conservation status of significant flora, fauna and ecological communities in Western Australia.

The EPBC Act provides a legal framework to protect and manage MNES including listed flora, fauna and ecological communities. These listed flora, fauna and ecological communities are allocated a conservation category, which are outlined in Tables B.1 and B.6 (Appendix B).

Ecological communities may be subject to processes that threaten to destroy or significantly modify it across much of its range. These communities are identified as threatened ecological communities (TECs) and are listed at both Commonwealth level under the EPBC Act and State level under the *Biodiversity Conservation Act 2016* (BC Act)[1] (Tables B.1 and B.2, Appendix B). The Department of Biodiversity, Conservation and Attractions (DBCA) maintains a list of priority ecological communities (PECs), which may also be under threat and are assigned one of four Priority rankings according to the criteria outlined in Table B.3 (Appendix B).

Under Western Australian legislation, all native fauna is protected and it is an offence to 'take' protected fauna. The BC Act also provides for native fauna species that have been adequately searched for and are deemed to be, in the wild, threatened, extinct or in need of special protection to be gazetted as Threatened, Extinct or Specially Protected (Table B.4, Appendix B). In addition, due to the diversity of Western Australia's fauna, many species are known from only a few collections or locations, but have not been adequately surveyed. Such fauna may be rare or threatened, but cannot be considered for declaration as Threatened fauna until adequate surveys have been undertaken. These fauna species are included on a supplementary conservation list managed by DBCA called the *Priority Fauna List*. Priority fauna are categorised according to level of threat and other information and the conservation categories are described in Table B.5 (Appendix B).

2.4 Land Use and Tenure

The survey area is located within the Shire of East Pilbara. The local area is mainly used for mineral exploration and mining activity. Karijini National Park is the nearest conservation reserve, located approximately 35 km to the west of the survey area (Figure 1).

[1] From 1 January 2019, the *Wildlife Conservation Act 1950* has been replaced by the *Biodiversity Conservation Act 2016* (BC Act) and its regulations. Phase 1 and 2 of this study was completed in 2017-18, prior to the BC Act being enacted.

3 Methods

3.1 Desktop Assessment

A desktop assessment was undertaken to assess whether any conservation listed vertebrate and invertebrate species, SRE invertebrate species or communities, or PECs/TECs were likely to occur within the survey area. For vertebrate species, the review focused on key habitats for conservation listed fauna and species of MNES. For SRE invertebrates, the review focused on invertebrate groups with a known high proportion of SRE species (the SRE groups): centipedes (Chilopoda), harvestmen (Opiliones), millipedes (Diplopoda), non-marine snails (Gastropoda), pseudoscorpions (Pseudoscorpiones), scorpions (Scorpiones), terrestrial slaters (Isopoda) and spiders (Araneae).

3.1.1 Database Searches

Environmentally Sensitive Areas (ESAs) are declared by the Minister for Environment under Section 51B of the *Environmental Protection Act 1986* to prevent incremental degradation of important environmental values such as declared rare flora, TECs or significant wetlands. A search for ESAs in the vicinity of the survey area was conducted using Western Australian government datasets (Department of Water and Environmental Regulation 2017) and the Register of the National Estate dataset (Department of the Environment and Energy 2008). In addition, database searches for fauna were conducted with search details summarised in Table 5.

Table 5: Database searches requested.

Database name	Date search results received	Search focus	Search area
NatureMap (Department of Biodiversity, Conservation, and Attractions 2017a)	25/10/2017	Terrestrial fauna and fauna of conservation significance	40 km radius from a central point defined by the coordinates: 23°04'04" S, 119°01'56" E
Threatened and Priority Ecological Communities Database (Department of Biodiversity, Conservation, and Attractions 2017b)	16/11/2017	Listed threatened and priority ecological communities	20 km radius from the survey area boundary
Threatened and Priority Fauna Database (Department of Biodiversity, Conservation, and Attractions 2017b)	03/11/2017	Threatened and Priority fauna species	40 km radius from the survey area boundary
Protected Matters Search Tool (Department of the Environment and Energy 2017d)	25/10/2017	Threatened and Priority fauna species	40 km radius from a central point defined by the coordinates: 23°04'04" S, 119°01'56" E
Western Australian Museum Invertebrate Database (Western Australian Museum 2018)	21/05/2018 - 28/05/2018	Arachnids, myriapods, crustaceans, and molluscs	100 km buffer from survey area bounded by the coordinates: Top left corner (north-west): -22.175902°, 118.070211°; Bottom right corner (south-east): -23.956909°, 120.008080°

3.1.2 Literature Review

Fauna surveys have been previously commissioned by Rio Tinto within the vicinity of the survey area and supplied to Astron for the desktop assessment. The previous survey areas in relation to the current survey area are shown in Figure 3. The reports reviewed as part of this assessment include:

- Biota Environmental Sciences (2006) Hope Downs Rail Corridor (Juna Downs Section) Fauna Survey
- Biota Environmental Sciences (2009) Hope Downs Section 45C Targeted Fauna Review
- Biota Environmental Sciences (2011) Hope Downs Project Life of Mine Targeted Fauna Survey
- Biota Environmental Sciences (2014) Hope Downs South West Marra Mamba Development Targeted Fauna Survey
- Ecologia Environment (2014) Greater West Angelas Terrestrial Fauna Assessment
- Ninox Wildlife Consulting (2009a) A Vertebrate Fauna Survey of the Proposed Hope Downs 4 Infrastructure Corridor Option 1 Near Newman Western Australia
- Ninox Wildlife Consulting (2009b) A Vertebrate Fauna Survey of the Proposed Hope Downs 4 Infrastructure Corridor Option 6 Near Newman Western Australia.

For further contextualisation of the survey records relevant to the local vicinity of the survey area, consideration was also made of recent publicly available Environmental Impact Assessments in proximity to Hope Downs, specifically the work conducted at Southern Flank as part of Mining Area C operations for BHP Billiton Iron Ore:

- Biologic Environmental Survey (2016) Mining Area C – Southern Flank Environmental Impact Assessment for Ghost Bat (*Macroderma gigas*)
- Biologic Environmental Survey (2017) Proposed Mining Area C Development Envelope Vertebrate Fauna Desktop Assessment.

3.1.3 Habitat Characterisation

Using orthophotos provided by Rio Tinto and the available literature, the survey area was split into distinct landform types that were evaluated further for their likelihood of conservation listed vertebrate or SRE species occurrence. The assessment followed several criteria, such as the availability of moisture, extent of shade and shelter, and soil and vegetation types. Emphasis was given to landforms that may contain 'relict' species (surviving in sheltered and moist conditions) and those that may support habitat specialists (i.e. species restricted to rocky outcrops).

3.1.4 Conservation Assessment

Conservation listed vertebrate fauna species returned from the database searches were categorised for likelihood of occurrence within the survey area prior to the field survey, according to the criteria listed in Table B.7 (Appendix B). Post survey, the likelihood table was re-assessed utilising the information obtained during the field survey (Table B.7, Appendix B) and updated accordingly.

SRE invertebrates are species with distributions of less than 10,000 km^2 and their occurrence within their distribution is usually fragmented and highly localised (Harvey 2002; Ponder and Colgan 2002). However, it is often difficult to determine whether or not a species in one of the target SRE groups actually has a range < 10,000 km^2. For the purpose of desktop review, SRE status was determined by

the staff of the Western Australian Museum (WAM) through providing the results of SRE searches of the WAM databases. This assessment was reviewed and supplemented with information contained in previous environmental reports, the published literature and online databases. For morphospecies collected during the survey, the criteria outlined in Table B.8 (Appendix B) were used to determine SRE status. The SRE categories of the WAM (confirmed SRE, potential SRE and widespread species) were used to assess the status of species, with sub-categories applied in accordance with the WAM Taxonomic Services guidelines (Table B.8, Appendix B).

690000 700000 710000 720000 730000

7460000

7450000

Survey Area

Previous Surveys

Hope Downs Project Life of Mine Targeted Fauna Survey (Biota 2011)

Hope Downs Rail Corridor (Juna Downs Section) Fauna Survey (Biota 2006)

Hope Downs South West Marra Mamba Development Targeted Fauna Survey (Biota 2014)

Greater West Angelas Terrestrial Fauna Assessment (Ecologia 2014)

A Vertebrate Fauna Survey of the Proposed Hope Downs 4 Infrastructure Corridor Option 1 Near Newman Western Australia (Ninox 2009a)

Hope Downs Section 45C Targeted Fauna Review (Biota 2009)

A Vertebrate Fauna Survey of the Proposed Hope Downs 4 Infrastructure Corridor Option 6 Near Newman Western Australia (Ninox 2009b)

Biota 2011

Biota 2009

Biota 2014

Biota 2006

Ninox 2009b

Ninox 2009a

Ecologia 2014

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Rio Tinto

Hope Downs 2 Proposal Fauna Survey

Figure 3: Previous fauna surveys conducted in the vicinity of the survey area

Coordinate System: GDA 1994 MGA Zone 50

0 2 4 6 8 10 Kilometres

N

astron delivering environmental intelligence™

Author: J. Johnston | Drawn: C. Dyde | Date: 12-11-2019 | Figure Ref: 14292B-19-BIDR-3RevB_191112_Fig03_PrevSurveys

3.2 Field Survey

3.2.1 Survey Timing and Personnel

The fauna assessment was conducted over three survey phases (Table 6). All technical survey personnel have over five years of experience conducting Level 2 vertebrate fauna surveys or invertebrate surveys.

Table 6: Details of the fauna surveys completed within the survey area.

Phase	Dates	Personnel	Fauna licence number
1	21 November – 2 December 2017	Matthew Love; Dr Kellie McMaster; Tim Sachse; Michael Brown; Ray Lloyd; Sam Mueller	08-002227-1
2	18 – 27 May 2018	Matthew Love; Dr Kellie McMaster; Tim Sachse; Michael Brown; Dr Palitha Jayasekara	08-002227-1
3	8 – 18 March 2019	Matthew Love, John Trainer, David Keirle, Dr Erich Volschenk	BA27000015

3.2.2 Weather

Daily observations for rainfall and temperature were recorded by Rio Tinto at the HD1 Weather Station; however there was a period between 13 and 31 January 2018 where data was not recorded. Data was substituted for this period from the nearby Hope Downs 4 Weather Station which is approximately 48 km south-east of the HD1 Weather Station. Long term rainfall and temperature observations were sourced from the Newman Aero Bureau of Meteorology station (number 007176), approximately 90 km south-east of the survey area and 87 km south-east of the HD1 Weather Station. Local rainfall and temperatures preceding the survey are presented in Figure 4.

The daily maximum temperatures during the Phase 1 survey averaged 37.2°C ± 2°C and daily minimum temperatures averaged 19.4°C ± 3°C. Mean maximum and minimum daily temperatures were similar during the Phase 1 survey and the long-term means for November (Bureau of Meteorology 2019). Rainfall in the 12 months preceding the Phase 1 survey in November 2017 was 175 mm (50%) above the long-term mean of 329.5 mm. Rainfall in the 12 weeks preceding the Phase 1 survey was 14 mm (14%) below the mean rainfall for the same period.

The daily maximum temperatures during the Phase 2 survey averaged 35.6°C ± 2°C and daily minimum temperatures averaged 18.6°C ± 2°C. Mean maximum daily temperatures were higher during the Phase 2 survey than the long-term mean and the mean minimum daily temperatures were comparable to the long-term mean for May (Bureau of Meteorology 2019). Rainfall in the 12 months preceding the Phase 2 survey in May 2018 was 121 mm (63%) below the long-term mean of 329.5 mm. In the 12 weeks preceding the Phase 2 survey 75 mm of rain was recorded, which equates to 56% below the mean average rainfall for the same time period (136 mm).

The daily maximum temperatures during the Phase 3 survey averaged 37.9°C ± 3°C and daily minimum temperatures averaged 25.5°C ± 4°C. Mean maximum and minimum daily temperatures were warmer during the Phase 3 survey compared to the long-term means for March (Bureau of Meteorology 2019). A total of 14.2 mm of rainfall fell over five days during the Phase 3 survey. Rainfall in the 12 months preceding the Phase 3 survey in March 2019 was 161 mm (51%) below the long-term mean of 329.5 mm. Rainfall in the 12 weeks preceding the Phase 3 survey was 110 mm (37%) below the mean rainfall for the same period.

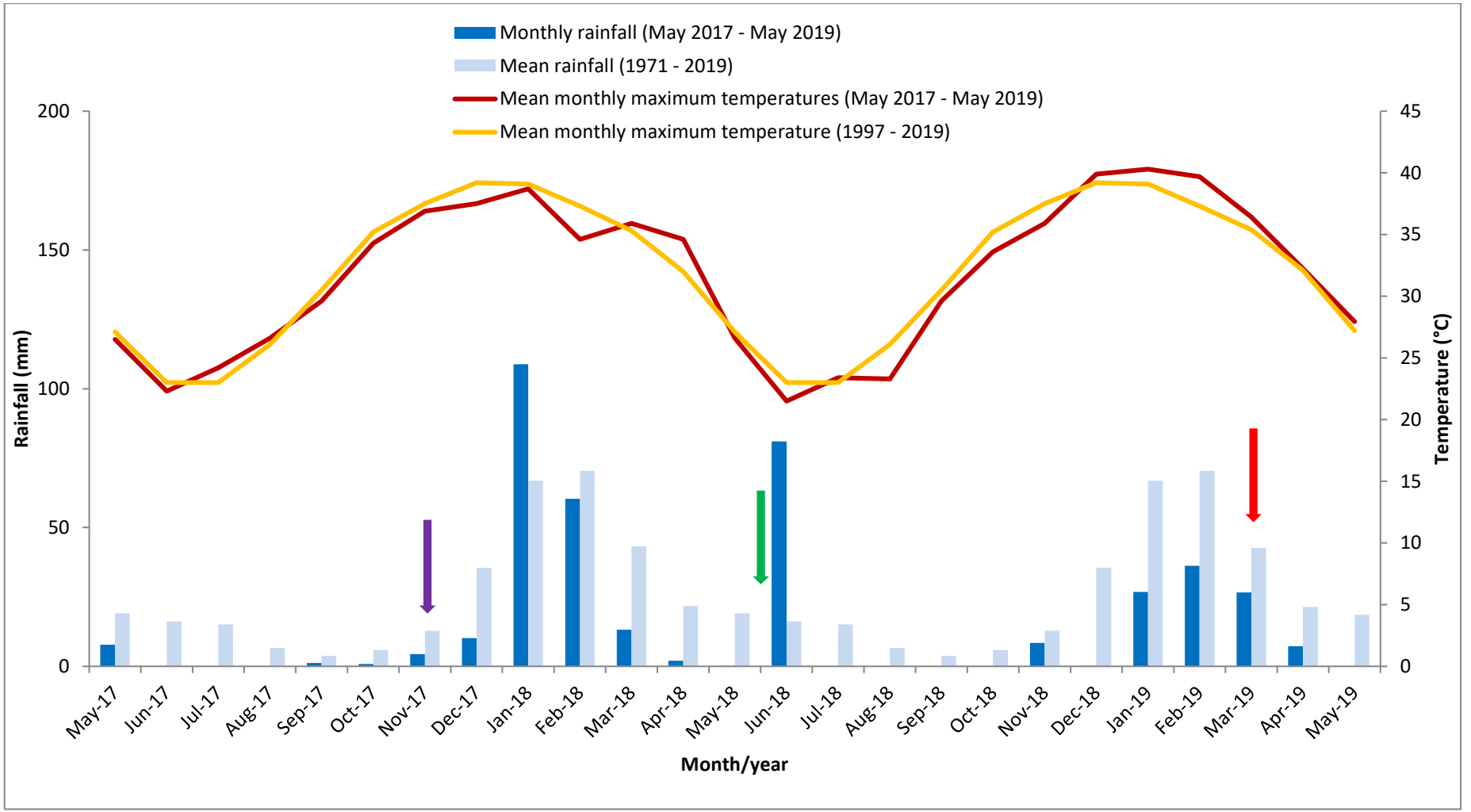


Figure 4: Mean monthly and recorded monthly rainfall (mm) and mean monthly and recorded monthly maximum temperatures (°C). Daily records supplied by Rio Tinto and long term records supplied by the Bureau of Meteorology from the Newman Aero station (number 007176) (Bureau of Meteorology 2019). The purple arrow displays the timing for the Phase 1 survey, the green arrow displays the timing for the Phase 2 survey and the red arrow displays the timing for the Phase 3 survey.

3.2.3 Vertebrate Fauna

3.2.3.1 Habitat Assessment

Twelve fauna habitat assessments conducted within the eight fauna habitat types present in the survey area (Table C.1, Appendix C). The locations of the fauna habitat assessments are shown in Figure C.1 (Appendix C). The following information was collected at each site:

- location – coordinates measured using a handheld GPS (GDA94)
- recorder and date – personnel involved in undertaking the fauna habitat assessment and the survey date
- habitat/landform – position in the landscape - major fauna habitat types were described based on the landform and vegetation
- vegetation type – a broad description of vegetation type and structure
- soils – a brief description of soil type
- microhabitat – presence of specific microhabitat features, for example, leaf litter, logs, burrows, rocky outcrops, rock crevices, hollows, permanent or semi-permanent water
- condition – habitat condition was assessed based on the presence of anthropogenic (human-induced) disturbances, and using the condition ratings suggested by Thompson and Thompson (2010) (Table B.9, Appendix B)
- disturbance – any disturbance such as clearing, fire, weeds, flooding, vehicular, machinery, tracks or grazing
- photographs – a representative photograph was taken of each habitat assessment site.

The information derived from the fauna habitat assessments was used to delineate fauna habitats throughout the survey area, which were then mapped accordingly. The potential for the mapped habitats to provide suitable habitat for MNES species Northern Quoll (*Dasyurus hallucatus*) (EN, EN), Ghost Bat (*Macroderma gigas*) (VU, VU), Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) (VU, VU), Night Parrot (*Pezoporus occidentalis*) (EN, CR) and Pilbara Olive Python (*Liasis olivaceus barroni*) (VU, VU) were ranked according to the criteria listed in Table B.10 (Appendix B).

Any caves identified within the survey area were assessed based on definitions for Ghost Bat usage according to Bat Call WA (2019) (Appendix I) and categorised as:

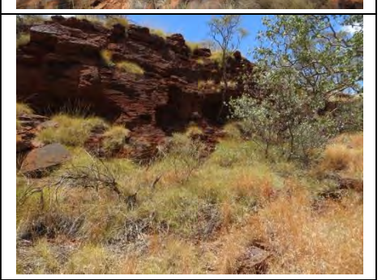
- Category 1 – diurnal roost caves with permanent occupancy
- Category 2 – diurnal roost caves with regular occupancy
- Category 3 – roost caves with occasional occupancy.
- Category 4 – nocturnal roost caves (opportunistic usage).

3.2.3.2 Trapping Sites

A total of 19 trapping sites were sampled within the survey area (Figure C.1, Appendix C). Changes to survey boundaries between surveys resulted in three of the trapping sites being outside the survey area. Eleven trapping sites were sampled during the Phase 1 fauna assessment, and 13 trapping sites during the Phase 2 fauna assessment (Table 7). An additional six trapping sites were sampled during the Phase 3 fauna assessment (Table 7). Further detail on the trapping sites are provided in Table C.1 (Appendix C).

Table 7: Trapping site locations and survey effort.

Site	MGA Zone 50 K		Habitat	Vegetation description	Habitat condition	Date opened	Date closed	Trap nights	No. of traps	Total trap nights	Photo
	Easting (mE)	Northing (mN)									
TS1	697504	7445613	Mulga Woodland	*Acacia catenulata*, (*A. pruinocarpa)* tall shrubland over *Eremophila fraseri* scattered tall shrubs over *Sida* ?*ectogama* open shrubland over *Triodia pungens* very open hummock grassland	1 (Excellent)	22/11/2017	29/11/2017	7	40	280	
						19/05/2018	26/05/2018	7	40	280	
TS2	696308	7446214	Alluvial Plain	*Acacia aptaneura*, (*A. pruinocarpa, Eremophila longifolia*) tall open shrubland over *Ptilotus astrolasius, E. lanceolata, E. forrestii* low open shrubland over *Chrysopogon fallax, Aristida* sp., (*Themeda triandra, Aristida contorta*) tussock grassland	0.8 (Very Good)	22/11/2017	29/11/2017	7	40	280	
						19/05/2018	26/05/2018	7	40	280	
TS3	699311	7446105	Mulga Woodland	*Acacia catenulata*, (*A. pruinocarpa*) tall shrubland over *Eremophila fraseri* scattered tall shrubs over *Sida* ?*ectogama* open shrubland over *Triodia pungens* very open hummock grassland	0.6 (Good)	22/11/2017	29/11/2017	7	40	280	
						19/05/2018	26/05/2018	7	40	280	
TS4	706249	7445883	Stony Plain	*Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Acacia maitlandii* scattered tall shrubs over *Triodia pungens, T. vanleeuwenii* hummock grassland	0.8 (Very Good)	22/11/2017	29/11/2017	7	40	280	
						19/05/2018	26/05/2018	7	40	280	
TS5	705107	7445902	Low Hills and Slopes	*Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Acacia maitlandii* scattered tall shrubs over *Triodia pungens, T. vanleeuwenii* hummock grassland	0.8 (Very Good)	23/11/2017	30/11/2017	7	40	280	
						19/05/2018	26/05/2018	7	40	280	

Site	MGA Zone 50 K		Habitat	Vegetation description	Habitat condition	Date opened	Date closed	Trap nights	No. of traps	Total trap nights	Photo
	Easting (mE)	Northing (mN)									
TS6	707293	7445814	Minor Drainage	*Eucalyptus camaldulensis*, (*E. victrix*) low woodland with *E. xerothermica* scattered low trees over *Petalostylis labicheoides*, (*Melaleuca bracteata*) tall open shrubland *Androcalva luteiflora* scattered shrubs over *Eulalia aurea, Themeda triandra, *Cenchrus ciliaris*, (*Enneapogon* sp.), *Aristida holathera* var. *holathera*) open tussock grassland	0.8 (Very Good)	23/11/2017	30/11/2017	7	40	280	
						19/05/2018	26/05/2018	7	40	280	
TS7	696251	7445929	Minor Drainage	*Eucalyptus victrix, E. xerothermica* low woodland over *Petalostylis labicheoides*, (*Acacia dictyophleba, A. pyrifolia* var. *pyrifolia, Androcalva luteiflora*) tall open scrub over *Triodia longiceps* open hummock grassland with *Themeda triandra*, (*Eulalia aurea, Panicum effusum, Chrysopogon fallax, Enneapogon robustissimus*) tussock grassland and *Chrysocephalum apiculatum* subsp. *pilbarensis* scattered herbs	0.6 (Good)	24/11/2017	1/12/2017	7	40	280	
						19/05/2018	26/05/2018	7	40	280	
TS8	713854	7450029	Breakaway	*Eucalyptus repullulans* scattered low mallee over *Acacia catenulata* subsp. *occidentalis, A. aptaneura*, (*A. incurvaneura, A. mulganeura, Grevillea saxicola*) tall open scrub over *Eremophila latrobei* subsp. *filiformis, Senna artemisioides* subsp. *helmsii* scattered shrubs over *S. stricta* scattered low shrubs over *Triodia pungens* very open hummock grassland with *Enneapogon polyphyllus* scattered tussock grasses	1 (Excellent)	24/11/2017	1/12/2017	7	20	140	
						19/05/2018	26/05/2018	7	20	140	
TS9	712816	7450165	Gorge/Gully	*Eucalyptus repullulans* scattered low mallee over *Acacia aptaneura, A. catenulata* subsp. *occidentalis*, (*A. ayersiana, Grevillea saxicola*) tall open scrub over *Eremophila latrobei* subsp. *filiformis* scattered shrubs over *Triodia pungens, T. vanleeuwenii* scattered hummock grasses	1 (Excellent)	24/11/2017	1/12/2017	7	20	140	
						19/05/2018	26/05/2018	7	20	140	
TS10	718871	7450712	Breakaway	*Eucalyptus leucophloia* subsp. *leucophloia*, *Corymbia opaca* and *Corymbia ferriticola* low open woodland over *Grevillea wickhamii*, (*Dodonaea petiolaris, Acacia bromilowiana*) tall open shrubland over *Triodia pungens* very open hummock grassland with *Themeda* sp. Mt Barricade (M.E. Trudgen 2471) open tussock grassland	1 (Excellent)	24/11/2017	1/12/2017	7	20	140	
						19/05/2018	26/05/2018	7	20	140	

Site	MGA Zone 50 K		Habitat	Vegetation description	Habitat condition	Date opened	Date closed	Trap nights	No. of traps	Total trap nights	Photo
	Easting (mE)	Northing (mN)									
TS11	718171	7450286	Gorge/Gully	*Eucalyptus leucophloia* subsp. *leucophloia*, *Corymbia opaca* and *Corymbia ferriticola* low open woodland over *Grevillea wickhamii*, (*Dodonaea petiolaris, Acacia bromilowiana*) tall open shrubland over *Triodia pungens* very open hummock grassland with *Themeda* sp. Mt Barricade (M.E. Trudgen 2471) open tussock grassland	1 (Excellent)	24/11/2017	1/12/2017	7	20	140	
						19/05/2018	26/05/2018	7	20	140	
TS12	717063	7450643	Rocky Hill	*Eucalyptus leucophloia* subsp. *leucophloia, Corymbia hamersleyana* low open woodland over *Gompholobium oreophilum, Acacia hilliana* low open shrubland over *Triodia vanleeuwenii*, (*T. wiseana, T. pungens)* open hummock grassland	1 (Excellent)	20/05/2018	27/05/2018	7	34	238	
TS13	717506	7450245	Rocky Hill	*Eucalyptus leucophloia* subsp. *leucophloia, Corymbia hamersleyana* low open woodland over *Gompholobium oreophilum, Acacia hilliana* low open shrubland over *Triodia vanleeuwenii*, (*T. wiseana, T. pungens)* open hummock grassland	1 (Excellent)	20/05/2018	27/05/2018	7	34	238	
TS14*	697906	7448526	Alluvial Plain	*Acacia aptaneura*, (*A. pruinocarpa, Eremophila longifolia*) tall open shrubland over *Ptilotus astrolasius, E. lanceolata, E. forrestii* low open shrubland over *Chrysopogon fallax, Aristida* sp., (*Themeda triandra, Aristida contorta*) tussock grassland	0.8 (Very Good)	09/03/2019	17/03/2019	9	40	360	
TS15*	700605	7448201	Rocky Hill	*Eucalyptus leucophloia* subsp. *leucophloia, Corymbia hamersleyana* low open woodland over *Gompholobium oreophilum, Acacia hilliana* low open shrubland over *Triodia vanleeuwenii*, (*T. wiseana, T. pungens)* open hummock grassland	1 (Excellent)	10/03/2019	17/03/2019	7	34	238	

Site	MGA Zone 50 K		Habitat	Vegetation description	Habitat condition	Date opened	Date closed	Trap nights	No. of traps	Total trap nights	Photo
	Easting (mE)	Northing (mN)									
TS16	706437	7448130	Low Hills and Slopes	*Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Acacia maitlandii* scattered tall shrubs over *Triodia pungens, T. vanleeuwenii* hummock grassland	1 (Excellent)	10/03/2019	17/03/2019	7	40	280	
TS17*	700743	7447421	Stony Plain	*Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Acacia maitlandii* scattered tall shrubs over *Triodia pungens, T. vanleeuwenii* hummock grassland	1 (Excellent)	11/03/2019	18/03/2019	7	40	280	
TS18	705435	7448646	Mulga Woodland	*Acacia catenulata*, (*A. pruinocarpa*) tall shrubland over *Eremophila fraseri* scattered tall shrubs over *Sida* ?*ectogama* open shrubland over *Triodia pungens* very open hummock grassland	1 (Excellent)	09/03/2019	17/03/2019	8	40	320	
TS19	707081	7449700	Breakaway	*Eucalyptus leucophloia* subsp. *leucophloia*, *Corymbia opaca* and *Corymbia ferriticola* low open woodland over *Grevillea wickhamii*, (*Dodonaea petiolaris, Acacia bromilowiana*) tall open shrubland over *Triodia pungens* very open hummock grassland with *Themeda* sp. Mt Barricade (M.E. Trudgen 2471) open tussock grassland	1 (Excellent)	09/03/2019	16/03/2019	7	20	140	
Q1	707086	7449689	Gorge/Gully	*Eucalyptus repullulans* low open mallee woodland over *Acacia catenulata* subsp. *occidentalis*, (*A. aptaneura, Grevillea saxicola, A. hamersleyensis* sens. lat., *A. pruinocarpa*) tall open scrub over *Triodia pungens, T. vanleeuwenii* very open hummock grassland	1 (Excellent)	25/05/2018	26/05/2018	1	5	5	No photo available
Total trapping effort										**1,539**	

*Due to changes in survey boundaries between phases, these trapping grids were outside the survey area.

Astron used the following trap design for the fauna assessment:

- 11 trap sites were established with 10 pitfall traps (20 L buckets), six funnel traps, 20 Elliot traps and four cage traps (wire mesh cage trap)
- five trap sites were established as cage/Elliot sites, each with 10 Elliott traps and 10 cage traps arranged in a linear layout along suitable habitat features
- three trap sites were established as funnel sites, each with 10 funnels, 20 Elliott traps and four cage traps arranged in a linear layout.

Pitfall traps were not established within the Breakaway, Gorge/Gully and Rocky Hill trap sites due to the rocky terrain and hard bedrock not being conducive to this type of trap. The ground dwelling reptiles and mammals in this area were targeted through other sampling techniques such as active searching and opportunistic recordings.

Five cage traps were established within the survey area during Phase 2 for one night to target Northern Quolls (Figure C.1 and Table C.1, Appendix C). This trap site was designed as an opportunistic capture of a Northern Quoll from noticeable site occupancy due to the presence of recent scats and foraging evidence. These data are not part of the data analysis detailed in Section 3.6.

All but one nominal trap site contained pitfall and funnel traps that were used in conjunction with a 100 m drift fence running over the centre of the pit, directing animal movement into the pitfall trap. One site (TS16) was designed as two independent lines of 50 m drift fence directing animal movement into the pitfall trap. The trap sites remained open for a minimum of seven nights during the phases of fauna surveying. Traps were cleared each morning within three hours of sunrise to minimise the potential of trap death.

3.2.3.3 Avifauna Surveys

A total of 2,280 minutes (38 hours) of systematic avifauna (bird) censuses were conducted within the survey area.

During the Phase 1 and Phase 2 fauna assessment, bird censuses were undertaken at each trapping grid for 20 minutes each day on four occasions resulting in 80 minutes of survey effort at each site. This equates to a total of 1,920 minutes (32 hours) of avifauna censuses conducted for Phase 1 and Phase 2.

During the Phase 3 fauna assessment the bird census were undertaken at each trapping grid for 20 minutes each day on three occasions resulting in 60 minutes of survey effort at each site for this phase. This equates to a total of 360 minutes (6 hours) of avifauna censuses conducted for Phase 3.

All species were recorded from sightings and/or from species-specific bird calls. Opportunistic records of species across the survey area were also recorded and habitats that may support species of conservation significance were targeted.

3.2.3.4 Motion Sensitive Cameras

Motion sensitive cameras (Moultrie and Reconyx HC600 HyperFire) were set at 35 locations for between three and nine nights with a combined trapping effort of 202 camera trap nights (Figure C.1 and Table C.1, Appendix C). The cameras were baited and placed in prospective/suitable habitat such as cave entrances and water holes aimed at targeting MNES species.

3.2.3.5 Acoustic Bat Surveys

Acoustic ultrahigh frequency equipment was used to record the presence of bats, in particular the Pilbara Leaf-nosed Bat and Ghost Bat. Acoustic recording devices (Song Meter (SM) 2 SM2BAT+ and SM4) were positioned in a total of 23 locations to achieve a broad coverage of the survey area (Figure C.1 and Table C.1, Appendix C). The detectors were set for two to nine nights, resulting in a total of 108 recording nights. The bat echolocation data collected in the field was analysed by Robert Bullen (Bat Call WA 2019). One unit at BAT22 (SM2 7634) failed to operate (Bat Call WA 2019) and BAT11 was found to be outside the survey area due to survey boundary changes; the results have not been included in this report.

3.2.3.6 Night Parrot Survey

Due to the recent discovery of Night Parrot populations in Western Australia, the DBCA have published interim guidelines for Night Parrot surveys in Western Australia (Department of Parks and Wildlife 2017). The survey area is located in the area mapped as 'high priority for survey' for this species so passive acoustic surveys using Autonomous Recording Units (ARUs) were undertaken in the most prospective habitats (Stony Plain habitat containing *Triodia*).

ARUs were positioned at two sites during the Phase 2 and Phase 3 surveys. The ARUs were set at each location for between four and seven nights, resulting in a total of 23 recording nights (Figure C.1 and Table C.1, Appendix C). The ARUs were set for recording between from 1 hour pre-sunset to 1 hour post-dawn. The audio data was recorded at 44.1 kHz sampling rate and covered the frequency range 100 kHz to 21,000 kHz which brackets the Night Parrot call frequency range of 1,500 kHz to 3,500 kHz. The ARU data collected in the field was analysed by Robert Bullen (Bat Call WA 2019).

3.2.3.7 Active Foraging

Active searches were undertaken in microhabitats suitable for ground-dwelling reptiles and mammals. Active searches included the following:

- searching and recording scats, tracks and other traces
- turning over rock and logs and peeling off bark
- raking soil and leaf litter
- searching rocky habitats in cracks and caves, around water bodies and inside bore hole caps.

3.2.3.8 Targeted Searches

The aim of the targeted searches was to identify areas of potentially suitable habitat for conservation significant fauna, such as caves, and secondary signs including tracks, scats, diggings and burrows. Visual observation for conservation significant fauna habitat was ongoing whilst moving through the survey area. Track logs were recorded using a handheld GPS and are shown in Figure C.1 (Appendix C). Any opportunistic sightings of fauna species were recorded whilst traversing the survey area.

3.2.3.9 Nocturnal Spotlighting

Spotlighting at night was undertaken on foot and from vehicles to target fauna that are nocturnal or crepuscular, particularly conservation significant species. A total of 72 person hours of nocturnal spotlighting was undertaken in the survey area over all three phases of the fauna assessment.

Approximately two nights of spotlighting (3 hours per night) was conducted per phase of fauna surveying.

3.2.4 SRE Invertebrates

3.2.4.1 Habitat Assessment

Fauna habitats within the survey area were mapped for their suitability to support SRE invertebrates as part of an initial desktop assessment (Section 3.1) that was further refined following the field survey.

3.2.4.2 Active Foraging

Astron sampled a total of 37 systematic sites (including the 14 pitfall/funnel trapping sites) for SRE fauna across the survey area (Figure C.1, Appendix C). All sites were sampled by active foraging and litter-soil samples. The sites were selected so that they represented the landforms and vegetation associations inferred as prospective in the desktop assessment. Detailed site descriptions, including associated landforms and vegetation features are provided in Table C.1 (Appendix C). The descriptions provide qualitative information about factors influencing the macroclimate (e.g. landform, vegetation type, dominant substrate, and indicative plant species) and microclimate (e.g. amount of organic matter or existing damage).

Foraging was focused under boulders, crevices in rocky outcrops, at the base of tree logs, under loose tree bark, in moist and dry leaf litter accumulations and in *Triodia* clumps, but occurred in all habitats. The search for mygalomorph spider burrows was by visual inspections. Night-time searching for scorpions was undertaken in conjunction with the nocturnal spotlighting. Leaf litter was sifted *in situ* with a 16 mm soil sieve, and potential SRE invertebrates preserved directly in 98% ethanol. Approximately 46 person hours were spent searching the 23 SRE active foraging sites (excluding the pitfall/funnel trapping sites). Any potential SRE invertebrates observed in the dry pitfall or funnel traps at each of the 14 relevant trapping grids were also collected.

3.3 Specimen Identification

All vertebrate fauna were identified in the field. Field guides and accepted scientific peer review references were used for fauna identification. One reptile specimen was vouchered with the WAM to confirm its identification as it was thought to be *Lerista macropisthopus remota*, a P2 species.

The samples were separated and sorted to morphospecies level under a dissecting microscope by Dr Erich Volschenk. Morphological identifications to species level were attempted for all collected specimens. These identifications were based on the available taxonomic literature and keys, environmental reports and online databases. Compound microscopes were used to examine fine taxonomic characters not visible otherwise, for example, trichobothria patterns in pseudoscorpions.

Dr Simon Judd contributed information about isopod distributions, SRE assessment and specimen identification. The remaining identifications (spiders, pseudoscorpions, scorpions and snails) were carried out by Dr Erich Volschenk. Further details on SRE specimen identification are provided in Appendix D (Alacran Environmental Science 2019).

3.4 Taxonomy and Nomenclature

Nomenclature and sequence for vertebrate fauna within this report is as per WAM's *Checklist of the Vertebrates of Western Australia* (Western Australian Museum 2019).

For species identified in the desktop assessment, every effort was made to determine the current scientific name for each taxon, including wherever there was doubt as to their true taxonomy (through subsequent name changes). A comprehensive description of SRE taxonomy and nomenclature is provided in Appendix D (Alacran Environmental Science 2019).

The biology of many SRE species is not well known and the precise distribution and life history are poorly, if at all, documented (Harvey 2002; Harvey et al. 2011). Species identification is often very difficult because few specimens have been collected, reference collections are unavailable, the specimens are the wrong sex or life stage for identification, or they are morphologically cryptic and require DNA analyses. Taxonomic resolution can also be poor, either because there are no published taxonomic revisions for a group in question (terrestrial isopods in Western Australia), or because there is no expert actively working on one of the SRE groups.

3.5 DNA-Barcoding

A number of invertebrates collected could not be identified morphologically, so molecular barcoding techniques were used in an attempt to verify the identity of some of these specimens.

All of the target samples were sourced from field collected specimens detailed in Appendix D (Alacran Environmental Science 2019). Sequences and tissue samples were obtained from the following sources:

- WAM (tissues and comparative sequences): codes beginning with “T” and followed by a string of numbers
- Alacran Environmental Science (comparative sequences and tissues): samples predating 2019 begin with “ESV” and later samples beginning with “AES”
- Genbank (comparative sequences): codes beginning with two letters and followed by six numbers.
- Dr Erich Volschenk scorpion research (comparative sequences): codes beginning with “EVR”.

Sequences of the gene COI (cytochrome c oxidase subunit I) were amplified from muscle tissues obtained from specimens preserved in >95% (WAM tissue collection) or *ca.* 70% to >95% ethanol (wet collections of WAM and Dr Simon Judd). Sequence generation from tissues was undertaken by Xytogen Pty Ltd and AGRF Perth.

Sequence contigs were assembled from forward and reverse amplicons using Geneious R7 version 7.1.9 and were subsequently edited and pruned by eye, prior to consensus sequences being created.

Phylogenetic analyses and sequence alignments undertaken by Alacran were performed with Geneious R7. For each analysis, sequences were assembled and aligned using ClausalW or the Geneious alignment tool. Eight separate analyses were undertaken, with each analysis aiming to assess the identification of the target taxa for the respective group: Selenopidae, Barychelidae, Idopidae, Pseudoscorpiones, *Lychas* (Scorpiones, Buthidae), *Urodacus* (Scorpiones, Urodacidae), Geophilomorpha and Diplopoda. Further details on the barcoding techniques and analyses are provided in Appendix D (Alacran Environmental Science 2019).

Nineteen of the sequences from Barychelidae, Buthidae, Chthoniidae, Olpiidae, Selenopidae, Trigoniulidae and Urodacidae were also provided to WAM to use their sequences to determine the taxonomic identity of the specimens. Provided DNA sequences were each blasted against publicly accessible sequences in GenBank and with data sets derived from current research projects at WAM. The top 20 blast hits for each major taxon were gathered, duplicates removed and analysed with a

Maximum Likelihood phylogenetic analysis using a GTR+G model of evolution and 100 bootstraps (RAxML). Distances were calculated via tree-based estimates of identical bases in Geneious Prime 2019.2.1. Further details on the analyses are provided in Appendix D (Wilson, Huey, and Harvey 2019).

3.6 Statistical Analyses

3.6.1 Sampling Effort

Sampling effort was assessed using species accumulation curves and modelled estimates of the total species pool. Species accumulation curves were created by randomly sampling an incremental number of sites while plotting the total number of species sampled. Species estimators are particular statistical models of species accumulation which estimate the total species pool available. Four species estimators were compared: Chao 2, Jackknife 1, Jackknife 2 and Bootstrap (Colwell and Coddington 1994). Species accumulation curves were created for each faunal group (mammals, birds and herpetofauna) and for the different surveys (Astron Phase 1, 2 and 3 surveys separately and combined). Species estimations shown were based on all phases of survey combined. All analyses were performed in R 3.2.1 (R Development Core Team 2016) using the package "Vegan".

3.6.2 Site Classification

The similarity of species assemblages amongst sites (using all surveys) was assessed using two dimensional ordinations based on Sorensen's index of similarity amongst sites. Significant groupings of sites by habitat type were identified using the ANOSIM function (Clarke, Somerfield, and Gorley 2008) within the package "Vegan". Ordinations and ANOSIM tests were performed for each faunal group (mammals, birds and herpetofauna) separately.

3.7 Limitations

Following completion of the desktop assessment and field survey, a review of any limitations that may affect a complete assessment of the data collected was conducted. The limitations listed in Table 8 are based on those suggested as considerations in Technical Guidance - Terrestrial Fauna Surveys (Environmental Protection Authority 2016c).

Species accumulation curves did not reach an asymptote, particularly for herpetofauna, but when taking into account previous records as well as species recorded from methods other than trapping, then a large portion of the predicted assemblage was recorded. The low number of captures and reduced herpetofauna assemblage recorded during the Astron trapping program is likely due to a combination of dry seasonal conditions experienced during the surveys and the trap methods used. Due to the rocky terrain and hard bedrock within certain habitat types, eight out of the 19 trap sites did not utilise pitfall traps. In addition eight sites (TS12 – TS19) only had a single phase (post-wet season) of trapping. However, the ground dwelling reptiles usually captured through pitfall traps were sampled through other techniques such as active searching and opportunistic recordings. This is considered a very minor limitation, as the herpetofauna assemblage expected to occur in the survey area is common and widespread and is unlikely to include any conservation significant fauna that have not been previously recorded from other fauna assessments conducted in the vicinity (Appendix E). The ground dwelling reptiles and mammals usually captured through pitfall traps were sampled through other techniques such as active searching and opportunistic recordings. Also the single phase sites (TS12-TS19) were conducted during the 'wet season' of the Pilbara region of Western Australia which is seen as the most productive period for sampling vertebrate fauna species.

Due to the number of targeted fauna surveys conducted in the survey area the populations of conservation significant fauna were well documented, particularly for the conservation significant Pilbara Leaf-nosed Bat and Ghost Bat. However, the presence of other conservation significant fauna within the general vicinity of the survey area, such as the Northern Quoll and Night Parrot, were less well known prior to the current surveys. Seventeen of the 49 SRE taxa identified are currently undescribed. Only one SRE specimen could be identified to a valid species name. Many others belong to known but unnamed taxa and many remain to be clarified at the species level.

Table 8: Statement of limitations for the vertebrate and SRE invertebrate fauna survey.

Potential limitation	Degree of limitation	Statement regarding potential limitations
(i) Competency/experience	No limitation	The ecologists responsible for conducting the survey have extensive experience in conducting Level 2 vertebrate and SRE fauna surveys in the Pilbara.
(ii) Scope What faunal groups were sampled and were some sampling methods not able to be employed because of constraints such as weather conditions.	Very minor limitation (Vertebrates)	The survey scope was completed to an adequate level. Most sampling methods were satisfactorily employed, although the low number of captures and reduced (between 66% and 85% of expected) herpetofauna assemblage recorded is likely due to a combination of dry conditions preceding the surveys and the trap methods used, where eight out of the 19 trap sites did not utilise pitfall traps. However, the ground dwelling reptiles usually captured through pitfall traps were sampled through other techniques such as active searching and opportunistic recordings. The number of herpetofauna species recorded were similar or greater than other previous surveys in the vicinity. The fauna observed and identified are likely to represent a portion of the suite of species that utilise the survey area and were typical of the Hamersley subregion.
(iii) Proportion of fauna identified, recorded and/or collected	Minor Limitation	The fauna observed and identified are likely to represent a portion of the suite of species that utilise the survey area. Fauna habitats were able to be adequately described and a list of species likely to be present was prepared based on this assessment. Species accumulation curves did not reach an asymptote, particularly for herpetofauna, but when taking into account previous records as well as species recorded from methods other than trapping, then a large portion of the predicted assemblage was recorded. It is not possible to determine bat species abundance from echolocation records; bat activity levels provide a relative measure of the abundance of each species within the survey area. Seventeen of the 49 SRE taxa sampled represented ambiguously identified groups.
(iv) Sources of information Previously available information (whether historic or recent) as distinct from new data.	No limitation	Adequate information was available from database searches and previous studies in the survey area and region.
(v) Proportion of task achieved. Further work which might be needed?	No limitation	The survey scope was completed and most sampling methods adequately employed. Trap sites TS12 - TS19 were only sampled over one phase of trapping (post-wet season), however this is seen as the most opportune time to sample vertebrate species in the Pilbara region of Western Australia.

Potential limitation	Degree of limitation	Statement regarding potential limitations
(vi) Timing/weather/season/ cycle	Minor Limitation	Rainfall in the three months preceding all three phases of survey was below average; however rainfall experienced during the Phase 3 survey enabled good SRE and vertebrate sampling opportunities aside from Opiliones (harvestmen spiders). The SRE target group Opiliones often requires a substantial buildup of rainfall preceding surveys to be effective in enabling capture of these species (pers. com. E. Voslchenck 15 May 2019) and 'post wet' season is considered the most optimal time for sampling the majority of vertebrate species. The temperatures during the survey were above or close to the long term average. As such fauna abundance should not have been adversely affected.
(vii) Disturbances For example fire, flood, accidental human intervention which affected results of survey	Minor limitation	Large areas of BHT were affected by recent fires and therefore were not suitable for sampling. No other disturbances were recorded in the survey area that would have affected the survey results.
(viii) Intensity In retrospect, was the intensity adequate?	No limitation	The intensity of the surveys was considered adequate for a Level 2 assessment.
(ix) Completeness Was the relevant area fully surveyed?	No limitation	All main habitats in the survey area were surveyed; coverage of habitat assessments and targeted surveys completed as part of this assessment and previous survey efforts are considered adequate.
(x) Resources Degree of expertise available in animal identification to taxon level.	No limitation	Adequate resources were available to identify fauna species. All technical personnel involved in identification have extensive experience in conducting Level 2 vertebrate and SRE fauna surveys in the Pilbara. Taxonomic experts were consulted for all SRE fauna groups to help identify the selected taxa.
(xi) Remoteness and/or access problems	No limitation	No access constraints affected the survey outcomes.
(xii) Availability of contextual information For example biogeographic information on the region.	No limitation	Database searches and previous vertebrate fauna surveys in the vicinity of the survey area provided contextual information.

4 Results

4.1 Desktop Assessment

4.1.1 Environmentally Sensitive Areas

No ESAs intersected the survey area. The nearest ESA is Hamersley Range National Park (1977 boundary), now referred to as Karijini National Park, the nearest boundary of which occurs approximately 35 km west of the survey area (Department of the Environment and Energy 2008).

4.1.2 Vertebrate Fauna

The database searches and literature review results indicate that 312 vertebrate fauna have been previously recorded in the vicinity of the survey area, including eight amphibian species, 109 reptile species, 147 bird species and 48 mammal species (including nine introduced mammal species) (Table E.1-E.4, Appendix E). Of these, 26 species are of conservation significance, including four reptile species, 15 bird species and seven mammal species (Table F.1, Appendix F). Of these, 10 species were considered to have a 'high' likelihood (inclusive of those recorded within the survey area), four species were considered to have a 'moderate' likelihood and 12 were considered to have a 'low' likelihood of occurrence within the survey area (Table F.1, Appendix F). This is based on their respective ecology, habitats considered likely to be present and any previous records from historic survey and database records.

Previous surveys undertaken for Rio Tinto in the vicinity of the survey area recorded six conservation significant vertebrate fauna species: Pilbara Barking gecko (*Underwoodisaurus seorsus*) (P2), Fork-tailed Swift (*Apus pacificus*) (IA; IA), Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat, and Western Pebble-mound Mouse (*Pseudomys chapmani*) (P4) (Table 9). The Rainbow Bee-eater (*Merops ornatus*), Cattle Egret (*Ardea ibis*) and the Eastern Great Egret (*Ardea modesta*) were previously listed as Migratory (IA) under the EPBC Act and Schedule 5 (IA) under the BC Act but have subsequently been delisted.

Table 9: Summary of literature review results from surveys conducted within the vicinity of the survey area.

Author (year)	Survey area; size (ha)	Survey level	Survey timing	Survey effort	Conservation significant vertebrate fauna recorded	Potential SRE invertebrate fauna recorded
Biota Environmental Sciences (2006)	Hope Downs Rail Corridor (Juna Downs). Size not stated	Level 2 (single phase)	September 2005	The survey focused on areas and habitat, which may not have been sampled in previous assessments. Sampling methods included the use of Elliott traps, avifauna surveys, harp nets, and opportunistic methods.	Ghost Bat (*Macroderma gigas*) Western Pebble-mound Mouse (*Pseudomys chapmani*)	*Quistrachia* aff. *Herberti* *Bothriembryon* ?*Austrostrophus* sp. *Synsphyronus gracilis* *Gaius* sp. A *Gaius* sp. B Ctenizidae sp. A Nemesiidae sp. A Barychelidae sp. A
Biota Environmental Sciences (2009)	Hope Downs 1 Iron Ore mine. Size not stated	Desktop Review	N/A	To provide a desktop and habitat-based review of potential SREs and troglobitic fauna values and habitats within the expanded project footprint for the Hope Downs Iron Ore mine project.	N/A	N/A
Biota Environmental Sciences (2011)	Hope Downs 1 Life of Mine. Size not stated	Targeted/ Level 1	June 2010	Five Elliott trapping transects located within potential Northern Quoll habitat and opportunistic searches.	Northern Quoll (*Dasyurus hallucatus*)	*Missulena* sp. *Synothele* sp. *Conothele* sp. *Aname* sp. *Antichiropus* sp.
Biota Environmental Sciences (2014)	Hope Downs South West Marra Mamba deposit. 2,758 ha	Targeted/ Level 1	September 2013	Four cage and large Elliott trapping transects located within potential Northern Quoll habitat and opportunistic searches. Motion sensor cameras and SM2 acoustic bat echolocation recorders were used to detect the presence of conservation significant fauna species.	Nil	'Sock' *Aname* 'big Angry Red' *Aname* 'Hooded' *Aname*

Author (year)	Survey area; size (ha)	Survey level	Survey timing	Survey effort	Conservation significant vertebrate fauna recorded	Potential SRE invertebrate fauna recorded
Ecologia Environment (2014)	Greater West Angelas. 17,565 ha	Level 2 (dual phase)	September – October 2012 March 2013	Habitat assessments, 12 trapping sites, avifauna censuses at each trapping site, foot traverses, nocturnal searches, targeted searches for both vertebrates and SRE invertebrates, and the use of SM2 acoustic bat echolocation recorders and motion sensor cameras.	Pilbara Barking gecko (*Underwoodisaurus seorsus*) Fork-tailed Swift (*Apus pacificus*) Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) Western Pebble-mound Mouse (*Pseudomys chapmani*)	*Aurecocrypta* sp. indet. *Yilgarnia* 'MYG197' *Urodacus* sp. indet. *Buddelundia* sp. nov. '10 1458A' *Buddelundia* sp. nov. '10 1458B' *Buddelundia* sp. nov. '10 1458C' *Buddelundia* sp. nov. '10 1458D' *Buddelundia* sp. nov. '68WA' Genus indet. sp. indet. *Beierolpium* sp. indet. *Euryolpium* sp. indet. *Xenolpium* sp. indet.
Ninox Wildlife Consulting (2009a)	Hope Downs 4 Option 1 Infrastructure Corridor. Size not stated	Level 2 (single phase)	May 2008	Four trapping sites, Anabat ultrasonic call detector, avifauna census, SRE sampling and opportunistic searches.	Western Pebble-mound Mouse (*Pseudomys chapmani*)	N/A
Ninox Wildlife Consulting (2009b)	Hope Downs 4 Option 6 Infrastructure Corridor. Size not stated	Level 2 (dual phase)	September 2008 April 2009	Six trapping sites, Anabat ultrasonic call detector, avifauna census, SRE sampling and opportunistic searches.	Western Pebble-mound Mouse (*Pseudomys chapmani*)	N/A

4.1.3 SRE Invertebrates

The database searches yielded a total of 12,376 records from within the search area (Appendix D; (Alacran Environmental Science 2019)). Of those, 4,335 records were attributed to SRE and potential SRE species. The SRE and potential SRE groups were represented by 282 taxa of which eight (3%) were named species, 182 (64%) were morphospecies and 92 (33%) were undetermined taxa, e.g. *Tyrannochthonius* sp. and Chthoniidae sp. (Table 10). The majority (260) of these taxa were classified as potential SRE 'Data Deficient' (DD) and 24 were confirmed SREs. The high proportion of potential SREs and undescribed morphospecies indicates a poor state of knowledge about these invertebrates in this region.

Table 10: Summary of Western Australian Museum database search results for SRE and potential SRE taxa.

Order	Named species	Morphospecies	Un-named taxa ("sp.")	Totals
Araneae: Araneomorphae (modern spiders)	2	5	3	**10**
Araneae: Mygalomorphae (trapdoor spiders)	2	78	21	**101**
Opiliones (harvestmen)	0	0	2	**2**
Pseudoscorpiones (pseudoscorpions)	3	31	18	**52**
Schizomida (short-tailed whip scorpions)	0	1	0	**1**
Scorpiones (scorpions)	0	19	6	**25**
Geophilomorpha (earth centipedes)	0	1	9	**10**
Scolopendromorpha (centipedes)	0	0	3	**3**
Polydesmida (flat-back millipedes	0	18	4	**22**
Polyzoniida (sucking millipedes)	0	0	1	**1**
Spirobolida (millipedes)	1	2	5	**8**
Symphyla (pseudocentipedes)	0	0	1	**1**
Isopoda (slaters)	0	25	9	**34**
Eupulmonata (land snails)	0	2	10	**12**
Totals	**8**	**182**	**92**	**282**

Of the 282 SRE taxa recorded from the database search area, 49 records from 15 species were present within the survey area (Table 11).

Table 11: Records of SREs from the database search areas that were present within the survey area.

Order	Family	Species	SRE category status
Arachnida	Actinopodidae	*Missulena* sp.	Potential SRE: DD
	Barychelidae	Barychelidae sp.	Potential SRE: DD
		Synothele 'MYG055'	Potential SRE: DD
		Synothele sp.	Potential SRE: DD
	Halonoproctidae	*Conothele* 'MYG002'	Potential SRE: DD
		Conothele sp.	Potential SRE: DD
	Idiopidae	*Idiosoma* sp.	Potential SRE: DD
	Nemesiidae	*Aname* 'MYG340'	Potential SRE: DD
		Aname sp.	Potential SRE: DD
		Kwonkan 'MYG339'	Potential SRE: DD
		Kwonkan sp.	Potential SRE: DD
		Teyl 'MYG027'	Potential SRE: DD
	Buthidae	*Isometroides* sp.	Potential SRE: DD
	Chthoniidae	*Tyrannochthonius aridus*	Potential SRE: DD
Diplopoda	Trigoniulidae	*Austrostrophus* sp.	Potential SRE: DD

4.2 Field Survey

4.2.1 Vertebrate Fauna Habitat

4.2.1.1 Fauna Habitats in the Survey Area

Eight broad fauna habitat types were recorded in the survey area: Minor Drainage, Gorge/Gully, Breakaway, Rocky Hill, Low Hill and Slopes, Alluvial Plain, Mulga Woodland and Stony Plain (Table 12 and Figure G.1, Appendix G).

Areas of cleared habitat were prevalent throughout the Bedded Hilltop (BHT) and HD2 sections of the survey area and associated with mineral drilling programs such as drill pads and drill access tracks. These areas totalled 832.3 ha (7.7%) and were considered in 'disturbed' condition. The fauna habitats surrounding these areas have been impacted by edge effects, lack of connectivity, grazing and the vegetation is often covered in dust. The majority of the habitats away from the mining operations were considered 'very good' to 'high quality' condition owing to the lack of disturbances from fire, weeds and grazing. The Minor Drainage habitats were heavily impacted by weed species such as **Cenchrus ciliaris* (Buffel Grass) and **Malvastrum americanum* (American Malvastrum), as well as impacts through extensive grazing and erosion from livestock. The Gorge and Breakaway habitats generally had the highest quality fauna habitat condition due to isolation from these threatening processes.

Minor Drainage habitat is a commonly recorded habitat for the Pilbara region and considered to be of moderate value to a wide spectrum of fauna species. The Minor Drainage habitat comprised a reduced diversity and density in vegetation species and communities, particularly when in the creek bed, and when present it was usually less dense and complex when compared to riparian habitats, such as Weeli Wolli Creek located to the east of the survey area. When present, vegetation typically exhibited a moderate diversity of microhabitats, with some tree hollows and woody debris such as

logs and leaf litter. The woody debris provides foraging and sheltering potential to ground dwelling reptiles and mammals. There were limited locations in this habitat that supported the potential for semi-permanent water bodies to form. Ground dwelling fauna are likely to utilise the linear nature of this habitat to traverse between habitats.

Gorge/Gully habitat is one of the more restricted habitats in the survey area. Gorges are a common feature of the Pilbara; however, as they tend to be narrow, linear features, gorges represent a small proportion of the total land area. In addition, they represent important shelter or roosting habitat for a number of MNES species, including the Pilbara Olive Python, Ghost Bat, Pilbara Leaf-nosed Bat and Northern Quoll. They may also support Priority listed species such as the blind snake *Anilios ganei* (P1). Occasional deep caves and semi-permanent rock pools are features within this habitat that can provide refuge for fauna during harsher drier seasonal conditions. There were no standing water bodies present during the survey; however, there are a number of locations where water could potentially pool after significant rain events, particularly within the BHT area. This habitat was considered of high value as it contains a complexity of microhabitats and potentially supports conservation significant fauna species.

Breakaway habitat is a common feature of the Pilbara but because they tend to be narrow, linear features, they represent a small proportion of the total land area. The breakaways of the survey area were often associated with the drop off areas of the Rocky Hill habitat and were specifically pertinent to BHT. Breakaway habitat contained microhabitats such as crevices, overhangs and shallow caves that provide shelter opportunities for MNES species. The caves have the potential to be used as diurnal roosts and nocturnal feeding roosts for the Ghost Bat, potential den sites for the Northern Quoll and Pilbara Olive Python. The Breakaway habitat provides important habitat values to a number of conservation listed species including MNES; therefore, it was considered of high importance for fauna.

Rocky Hill habitat is common and widespread throughout the Pilbara. This habitat generally has low vegetation complexity and low diversity of microhabitats; however, MNES species (such as the Northern Quoll) are likely to traverse and forage within these habitats. Other conservation significant species such as the Western Pebble-mound Mouse, *Anilios ganei* and the Pilbara Barking Gecko may also utilise this habitat. The soils are generally stony and compact, reducing the potential opportunities for burrowing species. Therefore this habitat was considered of moderate value for fauna.

Low Hill and Slopes habitat is widespread and common throughout the Pilbara region and although there are a few conservation listed species that may utilise this habitat, they are unlikely to be restricted to it, with the possible exception of the Western Pebble-mound Mouse. This habitat generally has low vegetation complexity and low diversity of microhabitats available for fauna species to exploit. The soils were generally stony and compact, reducing potential opportunities for burrowing species. This habitat was considered to be of low value to a broad spectrum of fauna species.

Alluvial Plain habitat is associated closely with drainage landforms of the Pilbara as it is often formed from the sediment overflow from drainage systems during flooding events. The Alluvial Plain habitat was considered to be of moderate value to a wide spectrum of fauna species as this habitat typically exhibited a moderate diversity of microhabitats, with some tree hollows and logs and some areas of sandy soils suitable for burrowing. At the time of the survey, the tree hollows of this habitat supported nesting potential for small passerines such as pardalotes, thornbills and multiple species of honeyeaters. Within the survey area the vegetation of this habitat was generally less complex when compared to Minor Drainage habitat, with an absence of large eucalypts. This habitat may provide some limited foraging opportunities for Ghost Bats and Pilbara Leaf-nosed Bats.

Mulga Woodland habitat is characterised by vegetation communities dominated by Mulga (*Acacia aneura*) on a stony mantle. The open to moderately dense woodlands consisted of an understorey composed of sparse tussock or hummock grasses. The woodlands provide nesting and shelter habitats for birds and reptiles and the tussocks and hummocks provide habitat for small birds, reptiles and mammals. Mulga Woodlands are also subject to sheet water flow after rainfall and vegetation is often densely clumped or banded due to the sheet flow, often forming large groves. However due to a low diversity of microhabitats present (generally the understorey and leaf litter were considered sparse), this habitat type was considered of low value to a wide spectrum of fauna species.

Stony Plain habitat is widespread and common throughout the Pilbara region and although there are a few species of conservation significance that may utilise it, they are not restricted to this habitat type. Conservation significant fauna likely to occur in this habitat type include the Western Pebble-mound Mouse. This habitat generally had low vegetation complexity and microhabitat diversity, and was considered to be of low value for fauna.

Table 12: Fauna habitat types recorded in the survey area.

Habitat type	Extent in survey area (proportion)	Broad habitat description	Vegetation description	Microhabitats	Sites	Habitat condition	Value (broad faunal assemblage and MNES species)	Representative photo
Minor Drainage	869.7 ha (8.1%)	Open drainage areas on stony soils. Water bodies only present during times of heavy inundation	*Eucalyptus victrix* (*Eucalyptus camaldulensis*) woodland over *Petalostylis labicheoides* and *Acacia* spp. tall open shrubland over tussock grassland	Hollow bearing trees and logs, thick ground cover/ vegetation, deep leaf litter	BAT9, BAT14, CAM15, CAM19, HA14, HA20, HA31, SRE3, SRE8, SRE14, TS6, TS7,	Good to High Quality	Moderate value to a wide spectrum of fauna species that are likely to reside in Minor Drainage habitats. Low value to target MNES species as they do not provide significant shelter.	
Gorge/ Gully	65.5 ha (0.6%)	Deep often rocky gorges, sometimes with ephemeral or semi-permanent pools	*Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia ferriticola* scattered low trees or *Eucalyptus repullulans* scattered low mallee over *Triodia pungens*, *Triodia vanleeuwenii* very open hummock grassland and scattered tussock grasses	Overhangs, crevices, caves, tree hollows, ephemeral, semi-permanent water	BAT1, BAT2, BAT7, BAT10, BAT17, BAT19, BAT22, BAT24, BAT25, CAM2, CAM3, CAM4, CAM5, CAM9, CAM18, CAM20, CAM22, CAM23, CAM24, CAM27, CAM28, CAM31, CAM32, CAM33, HA1, HA8, HA33, HA35, HA40, Q1, SRE1, SRE2, SRE4, SRE10, SRE13, SRE17, SRE18, SRE19, SRE20, TS10, TS11,	Very Good to High Quality	Primary high value habitat for target MNES species. Provides significant shelter sites and supports a diversity of fauna species.	
Breakaway	241.6 ha (2.2%)	Breakaway or ridge line, falling away to steep scree slope or drainage	*E. leucophloia* subsp. *leucophloia* scattered low trees over *Acacia* spp. tall shrubs over *T. pungens* very open hummock grassland, sometimes with scattered tussock grasses	Caves (roost/feed caves), cracks and crevices, sheltered leaf litter	BAT3, BAT4, BAT6, BAT8, BAT13, BAT16, BAT21, BAT23, BAT26, CAM1, CAM6, CAM7, CAM8, CAM11, CAM12, CAM13, CAM14, CAM17, CAM21, CAM30, CAM34, CAM35, HA4, HA5, HA9, HA24, HA38, SRE5, SRE9, TS8, TS9, TS19	Very Good to High Quality	High value to a low diversity of fauna species that are likely to reside in Breakaway habitats. High value to target MNES species as they are likely to roost and den within this habitat type.	
Rocky Hill	987.9 ha (9.1%)	Stony hills on high ranges with dissected valleys and gorges	*E. leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* scattered low trees to low open woodland over mixed open shrubland over open *Triodia wiseana, T. pungens, T. vanleeuwenii* hummock grassland	Shallow overhangs, boulders and crevices	BAT5, BAT15, CAM10, CAM16, CAM25, CAM26, CAM29, HA3, HA7, HA10, HA11, HA12, HA13, HA34, HA39, SRE11, SRE21, TS4, TS12, TS13, TS15	Good to High Quality	Moderate value for target MNES species as they are likely to traverse and forage within these habitats. Moderate value to a low diversity of fauna species that are rocky habitat specialists.	

Habitat type	Extent in survey area (proportion)	Broad habitat description	Vegetation description	Microhabitats	Sites	Habitat condition	Value (broad faunal assemblage and MNES species)	Representative photo
Low Hills and Slopes	5,460.0 ha (50.5%)	Low stony hills and slopes with dissected valleys and drainage on stony soils	*E. leucophloia* subsp. *leucophloia* and/or *C. hamersleyana* scattered low trees over mixed and *Acacia* spp. open shrubland over open *T. pungens, T. vanleeuwenii* hummock grassland	Termite mounds, *Triodia* hummocks, minimal leaf litter	AU2, HA2, HA17, HA19, HA22, HA25, HA36, HA37, HA41, HA42, TS5, TS16	Very Good to High Quality	Low value to a wide spectrum of fauna species that are likely to reside in within these habitats. Low value to target MNES species as this habitat type offers minimal ecological value to these species.	
Alluvial Plain	161.8 ha (1.5%)	Flood plain surrounding drainage areas	*Acacia pruinocarpa, Acacia aptaneura, Eremophila longifolia* tall open shrubland over tussock grassland	Dense leaf litter, termite mounds and spinifex clumps, cracking clays	TS2, TS14	Very Good	Low value to a wide spectrum of fauna species that are likely to reside in within these habitats. Low value to target MNES species as this habitat type offers minimal ecological value to these species.	
Mulga Woodland	1,031.4 ha (9.5%)	Stands of Mulga groves on clay based stony plains	*Acacia catenulata*, (*A. pruinocarpa*) tall shrubland over *Eremophila fraseri* scattered tall shrubs over *T. pungens* very open hummock grassland	Limited microhabitats, termite mounds, minimal leaf litter	AU1, BAT12, HA6, HA18, HA28, HA29, HA30, HA32, SRE6, SRE7, SRE12, SRE15, SRE16, SRE23, TS1, TS3, TS18	Disturbed to High Quality	Low value to a wide spectrum of fauna species that are likely to reside in within these habitats. Low value to target MNES species as this habitat type offers minimal ecological value to these species.	
Stony Plain	1,167.6 ha (10.8%)	Broad flat low lying plains to undulating plain on soft loamy soils	*A. aptaneura, A. pruinocarpa, A. catenulata* tall shrubland over *T. pungens* (and sometimes *T. vanleeuwenii)* hummock grassland or tussock grassland	Limited leaf litter, termite mounds and spinifex clumps	AU3, AU4, HA15, HA16, HA27, SRE11, SRE22, TS4, TS17	Very Good	Low value to a wide spectrum of fauna species that are likely to reside in within these habitats. Low value to target MNES species as this habitat type offers minimal ecological value to these species.	
Cleared	832.3 ha (7.7%)	Cleared areas from mining and pastoralism activities	Vegetation structure disturbed or absent.	None	None	Highly Degraded	Little value as fauna habitat.	

4.2.1.2 Significant Habitat Areas

None of the fauna habitats were considered to be synonymous with any TECs or PECs relating to terrestrial fauna listed in the Pilbara region (Department of Biodiversity, Conservation, and Attractions 2018).

Gorge/Gully habitats present in the survey area are considered important as refuge sites on a local scale due to the significant microhabitats they provide, such as caves and water pools. This habitat was considered highly suitable foraging and potential shelter for the MNES species Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python and would be considered habitat critical to the survival of the Northern Quoll and Ghost Bat under the EPBC Act definitions (Department of Environment 2013; Department of the Environment and Energy 2016; Threatened Species Scientific Committee 2016).

Twelve significant habitat features were recorded throughout the survey area: seven caves and five pebble mounds of the Western Pebble-mound Mouse (Figure G.1 and Table G.1, Appendix G). Of the seven caves, two caves (Caves 1 and 5) were categorised as Category 3 roost caves with occasional occupancy due to the presence of Ghost Bat feeding evidence (scats) and/or the physical properties of the caves were conducive to diurnal roosting. The remaining five caves (Cave 2, 4, 6, 7 and 8) were categorised as Category 4 nocturnal roost caves (opportunistic usage) given the physical properties of the caves. Ghost Bat feeding evidence was recorded in Caves 4 and 7; however, these sites were more overhangs rather than caves and not conducive to diurnal roosting for this species. An additional two Category 4 nocturnal roost caves (Caves 3 and 9) were recorded just outside the survey area (Figure G.1 and Table G.2, Appendix G). One additional pebble mound was also recorded just outside the survey area (Figure G.1 and Table G.1, Appendix G).

The survey area contained habitat with the potential to support semi-permanent surface water, specifically in the Gorge/Gully habitat within the BHT area. However no pools (standing water), semi-permanent wetlands or surface water were recorded in the survey area at the time of survey. All refuge areas in the gorges or gullies of the survey area were generally dry.

4.2.1.3 Habitat Suitability for MNES Species

Northern Quoll

Approximately 107 ha (1%) of the survey area, comprising Gorge/Gully and some Breakaway habitats mainly within the BHT area, was considered 'probable shelter and foraging habitat' (or core habitat as per the referral guidelines (Department of the Environment and Energy 2016)), based on proximity to known quoll records, microhabitat features and orientation aspect (Figure G.2, Appendix G). Approximately 200 ha (2%) of the survey area was considered 'potential shelter and foraging habitat', comprising mainly smaller Breakaway habitat within the HD2 area (Figure G.2, Appendix G). The Gorge/Gully and Breakaway habitats contain rocky environments of high relief that are particularly important for Northern Quolls in the Pilbara as they provide potential denning sites for breeding and shelter and diverse microhabitats for foraging.

Approximately 1,858 ha (17%) of the survey area was considered suitable foraging and dispersal habitat (Minor Drainage and Rocky Hill habitats), particularly where these habitats were in close association with the Gorge/Gully and Breakaway habitats as they provided microhabitats such as crevices and cracks for foraging (Figure G.2, Appendix G). The remaining 8,653 ha (80%) of the survey area was considered to provide limited foraging and dispersal habitat, consisting of Alluvial Plain, Low Hills and Slopes, Mulga Woodland, Stony Plain and Disturbed habitats (Figure G.2, Appendix G).

Pilbara Leaf-nosed Bat

Approximately 307 ha (3%) of the survey area, comprising the Gorge/Gully and Breakaway habitat, was considered potential shelter and foraging habitat for this species due to the presence of nocturnal refuge caves (Figure G.3, Appendix G). Approximately 9,678 ha (89%) of the survey area, which consisted of Alluvial Plain, Minor Drainage, Low Hills and Slopes, Mulga Woodland, Rocky Hill and Stony Plain habitats was considered suitable foraging and dispersal habitat (Figure G.3, Appendix G). The remaining 833 ha (8%) of the survey area, comprising Disturbed areas, was considered to provide limited foraging and dispersal habitat (Figure G.3, Appendix G).

Ghost Bat

Approximately 307 ha (3%) of the survey area, comprising the Gorge/Gully and Breakaway habitat, was considered potential shelter and foraging habitat (Figure G.4, Appendix G), due to the presence of caves that potentially support roost sites. Often Gorge/Gully and Breakaway habitats contain caves and deep shelters that are used as nocturnal feeding roosts by Ghost Bats. During the survey two caves (Caves 1 and 5) were categorised as Category 3 roost caves with occasional occupancy due to the presence of Ghost Bat feeding evidence (scats) and/or the physical properties of the caves were conducive to diurnal roosting. The remaining five caves (Cave 2, 4, 6, 7 and 8) were categorised as Category 4 nocturnal roost caves (opportunistic usage) given the physical properties of the caves. It is considered unlikely that additional significant caves exist within the survey area; however, the possibility cannot be discounted as the survey area was not searched in its entirety. If present, they are likely to be found within the Gorge/Gully and Breakaway habitats only. No previously known or confirmed diurnal roosts or maternal roosts have been recorded in the survey area. Both habitats also contain complex vegetation structures and microhabitats that support prey species and foraging sites for the Ghost Bat.

Approximately 1,858 ha (17%) of the survey area, which consisted of Minor Drainage and Rocky Hill habitats, was considered suitable foraging and dispersal habitat (Figure G.4, Appendix G). The taller trees found in the Minor Drainage habitats provide ideal foraging/hunting perches particularly in areas that have the potential for semi-permanent surface water and contain thicker vegetation. The Rocky Hill habitat contains microhabitats such as boulder piles, cracks and crevices that support a wide range of prey species for the Ghost Bat. The remaining 8,653 ha (80%) of the survey area, comprising the Alluvial Plain, Low Hills and Slopes, Mulga Woodland, Stony Plain and Disturbed habitats, was considered to provide limited foraging and dispersal habitat (Figure G.4, Appendix G).

Night Parrot

None of the habitats of the survey area supported old, large and unburnt *Triodia* clumps that are considered the primary habitat requirement for the Night Parrot (Department of Parks and Wildlife 2017). The Alluvial Plain, Minor Drainage, Mulga Woodland and Stony Plain habitats (3,230 ha, 30%) within the survey area were mapped as suitable foraging and dispersal habitat; however, the Night Parrot is unlikely to occur within the survey area (Figure G.5, Appendix G). However, most of these habitats (particularly within the BHT and HD2 areas) were impacted by recent fires (less than 10 years old), pastoral and mining impacts over a long duration, very sparse ground cover vegetation and a lack of chenopod communities or suitable size/age *Triodia* hummocks and are unlikely to support the Night Parrot. The remaining 7,587 ha (70%) was considered to provide limited foraging and dispersal habitat (Figure G.5, Appendix G).

Pilbara Olive Python

Approximately 307 ha (3%) of the survey area, comprising the Gorge/Gully and Breakaway habitats, was considered as potential shelter and foraging habitat for the Pilbara Olive Python (Figure G.6, Appendix G). The caves and overhangs of the Gorge and Breakaway habitats are likely to provide denning sites and ambush locations frequented by this species.

Approximately 870 ha (8%) of the survey area was considered suitable foraging and dispersal habitat, which consisted of Minor Drainage habitat (Figure G.6, Appendix G). The remaining 9,641 ha (89%) of the survey area was considered to provide limited foraging and dispersal habitat, consisting of Alluvial Plain, Low Hills and Slopes, Mulga Woodland, Rocky Hill, Stony Plain and Disturbed habitats (Figure G.6, Appendix G).

4.2.2 Vertebrate Fauna Species

There were 174 vertebrate fauna species recorded within the survey area over the three phases of fauna surveying (Table 13). A complete list of recorded species is provided in Tables E.5-E.9 (Appendix E). The following sections provide detailed results for each major taxonomic group sampled.

Table 13: Number of vertebrate fauna species recorded during the survey.

Fauna taxonomic group	No. of species recorded	No. of conservation significant species recorded	No. of introduced species recorded
Amphibians	2	0	0
Reptiles	55	1	0
Birds	84	2	0
Mammals	33	4	7
Total	**174**	**7**	**7**

4.2.2.1 Herpetofauna

Two amphibian species were recorded during the fauna assessment: *Litoria rubella* (19 records) and *Cyclorana maini* (four records) (Table E.5, Appendix E). Frogs were either sighted (trapped) or heard calling during targeted searches. No conservation significant species were recorded.

Fifty-five reptile species were recorded the three phases of fauna surveying (Table E.6, Appendix E). The most abundant groups encountered were the skinks (114 records, 43%), followed by the geckos (84 records, 31%). Both of these groups were also the most speciose with 17 species of skinks and 12 species of geckos. The most commonly recorded species were *Carlia munda* (30 records), *Ctenotus pantherinus* (20 records) and *Oedura fimbria* (17 records). The most speciose sites were TS04 (Stony Plain) with 15 species and TS16 (Low Hills and Slopes) with 12 species. Ten species were recorded by methods other than trapping. One conservation significant reptile species was recorded during the survey, *Lerista macropisthopus remota* (P2).

Species accumulation curves did not asymptote when all surveys were considered (Figure 5), and based on estimates of total species richness, between 66% and 85% of the total species pool was recorded (Table 14). Only one of the previous surveys within the vicinity of the survey area used species accumulation curves and determined that 92% of the total expected species was recorded for herpetofauna (Ecologia Environment 2014). The reduced herpetofauna captures are likely to be a combination of the dry seasonal conditions and the trap methods used, with only eight out of the 19

trap sites using pitfall traps (see Section 3.7 for more detail). Ten reptile species (18%) were recorded opportunistically during the fauna assessment.

There was a significant difference in species composition between habitat types (ANOSIM R = 0.458, P = 0.004). The two Mulga Woodland (TS1, TS3) and two Low Hills and slopes (TS5, TS16) sites showed the highest within habitat type similarity, while the Rocky Hills habitat was the most distinct herpetofauna assemblage (Figure 6). This is because three species were recorded only in this habitat type: *Delma butleri*, *Furina ornata* and *Pseudonaja nuchalis*. These species are habitat generalists (and not rock-dwelling specialists), so it is likely they were only recorded in this habitat type due to the higher number of funnel traps used, as they are considered a more effective trap to capture reptiles such as snakes that readily escape pit traps (Environmental Protection Authority 2016a).

Table 14: Total number of herpetofauna taxa systematically sampled in comparison to estimates of the total species pool based on several models.

	Observed	Estimated			
		Chao2	Jackknife 1	Jackknife 2	Bootstrap
Number of species	47	61	64	71	55
Estimated % sampled		77	73	66	85

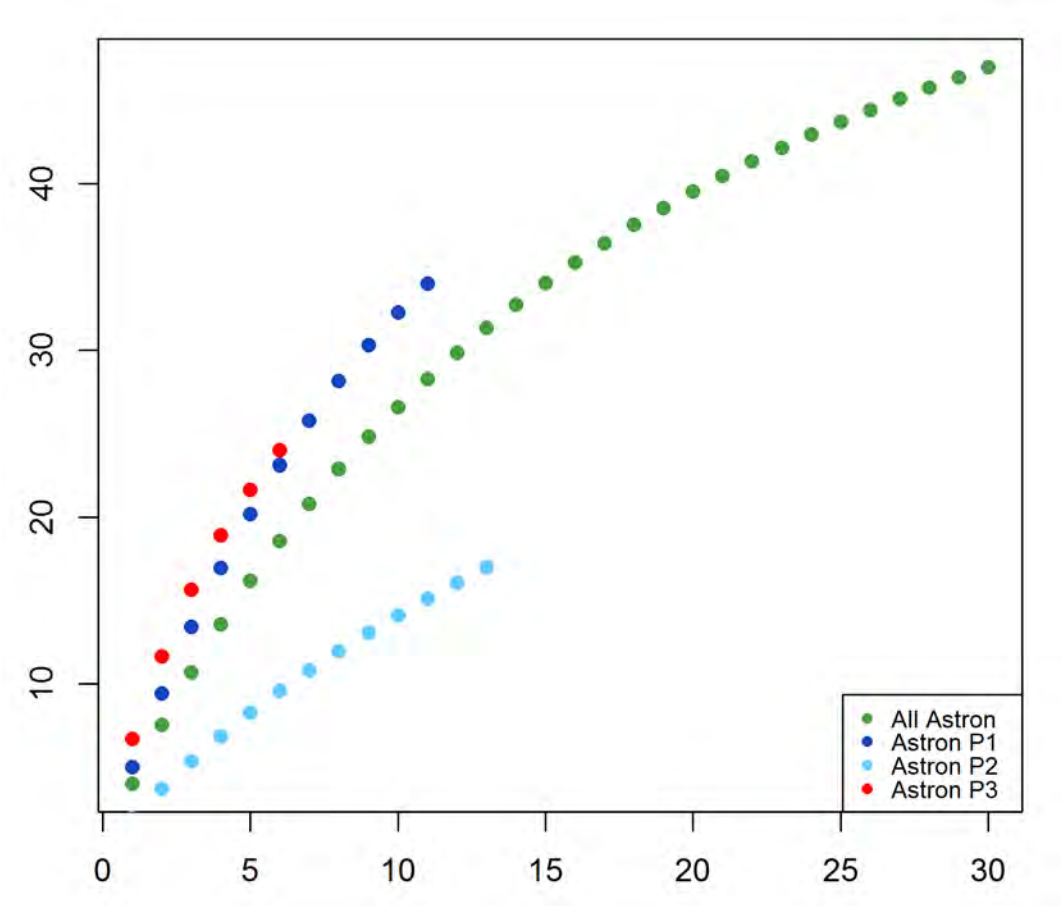


Figure 5: Species accumulation curves for herpetofauna surveys.

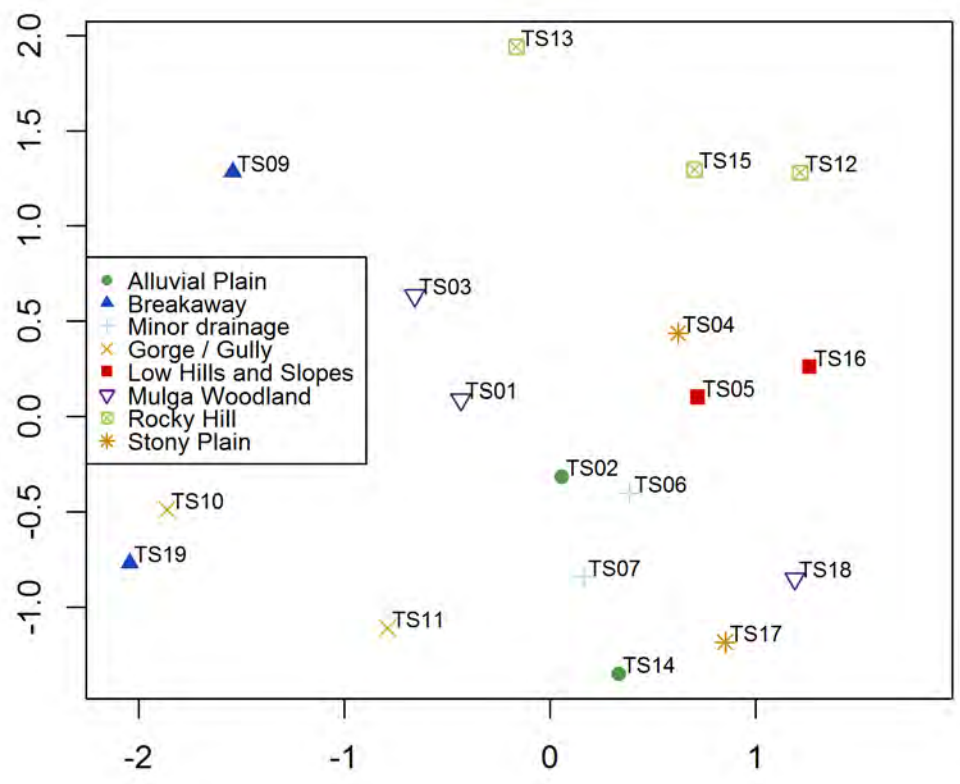


Figure 6: Two-dimensional ordination of herpetofauna species assemblages of each site.

4.2.2.2 Birds

Eighty-four bird species were recorded over the three phases of fauna surveying (Table E.7, Appendix E). The most commonly recorded species was the Weebill (*Smicrornis brevirostris*) with 50 records followed by the Zebra Finch (*Taeniopygia guttata*) with 44 records and the Singing Honeyeater (*Gavicalis virescens*) with 43 records. The most commonly recorded group of birds was the Meliphagidae (honeyeaters), with 120 records, followed by the Acanthizidae (Australasian warblers) with 70 records and Estrildidae (finches) with 63 records. The most speciose families observed were the Accipitridae (eagles, kites and hawks) and Meliphagidae (honeyeaters), which comprised eight and six species, respectively. The most speciose sites were TS6 (Minor Drainage) with 29 species and TS4 (Stony Plain) with 27 species. Of the 84 bird species recorded 19 species (22%) were not recorded at trapping grids, but from targeted and opportunistic searches.

Two bird species of conservation significance was recorded during the survey, Oriental Plover (*Charadrius veredus*) (IA; IA) and the Letter-winged Kite (*Elanus scriptus*) (P4).

The species accumulation curve for total survey effort is tending towards an asymptote (Figure 7), and based on estimates of total species richness, between 71% and 89% of the total species pool was recorded (Table 15). This compares with Ecologia Environment (2014) that recorded between 82% and 98% of the total expected species for birds.

There was a significant difference in species composition between habitat types (ANOSIM R = 0.353, P = 0.003; Figure 8) with the Rocky Hill sites showing the most distinct species composition compared to sites of other habitat types (Figure 8). This is most likely due to the low species richness recorded at the Rocky Hill sites, with only between three and six species recorded. Avifauna of hill tops and hill slopes is typically of low variety as it consists of open vegetation with limited dense vegetation cover from shrubs or trees (Ecologia Environment 2014).

Table 15: Total number of bird taxa systematically sampled in comparison to estimates of the total species pool based on several models.

	Observed	Estimated			
		Chao2	Jackknife 1	Jackknife 2	Bootstrap
Number of species	65	85	82	92	73
Estimated % sampled		76	79	71	89

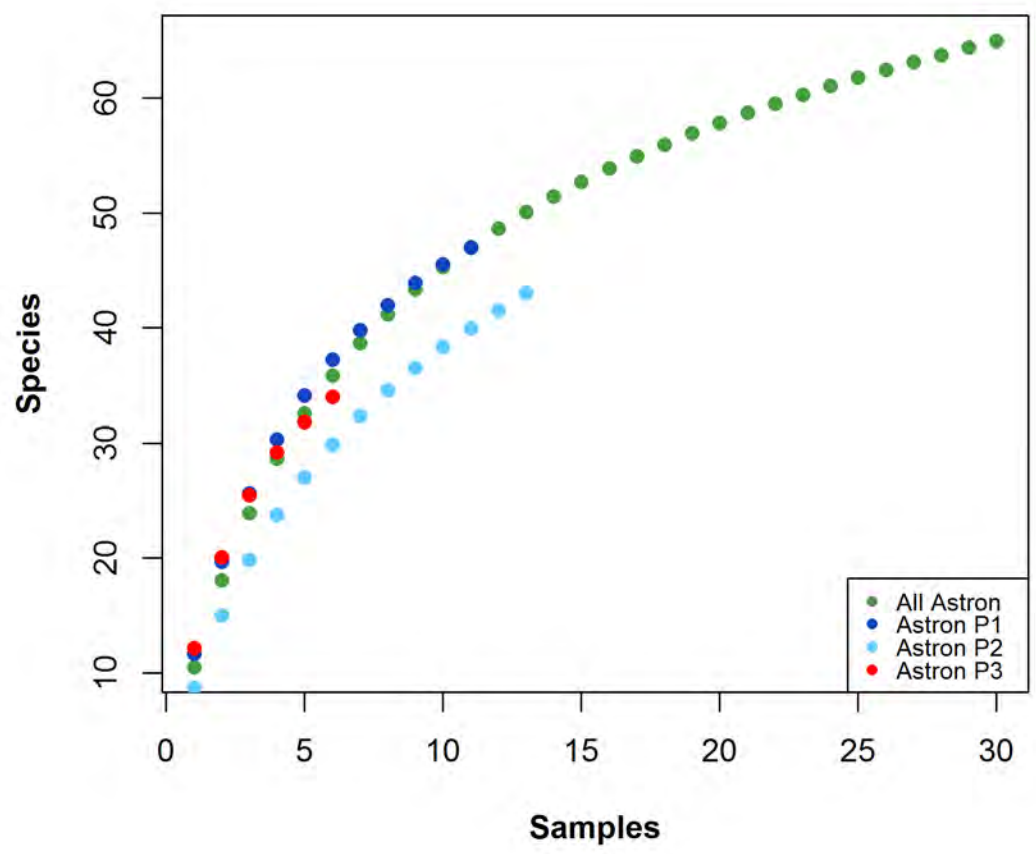


Figure 7: Species accumulation curves for bird surveys.

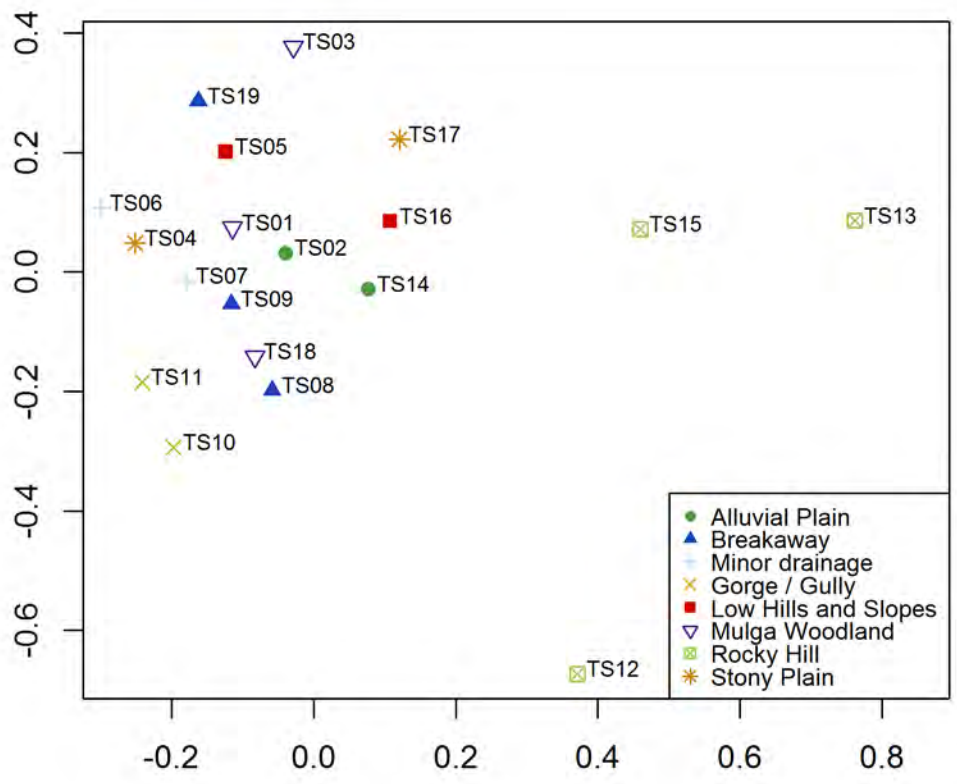


Figure 8: Two-dimensional ordination of bird species assemblages of each site.

4.2.2.3 Mammals

Thirty-three species of mammal were recorded during the three phases of fauna surveying, including seven introduced species: Cat (**Felis catus*), Dog/Dingo (**Canis familiaris*), European Cattle (**Bos taurus*), Camel (**Camelus dromedarius*), Donkey (**Equus asinus*), Rabbit (**Oryctolagus cuniculus*) and House Mouse (**Mus musculus*) (Table E.8, Appendix E). The most commonly recorded species was the Common Rock-rat (*Zyzomys argurus*) with 37 records followed by the Kaluta (*Dasykaluta rosamondae*) with 33 records. The most speciose trapping sites were TS4 (Stony Plain), TS5 (Low Hills and Slopes) and TS6 (Minor Drainage) with five species each. Twelve bat species were recorded from the echolocation recording sites (Table E.9, Appendix E).

Four species of conservation significance were recorded during the survey: Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Western Pebble-mound Mouse.

Species accumulation curves were starting to reach an asymptote during the current survey (Figure 9), and based on estimates of total species richness, between 88% and 93% of the total species pool were recorded (Table 16). This compares with Ecologia Environment (2014) that recorded between 81% and 96% of the total expected species for birds. The data do not include bat species, which make up 36% (12 species) of the mammal species recorded. Also seven species were only recorded opportunistically and not using acoustic or trapping methods.

There was no significant difference in species composition between habitat types (ANOSIM R = 0.206, P=0.088, Figure 10), which was considered to be expected as most mammal species are habitat generalists, with the exception of only a few species that are rock-specialists. Rocky sites (i.e. Rocky Hill, Gorges/Gullies and Breakaway habitats) were generally grouped together and showed a slightly different species composition from sites in the other habitat types.

Table 16: Total number of mammal taxa systematically sampled in comparison to estimates of the total species pool based on several models.

	Observed	Estimated			
		Chao2	Jackknife 1	Jackknife 2	Bootstrap
Number of species	14	15	16	15	15
Estimated % sampled		93	88	93	93

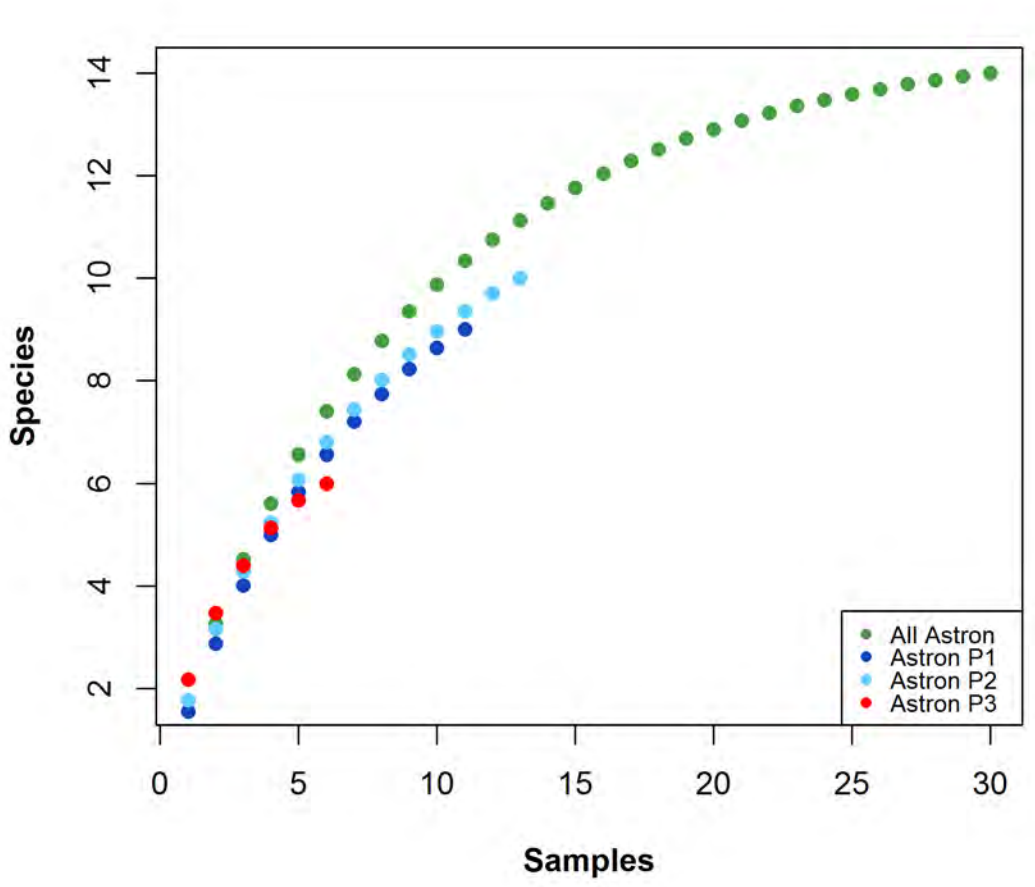


Figure 9: Species accumulation curves for mammal surveys.

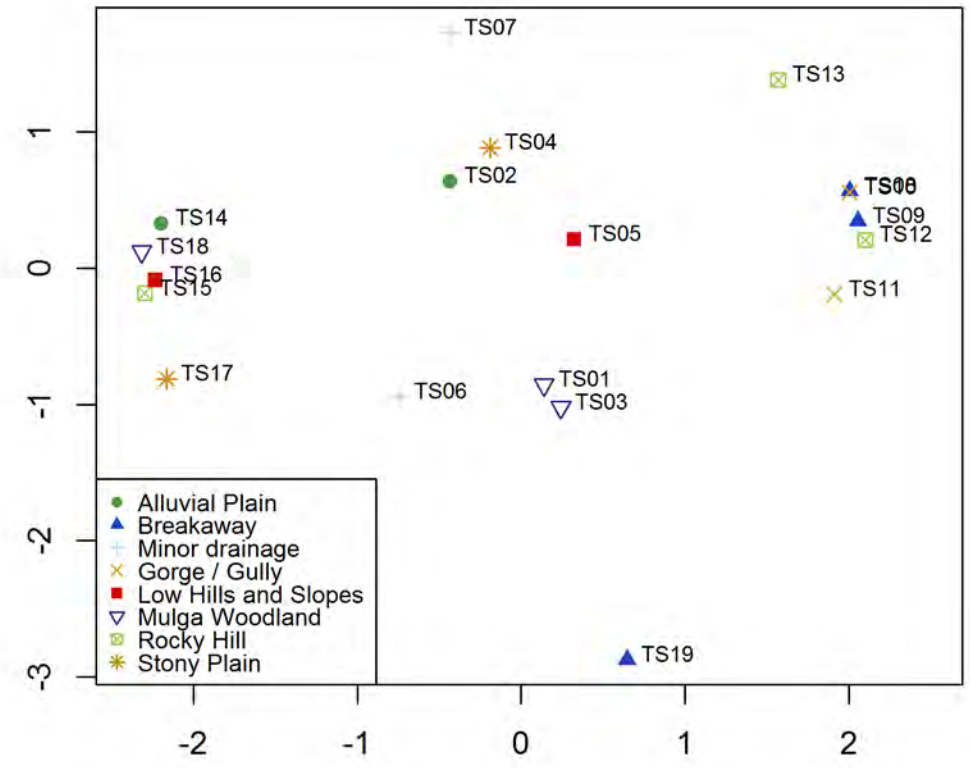


Figure 10: Two-dimensional ordination of mammal species assemblages of each site.

4.2.2.4 Conservation Listed Species Recorded

Seven vertebrate species of conservation significance were recorded within the survey area (Figure H.1 and Table H.1, Appendix H).

Northern Quoll (*Dasyurus hallucatus*) (EN; EN)

The Northern Quoll occurs in a variety of habitats (Oakwood 2008) but is commonly found in open lowland savannah forest and rocky escarpments. Rocky areas are a particularly important zone for Northern Quolls in the Pilbara as these areas retain water and provide a diversity of microhabitats. These areas also tend to have greater floristic diversity and productivity resulting in greater prey density compared to non-rocky areas. These rocky areas also provide refuge from feral cats, fire and livestock (Hill and Ward 2010) and provide breeding potential (Department of the Environment 2013).

The Northern Quoll was recorded 14 times during the fauna assessment: one record during Phase 1, 12 records during Phase 2 and one record during Phase 3 (Figure H.1 and Table H.1, Appendix H). The majority of the records were made via motion camera detection (10 records), followed by scat recordings (three records) and a solitary male individual was captured. Most of the records were made at BHT (10 recordings), followed by four records at the Wonmunna (WM) area. No records of the Northern Quoll were made within the HD2 area. The recordings were generally made within the Gorge/Gully or Breakaway fauna habitat types at BHT.

During Phase 2 a capture of an individual Northern Quoll was made at a Gorge/Gully habitat behind the HD1 village camp on the night of 25 May 2018 (potentially early in the evening, released on the morning of 26 May 2018). This individual was male and determined as a sub-adult potentially

looking to expand its individual home range in preparation for the breeding season. The scats recorded in this area are likely to be from the same individual.

The camera recordings were made at two separate locations also on 25 May 2018, suggesting that at least two individuals, possibly three, may be present in the survey area. Camera recordings were also made at two separate locations on the nights of the 22, 23 and 24 May 2018. These two locations are separated by approximately 5 km, suggesting that more than one individual is present in the area.

During Phase 3 a solitary recording of an individual was made at one location on motion camera at BHT. The individual was recorded on 14 March 2019 within a Breakaway habitat type.

The Northern Quoll records within the survey area are significant due to the paucity of previous local and regional records and that the survey area is at the edge of this species' regional distribution. The Northern Quoll has been previously recorded from fauna surveys highlighted in the desktop review, near HD1 mine site (Biota Environmental Sciences 2011). One male Northern Quoll was captured within a drainage line fauna habitat and subsequently recaptured over an additional two nights (Biota Environmental Sciences 2011).

Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) (VU; VU)

Pilbara Leaf-nosed Bats are known to require deep caves characterised by high levels of humidity and stable temperatures (Churchill 2008). This is a result of their limited ability to conserve heat and water (Armstrong 2001; Churchill 1991). Caves deep enough to create this environment are relatively uncommon in the Pilbara, with only 20 to 25 roost sites being known (R. Bullen 2014, pers. comm. 20 Oct 2014). Foraging habitat for the Pilbara Leaf-nosed Bat is diverse and includes riparian vegetation, hummock grassland, and sparse tree and shrub savannah (Duncan, Baker, and Montgomery 1999). Roost sites for the Pilbara Leaf-nosed Bat can be classified (Department of the Environment 2017) based on the following criteria:

- Permanent diurnal roosts—occupied year-round and likely the focus for some part of the nine-month breeding cycle; considered as critical habitat that is essential for daily survival.
- Non-permanent breeding (maternal) roosts—evidence of usage during some part of the nine-month breeding cycle (July to March), but not occupied year-round; considered as critical habitat that is essential for both daily and long-term survival.
- Transitory diurnal roosts—occupied for part of the year only, outside the breeding season (i.e. April to June), and which could facilitate long distance dispersal in the region; considered as critical habitat that is essential for both daily and long-term survival.
- Nocturnal refuge—occupied or entered at night for resting, feeding or other purposes, with perching not a requirement. Excludes overhangs. Not considered critical habitat, but are important for persistence in a local area.

Pilbara Leaf-nosed Bats have also been recorded flying over small watercourses amongst granite boulder terrain, over pools and low shrubs in ironstone gorges, and above low shrubs and around pools in gravelly watercourses with *Melaleuca leucadendron*, such as in Barlee Range Nature Reserve (Armstrong 2001). In the Pilbara, the species has been observed in *Triodia* hummock grasslands covering low rolling hills and shallow gullies, with scattered *Eucalyptus camaldulensis* along the creeks (Armstrong 2001; Churchill 1991).

The Pilbara Leaf-nosed Bat was recorded at three of the23 bat detector locations (BAT13, BAT17 and BAT21) at low activity levels (Appendix I; Bat Call WA (2019)). BAT13 and BAT17 were located within

the BHT area and BAT21 was located within the HD2 area (Figure H.1 and Table H.1, Appendix H). The Pilbara Leaf-nosed Bat records were from foraging individuals in Gorge/Gully and Breakaway fauna habitats, as the calls at all three sites were at least three hours after dusk and are not consistent with the presence of a permanent roost cave nearby (Appendix I; Bat Call WA (2019)). This species was not detected at any of the caves at which bat detectors were placed. This species is likely to forage only occasionally within the survey area taking advantage of benign conditions and dispersing temporarily in search of additional foraging and roosting opportunities (Bat Call WA 2019).

This species was previously recorded by Ecologia Environment (2014) at Greater West Angelas, approximately 15 km south-west of the survey area. Three locations were recorded, all at low levels, with call times not conducive to a roost nearby (Ecologia Environment 2014). A further nine records were recorded within the vicinity of the survey area (Department of Biodiversity, Conservation, and Attractions 2017b).

Ghost Bat (*Macroderma gigas*) (VU; VU)

The preferred habitat of Ghost Bats is considered to be rocky gorges and breakaways that support caves and crevices used as maternity roosts. The Ghost Bat uses different natural formations for various purposes and for groups to persist they generally require habitats that provide:

- a selection of roosting opportunities with night roosts or feeding sites, day roosts and at least one deep cave with characteristics of a maternity roost
- nearby gullies and gorges with vegetation of vertical complexity (diverse vegetation heights and density) and presence of water that would attract prey species
- a productive foraging area within a 5 km to 10 km radius, usually including a good quality riparian drainage line.

Transient roosts and feeding sites are used by small numbers of Ghost Bats, whereas maternity roosts are used by larger colonies (Armstrong and Anstee 2000). Ghost Bats require caves of varying shapes and sizes to fulfil each of its ecological requirements. Cave usage can be classified into three categories: feed caves, day roosts and maternal roosts.

- Feed caves are typically shallow caves or overhangs high in the strata that are poorly insulated from the elements (Armstrong and Anstee 2000). Ghost Bats hunt at night and use feed caves to consume prey they have captured in the surrounding area. Feed caves often contain Ghost Bat scats and/or feeding remnants (typically feathers and small animal bones).
- Day roosts are generally deep, complex caves or disused mines that contain domed ceilings, fissures or passages which create a stable microclimate. These caves are usually lower in the strata making them well insulated. The stable temperature and elevated humidity of these caves relative to the ambient conditions create physiologically benign conditions (McKenzie and Bullen 2009; Armstrong and Anstee 2000; Hall et al. 1997; Leitner and Nelson 1967).
- Maternal roosts like day roosts are generally deep, complex caves or disused mines that contain domed ceilings, fissures or passages which create a stable microclimate and often contain multiple entrances (McKenzie and Hall 2008). Maternal roosts have a stable temperature of 23°C to 28°C and moderate to high relative humidity of 50% to 100% (Armstrong and Anstee 2000; Churchill 1991; Churchill and Helman 1990; Pettigrew et al. 1986).

The Ghost Bat can have a relatively small nightly foraging range (up to 2 km from the roost where it has been studied in Queensland) (Tidemann et al. 1985; Pettigrew et al. 1986), but has the flight capability to range widely (Bullen and McKenzie 2002), perhaps tens of kilometres in a night. This is evident from genetic markers, which suggest that males are particularly likely to disperse long distances throughout the landscape (Worthington Wilmer et al. 1994; 1999).

The Ghost Bat was recorded on nine occasions over the three phases of survey within the survey area through acoustic recordings (calls), scats recorded in nocturnal feed caves and an individual sighted during spotlighting within the HD2 area (Figure H.1 and Table H.1, Appendix H). Four records were made within the HD2 area, four records within the BHT area and one record within the WM area (Figure H.1, Appendix H). One Ghost Bat record (scats recorded in Cave 9) was made outside the survey area boundary (Figure H.1 and Table H.1, Appendix H).

A total of seven caves were recorded within the survey area, two which (Caves 1 and 5) were deemed to be Category 3 roost caves with occasional occupancy. These caves are not considered significant to the long-term presence of the species (Bat Call WA 2019) (Appendix I). The other five previously recorded caves were deemed to be Category 4 nocturnal roost caves (opportunistic usage) and are not considered significant. An additional two caves (Caves 3 and 9), deemed to be Category 4 nocturnal roost caves (opportunistic usage) were recorded outside the survey area (Figure G.1 and Table G.2, Appendix G). It is considered unlikely that additional significant caves exist within the survey area; however, the possibility cannot be discounted as the survey area was not searched in its entirety. If present, they are likely to be found within the Gorge/Gully and Breakaway habitats only.

The individual recorded during Phase 2 nocturnal spotlighting is significant given the sighting was made approximately 1 to 1.5 hours post-civil twilight, so it is likely to have originated from a roost nearby, but possibly outside the survey area. The ridge line where it was recorded is important foraging habitat for this species as another record was made from an echolocation recording device on a separate evening.

An opportunistic recording of a solitary individual found hooked on a fence line was recorded by Biota (2006) in the Hope Downs area, approximately 10 km west of the survey area. Regionally this species has a strong presence in the vicinity of the survey area. In particular, numerous records were made at Southern Flank, approximately 10 km to the north-west of the survey area. Thirty-three caves (12 high value, 21 low value) were recorded at Southern Flank through an extensive search of gorges and gullies (Biologic Environmental Survey 2016). In addition a further 75 records in a 40 km radius around the survey area, mainly to the north and north-east, were detailed through DBCA's Threatened and Priority Fauna Database (Department of Biodiversity, Conservation, and Attractions 2017b).

Oriental Plover (*Charadrius veredus*) (IA, IA)

The Oriental Plover is a non-breeding visitor to Australia, where the species occurs in both coastal and inland areas, mostly in northern Australia. Most records are along the north-western coast, between Exmouth Gulf and Derby in Western Australia (Department of the Environment and Energy 2019). This species occupies sparsely vegetated plains, beaches and tidal flats, and saltworks and sometimes sewage ponds.

One individual was opportunistically sighted during the Phase 3 survey at the HD1 village camp, likely due to the presence of water at the camp. (Figure H.1, Appendix H). This species was not previously recorded from fauna surveys conducted within the vicinity of the survey area (Biota

Environmental Sciences 2006, 2009, 2011, 2014; Ecologia Environment 2014; Ninox Wildlife Consulting 2009a, 2009b).

***Lerista macropisthopus remota* (P2)**

This species favours sandy to sandy loam soils which support *Acacia* shrubland or woodland. It inhabits loose soil under leaf litter at the base of shrubs (Wilson and Swan 2010). Threats to this species are not well known, it is listed as conservation significant due to its very restricted distribution range. This subspecies was described in 1991 and was only known from one locality at the time in the arid central interior of Western Australia, 40 km north-east of Jiggalong (Storr 1991); there are currently no records on NatureMap (Department of Biodiversity, Conservation, and Attractions 2019a). Three records all within 2 km of each other were detailed through DBCA's Threatened and Priority Fauna Database (Department of Biodiversity, Conservation, and Attractions 2017b). The nearest record from the DBCA database is within 4 km of the survey area. From this limited information, it appears that this subspecies is rarely recorded due to a restricted distribution.

One individual was captured during the Phase 3 survey within a Mulga Woodland habitat within the WM area (Figure H.1, Appendix H). This individual was lodged and its identification confirmed at the WAM (#R179612). This species may also be found within the Alluvial Plain and Minor Drainage habitats of the survey area.

Letter-winged Kite (*Elanus scriptus*) (P4)

The Letter-winged Kite is classified as an infrequent non-breeding visitor to Western Australia (Johnstone and Storr 1998). This species inhabits open country and grasslands across arid and semi-arid Australia. When a dry spell follows a number of good seasons, single individuals or small groups of this species appear in north Western Australia, outside of their core range and generally do not stay long in these areas (Menkhorst et al. 2017).

One individual was opportunistically sighted during the Phase 2 survey from Minor Drainage habitat within the HD2 area (Figure H.1, Appendix H). It may also occur within the Stony Plain, Alluvial Plain and Mulga Woodland habitats of the survey area. This species was not previously recorded from fauna surveys conducted within the vicinity of the survey area (Biota Environmental Sciences 2006, 2009, 2011, 2014; Ecologia Environment 2014; Ninox Wildlife Consulting 2009a, 2009b), or identified via desktop review (Department of Biodiversity, Conservation, and Attractions 2017b, 2017a; Department of the Environment and Energy 2017d). The record during the current survey represents a new record for this species within the local area as the nearest record to the survey area is approximately 120 km to the north (Department of Biodiversity, Conservation, and Attractions 2017a). This reflects their habits of translocating across a landscape in response to increased foraging resources (Menkhorst et al. 2017).

Western Pebble-mound Mouse (*Pseudomys chapmani*) (P4)

Extant Western Pebble-mound Mouse populations are widespread in the extensive ranges of the central and southern Pilbara region (Start 2008). The persistence of abandoned mounds in the Gascoyne and Murchison regions and small, isolated, coastal ranges in the Pilbara indicates considerable recent decline (Start 2008). Colonies occur on the gentler slopes of rocky ranges where the ground is covered by stony mulch and vegetated by hard spinifex, often with a sparse overstorey of eucalypts and scattered shrubs, typically *Senna, Acacia* and *Ptilotus* (Start 2008). Mounds are also sited close to narrow ribbons of *Acacia* dominated scrub along incised drainage lines (Start 2008).

The Western Pebble-mound Mouse was recorded nine times during the Astron surveys, comprising of six pebble mounds (three active) and three individual captures. Five pebble mounds were recorded within the Stony Plain, Rocky Hill and Mulga Woodland habitats of the survey area (Figure H.1 and Table H.1, Appendix H). This species is also likely to be found within the Low Hills and Slopes habitat and possibly stony areas within the Alluvial Plain habitat of the survey area. The three individuals and one recently inactive mound (PMM 3) were recorded outside the survey area (Figure H.1 and Table H.1, Appendix H).

Numerous records of this species exist from the vicinity of the survey area, given the commonality of their preferred habitat (stony plains, hills and rises) across the bioregion. The DBCA Threatened and Priority Fauna Database search identified 237 records (Department of Biodiversity, Conservation, and Attractions 2017b). This species was previously recorded from all systematic fauna assessments conducted within the vicinity of the survey area (Biota Environmental Sciences 2006; Ecologia Environment 2014; Ninox Wildlife Consulting 2009a, 2009b).

4.2.2.5 Conservation Listed Species Potentially Occurring in the Survey Area

Three species that were not recorded during the current survey were considered highly likely to occur, given that suitable habitat occurs and a number of records are known from within the vicinity of the survey area.

Pilbara Olive Python (*Liasis olivaceus barroni*) (VU; VU)

The Pilbara Olive Python prefers escarpments, deep gorges, water holes and rock piles associated with permanent pools in rocky areas in the ranges of the Pilbara region (Pearson 1993; Wilson and Swan 2010). Microhabitat preferences of the Pilbara Olive Python are under rock piles, on top of rocks or under spinifex (Tutt et al. 2004). Individuals spend the cooler winter months within caves and rock crevices away from water sources. In the warmer summer months, the pythons are found to move around widely, usually in close proximity to water and rock outcrops (Wilson and Swan 2010).

This species is likely to be found within the Gorge/Gully, Breakaway and Minor Drainage habitats, particularly at sites that have the potential to support semi-permanent water. There are 14 previous records of this species in the vicinity of the survey area (Department of Biodiversity, Conservation, and Attractions 2017b), 10 of which are associated with river systems including Weeli Wolli Creek, Marillana Creek and Tunnel Creek.

***Anilios ganei* (P1)**

The blind snake, *Anilios ganei*, is often poorly collected in vertebrate fauna surveys, but is known from the Hope Downs area. This species has been associated with moist gorges and gullies (Wilson and Swan 2010), but potentially occurs over a wide range of other stony habitats. Given its cryptic

fossorial habit this species is rarely encountered. Little is known of this species' ecology but like most other blind snakes, it is insectivorous, feeding on termites and their eggs, and larvae and pupae of ants (Wilson and Swan 2010).

This species was not previously recorded from fauna surveys conducted within the vicinity of the survey area for Rio Tinto (Biota Environmental Sciences 2006, 2009, 2011, 2014; Ecologia Environment 2014; Ninox Wildlife Consulting 2009a, 2009b), however it has been recorded (four records) within the vicinity of the survey area (Department of Biodiversity, Conservation, and Attractions 2017b). This species is likely to be present within suitable habitats, including the Gorge/Gully, Breakaway and Rocky Hill habitat types of the survey area.

Pilbara Barking Gecko (*Underwoodisaurus seorsus*) (P2)

The Pilbara Barking Gecko is a rock-inhabiting, restricted-range species encountered at mid elevations in the Hamersley Ranges, widely separated from the closest populations of the related Barking Gecko *Underwoodisaurus milii* in the northern Goldfields and Shark Bay in Western Australia (Doughty and Oliver 2011).

This species was recorded at Greater West Angelas (Ecologia Environment 2014) and an additional eight records are detailed within DBCA's Threatened and Priority Fauna Database (Department of Biodiversity, Conservation, and Attractions 2017b) within a 30 km range, with the nearest record to the survey area less than 500 m. This species is likely to be found in elevated fauna habitat such as the Rocky Hill recorded within the BHT area of the survey area.

Four species were not found in the survey area but were all considered to have a moderate likelihood of occurrence: Fork-tailed Swift (*Apus pacificus*) (IA; IA), Grey Falcon (*Falco hypoleucos*) (VU), Peregrine Falcon (*Falco peregrinus*) (OS), and Short-tailed Mouse (*Leggadina lakedownensis*) (P4) (Table F.1, Appendix F). Although suitable habitat is present within the survey area, these species are seasonal migrants that are only present at certain times of the year, species that are not readily trapped during fauna surveys, and/or species with large home ranges.

An additional 12 species not found in the survey area were considered to have a low likelihood of occurrence due to lack of suitable habitats, including the Night Parrot (Table F.1, Appendix F). No calls attributed to the Night Parrot were recorded during two passive acoustic surveys or analysis of the data recorded from the ARUs (Appendix I; Bat Call WA (2019)). The Stony Plain habitat generally did not support old, large and unburnt *Triodia* clumps that are considered the primary habitat requirement for this species, particularly the plains at BHT and HD2, due to the effects of recent fires (less than 10 years old), pastoral and mining impacts over a long duration, very sparse ground cover vegetation and lack of chenopod communities or suitable size/age hummocks. As such, the Night Parrot was classified as having a low likelihood of occurrence in the survey area.

4.2.3 Invertebrate Fauna Habitats

Eight potential SRE habitat types were identified differing in their prospectivity for SRE fauna (Figure G.1, Appendix G). Whilst all of the habitats have the potential to support SREs, five habitats were considered more conducive to relictual SREs: Breakaway, Minor Drainage, Gorge/Gully, Rocky Hill and Mulga Woodland habitats (Table 17). The rocky habitats are associated with an isolated ridge running in an east-west direction, so most of the breakaways and rocky slopes are south-facing and therefore conducive to SREs (Harvey 2002). The Breakaway and Gorge/Gully habitats provide moist, shaded microhabitats that potentially support relictual endemism. These habitats supported Philosciidae sp, *Troglarmadillo* sp. and *Pseudodiploexochus* sp. which, while being ambiguously defined, represent likely SREs. The latter two taxa represent forms that are very rarely sampled from

epigean habitats in the Pilbara and are not arid adapted. The presence of arid sensitive taxa in these habitats indicates that SRE habitats are present. Additional SRE species are likely to occur in these habitats.

The Minor Drainage and Rocky Hill habitats provide a moderate level of habitat suitability for SRE species but lack the moist microhabitats preferred by SRE groups. The pseudoscorpion *Anatemnus* sp. is enigmatic in that it has all of the features of a troglobite (blind and pale) and the only other Pilbara record of this genus is troglobitic. One specimen was sampled from riparian leaf litter of a dry creek line (SRE10). There is a small chance that this species is troglobitic and in rare cases, troglobites have been observed at the entrance of caves during very humid conditions. In the Pilbara, troglobitic *Nocticola* have been sampled from creek gravels (Volschenk personal observations) indicating that Minor Drainage is potential habitat for troglobitic taxa. The Mulga Woodland contained deep leaf litter supporting SRE species and specifically the Mulga Woodland in HD2 was species rich where eight of the nine centipede taxa and four of the five millipede taxa were recorded.

Table 17: SRE fauna habitats present within the survey area, with prospective habitats shaded in grey.

Habitat type	Extent in survey area (ha)	Proportion in survey area (%)
Alluvial Plain	161.8	1.5
Breakaway	241.6	2.2
Minor Drainage	869.7	8.1
Gorge/Gully	65.5	0.6
Low Hills and Slopes	5,460.0	50.5
Mulga Woodland	1,031.4	9.5
Rocky Hill	987.9	9.1
Stony Plain	1,167.6	10.8
Cleared	832.3	7.7
Total	**10,817.7**	**100.0**

Minor Drainage habitats were generally comprised a reduced diversity and density in vegetation species and communities, particularly when in the creek bed, and when present it was usually less dense and complex when compared to major riparian habitats, such as Weeli Wolli Creek located to the east of the survey area. There were limited locations in this habitat that supported the potential for semi-permanent water bodies to form; however, there were some areas of deep, moist leaf litter. This habitat was sampled as sites SRE3, SRE8, SRE14, TS6 and TS7. The potential SRE scorpion *Lychas* 'multipunctatus complex' and potential SRE pseudoscorpions *Anatemnus* sp., *Tyrannochthonius* 'sp. indet. (AESHD2)' and *Beierolpium* 'sp. indet. (AESHD1)' were collected from this habitat.

Gorge/Gully habitat was associated with the Rocky Hill or Breakaway habitats, where deeply carved rock incisions and drainage lines provide shade and diverse microhabitats. Minor creek lines and water run-off lead to higher moisture availability compared to the surrounding areas. This was a relatively uncommon habitat type in the survey area but due to its prospectivity for SRE species it was well sampled; sites included SRE1, SRE2, SRE4, SRE10, SRE13, SRE17, SRE18, SRE19 and SRE20. As a result a substantial number of potential and confirmed SRE species were collected from this habitat type: spiders *Karaops banyjima*, *Karaops* sp. 'ARA001', *Aurecocrypta* 'sp. indet. (AESHD1)' and *Synothele* sp.; pseudoscorpions *Austrohorus* 'sp. indet. (AESHD5)', *Euryolpium* sp., *Indolpium* sp., Olpiidae sp. 'Genus 7/4 PSE118' and *Tyrannochthonius* 'sp. indet. (AESHD2)'; scorpion *Urodacus* 'HD1'; earth centipedes *Sepedonophilus* sp., *Sepedonophilus*'HD1' and *Mecistocephalus* 'HD1';

round-backed millipedes *Austrostrophus* 'Clade A' and *Austrostrophus* sp.; and isopods *Buddelundia* '77', *Troglarmadillo* sp., *Pseudodiploexochus* sp. and Philosciidae sp.

Breakaway habitat was often associated with the drop off areas of the Rocky Hill habitat, specifically within the BHT area. It contained exposed south-facing rock faces with accumulations of rock boulders and scree, conducive to SREs. It provides shelter for SRE fauna and diverse microhabitats for both habitat specialists and moisture-dependent SRE fauna. This habitat type was sampled at sites SRE5 and SRE9. This habitat is small in size, as well as being vertical and linear in the landscape, hence only two sites were sampled. Breakaway habitat was closely associated with Gorge/Gully habitat, so although only two sites were sampled, some of the Gorge/Gully sites sampled also had breakaway features. One potential SRE species was recorded from this habitat: the pseudoscorpion *Euryolpium* 'sp. indet. (AESHD7)'.

Rocky Hill habitat denoted the high-elevation rock features, mostly associated with the BHT deposit running in an east-west direction, meaning most rocky slopes were south-facing and therefore, conducive to SREs. This habitat type was sampled at site SRE21 and dry pitfall trapping (funnel traps only) sites TS12, TS13 and TS15. Based on its rocky microhabitats it is expected to provide habitat for specialist species that live under rocks and gravel, similar to those found in the Breakaway habitats. The potential and confirmed SRE species that were collected from this habitat include the spiders *Karaops banyjima* and *Aname* sp.; pseudoscorpion 'Genus 7/4 PSE118'; and earth centipede *Mecistocephalus* 'HD1'.

Low Hills and Slopes habitat generally had low vegetation complexity and low diversity of microhabitats available for SRE species. No targeted SRE sampling was undertaken in the Low Hills and Slopes habitat as it was not considered prospective SRE habitat; however, vertebrate trap sites TS5 and TS16 were located within this habitat type. Two potential SRE species was recorded from this habitat: the scorpion *Lychas* 'bituberculatus complex' and the isopod *Buddelundia* '10ma'.

Alluvial Plain habitat exhibited a good diversity of microhabitats, with some tree hollows and logs, and some areas of sandy soils suitable for burrowing, dense leaf litter and large *Triodia* hummocks. No targeted SRE sampling was undertaken in the Alluvial Plain habitat as it was not considered prospective SRE habitat; however, vertebrate trap sites TS2 and TS14 were located within this habitat type. In addition some targeted 'blacklighting' for scorpions occurred during the nocturnal surveying events for the fauna assessment, collecting *Urodacus* 'HD1'. A large number of potential SRE species was recorded from this habitat including: the trapdoor spider *Yilgarnia* 'MYG197'*;* pseudoscorpion *Beierolpium* 'sp. indet. (AESHD2)'; scorpions *Lychas* 'bituberculatus complex' and *Lychas* 'multipunctatus complex'; the millipede *Austrostrophus* 'Clade E'; and isopods Buddelundiinae sp. and Philosciidae sp.

Mulga Woodland habitat was characterised by vegetation communities dominated by Mulga with a stony mantle; however, the SRE sites sampled comprised softer soil, suitable for burrowing species. The deep leaf litter were considered important for SRE species within this habitat and often mygalomorph spider burrows are found here. This habitat type was sampled at sites SRE6, SRE7, SRE12, SRE15, SRE16, SRE23, and trap sites at TS1, TS3 and TS18. The Mulga Woodland in HD2 supported numerous centipede taxa: *Mecistocephalus* 'HD1', *Mecistocephalus* 'HD2', *Mecistocephalus* 'HD3', *Sepedonophilus* 'HD1', *Sepedonophilus* 'HD2', Geophilomorpha sp., *Orphnaeus* 'HD1' and *Cryptops* 'HD1'; and the millipede taxa *Antichiropus* sp., *Antichiropus* 'wonmunna', *Austrostrophus* sp. and *Austrostrophus* 'Clade E'. Other SRE species include isopods *Buddelundia* '77', *Buddelundia* sp. and Buddelundiinae sp.; pseudoscorpions '*PSEAAA* sp. indet. (AESHD4)' and *Sundochernes* sp.; and mygalomorphs: *Synothele* sp., *Synothele* 'MYG309' and *Synothele* 'MYG311'.

Stony Plain habitat was generally exposed and had low microhabitat diversity compared to other landforms. The Stony Plain habitat was sampled at sites SRE11 and SRE22 and trap sites TS4 and TS17. Ten potential SRE species were recorded from this habitat: the isopods *Buddelundia* '10ma' and *Buddelundia* '77'; the millipede *Austrostrophus* 'Clade E'; scorpions *Lychas* 'bituberculatus complex' *Lychas* 'hairy tail complex' and *Lychas* 'multipunctatus complex'; pseudoscorpion *Euryolpium* 'sp. indet. (AESHD6)' and mygalomorph spiders: Nemesiidae sp., *Synothele* sp. and *Aurecocrypta* 'MYG315'.

4.2.4 Invertebrate Fauna Species

The field surveys generated a total of 202 samples (comprising 358 individual specimens) from SRE target taxa. Morphological and DNA-barcoding identified 67 different taxa. One species was an SRE (*Karaops banyjima*), 48 were either likely or potential SREs and 18 were known to be widespread (Table 18 and Table E.10, Appendix E). The locations of these species records from the current survey are shown in Figure H.2 and Table H.2 (Appendix H). WAM lodgement details for representative vouchers to date are provided in Appendix J.

Table 18: Summary of the potential SRE species recorded within the survey area.

Order	Family	Species	Taxonomic resolution	SRE status
Araneae	Selenopidae	*Karaops banyjima*	Species confirmed using morphology (DNA sequencing suggested different species)	SRE
	Selenopidae	*Karaops* sp. 'ARA001' DNA	Species confirmed (restricted/unknown distribution)	Potential SRE: DD
	Actinopodidae	*Missulena rutraspina*	Species confirmed (widespread distribution)	Widespread
	Barychelidae	*Aurecocrypta* 'MYG315' DNA	Species confirmed (restricted/unknown distribution)	Potential SRE: DD
	Barychelidae	*Aurecocrypta* 'sp. indet. (AESHD1)' DNA	No DNA matches available	Potential SRE: DD
	Barychelidae	*Synothele* 'MYG309' DNA	Species confirmed (restricted/unknown distribution)	Potential SRE: DD
	Barychelidae	*Synothele* 'MYG311' DNA	Species confirmed (restricted/unknown distribution)	Potential SRE: DD
	Barychelidae	*Synothele* sp.	Not sequenced	Potential SRE: DD
	Barychelidae	*Synothele* 'xkarara'	Species confirmed (widespread distribution)	Widespread
	Idiopidae	*Gaius tealei*	Species confirmed (widespread distribution)	Widespread
	Nemesiidae	*Aname mellosa*	Species confirmed (widespread distribution)	Widespread
	Nemesiidae	*Aname* 'MYG004'	Species confirmed (widespread distribution)	Widespread
	Nemesiidae	*Aname* sp.	Species unknown (not sequenced)	Potential SRE: DD
	Nemesiidae	*Yilgarnia* 'MYG197'	Species confirmed (restricted/unknown distribution)	Potential SRE: DD
	Nemesiidae	Nemesiidae sp.	DNA sequencing failed	Potential SRE: DD
Pseudoscorpiones	Atemnidae	*Anatemnus* sp.	Species unknown (not sequenced)	Potential SRE: DD
	Atemnidae	*Oratemnus* sp.	Species unknown (not sequenced)	Widespread
	Chernetidae	*Sundochernes* sp.	Species unknown (not sequenced)	Potential SRE: DD
	Chthoniidae	*Tyrannochthonius* 'sp. indet. (AESHD1)' DNA	No DNA matches available	Potential SRE: DD
	Chthoniidae	*Tyrannochthonius* 'sp. indet. (AESHD2)' DNA	No DNA matches available	Potential SRE: DD
	Olpiidae	*Austrohorus* 'sp. indet. (AESHD5)' DNA	No DNA matches available	Potential SRE: DD
	Olpiidae	*Beierolpium* '8/4 small'	Species confirmed (widespread distribution)	Widespread

Order	Family	Species	Taxonomic resolution	SRE status
Pseudoscorpiones	Olpiidae	*Beierolpium* 'sp. indet. (AESHD1)' DNA	No DNA matches available	Potential SRE: DD
	Olpiidae	*Beierolpium* 'sp. indet. (AESHD2)' DNA	No DNA matches available	Potential SRE: DD
	Olpiidae	*Beierolpium* '8/4'DNA	Species confirmed (widespread distribution)	Widespread
	Olpiidae	*Euryolpium* 'sp. indet. (AESHD6)' DNA	No DNA matches available	Potential SRE: DD
	Olpiidae	*Euryolpium* 'sp. indet. (AESHD7)' DNA	No DNA matches available	Potential SRE: DD
	Olpiidae	*Euryolpium* sp.	Species unknown (not sequenced)	Potential SRE: DD
	Olpiidae	'Genus 7/4 PSE118' DNA	Species confirmed (restricted/unknown distribution)	Potential SRE: DD
	Olpiidae	'*PSEAAA* sp. indet. (AESHD4)' DNA	No DNA matches available	Potential SRE: DD
	Olpiidae	*Indolpium* sp.	Species unknown (not sequenced)	Potential SRE: DD
	Olpiidae	Olpiidae sp.	DNA sequencing failed	Potential SRE: DD
Scorpiones	Buthidae	*Isometroides* 'pilbara 1'	Species confirmed (widespread distribution)	Widespread
	Buthidae	*Lychas* 'bituberculatus complex'	Unresolved taxonomic clade (restricted/unknown distribution)	Potential SRE: DD
	Buthidae	*Lychas* 'hairy tail complex'	Unresolved taxonomic clade (restricted/unknown distribution)	Potential SRE: DD
	Buthidae	*Lychas* 'harveyi complex'	Unresolved taxonomic clade (widespread distribution)	Widespread
	Buthidae	*Lychas* 'multipunctatus complex'	Unresolved taxonomic clade (restricted/unknown distribution)	Potential SRE: DD
	Buthidae	*Lychas* 'pilbara 1'	Species confirmed (widespread distribution)	Widespread
	Urodacidae	*Urodacus* 'pilbara 12'	Species confirmed (widespread distribution)	Widespread
	Urodacidae	*Urodacus* 'HD1' DNA	No DNA matches available	Potential SRE: DD
Geophilomorpha	Chilenophilidae	*Sepedonophilus* 'HD1' DNA	No DNA matches available	Potential SRE: DD
	Chilenophilidae	*Sepedonophilus* 'HD2' DNA	No DNA matches available	Potential SRE: DD
	Chilenophilidae	*Sepedonophilus* sp.	DNA sequencing failed	Potential SRE: DD

Order	Family	Species	Taxonomic resolution	SRE status
Geophilomorpha	Geophilomorpha^	Geophilomorpha sp.	DNA sequencing failed	Potential SRE: DD
	Mecistocephalidae	*Mecistocephalus* 'HD1' DNA	No DNA matches available	Potential SRE: DD
	Mecistocephalidae	*Mecistocephalus* 'HD2' DNA	No DNA matches available	Potential SRE: DD
	Mecistocephalidae	*Mecistocephalus* 'HD3' DNA	No DNA matches available	Potential SRE: DD
	Oryidae	*Orphnaeus* 'HD1' DNA	No DNA matches available	Potential SRE: DD
Scolopendromorpha	Cryptopidae	*Cryptops* 'HD1' DNA	No DNA matches available	Potential SRE: DD
Polydesmida	Paradoxosomatidae	*Antichiropus* sp.	Species unknown (not sequenced)	Potential SRE: DD
	Paradoxosomatidae	*Antichiropus* 'wonmunna' DNA	Species confirmed (restricted/unknown distribution)	Potential SRE: DD
Spirobolida	Trigoniulidae	*Austrostrophus* 'Clade A' DNA	Species confirmed (restricted/unknown distribution)	Potential SRE: DD
	Trigoniulidae	*Austrostrophus* 'Clade E' DNA	Species confirmed (restricted/unknown distribution)	Potential SRE: DD
	Trigoniulidae	*Austrostrophus* sp.	Species unknown (not sequenced)	Potential SRE: DD
Eupulmonata	Pupillidae	*Gastrocopta* sp.	Species unknown	Widespread
	Pupillidae	*Pupoides* sp.	Species unknown	Widespread
	Subulinidae	*Eremopeas interioris*	Species confirmed (widespread distribution)	Widespread
	Subulinidae	Subulinidae sp.	Species unknown	Widespread
Isopoda	Armadillidae	*Buddelundia* '10ma'	Species confirmed (restricted/unknown distribution)	Potential SRE: DD
	Armadillidae	*Buddelundia* '15'	Species confirmed (widespread distribution)	Widespread
	Armadillidae	*Buddelundia* '16'	Species confirmed (widespread distribution)	Widespread
	Armadillidae	*Buddelundia* '77'	Species confirmed (restricted/unknown distribution)	Potential SRE: DD
	Armadillidae	*Buddelundia* sp.	Species unknown (not sequenced)	Potential SRE: DD
	Armadillidae	Buddelundiinae sp.	Species unknown (not sequenced)	Potential SRE: DD
	Armadillidae	*Pseudodiploexochus* sp.	Species unknown (not sequenced)	Potential SRE: DD
	Armadillidae	*Troglarmadillo* sp.	Species unknown (not sequenced)	Likely SRE
	Philosciidae	Philosciidae sp.	Species unknown (not sequenced)	Potential SRE: DD

DNA putative species recognised with DNA barcoding

Of these SRE category taxa, 32 were identified to the level of species or morphospecies:

- seven spiders: *Karaops banyjima*, *Karaops* sp. 'ARA001', *Aurecocrypta* 'MYG315', *Aurecocrypta* 'sp. indet. (AESHD1)', *Synothele* 'MYG309', *Synothele* 'MYG311' and *Yilgarnia* 'MYG197'
- nine pseudoscorpions: *Tyrannochthonius* 'sp. indet. (AESHD1)', *Tyrannochthonius* 'sp. indet. (AESHD2)', *Austrohorus* 'sp. indet. (AESHD5)', *Beierolpium* 'sp. indet. (AESHD1)', *Beierolpium* 'sp. indet. (AESHD2)', *Euryolpium* 'sp. indet. (AESHD6)', *Euryolpium* 'sp. indet. (AESHD7)', 'Genus 7/4 PSE118' and '*PSEAAA* sp. indet. (AESHD4)'.
- four scorpions; *Lychas* 'bituberculatus complex', *Lychas* 'hairy tail complex', *Lychas* 'multipunctatus complex' and *Urodacus* 'HD1'
- seven centipedes: *Sepedonophilus* 'HD1', *Sepedonophilus* 'HD2', *Mecistocephalus* 'HD1', *Mecistocephalus* 'HD2', *Mecistocephalus* 'HD3', *Cryptops* 'HD1' and *Orphnaeus* 'HD1'
- three millipedes: *Antichiropus* 'wonmunna', *Austrostrophus* 'Clade A' and *Austrostrophus* 'Clade E'
- two isopods: *Buddelundia* '10ma' and *Buddelundia* '77'.

Seventeen SRE taxa sampled represented ambiguously identified groups:

- three spiders: *Synothele* sp., *Aname* sp. and Nemesiidae sp.
- five pseudoscorpions: *Anatemnus* sp., *Sundochernes* sp., *Euryolpium* sp., *Indolpium* sp. and Olpiidae sp.
- two centipedes: *Sepedonophilus* sp. and Geophilomorpha sp.
- two millipedes: *Antichiropus* sp. and *Austrostrophus* sp.
- five isopods: *Buddelundia* sp., Buddelundiinae sp., *Pseudodiploexochus* sp., *Troglarmadillo* sp. and Philosciidae sp.

5 Discussion

5.1 Vertebrate Fauna

5.1.1 Habitats

Habitats within the survey area were not restricted at the local or sub-regional scale and no uncommon geological units or land systems occurred within the survey area. In a regional context, the Gorge and Breakaway habitats in the Pilbara are restricted to the Chichester and Hamersley Ranges, but they are well represented in these areas. The Gorge/Gully habitat, and Breakaway habitat to a lesser extent, were considered important habitat for fauna, including several MNES species. Deeply incised gorges, characteristic of the Hamersley subregion, generally have high levels of species endemism and diversity, and are considered important refuge sites in a local context (Kendrick 2001). This is due to the microhabitats they provide such as caves and semi-permanent water pools that can exist in these refuge type areas and are important for species foraging and sheltering requirements. Gorge/Gully and Breakaway habitats were considered suitable for MNES species including the Northern Quoll, Ghost Bat and Pilbara Leaf-nosed Bat that have all been recorded within the survey area and the Pilbara Olive Python that is considered highly likely to occur.

The Rocky Hill habitat is widespread and common throughout the Pilbara bioregion and is not restricted to the Chichester and Hamersley Ranges. This habitat generally had low vegetation complexity and low diversity of microhabitats as evidenced by a depauperate bird assemblage; however, MNES species such as the Northern Quoll and Pilbara Leaf-nosed Bat are likely to traverse and forage within these habitats.

The Minor Drainage habitats within the survey area were generally comprised of a reduced diversity and density in vegetation species and communities, particularly when compared to riparian habitats, such as Weeli Wolli Creek and are unlikely to provide significant refuge for species, although they may act as foraging or dispersal habitat for some fauna species. Minor drainage line habitats, although not necessarily large in terms of area, are also common and well-represented habitats within the immediate vicinity of the survey area and the wider Pilbara region.

The Low Hills and Slopes, Alluvial Plain, Mulga Woodland and Stony Plain habitat in the survey area provide fewer microhabitat opportunities for terrestrial fauna and are also more widespread in the immediate vicinity as well as the Hamersley subregion and wider bioregion.

5.1.2 Species

5.1.2.1 General Assemblage

The fauna species assemblage recorded during the survey is considered typical of the Hamersley subregion as well as a subset of typical fauna assemblages across the Pilbara bioregion. There were 174 vertebrate fauna species, comprising two amphibians, 55 reptiles, 84 birds and 33 mammals (including seven introduced species) recorded within the survey area. This equates to 56% of the vertebrate fauna species previously recorded for the local vicinity identified from the desktop assessment (312 vertebrate fauna species). However, not all species detailed through the desktop assessment are expected to be recorded during the survey given some species have specific habitat requirements, are seasonal migrants, are cryptic in behaviour and may not be readily trapped. Additionally, at the time of survey the survey area did not contain any permanent or semi-permanent water bodies that would support a number of wetland bird species and other species closely associated with water.

Species accumulation curves did not reach an asymptote for reptiles but were approaching, if not achieved, asymptote for birds and mammals. When taking into account previous records as well as species recorded from methods other than trapping, a large portion of the predicted assemblage was recorded. The lower number of captures and reduced herpetofauna assemblage recorded during the current survey is likely due to the dry seasonal conditions and moderated trap methods used. However, this is considered a very minor limitation that does not negatively impact on the outcome of the survey, as the herpetofauna assemblage expected to occur in the survey area is common and widespread and is unlikely to include any conservation significant fauna that have not been previously recorded from other fauna assessments conducted in the vicinity.

5.1.2.2 Contextual Analysis

The total recorded species from the current survey (174 species) is comparable or exceeds other systematic trapping surveys, where 97, 169, 74 and 124 vertebrate fauna species were recorded, respectively (Biota Environmental Sciences 2006; Ecologia Environment 2014; Ninox Wildlife Consulting 2009a, 2009b). However, the species composition is likely to be different due to the additional habitats surveyed, such as cracking clay and major drainage habitats (Ecologia Environment 2014) and a permanent pool on Weeli Wolli Creek (Ninox Wildlife Consulting 2009b), as well as the large area (17,565 ha) covered in the Greater West Angelas fauna assessment (Ecologia Environment 2014).

Although the species accumulation curve indicated that not all herpetofauna were recorded during the current survey (likely due to a combination of seasonal conditions and lack of pitfall traps used at some of the trap sites), the herpetofauna assemblage recorded was similar to other areas within the vicinity. The number of reptile and amphibian species recorded (55 species) is higher than most other Level 2 surveys conducted in the vicinity of the survey area, with the exception of 64 species recorded at Greater West Angelas (Ecologia Environment 2014). This is probably due to the larger size of the Greater West Angelas survey area, greater trapping effort and presence of additional fauna habitats (Ecologia Environment 2014).

The number of bird species recorded during the survey (84 species) is higher than other dual season surveys conducted in the area (37 to 80 species), which is unexpected given the lack of riparian habitats within the survey area compared to previous surveys such as the Greater West Angelas fauna assessment (Ecologia Environment 2014). The lower number of bird species recorded by Biota (2006) and Ninox (2009a) can be attributed to a single season survey only, and that a recent fire had affected 80% of the survey area in the Ninox (2009a) survey.

The current survey recorded a comparatively high number of mammal species (33 species) compared to other Level 2 surveys in the vicinity (13 to 25 species) (Biota Environmental Sciences 2006; Ecologia Environment 2014; Ninox Wildlife Consulting 2009a, 2009b). This was mainly due to the high number of bat species recorded; 12 species were recorded in the current survey compared to a maximum of nine species recorded in previous surveys (Ecologia Environment 2014; Ninox Wildlife Consulting 2009b), as well as a high number of introduced species recorded; six species recorded in the current survey compared to a maximum of three species in previous surveys (Biota Environmental Sciences 2006; Ninox Wildlife Consulting 2009a). The higher number of bat and introduced species recorded during the current survey is likely due to the increased use of sampling methods, such as acoustic bat recorders and motion sensitive cameras compared to the earlier surveys (Ninox Wildlife Consulting 2009b, 2009a; Biota Environmental Sciences 2006).

5.1.2.3 Conservation Significant Species

Of the 26 conservation significant species identified in the desktop assessment, seven species were recorded during the current survey and an additional three species were considered to have a 'high' likelihood of occurrence. Four species were deemed to have a 'moderate' likelihood and 12 species to have a 'low' likelihood.

Three of the five recorded conservation listed species are classified under the EPBC Act as MNES species: Northern Quoll, Pilbara Leaf-nosed Bat and Ghost Bat.

Recorded MNES Species

The Gorge and Breakaway habitats within the survey area were considered highly suitable for the recorded MNES species: Northern Quoll, Pilbara Leaf-nosed Bat and Ghost Bat and would be considered habitat critical to the survival of the Northern Quoll and Ghost Bat under the EPBC Act definitions (Department of Environment 2013, Department of the Environment and Energy 2016, Threatened Species Scientific Committee 2016). The breakaways, gorges and gullies contained microhabitats such as caves and semi-permanent water pools; approximately 307 ha (3%) of potential shelter and foraging habitat was recorded in the survey area. With respect to the Northern Quoll, these habitats were divided into 'probable shelter and foraging habitat' (or critical habitat), which comprised 107 ha (1%) of the Gorge/Gully habitat and some Breakaway habitats, particularly within the BHT area; and 'potential shelter and foraging habitat', comprising 200 ha (2%) of the smaller Breakaway habitats, particularly with the HD2 area.

The remaining habitats of the survey area were classified as 'lower' habitat suitability for these species as these habitats contained no significant refuge sites, shelter, or semi-permanent water and were considered less vital for these species' persistence. Differing foraging strategies exist for the conservation significant bat species recorded for the survey area. The Pilbara Leaf-nosed Bat have greater foraging capabilities and are known to traverse more of the landscape and across wide open plains as opposed to Ghost Bats who are known to follow drainage lines and/or ridgelines searching for prey.

The Northern Quoll was recorded 14 times during the current survey, mainly within the Gorge/Gully or Breakaway habitats. The relatively high number of records for this species within the survey area is significant given only one other record was made from previous fauna assessments in the vicinity of the survey area (Biota Environmental Sciences 2011). Also the survey area is at the fringe of this species' distribution, so generally a lower number of records are made within the Hamersley Ranges when compared to more coastal zones. A sub-adult male was captured during the Phase 2 survey, close to the HD1 village. Males, particularly this sub-adult male, may have been expanding their home range in preparation for the oncoming breeding season at the time of survey. However, a large number of motion camera recordings suggest that a resident population may exist in the survey area, particularly within the BHT area. The BHT deposit is a large isolated ridge in the landscape that contains numerous breakaways, gorges and gullies that support micro-niches important for the Northern Quoll.

The three Pilbara Leaf-nosed Bat recordings made in the survey area were from foraging individuals in Gorge/Gully and Breakaway fauna habitats. The recorded calls at low activity levels were made at least three hours after dusk and are not consistent with the presence of a permanent roost cave nearby (Bat Call WA 2019). This corresponds with the records by Ecologia Environment (2014) at Greater West Angelas, approximately 15 km south-west of the survey area, where call times were also not conducive to a nearby roost (Ecologia Environment 2014). This species is likely to forage occasionally within the survey area taking advantage of benign conditions and dispersing

temporarily in search of additional foraging and roosting opportunities (Bat Call WA 2019). Foraging habitat for this species is much broader than for the Ghost Bat and includes water courses, riparian vegetation, hummock grassland and sparse tree and shrub savannah habitats. Therefore the Pilbara Leaf-nosed Bat is likely to be found across the majority of the survey area, with the exception of cleared habitats.

The Ghost Bat was recorded on nine occasions within the survey area through acoustic recordings (calls), scats recorded in nocturnal feed caves and an individual sighted during spotlighting within the HD2 area. Regionally this species has a strong presence in the vicinity of the survey area, identified from previous fauna assessments in the Hope Downs area by Biota Environmental Sciences (2006), and Southern Flank area (Biologic Environmental Survey 2016), as well as 75 records from DBCA's Threatened and Priority Fauna Database (Department of Biodiversity, Conservation, and Attractions 2017b). Two of the seven caves recorded within the survey area (Caves 1 and 5) were deemed to be Category 3 roost caves with occasional occupancy based on their size and depth; however, no ultrasonic detections were recorded. The other five recorded caves were deemed to be Category 4 nocturnal roost caves (opportunistic usage). These Category 4 caves are common in the landscape as numerous observations suggest that the majority of caves and adits in the Pilbara are used in at least an opportunistic manner by itinerant Ghost Bats (Bat Call WA 2019). The caves recorded within the survey area are not considered significant to the long-term presence of the species (Bat Call WA 2019). The records are consistent with the Ghost Bat foraging in low numbers on the HD2 and BHT ridges (Bat Call WA 2019). It is also consistent with the known regional presence of the Ghost Bat across the central Pilbara region as well as locally on the major ridges immediately to the north of the survey area and west of the HD1 mining area (Bat Call WA 2019). It is highly unlikely that additional significant caves (Category 1 or 2) exist within the survey area.

Other Conservation Significant Species

Other conservation significant species recorded from, or likely to occur, within the survey area included the recorded Oriental Plover, *L. macropisthopus remota*, Letter-winged Kite and Western Pebble-mound Mouse; and the likely to occur Pilbara Barking Gecko, *Anilios ganei* and Pilbara Olive Python.

The Oriental Plover was recorded opportunistically during the Phase 3 survey at the HD1 village camp within the WM area. This species is a seasonal migrant and is only present during certain times of the year and is unlikely to be reliant upon the habitats present within the survey area given more suitable habitat is found outside the survey area.

The fossorial skink, *L. macropisthopus remota* was captured within the Mulga Woodland fauna habitat in the survey area. This ground-dwelling skink often favours sandy to loamy sand based substrates which support *Acacia* shrublands (such as Mulga) and woodlands where it inhabits loose soil under leaf litter usually at the base of shrubs. Threats to this species are not well known, it is listed as contribution significant due to its very restricted distribution range and its basic ecology is seen as poorly known.

One individual Letter-winged Kite was recorded during Phase 2 within Minor Drainage habitat of the survey area. This species is sparsely distributed and rarely encountered across its range and is unlikely to be reliant upon the habitats present within the survey area.

The Western Pebble-mound Mouse was recorded by five pebble mounds within the Stony Plain and Rocky Hill habitat of the survey area. An additional one pebble mound, as well as three individual captures, were also recorded just outside the survey area, indicating they are common within the local area. The Low Hill and Slopes, Stony Plain and Rocky Hill habitats of the survey area are likely to

support this species. These habitats are widespread and common within the vicinity of the survey area and the wider Pilbara region.

The small ground dwelling reptiles, *A. ganei* and Pilbara Barking Gecko, are difficult to detect due to their cryptic behaviours. The trap sites (particularly sites TS12, TS13 and TS15 within Rocky Hill habitat) did not capture these species during the current survey. Suitable Rocky Hill fauna habitat was found mainly within the BHT and WM areas and these areas generally had been heavily impacted from clearing due to exploration drilling operations and recent fire, possibly reducing their potential occurrence.

The Pilbara Olive Python has been previously recorded in the vicinity of the survey area and suitable foraging and denning habitats occur within the Gorge/Gully, Breakaway and Minor Drainage habitats, particularly in the locations that have the potential to support semi-permanent and permanent water, although no surface water was recorded during the survey.

5.2 SRE Invertebrates

5.2.1 Habitats

In general, the survey area appears to have great potential to support SRE species owing to the abundance of ideal habitats. These include the 'typical' SRE target habitats: south facing gorges, rocky slopes and breakaways. Prospective SRE habitats were mapped as Gorge/Gully, Breakaway, Rocky Hills and Minor Drainage habitats in the survey area. These habitats, particularly those associated with the BHT area, were considered as having a high likelihood of supporting SREs. BHT occupies a large portion of an isolated, east-west running ridge and appears to support numerous south facing rocky slopes and breakaways, as well as gullies and gorges. It therefore seems to have all the requirements for supporting relictual SREs species. These habitats supported Philosciidae sp, *Troglarmadillo* sp. and *Pseudodiploexochus* sp. which, while being ambiguously defined, represent likely SREs. The latter two taxa represent forms that are very rarely sampled from epigean habitats in the Pilbara and are not arid adapted. The presence of arid sensitive taxa in these habitats indicates that SRE habitats are present. Additional SRE species are likely to occur in these habitats.

The pseudoscorpion *Anatemnus* sp. has all of the features of a troglobite (blind and pale) and the only other Pilbara record of this genus is troglobitic. One specimen was sampled from a Minor Drainage Line habitat. There is a small chance that this species is troglobitic and in the Pilbara, troglobitic *Nocticola* have been sampled from creek gravels (Dr. E. Volschenk pers. obs.) indicating that this is potential habitat for troglobitic taxa.

In addition the Mulga Woodland contained deep leaf litter supporting SRE species and specifically the Mulga Woodland in HD2 was species rich, where eight of the nine centipede taxa and four of the five millipede taxa were recorded.

Several Short Range Endemic category invertebrates were found in multiple habitat types, suggesting that they may be less specialised with respect to their habitat preferences:

- *Lychas* 'bituberculatus complex', from Stony Plain, Alluvial Plain and Low Hills
- *Sepedenophilus* 'HD1', from Gorge/Gully and Mulga Woodland
- *Mecistocephalus* 'HD1', from Rocky Hills, Gorge/Gully and Mulga Woodland
- *Austrostrophus* 'Clade E', from Stony Plain, Alluvial Plain and Mulga Woodland

- *Antichiropus* 'wonmunna', from Mulga Woodland in the survey area, but from gully slopes and riparian vegetation outside of the survey area.

These species are likely to be found outside of the survey area.

5.2.2 Invertebrate Fauna Species

The database search results revealed a very species rich SRE category invertebrate taxa and most of these taxa were present within the Hamersley Range - the SRE and potential SRE groups were represented by 282 taxa of which eight (3%) were named species, 182 (64%) were morphospecies and 92 (33%) were undetermined taxa. The high degree of morphospecies most likely reflects the poor level of taxonomic knowledge about SREs in this part of the Pilbara. This position is reflected by the high degree of DD potential SRE taxa. Fifteen SRE taxa detailed from the database search were previously recorded within the survey area. Six of these taxa have been assigned to a species or morphospecies.

The field surveys generated a total of 202 samples from SRE target groups comprising 358 individuals. Following morphological identification and DNA-barcoding, the samples were found to comprise 67 different taxa; 18 of which were known to be widespread, one species was a known SRE (*Karaops banyjima*) and 48 were either likely or potential SREs. Of the 32 SREs or potential SREs recorded within the survey area that were identified to the level of species or morphospecies, 11 of these have previously been recorded within the 10,000 km^2 search area but outside the survey area.

Spiders

The search area contained 111 SRE category spider taxa, of which four were named species, 83 were morphospecies and 24 were unidentified taxa. Four of these taxa are SREs and the remainder are potential SRE (DD). Four potential SRE (DD) spider taxa were previously recorded from within the survey area:

- *Synothele* sp.: T116849, T116852
- *Idiosoma* sp.: T116854, T116851
- *Aname* sp.: T116850
- *Kwonkan* 'MYG339': T116853.

Additional species were also revealed to the north and south of the search area, suggesting that a greater diversity of trapdoor spiders might be expected than the survey yielded. It is likely that survey conditions or methods were not optimal for sampling the broader diversity of trapdoor spiders in the area. No harvestmen were recorded during the field survey and no previous records were within the survey area. The absence of Opiliones was difficult to interpret as conditions leading up to both surveys was quite dry and if they are present, the rain experienced during the Phase 3 survey may not have been sufficient to bring them out. If present, they are likely to be in the Gorge/Gully habitat of the BHT and WM areas.

Fifteen spider taxa were collected during these surveys, representing the families Selenopidae, Actinopodidae, Barychelidae, Idiopidae and Nemesiidae. Five of these represented widespread taxa, nine species were potential SRE owing to data deficiency (*Aname* sp., *Synothele* sp., *Yilgarnia* 'MYG197', *Karaops* sp. 'ARA001', Nemesiidae sp., *Aurecocrypta* 'sp. indet. (AESHD1)', *Aurecocrypta* 'MYG315', *Synothele* 'MYG309' and *Synothele* 'MYG311') and one species was a known SRE (*Karaops banyjima*). The assessment identity of *Karaops banyjima, Karaops* sp. 'ARA001', *Aurecocrypta*

'MYG315', *Synothele* 'MYG309' and *Synothele* 'MYG311' were verified using DNA-barcoding methods.

The SRE species *Karaops banyjima* was recorded from three unique localities within the survey area. Two of these localities were represented by Gorge/Gully habitat, and one by the Rocky Hill habitat. The WAM identified the *Karaops banyjima* (AES190099) specimen as *Karaops nyangumarta* as it was highly supported as conspecific with WAMT134063 (and others), sharing 98.88% genetic pairwise similarity (Wilson, Huey, and Harvey 2019). However, this species possesses very different morphological features to *Karaops banyjima*. Further consultation with Dr Sarah Crews, who described both species (Crews 2013), found that the morphological data strongly indicate that the specimen should be *Karaops banyjima*. Hence, the specimen remains as *Karaops banyjima*. This species is an SRE and the type locality is approximately 20 km north of the survey area.

Aurecocrypta 'MYG315' was identified from a single juvenile specimen. *Aurecocrypta* 'MYG315' was recorded from the search area and is a potential SRE owing to data deficiency regarding its distribution limits. The species appears to have a relatively wide distribution, within the constraints of an SRE, with records occurring approximately 5 km to the south of the survey area.

Synothele 'MYG309' and *Synothele* 'MYG311' were confirmed with DNA barcoding and are considered potential SRE: DD. These species were well represented within the search area but outside the survey area. The distribution of these species suggest they are restricted to the Eastern Hamersley range, but that their distributions extend outside of the survey area.

Pseudoscorpions

The search area contained 52 SRE category pseudoscorpion taxa, of which three are named species, 31 were morphospecies and 18 were unidentified taxa. Two species are SREs and the remaining taxa are potential SRE (DD). The field survey sampled 16 pseudoscorpion taxa from four families: Atemidae, Chernetidae, Chthoniidae and Olpiidae. Fourteen of the 16 pseudoscorpion taxa were classified as potential SRE including *Anatemnus* sp., *Austrohorus* 'sp. indet. (AESHD5)', *Beierolpium* 'sp. indet. (AESHD1)', *Beierolpium* 'sp. indet. (AESHD2)', *Euryolpium* 'sp. indet. (AESHD6)', *Euryolpium* 'sp. indet. (AESHD7)', *Euryolpium* sp., 'Genus 7/4 PSE118', '*PSEAAA* sp. indet. (AESHD4)', *Indolpium* sp., Olpiidae sp., *Sundochernes* sp., *Tyrannochthonius* 'sp. indet. (AESHD1)' and *Tyrannochthonius* 'sp. indet. (AESHD2)'.

In the Pilbara, epigean Olpiidae constitute species of *Austrohorus*, *Beierolpium*, *Euryolpium*, *Indolpium*, *Xenolpium,* Genus *PSEAAA* and 'Genus 7/4'. The constituent species of these genera have been problematic to assess using morphology alone. In the current survey, representatives of unresolved (using morphology) putative olpiid taxa from each sample sites were assessed using DNA-barcoding:

- *Austrohorus* 'sp. indet. (AESHD5)' was a distinct species, but its generic placement was ambiguous with an unresolved polytomy of *Austrohorus*, 'Genus 7/4' and *Nanolpium*
- two putative species of *Beierolpium* were recognised using DNA-barcoding: *Beierolpium* 'sp. indet. (AESHD1)' and *Beierolpium* 'sp. indet. (AESHD2)'
- two putative species of *Euryolpium* were recognised using DNA-barcoding: *Euryolpium* 'sp. indet. (AESHD6)' and *Euryolpium* 'sp. indet. (AESHD7)'
- all four specimens of 'Genus 7/4 PSE118' were confirmed with DNA barcoding
- '*PSEAAA* sp. indet. (AESHD4)' was identified by WAM using DNA barcoding.

Two samples were identified to *Euryolpium* sp., but the relationship of these with the two genetic species is not known. With the discovery *Euryolpium* 'sp. indet. (AESHD6)' and *Euryolpium* 'sp. indet. (AESHD7)', both potential SREs, unresolved *Euryolpium* sp. can no longer be regarded as widespread and are here considered to be potential SRE owing to taxonomic data deficiency. Attempts to obtain DNA sequences from this specimen of Olipiidae sp. were unsuccessful.

Four specimens belonging to 'Genus 7/4 PSE118' were confirmed with DNA barcoding. This species is currently regarded as a potential SRE owing to limited knowledge about its distribution. Area search records included a single representative of this species approximately 20 km north of the survey area.

The current survey obtained two samples of *Tyrannochthonius* which were identified as belonging to two different species using DNA barcoding: *Tyrannochthonius* 'sp. indet. (AESHD1)' and *Tyrannochthonius* 'sp. indet. (AESHD2)'. Both species represent potential SREs owing to data deficiency regarding their distribution limits. They either represent new discovered taxa or not-yet-sequenced taxa (Wilson, Huey, and Harvey 2019).

Of note, one specimen from the Atemidae family included a single adult female *Anatemnus* sp. This species was obtained from site SRE10, within a Gorge/Gully fauna habitat type. This species is very unusual by being eyeless and having relatively pale body colour colouration. These features closely resemble those seen in the troglobitic *Anatemnus subvastus*, the only described species in this genus from the Pilbara (Alexander, Burger, and Harvey 2014). The placement of this species into *Anatemnus* is also tentative owing to the uncertain relationship between this genus and several other genera in Atemnidae (Alexander, Burger, and Harvey 2014). This sample represents the first epigean representative of *Anatemnus* from the Pilbara. This species is a potential SRE owing to data deficiency regarding its taxonomy or distribution.

Scorpions

The search contained 25 scorpion taxa, of which none were named, 21 were morphospecies and four were unidentified taxa. One species is an SRE and the remaining 24 taxa are potential SRE (DD).

The field survey yielded eight species of scorpions from the families Buthidae and Urodacidae. Four potential SRE scorpions were collected from the survey area: *Lychas* 'bituberculatus complex', *Lychas* 'hairy tail complex', *Lychas* 'multipunctatus complex' and *Urodacus* 'HD1'. Representatives of *Lychas* are frequently collected in surveys and current investigations on the genus *Lychas* indicate the presence of several species' complexes, some of which appear to contain SREs. *Lychas* 'hairy tail complex' and *Lychas* 'bituberculatus complex' specimens have previously been recorded within approximately 1 km and 3 km of the survey area, respectively. The *Urodacus* specimen collected was a juvenile from site SRE13 and adult males are usually required for morphological identification. Preliminary barcoding analyses could not match this species to any within Alacran's sequence database (Alacran Environmental Science 2019). WAM sequencing found the specimen was supported as a conspecific with WAMT91922 (and others), sharing 93.49% genetic pairwise similarity, which did not allow a conclusion about whether they are conspecific or not (Wilson, Huey, and Harvey 2019). The closely related specimens are also unidentified at present (Wilson, Huey, and Harvey 2019).

Centipedes and Millipedes

The search area contained 13 centipede taxa, of which none were named species, two were morphospecies and 11 were unidentified taxa. All were considered potential SRE (DD). None of the search area records fell within the survey area; however, a large cluster of records of

Mecistocephalidae sp. and *Sepedenophilus* sp. records were recorded from the area immediately south of the survey area.

The field surveys yielded nine centipede taxa representing five families Cryptopidae, Chilenophilidae, Mecistocephalidae, Geophilomorpha and Oryidae. All taxon within the Geophilomorpha and Cryptopidae families are very poorly known in Western Australia. While keys to genera and families are available, there is no working morphological taxonomy for Australian species and all species assessments are currently based on comparisons using DNA sequences. DNA sequencing identified seven of these species, whilst sequencing failed for the other two taxa: *Sepedenophilus* sp. and Geophilomorpha sp. Two of the centipede taxa *Sepedenophilus* 'HD1' and *Mecistocephalus* 'HD1' were sampled from four and three separate locations each. These were represented by Rocky Hills, Gorge/Gully and Mulga Woodland, suggesting that these species may not be restricted to one habitat type.

The search area contained 30 millipede taxa, of which one was a named species, 20 were morphospecies and nine were unidentified taxa. Seventeen of these species were SREs and 13 species were potential SRE (DD). The field survey yielded numerous millipede samples belonging to the families Trigoniulidae and Paradoxosomatidae. The five species of millipede collected during the survey were classified as potential SRE (DD). *Antichiropus* 'wonmunna' was recorded from three separate localities in Mulga Woodland within the HD2 area. This species is also known from five records all within 10 km of the SRE sites SRE15 and SRE23 (Alacran Environmental Science 2019). *Antichiropus* sp. collected from two sites are likely to represent *Antichiropus* 'wonmunna'; however, there is also a chance that one or more may represent different species since multiple species of Paradoxosomatidae have been collected from the same locality (Alacran Environmental Science 2019).

Species delimitation using DNA barcoding indicated the presence of two putative species: *Austrostrophus '*Clade A' and *Austrostrophus* 'Clade E', as the specimens provided were highly supported as conspecific with WAMT122166 (and others) and WAMT100768 (and others), respectively (Wilson, Huey, and Harvey 2019). *Austrostrophus* sp. represents specimens that were not sequenced and were found at sites SRE13, SRE15, SRE16, SRE17, SRE18 and SRE19. In the absence of clear unambiguous identification, this taxon is regarded as a potential SRE owing to data limitation regarding species identity.

Isopods

The search area contained 34 isopod taxa, of which none were named species, 25 were morphospecies and nine were unidentified taxa; all are considered to be potential SRE (DD). The field survey collected seven potential SRE isopod species: *Buddelundia* '10ma', *Buddelundia* '77', *Buddelundia* sp., Buddelundiinae sp., *Pseudodiploexochus* sp., *Troglarmadillo* sp. and *Philosciidae* sp. Buddelundiinae sp. belongs to an undescribed genus closely related to *Buddelundia*. This genus is mostly found in the Pilbara region and lacks the morphological characters used to determine *Buddelundia*. Morphospecies are difficult to define in this group and there is a general lack of sequences with which to make comparisons. The *Buddelundia* '10' species group contains several species, including *Buddelundia* '10ma' recorded in this survey. This taxon has been previously collected from the Marillana and West Angelas areas and is regarded as a potential SRE (DD).

The *Pseudodiploexochus* sp. is only the second record of this genus from the Pilbara. The only other record of this genus in the Pilbara is from the West Angelas area, approximately 25 km south-west of this current record. This previous specimen is part of Simon Judd's isopod collections and is therefore not present in the WAM data records. Members of this genus do not have the well-developed lungs present in most terrestrial Armadillidae. For this reason, they are far more

susceptible to desiccation and are nearly always considered to be SRE in arid or semi-arid environments. *Pseudodiploexochus* sp. is therefore likely to represent an SRE but in the absence of additional taxonomic or distributional data, it is a potential SRE.

The *Troglarmadillo* sp. specimen could not be unambiguously identified; however, it showed closest affinity to *Troglarmadillo*, a genus almost entirely represented by troglobites in the Pilbara. Despite the genus name, the species sampled possesses well developed eyes and has faint body patterning, suggesting that it is not a troglobite. Subterranean *Troglarmadillo* species are nearly always SRE and it is likely that this species will be as well. In the absence of more resolved taxonomic and distributional data, this species is a potential SRE. While there are a number of sources for sequences for Pilbara *Troglarmadillo* species, all of them are from troglobites; therefore, sequencing this specimen is unlikely to provide useful results until more specimens are obtained.

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Appendix A: Background Information Figures

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700000 710000 720000

7460000

7450000

Survey Area

WA Geology

QUATERNARY

Qa

Qrc

CENOZOIC

Czk

Czl

PALEOPROTEROZOIC

Lchk

Lchw

ARCHEAN

Alhw

Ashm

Adf

Awfj

Achm

Qrc Awfj Czk Achm Awfj Qrc Awfj Qrc Ashm Czl Qrc Czl Ashm Qa Lchk Lchw Ashm Lchk Alhw Alhw Ashm Qrc Achm Achm Lchw Qrc Achm Lchk Ashm Qa Qrc Achm Achm Awfj Adf Achm Awfj Awfj Awfj Achm Awfj Czl

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Hope Downs 2 Proposal Fauna Survey

Figure A.1: Geological units of the survey area.

Coordinate System: GDA 1994 MGA Zone 50

0 1 2 3 4 5 Kilometres

N

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700000 710000 720000

7460000

7450000

Survey Area

Land System

- Boolgeeda System
- Calcrete System
- Egerton System
- McKay System
- Newman System
- Oakover System
- Pindering System
- Platform System
- River System
- Rocklea System
- Wannamunna System

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Hope Downs 2 Proposal Fauna Survey

Figure A.2: Land systems of the survey area

Coordinate System: GDA 1994 MGA Zone 50

0 1 2 3 4 5 Kilometres

N

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700000 710000 720000

7460000

7450000

Survey Area

System Association

HAMERSLEY_18

HAMERSLEY_29

HAMERSLEY_82

HAMMERSLEY_18

HAMMERSLEY_82

HAMMERSLEY_18

HAMMERSLEY_82

HAMMERSLEY_82

HAMMERSLEY_18

HAMMERSLEY_82

HAMMERSLEY_29

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Hope Downs 2 Proposal Fauna Survey

Figure A.3: Pre-European vegetation of the survey area

Coordinate System: GDA 1994 MGA Zone 50

0 1 2 3 4 5 Kilometres

N

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Author: J. Johnston | Drawn: C. Dyde | Date: 31-01-2020 | Figure Ref: 14292B-19-BIDR-3Rev2_200131_FigA3_PreEuroVeg

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Appendix B: Conservation Fauna Categories, Habitat Condition Scales and Likelihood Criteria

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Table B.1: Categories of Threatened Ecological Communities (Department of Environment and Conservation 2013).

PD: Presumed Destroyed
An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant **and either** of the following applies (A or B): A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats **or** B) All occurrences recorded within the last 50 years have since been destroyed.
CR : Critically Endangered
An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. An ecological community will be listed as **Critically Endangered** when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting **any one or more of** the following criteria (A, B or C): A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% **and either or both** of the following apply (i or ii): i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years); ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated. B) Current distribution is limited, **and one or more** of the following apply (i, ii or iii): i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years); ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes; iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

En: Endangered

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.

An ecological community will be listed as **Endangered** when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting **any one or more** of the following criteria (A, B, or C):

A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement **and either or both** of the following apply (i or ii):

i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years);

ii) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.

B) Current distribution is limited, **and one or more** of the following apply (i, ii or iii):

i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years);

ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes;

iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.

C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

VU: Vulnerable

An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

An ecological community will be listed as **Vulnerable** when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting **any one or more of** the following criteria (A, B or C):

A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.

B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.

C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

Reference: Department of Environment and Conservation 2013, Definitions, Categories and Criteria for Threatened and Priority Ecological Communities DEC (Parks and Wildlife), <https://www.dpaw.wa.gov.au/images/plants-animals/threatened-species/definitions_categories_and_criteria_for_threatened_and_priority_ecological_communities.pdf.>

Table B.2: Definitions and criteria for Threatened Ecological Communities (Department of Environment and Conservation 2013).

Three categories exist for listing Threatened Ecological Communities under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). An ecological community may be categorised as:

Categories of ecological communities	
Critically endangered	If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future.
Vulnerable	If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future.

Reference: Department of Environment and Conservation 2013, Definitions, Categories and Criteria for Threatened and Priority Ecological Communities DEC (Parks and Wildlife), <https://www.dpaw.wa.gov.au/images/plants-animals/threatened-species/definitions_categories_and_criteria_for_threatened_and_priority_ecological_communities.pdf.>

Table B.3: Definitions and criteria for Priority Ecological Communities (Department of Environment and Conservation 2013).

Possible Threatened Ecological Communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community Lists under Priorities 1, 2 and 3. Ecological communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

P1: Priority One – Poorly-known ecological communities
Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
P2: Priority Two – Poorly-known ecological communities
Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
P3: Priority Three – Poorly-known ecological communities
(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) communities known from a few widespread occurrences, which are either large or with significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) communities made up of large, and/or widespread occurrences, that may or may not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
P4: Priority Four
Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. (i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. (ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.
P5: Priority Five – Conservation dependent ecological communities
Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Reference: Department of Environment and Conservation 2013, Definitions, Categories and Criteria for Threatened and Priority Ecological Communities DEC (Parks and Wildlife), <https://www.dpaw.wa.gov.au/images/plants-animals/threatened-species/definitions_categories_and_criteria_for_threatened_and_priority_ecological_communities.pdf.>

Table B.4: Conservation codes for Western Australian fauna (Department of Parks and Wildlife 2019).

Code	Conservation category	Definition
CR	Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Biodiversity Conservation Act 2016*.	Fauna that is rare or likely to become extinct, as critically endangered fauna.
EN	Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Biodiversity Conservation Act 2016*.	Fauna that is rare or likely to become extinct, as endangered fauna.
VU	Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Biodiversity Conservation Act 2016*.	Fauna that is rare or likely to become extinct, as vulnerable fauna.
EX	Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Biodiversity Conservation Act 2016*.	Fauna that is presumed to be extinct.
IA	Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Biodiversity Conservation Act 2016*.	Birds that are subject to international agreements relating to the protection of migratory birds.
CD	Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Biodiversity Conservation Act 2016*.	Fauna that are of special conservation need being species dependent on ongoing conservation intervention.
OS	Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice under the *Biodiversity Conservation Act 2016*.	Declared to be fauna that is in need of special protection, otherwise than for the reasons mentioned.

Reference: Department of Parks and Wildlife 2019, *Conservation Codes For Western Australian flora and fauna*, The Government of Western Australia.

Table B.5: Priority species under Western Australian *Biodiversity Conservation Act 2016* (Department of Parks and Wildlife 2019).

Taxa that have not yet been adequately surveyed to be listed under Schedule 1 or 2 are added to the Priority Flora and Priority Fauna Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna. Taxa that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These taxa require regular monitoring. Conservation Dependent species are placed in Priority 5.

P1: Priority One – Poorly known taxa
Taxa that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.
P2: Priority Two – Poorly known taxa
Taxa that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.
P3: Priority Three – Poorly known taxa
Taxa that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Taxa may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them.
P4: Priority Four: Rare, near threatened and other taxa in need of monitoring
(a) Rare. Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands. (b) Near Threatened. Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (c) Taxa that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.
P5: Priority Five: Conservation dependent taxa
Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the taxa becoming threatened within five years.

Reference: Department of Parks and Wildlife 2019, *Conservation Codes For Western Australian flora and fauna*, The Government of Western Australia.

Table B.6: Categories and definitions for EPBC Act listed fauna species.

Conservation category	Definition
Extinct	Taxa with no reasonable doubt that the last member of the species has died.
Extinct in the wild	Taxa known to survive only in cultivation, in captivity or as a naturalized population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriated seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically endangered (CR)	Taxa facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered (EN)	Taxa are not critically endangered; and are facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (VU)	Taxa are not critically endangered or endangered; and are facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.
Conservation dependent (CD)	Taxa are the focus of a specific conservation program the cessation of which would result in the species becoming vulnerable, endangered or critically endangered; or the following subparagraphs are satisfied: i) the taxa is a species of fish; ii) the taxa is the focus of a management plan that provides management actions necessary to stop the decline of, and support the recovery of, the taxa so that its chances of long term survival in nature are maximized; iii) the management plan is in force under a law of the Commonwealth or of a State or Territory; iv) Cessation of the management plan would adversely affect the conservation status of the taxa Fish includes all taxa of bony fish, sharks, rays, crustaceans, molluscs and other marine organisms, but does not include marine mammals/reptiles.
Migratory (IA)	Taxa are considered migratory species on International Agreements; i) if they are native to Australia and are included in the appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II); ii) all migratory species included in annexes established under the Japan-Australia Migratory Bird Agreement (JAMBA) and the China-Australia Migratory Bird Agreement (CAMBA); and iii) Are native, migratory species identified in a list established under, or an instrument made under, an international agreement approved by the Minister, such as the Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

Note: CD and IA are only related to conservation significant fauna

Table B.7: Criteria used to define likelihood occurrence of conservation significant fauna species.

Likelihood of occurrence	Pre-survey	Post-survey
Recorded	N/A	Species or evidence of species recorded during survey.
High	Species has been recorded within the survey area or within 20 km of the survey area and preferred habitat appears to be present.	Core or preferred habitats present in the survey area which are abundant and/or high quality condition. OR Species is known to be cryptic and may not have been detected despite adequate survey effort and suitable habitat present within the survey area. OR Species or evidence of species recorded within the survey area however doubt remains over the taxonomic identification, validity of record.
Moderate	Species has not been recorded from within the survey area, however species has been recorded within the prescribed database search area and suitable habitat appears to be present.	Core or highly suitable habitats present in the survey area, however non-cryptic species that was not detected despite adequate survey effort. OR Core or preferred habitats present in the survey area are mainly in poor or modified condition.
Low	Species recorded from within the prescribed database search area but suitable habitat does not appear to be present.	Species has not been recorded in the survey area despite adequate survey effort. OR Species dependent on specific habitats that do not occur in the survey area. OR Species considered locally extinct.

Table B.8: Criteria used to determine SRE status of invertebrates.

Status	Criteria
Confirmed	This species has a high probability of being an SRE based on expert opinion, reference databases or the scientific literature. Usually, this species belongs to a group that is well known taxonomically and contains a high proportion of SRE species. Example: Millipedes belonging to the genus *Boreohesperus* (Car and Harvey 2013).
Potential	This species has a moderate probability of being an SRE because it belongs to a group with a high proportion of SRE species, has specific biological and/or ecological attributes that may indicate range restriction, or has been collected from a single microhabitat type. Usually, this species will belong to a group with a poorly or moderately resolved taxonomy. Example: Many trapdoor spiders in the infraorder Mygalomorphae (Castalanelli *et al.* 2014). The WAM recognises the uncertainty involved with this category and lists five sub-categories that may help elucidating this status: i) data deficient because there is insufficient information; ii) habitat indicators that are associated with potential SRE status; iii) morphological indicators; iv) molecular evidence; and v) research and expert knowledge held within the WAM (WAMTS staff 2013). These sub-categories are implicitly addressed as part of the species assessments.

Reference: Car, CA & Harvey, MS 2013, 'A review of the Western Australian keeled millipede genus *Boreohesperus* (Diplopoda, Polydesmida, Paradoxosomatidae)', *ZooKeys*, vol. 290, pp. 1-19.

Castalanelli, MA, Teale, RJ, Rix, MG, Kennington, WJ & Harvey, MS 2013, 'Barcoding of mygalomorph spiders (Araneae: Mygalomorphae) in the Pilbara bioregion of Western Australia reveals a highly diverse biota', *Invertebrate Systematics*, vol. 28, pp. 375-85.

Table B.9: Fauna habitat condition scale (Thompson and Thompson 2010).

Habitat condition	Condition description
High Quality Fauna Habitat (1.0)	These areas closely approximate the vegetation mix and quality that would have been in the area prior to any human induced disturbance. The habitat has connectivity with other habitats and is likely to support the most natural vertebrate fauna assemblage.
Very Good Fauna Habitat (0.8)	These areas show minimal signs of human induced disturbance (e.g. grazing, clearing, fragmentation, weeds) and retain almost all of the characteristics of the habitat had it not been disturbed. The habitat has connectivity with other habitats, and fauna assemblages in these areas are likely to be minimally effected by disturbance.
Good Fauna Habitat (0.6)	These areas show signs of human induced disturbance (e.g. grazing, clearing, fragmentation, weeds) but generally retain many of the characteristics of the habitat had it not been disturbed. The habitat still retains some connectivity with other habitats but fauna assemblages in these areas are likely to be affected by disturbance. Fauna assemblages in these areas are likely to be similar to what might be expected in this habitat.
Disturbed Fauna Habitat (0.4)	These areas show signs of human induced significant disturbance (e.g. mining, clearing, tracks and roads). Many of the trees, shrubs and undergrowth have died or have been cleared. These areas may be in the early succession and regeneration stages. Areas may show signs of significant grazing, contain an abundance of weeds or have been damaged by vehicles or machinery. Habitats are fragmented or have limited connectivity with other fauna habitats. Fauna assemblages in these areas are likely to differ significantly from what might be expected in the area had the disturbance not occurred.
Highly Degraded Fauna Habitat (<0.2)	These areas often have a significant human induced loss of vegetation, and / or a large number of vehicle tracks and / or have been completely cleared, and / or areas have been heavily grazed or farmed. There is limited or no fauna habitat connectivity. Fauna assemblages in these areas are likely to differ significantly from what existed prior to the disturbance, and are often depleted compared to what existed prior to the disturbance.

Reference: Thompson, SA & Thompson, GG 2010, *Terrestrial Vertebrate Fauna Assessments for Ecological Impact Assessment*, Terrestrial Ecosystems, Mt Claremont.

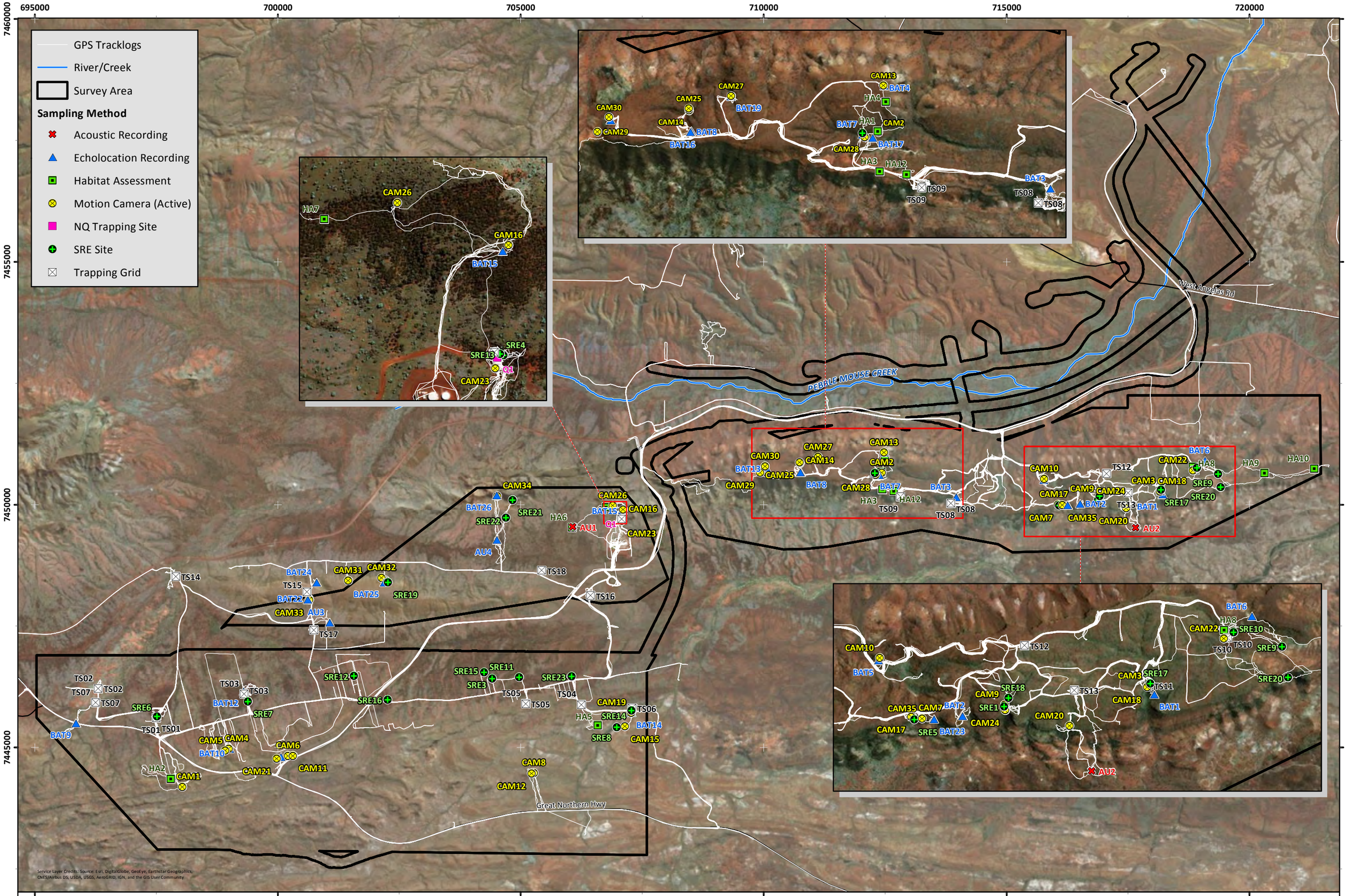
Table B.10: Suitability/significance of habitat ranking criteria for the target Matters of National Environmental Significance (MNES) species.

Species	Probable shelter and foraging habitat	Potential shelter and foraging habitat	Suitable foraging and dispersal habitat	Limited foraging and dispersal habitat
Pilbara Olive Python (*Liasis olivaceus barroni*)	N/A	Rocky habitat such as gorges, escarpments and breakaways along with drainage lines including or in close proximity to permanent or semi-permanent water holes.	Drainage lines with dense vegetation enabling transitory behaviours and/or providing foraging potential. Rocky habitats that are not in close proximity to water.	Habitat that has limited sheltering and foraging capacity with no permanent or semi-permanent water.
Northern Quoll *(Dasyurus hallucatus)*	Habitat as described in potential shelter and foraging habitat but is considered core habitat critical to the Northern Quoll. This was determined by proximity to known records and microhabitat features, such as south-facing, extent of habitat and whether it was in close association with a gorge or gully.	Rocky habitats such as ranges, escarpments, mesas, ranges, gorges, breakaways and boulder fields. Also major drainage lines or tree-lined drainage systems that are structurally diverse and contain large diameter trees, termite mounds or hollow logs.	Habitat important for foraging, dispersal and buffering of the species including moderate to small sized drainage lines and native vegetation in close proximity (within 2 km) denning or shelter habitat.	Habitat that has limited sheltering and foraging capacity and not connected to potential denning/shelter and foraging habitat.
Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) and Ghost Bat (*Macroderma gigas*)	N/A	Rocky habitat that contains caves suitable as diurnal or maternity roosts sites, or potentially contains these caves and has not adequately surveyed OR Areas highly suitable for foraging that are likely to be used on a regular basis.	Habitat important for foraging including diverse rocky terrain, moderately sized drainage lines and dense complex vegetation stands.	Habitat that has limited ecological value but may provide capacity for transitory movement across the landscape and/or limited foraging potential.

Species	Probable shelter and foraging habitat	Potential shelter and foraging habitat	Suitable foraging and dispersal habitat	Limited foraging and dispersal habitat
Night Parrot (*Pezoporus occidentalis*)	N/A	Isolated habitat not subjected to predation pressure, fire pressure, and altered habitat from pastoralism and mining activities. Generally roosting habitat that contains old and large spinifex clumps (>50 years unburnt), particularly ring-forming hummocks. OR Areas highly suitable for foraging in close association (<10 km) to potential roosting habitat, including *Triodia* (particularly at times of mass flowering and seeding) and chenopod communities dominated by *Sclerolaena*.	Very little is known on the foraging requirements of the Night Parrot. Habitat within 40 km of potential roosting and nesting sites, potentially important for foraging, including chenopod communities (particularly those dominated by *Sclerolaena*), *Triodia* and areas rich in herbs, including forbs, grasses and grass-like plants.	Habitat that has limited roosting and foraging potential for the Night Parrot.

Appendix C: Survey Sampling Locations

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Rio Tinto

Hope Downs 2 Proposal Fauna Survey

Figure C.1: Fauna Sampling Locations within the Survey Area

Coordinate System: GDA 1994 MGA Zone 50

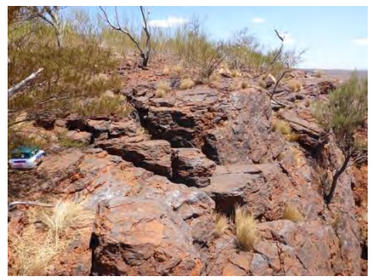
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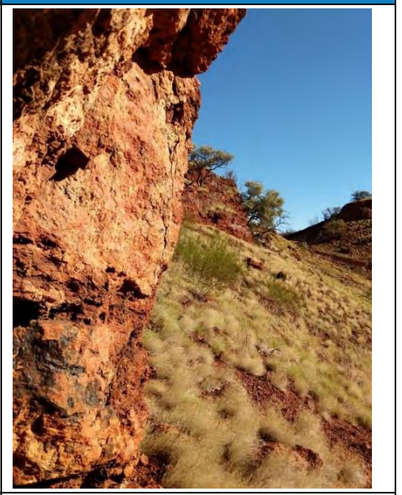
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Table C.1: Astron fauna sampling locations.

Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
Acoustic/echolocation recording sites												
BAT1	718218	7450208	Bedded Hilltop	1	Echolocation Recording	24/11/17	28/11/17	Gorge/Gully	1	None	Cracks and crevices; leaf litter; tree hollows	No photo available
BAT2	716514	7450015	Bedded Hilltop	1	Echolocation Recording	28/11/17	1/12/17	Gorge/Gully	1	Drill lines	Cracks and crevices; leaf litter; tree hollows	No photo available
BAT3	713964	7450155	Bedded Hilltop	1	Echolocation Recording	24/11/17	28/11/17	Breakaway	1	None	Brief shallow overhang; potential flyway through gully	No photo available
BAT4	712483	7451071	Bedded Hilltop	1	Echolocation Recording	28/11/17	1/12/17	Breakaway	1	Drill lines	Cracks and crevices; boulders	
BAT5	715766	7450509	Bedded Hilltop	1	Echolocation Recording	24/11/17	28/11/17	Rocky Hill	0.8	Tracks, Drill lines	Shallow overhangs; boulders and crevices	No photo available
BAT6	719087	7450901	Bedded Hilltop	1	Echolocation Recording	28/11/17	1/12/17	Breakaway	1	None	Steep sided gorge with numerous overhangs and caves (on edge)	No photo available
BAT7	712290	7450636	Bedded Hilltop	1	Echolocation Recording	24/11/17	28/11/17	Gorge/Gully (entrance of cave)	1	None	Cracks and crevices; boulders	No photo available
BAT8	710766	7450668	Bedded Hilltop	1	Echolocation Recording	28/11/17	1/12/17	Breakaway	1	Drill lines	Caves, hollows and crevices	
BAT9	695851	7445500	Hope Downs 2	1	Echolocation Recording	25/11/17	29/11/17	Minor Drainage	0.8	Grazing, clearing, weeds	Large Eucalypts with potential hollows	No photo available

Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
BAT10	699015	7444976	Hope Downs 2	1	Echolocation Recording	29/11/17	1/12/17	Gorge/Gully (entrance of cave)	0.8	Drill lines, clearing	Caves, hollows and crevices	
BAT12	699301	7446157	Hope Downs 2	1	Echolocation Recording	29/11/17	1/12/17	Mulga Woodland	1	Drill lines	Limited microhabitats, sparse leaf litter, some termite mounds	No photo available
BAT13	710050	7450766	Bedded Hilltop	2	Echolocation Recording	18/05/18	23/05/18	Breakaway	0.8	Drill lines	Rocky outcrop, overhangs, crevices	
BAT14	707275	7445721	Hope Downs 2	2	Echolocation Recording	21/05/18	26/05/18	Minor Drainage	0.8	None	Logs, tree hollows, thick undergrowth, soft soil (burrows), old *Triodia*, leaf litter	
BAT15	707097	7449888	Wonmunna	2	Echolocation Recording	21/05/18	25/05/18	Rocky Hill	0.6	None	Rocky outcrop, crevices	

Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
BAT16	710759	7450661	Bedded Hilltop	2	Echolocation Recording	18/05/18	27/05/18	Breakaway	1	Drill lines	Caves	
BAT17	712383	7450606	Bedded Hilltop	2	Echolocation Recording	23/05/18	27/05/18	Gorge/Gully	1	None	Caves	
BAT19	711117	7450976	Bedded Hilltop	2	Echolocation Recording	20/05/18	25/05/18	Gorge/Gully	0.8	Drill lines	Rocky outcrop, caves, overhangs, logs, tree hollows, crevices, thick undergrowth, rock pile, leaf litter	
BAT21	700067	7444800	Hope Downs 2	2	Echolocation Recording	21/05/18	26/05/18	Breakaway	0.8	Roads	South facing, rocky outcrop, overhangs, crevices, rock pile	

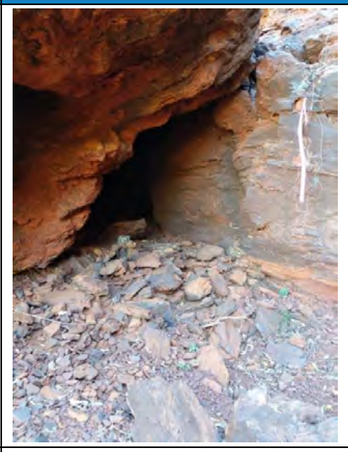
Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
BAT22#	700620	7448044	Wonmunna	3	Echolocation Recording	11/03/19	18/03/19	Gorge/Gully	0.8	Drill lines	South facing, rocky outcrops, overhangs, logs, crevices, rock piles	
BAT23	716260	7450002	Bedded Hilltop	3	Echolocation Recording	13/03/19	18/03/19	Breakaway	1	None	Overhangs, crevices, rock piles, leaf litter	
BAT25	702312	7448352	Wonmunna	3	Echolocation Recording	11/03/19	18/03/19	Gorge/Gully	1	None	Caves	
BAT26	704514	7450194	Wonmunna	3	Echolocation Recording	13/03/19	18/03/19	Breakaway	1	None	Overhangs, crevices, rock pile, leaf litter	

Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
AU1	706071	7449544	Wonmunna	2	Acoustic recording	21/05/18	25/05/18	Mulga Woodland	1	None	Thick undergrowth, old *Triodia*, leaf litter	
AU2	717660	7449529	Bedded Hilltop	2	Acoustic recording	20/05/18	27/05/18	Low Hills and Slopes	1	None	Leaf litter	
AU3	701074	7447576	Wonmunna	3	Acoustic Recording	11/03/19	18/03/19	Stony Plain	0.8	Drill lines	Logs, thick undergrowth, soft soil (burrows), rock piles, old *Triodia*, leaf litter, termite mounds	
AU4	704512	7449271	Wonmunna	3	Acoustic Recording	13/03/19	18/03/19	Stony Plain	1	None	Soft soil (burrows), old *Triodia*, leaf litter, termite mounds	

Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
BAT24*	700799	7448403	Wonmunna	3	Echolocation Recording	11/03/19	18/03/19	Gorge/Gully	1	None	Overhangs, crevices, leaf litter	
Motion sensitive camera sites												
CAM1	698036	7444190	Hope Downs 2	1	Camera (active)	26/11/17	1/12/17	Breakaway	1	None	Shallow overhangs; boulders and crevices	No photo available
CAM2	712432	7450658	Bedded Hilltop	1	Camera (active)	24/11/17	1/12/17	Gorge/Gully	1	None	Cracks and crevices; leaf litter; tree hollows	No photo available
CAM3	718157	7450285	Bedded Hilltop	1	Camera (active)	24/11/17	1/12/17	Gorge/Gully	1	None	Cracks and crevices; leaf litter; tree hollows	No photo available
CAM4	698989	7444977	Hope Downs 2	1	Camera (active)	26/11/17	1/12/17	Gorge/Gully	0.8	Tracks, drill lines	Rocky breakaway with shallow overhangs (day shelter)	No photo available
CAM5	698917	7444935	Hope Downs 2	1	Camera (active)	26/11/17	1/12/17	Gorge/Gully	0.8	Tracks, drill lines	Rocky breakaway with shallow overhangs (day shelter)	No photo available
CAM6	700214	7444832	Hope Downs 2	1	Camera (active)	25/11/17	1/12/17	Breakaway	1	None	Rocky breakaway with shallow caves (day shelter)	No photo available
CAM7	716072	7449996	Bedded Hilltop	1	Camera (active)	27/11/17	1/12/17	Breakaway	0.8	Drill lines	Shallow overhangs; boulders and crevices	

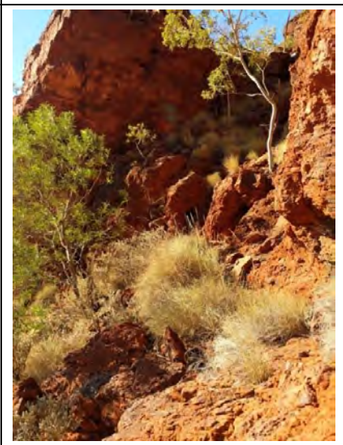
Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
CAM8	705275	7444478	Hope Downs 2	1	Camera (active)	25/11/17	1/12/17	Breakaway	1	None	Rocky breakaway with shallow caves (day shelter)	
CAM9	716887	7450118	Bedded Hilltop	1	Camera (active)	26/11/17	1/12/17	Gorge/Gully	1	None	Shallow overhangs; boulders and crevices	
CAM10	715775	7450532	Bedded Hilltop	1	Camera (active)	24/11/17	1/12/17	Rocky Hill	0.8	Tracks, drill lines	Shallow overhangs; boulders and crevices	No photo available
CAM11	700313	7444832	Hope Downs 2	1	Camera (active)	25/11/17	1/12/17	Breakaway	1	None	Rocky breakaway with shallow caves (day shelter)	No photo available
CAM12	705222	7444468	Hope Downs 2	1	Camera (active)	25/11/17	1/12/17	Breakaway	1	None	Rocky breakaway with shallow caves (day shelter)	
CAM13	712477	7451075	Bedded Hilltop	1	Camera (active)	25/11/17	1/12/17	Breakaway	0.8	Tracks, drill lines	Rock cracks and crevices; overhangs; deep leaf litter and logs; cracks in logs	No photo available
CAM14	710747	7450853	Bedded Hilltop	1	Camera (active)	25/11/17	1/12/17	Breakaway	0.8	Tracks, drill lines	Rock cracks and crevices; overhangs; deep leaf litter and logs; cracks in logs	No photo available

Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
CAM15	707148	7445434	Hope Downs 2	2	Camera (active)	23/05/18	26/05/18	Minor Drainage	0.8	Grazing, weeds	Logs, tree hollows, leaf litter	
CAM16	707107	7449901	Wonmunna	2	Camera (active)	21/05/18	25/05/18	Rocky Hill	1	None	Rocky outcrop, caves, overhangs, crevices	
CAM17	716057	7450006	Bedded Hilltop	2	Camera (active)	22/05/18	27/05/18	Breakaway	1	None	South facing, rocky outcrop, overhangs, crevices, rock pile, leaf litter	

Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
CAM18	718154	7450273	Bedded Hilltop	2	Camera (active)	20/05/18	27/05/18	Gorge/Gully	1	None	South facing, moist, rocky outcrop, caves, overhangs, logs, tree hollows, crevices, thick undergrowth, rock pile, leaf litter	
CAM19	707275	7445716	Hope Downs 2	2	Camera (active)	21/05/18	26/05/18	Minor Drainage	0.8	Weeds	Logs, tree hollows, thick undergrowth, old *Triodia*, leaf litter	
CAM20	717463	7449927	Bedded Hilltop	2	Camera (active)	20/05/18	20/05/18	Gorge/Gully	0.8	None	South facing, rocky outcrop, tree hollows, crevices, leaf litter	

Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
CAM21	699981	7444771	Hope Downs 2	2	Camera (active)	21/05/18	26/05/18	Breakaway	1	None	Rocky outcrop, overhangs, crevices, rock pile, leaf litter	
CAM22	718837	7450704	Bedded Hilltop	2	Camera (active)	20/05/18	26/05/18	Gorge/Gully	1	None	Overhangs	No photo available
CAM23	707082	7449669	Wonmunna	2	Camera (active)	23/05/18	26/05/18	Gorge/Gully	1	Drill lines	South facing, moist, rocky outcrop, overhangs, crevices, rock pile, leaf litter	
CAM24	716893	7450067	Bedded Hilltop	2	Camera (active)	22/05/18	27/05/18	Gorge/Gully	1	None	Rocky outcrop, caves, overhangs, tree hollows, crevices, thick undergrowth, rock pile, leaf litter	

Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
CAM25	710744	7450871	Bedded Hilltop	2	Camera (active)	18/05/18	27/05/18	Rocky Hill	0.8	Drill lines	Caves, overhangs, logs ,tree hollows, crevices, rock pile, leaf litter	
CAM26	706898	7449980	Wonmunna	2	Camera (active)	21/05/18	25/05/18	Rocky Hill	1	None	Rocky outcrop, overhangs, logs, tree hollows	
CAM27	711120	7450982	Bedded Hilltop	2	Camera (active)	20/05/18	27/05/18	Gorge/Gully	0.8	Drill lines	Rocky outcrop, caves, overhangs, logs, tree hollows, crevices, thick undergrowth, rock pile, leaf litter	
CAM28	712309	7450614	Bedded Hilltop	2	Camera (active)	22/05/18	27/05/18	Gorge/Gully	0.8	Drill lines	South facing, rocky outcrop, caves, overhangs, logs, tree hollows, crevices, rock pile, leaf litter	

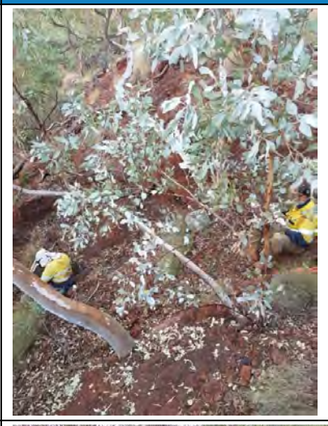
Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
CAM29	709931	7450663	Bedded Hilltop	2	Camera (active)	20/05/18	27/05/18	Rocky Hill	0.6	None	Rocky outcrop, overhangs, logs, tree hollows	
CAM30	710033	7450792	Bedded Hilltop	2	Camera (active)	18/05/18	27/05/18	Breakaway	1	None	Rocky outcrop, overhangs, crevices	
CAM32	702136	7448494	Hope Downs 2	3	Camera (active)	11/03/19	18/03/19	Gorge/Gully	0.8	Drill lines	Rocky outcrop, caves, overhangs, thick undergrowth, rock piles	

Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
CAM33	700647	7448043	Hope Downs 2	3	Camera (active)	11/03/19	18/03/19	Gorge/Gully	0.8	Drill lines	South facing, rocky outcrop, overhangs, logs, crevices, rock piles	
CAM34	704520	7450177	Wonmunna	3	Camera (active)	13/03/19	18/03/19	Breakaway	1	None	Overhangs, crevices, rock piles, leaf litter	
CAM35	716150	7449991	Bedded Hilltop	3	Camera (active)	11/03/19	18/03/19	Breakaway	1	None	South facing, moist, caves, overhangs, rock piles, leaf litter	
CAM31*	701449	7448438	Hope Downs 2	3	Camera (active)	11/03/19	18/03/19	Gorge/Gully	1	None	Overhangs	

Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
Habitat assessment sites												
HA1	712426	7450668	Bedded Hilltop	1	Other	24/11/17	N/A	Gorge/Gully	1	None	Cracks and crevices; leaf litter; tree hollows	
HA2	697800	7444359	Hope Downs 2	1	Other	24/11/17	N/A	Low Hills and Slopes	0.8	Drill lines	Spinifex hummocks and dead stags	
HA3	712444	7450310	Bedded Hilltop	1	Other	25/11/17	N/A	Rocky Hill	0.8	Tracks, drill lines	Tree hollows; rocky outcropping; spinifex hummocks	No photo available
HA4	712497	7450930	Bedded Hilltop	1	Other	25/11/17	N/A	Breakaway	0.8	Tracks, drill lines	Rock cracks and crevices; overhangs; deep leaf litter and logs; cracks in logs	No photo available
HA5	706586	7445460	Hope Downs 2	1	Other	25/11/17	N/A	Breakaway	1	None	Rocky breakaway with shallow caves (day shelter)	No photo available
HA6	706063	7449531	Wonmunna	2	Other	21/05/18	N/A	Mulga Woodland	1	None	Thick undergrowth, old *Triodia*, leaf litter	

Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
HA7	706761	7449949	Wonmunna	2	Other	21/05/18	N/A	Rocky Hill	1	None	Rocky outcrop, logs, crevices	
HA8	718838	7450779	Bedded Hilltop	2	Other	22/05/18	N/A	Gorge/Gully	1	None	Rocky outcrop, caves, overhangs, thick undergrowth, old *Triodia*, leaf litter	
HA9	720309	7450652	Bedded Hilltop	2	Other	24/05/18	N/A	Breakaway	1	None	South facing, rocky outcrop, caves, overhangs, crevices	

Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
HA10	721334	7450737	Bedded Hilltop	2	Other	24/05/18	N/A	Rocky Hill	1	None	Old *Triodia*, leaf litter	
HA11	721637	7450813	Bedded Hilltop	2	Other	24/05/18	N/A	Rocky Hill	1	None	Rock pile, leaf litter	
HA12	712682	7450284	Bedded Hilltop	2	Other	25/05/18	N/A	Rocky Hill	0.8	Drill lines, roads	Leaf litter	
Active SRE foraging sites												
SRE1	716881	7450100	Bedded Hilltop	1	Other	22/05/18	N/A	Gorge/Gully	0.8	None	Logs, leaf litter	

Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
SRE2	712291	7450649	Bedded Hilltop	1	Other	22/05/18	N/A	Gorge/Gully	0.8	None	South facing, rocky outcrop, caves, overhangs, logs, tree hollows, crevices, rock pile, leaf litter	
SRE3	704413	7446421	Hope Downs 2	1	Other	25/05/18	N/A	Minor Drainage	0.8	Drill lines	Logs, crevices, old *Triodia*, leaf litter, termite mounds	
SRE4	707098	7449693	Wonmunna	1	Other	25/05/18	N/A	Gorge/Gully	1	None	South facing, moist, rocky outcrop, overhangs, logs, crevices, rock pile, leaf litter	
SRE5	716083	7449984	Bedded Hilltop	1	Other	22/05/18	N/A	Breakaway	0.8	None	South facing, moist, rocky outcrop, overhangs, logs, crevices, rock pile, old *Triodia*, leaf litter	

Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
SRE6	697516	7445637	Hope Downs 2	1	Other	23/05/18	N/A	Mulga Woodland	0.6	Drill lines, roads, rubbish	Soft soil (burrows), leaf litter, termite mounds	
SRE7	699385	7445954	Hope Downs 2	1	Other	23/05/18	N/A	Mulga Woodland	0.4	Drill lines, roads	Soft soil (burrows), leaf litter, termite mounds	
SRE8	706977	7445419	Hope Downs 2	1	Other	23/05/18	N/A	Minor Drainage	0.6	Grazing	Logs, tree hollows, soft soil (burrows), leaf litter	
SRE9	719353	7450631	Bedded Hilltop	1	Other	24/05/18	N/A	Breakaway	1	None	South facing, rocky outcrop, overhangs, logs, tree hollows, crevices, rock pile, leaf litter	

Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
SRE10	718923	7450760	Bedded Hilltop	1	Other	24/05/18	N/A	Gorge/Gully	0.8	Drill lines	South facing, rocky outcrop, caves, overhangs, logs, tree hollows, crevices, semi-permanent water, rock pile, leaf litter	
SRE11	704970	7446447	Hope Downs 2	1	Other	25/05/18	N/A	Stony Plain	0.8	Drill lines, roads	Leaf litter	
SRE12	701571	7446480	Hope Downs 2	3	Other	14/03/19	N/A	Mulga Woodland	0.8	Grazing, drill lines	Thick undergrowth, leaf litter, termite mounds	
SRE13	707092	7449696	Wonmunna	3	Other	09/03/19	N/A	Gorge/Gully	0.8	Drill lines	Rocky outcrops, overhangs, logs, rock piles, leaf litter	

Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
SRE14	707283	7445763	Hope Downs 2	3	Other	17/03/19	N/A	Minor Drainage	0.8	Grazing, drill lines	Moist, logs, tree hollows, thick undergrowth, rock piles, old *Triodia*, leaf litter	
SRE15	704246	7446549	Hope Downs 2	3	Other	17/03/19	N/A	Mulga Woodland	1	Drill lines	Logs, tree hollows, old *Triodia*, leaf litter	
SRE16	702264	7445989	Hope Downs 2	3	Other	10/03/19	N/A	Mulga Woodland	1	Drill lines	Logs, soft soil (burrows), leaf litter, termite mounds	
SRE17	718183	7450305	Bedded Hilltop	3	Other	11/03/19	N/A	Gorge/Gully	0.8	None	South facing, moist, caves, overhangs, logs, rock piles, leaf litter	

Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
SRE18	716920	7450177	Bedded Hilltop	3	Other	11/03/19	N/A	Gorge/Gully	0.8	None	South facing, overhangs, logs, crevices, rock piles, leaf litter	
SRE19	702270	7448405	Wonmunna	3	Other	12/03/19	N/A	Gorge/Gully	0.8	None	South facing, overhangs, logs, crevices, leaf litter	
SRE20	719408	7450358	Bedded Hilltop	3	Other	13/03/19	N/A	Gorge/Gully	1	None	South facing, rocky outcrops, overhangs, logs, tree hollows, crevices, rock piles	
SRE21	704835	7450098	Wonmunna	3	Other	14/03/19	N/A	Rocky Hill	1	None	South facing, rocky outcrops, logs, crevices, rock piles, Leaf litter	

Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
SRE22	704698	7449733	Wonmunna	3	Other	14/03/19	N/A	Stony Plain	1	None	Logs, tree hollows, soft soil (burrows), leaf litter	
SRE23	706050	7446465	Hope Downs 2	3	Other	16/03/19	N/A	Mulga Woodland	0.8	Drill lines	Tree hollows, thick undergrowth, old *Triodia*, leaf litter, termite mounds	
Trapping sites												
TS01	697504	7445613	Hope Downs 2	1,2	Trapping grid	22/11/17 19/05/18	29/11/17 26/05/18	Mulga Woodland	1	Tracks	Limited microhabitats, sparse leaf litter, some termite mounds	
TS02	696308	7446214	Hope Downs 2	1,2	Trapping grid	22/11/17 19/05/18	29/11/17 26/05/18	Alluvial Plain	0.8	Grazing	Dense leaf litter, termite mounds and spinifex clumps; cracking clays	

Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
TS03	699311	7446105	Hope Downs 2	1, 2	Trapping grid	22/11/17 19/05/18	29/11/17 26/05/18	Mulga Woodland	0.6	Vehicular	Limited microhabitats, sparse leaf litter	
TS04	706249	7445883	Hope Downs 2	1, 2	Trapping grid	22/11/17 19/05/18	29/11/17 26/05/18	Stony Plain	0.8	Grazing, roads	Limited leaf litter, termite mounds and spinifex clumps	
TS05	705107	7445902	Hope Downs 2	1, 2	Trapping grid	23/11/17 19/05/18	30/11/17 26/05/18	Low Hills and Slopes	0.8	Tracks, drill lines	Limited leaf litter, termite mounds and spinifex clumps	
TS06	707293	7445814	Hope Downs 2	1, 2	Trapping grid	23/11/17 19/05/18	30/11/17 26/05/18	Minor Drainage	0.8	Grazing, tracks	Large Eucalypts with hollows; deep leaf litter	
TS07	696251	7445929	Hope Downs 2	1, 2	Trapping grid	24/11/17 19/05/18	1/12/17 26/05/18	Minor Drainage	0.6	Grazing, tracks, roads, weeds	Large Eucalypts with hollows; deep leaf litter; dense grass ground cover	

Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
TS08	713854	7450029	Bedded Hilltop	1, 2	Trapping grid	24/11/17 19/05/18	1/12/17 26/05/18	Breakaway	1	None	Rocky overhangs, crevices and small caves; low levels of leaf litter, sparse open vegetation.	
TS09	712816	7450165	Bedded Hilltop	1, 2	Trapping grid	24/11/17 19/05/18	1/12/17 26/05/18	Breakaway	1	None	Rocky overhangs, crevices and small caves; low levels of leaf litter, sparse open vegetation.	
TS10	718871	7450712	Bedded Hilltop	1, 2	Trapping grid	24/11/17 19/05/18	1/12/17 26/05/18	Gorge / Gully	1	None	Rocky overhangs, crevices and small caves; dense deep leaf litter, open vegetation.	
TS11	718171	7450286	Bedded Hilltop	1,2	Trapping grid	24/11/17 19/05/18	1/12/17 26/05/18	Gorge / Gully	1	None	Steep sided gorge with numerous overhangs and caves	
TS12	717063	7450643	Bedded Hilltop	2	Trapping grid	20/05/18	27/05/18	Rocky Hill	1	Drill lines	Rocky outcrop, old *Triodia*, leaf litter	

Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
TS13	717506	7450245	Bedded Hilltop	2	Trapping grid	20/05/18	27/05/18	Rocky Hill	1	Drill lines	Logs, thick undergrowth, rock pile, leaf litter	
TS16	706437	7448130	Wonmunna	3	Trapping grid	10/03/19	17/03/19	Low Hills and Slopes	1	None	Leaf litter, termite mounds	
TS18	705435	7448646	Wonmunna	3	Trapping grid	09/03/19	17/03/19	Mulga Woodland	1	None	Tree hollows, thick undergrowth	
TS19	707081	7449700	Wonmunna	3	Trapping grid	09/03/19	16/03/19	Breakaway	1	None	Rocky outcrops, caves, overhangs, logs, crevices, thick undergrowth	
Q1	707086	7449689	Wonmunna	2	Trapping grid	25/05/18	26/05/2018	Gorge/Gully	1	None	South facing, moist, rocky outcrop, caves, overhangs, logs, crevices, leaf litter	No photo available

Site ID	MGA Zone 50 K		Site location	Phase	Sampling method	Sample start date	Sample finish date	Habitat	Condition	Disturbance	Microhabitats	Photo
	Easting (mE)	Northing (mN)										
TS14*	697906	7448526	Wonmunna	3	Trapping grid	09/03/19	17/03/19	Alluvial Plain	0.8	Grazing, weeds	Logs, tree hollows, thick undergrowth	
TS15*	700605	7448201	Wonmunna	3	Trapping grid	10/03/19	17/03/19	Rocky Hill	1	None	Rock piles, leaf litter, termite mounds	
TS17*	700743	7447421	Wonmunna	3	Trapping grid	11/03/19	18/03/19	Stony Plain	1	None	Logs, thick undergrowth, old *Triodia*, leaf litter, termite mounds	

Habitat Condition: 1 (Excellent); 0.8 (Very Good); 0.6 (Good); 0.4 (Poor); 0.2 (Very Poor); 0.1 (Completely Degraded)

Failed to operate

*Recorded outside the survey area due to survey boundary changes post survey.

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Appendix D: Alacran Environmental Services and Western Australian Museum Report

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Alacran Environmental Science

Report No. 1901

Short-range Endemic Assessment of Invertebrates from the Hope Downs 2 Level 2 Survey Area

Prepared for

Astron (Rio Tinto)



Antichiropus 'wonmunna'

ABN 33577027061

www.alacranenvironmental.com

Document Version

Version	Author	Date submitted	Delivered to
Version 4	E.S. Volschenk	6 October 2019	Jessica Johnston (Astron)

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Limitation: The purpose of this report is to inform Astron about the identity and distribution of conservation significant invertebrates (short-range endemics) within the proposed Short-range Endemic Assessment of Invertebrates from the Hope Downs 2 Level 2 Survey Area. Alacran Environmental Science accepts no liability or responsibility for any use or reliance on this report for any other purpose. The accuracy and completeness of the information supplied by Astron or other data sources including (but not limited to) The Western Australian Museum, The Australian Bureau of Meteorology or the Western Australian Department of Minerals and Petroleum, have not been reviewed or verified.

EXECUTIVE SUMMARY

This report presents the findings of a desktop study, and the identification and SRE (short-range endemic) assessment of invertebrates sampled during two field surveys undertaken by Astron. The information in this report is intended to be used by Astron in their preparation of an overarching fauna report for Rio Tinto. The aim of that report is to provide information to Rio Tinto to enhance the level of knowledge about fauna within the Hope Downs 2 Level 2 Survey Area (the Study Area). This information is also intended to inform any future environmental impact assessment within the region.

The study area occupies 10,817.7 ha and is located approximately 75 km west north-west of Newman.

The desktop assessment of SRE invertebrates was undertaken within approximately 40,000 km^2 square area (the Search Area) centred on the Study Area. Database searches were undertaken for SRE invertebrate records from the W. A. Museum's Arachnids and Myriapods, Crustaceans and Molluscs databases. These data were subsequently edited to enforce consistency in naming and then filtered for SREs and potential SREs.

The database search yielded 12,376 records from within the Search Area. Of those, 4,335 records were attributed to SRE groups, SREs and Potential SREs. The SRE groups represented 282 taxa, of which eight (2.8%) represented named species, 182 (64.5%) represented named morphospecies and 92 (32.6%) represented unidentified species belonging to taxa known to contain SRE representatives. Twenty-four (24) species and morphospecies represented SREs with the remaining 258 taxa being Potential SRE owing largely to data deficiency (DD).

The field surveys generated a total of 202 samples from SRE target taxa comprising 67 different taxa. Eighteen (18) of these species were known to be widespread, 48 were either likely or potential SREs and one confirmed SRE, *Karaops banyjima*. Of these SRE category taxa, 32 were identified to the level of species or morphospecies:

- seven spiders: *Karaops banyjima*, *Karaops* 'ARA001', *Aurecocrypta* 'MYG315', *Aurecocrypta* 'HD1', *Synothele* 'MYG309', *Synothele* 'MYG311' and *Yilgarnia* 'MYG197';
- nine pseudoscorpions: *Tyrannochthonius* 'HD1', *Tyrannochthonius* 'HD2', *Austrohorus* 'HD5', *Beierolpium* 'HD1', *Beierolpium* 'HD2', *Euryolpium* 'HD6', *Euryolpium* 'HD7', 'Genus 7/4 PSE118', 'PSEAAA HD4';
- four scorpions; *Lychas* 'bituberculatus complex', *Lychas* 'hairy tail complex', *Lychas* 'multipunctatus complex', *Urodacus* 'HD1';
- seven centipedes: *Sepedonophilus* 'HD1', *Sepedonophilus* 'HD2', *Mecistocephalus* 'HD1', *Mecistocephalus* 'HD2', *Mecistocephalus* 'HD3', *Orphnaeus* 'HD1', *Cryptops* 'HD1',
- three millipedes: *Antichiropus* 'wonmunna', *Austrostrophus* 'Clade A', *Austrostrophus* 'Clade E', and
- two isopods: *Buddelundia* '10ma', *Buddelundia* '77'.

Seventeen (17) SRE taxa sampled represent ambiguously identified groups:

- three spiders: *Synothele* sp., *Aname* sp., Nemesiidae sp.;
- five pseudoscorpions: *Anatemnus* sp., *Sundochernes* sp., *Indolpium* sp., *Euryolpium* sp., Olpiidae sp.;
- two centipedes: *Sepedonophilus* sp., Geophilomorpha sp.;

- two millipedes: *Antichiropus* sp. and *Austrostrophus* sp., and
- five isopods: *Buddelundia* sp., Buddelundiinae sp., *Pseudodiploexochus* sp., *Troglarmadillo* sp., Philosciidae sp.

Habitat mapping was undertaken by Astron and five habitats stand out as being conducive to relictual SREs: Breakaways, Mulga Woodland, Minor Drainage lines, Gorges and Gullies, and Rocky Hills. Most of these latter habitats are associated with an isolated ridge running in an east-west direction, so most of the breakaways and rocky slopes are south-facing and therefore conducive to SREs.

Several SRE category invertebrates were found in multiple habitat types, suggesting that they may be less specialised with respect to their habitat preferences:

- *Lychas* 'bituberculatus complex', from stony hills and eucalypt woodland;
- *Sepedenophilus* 'HD1', from rocky slopes and gullies, and mulga woodland;
- *Mecistocephalus* 'HD1', from rocky slopes and gullies, and mulga woodland;
- *Austrostrophus* 'Clade E', from mulga woodland and open eucalypt woodland;
- *Antichiropus* 'wonmunna', from mulga woodland in this study area, but from gully slopes and riparian vegetation outside of this study area.

These species are likely to be found outside of the limits of the study area.

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1 INTRODUCTION

1.1 SCOPE

In March 2019, Rio Tinto (Rio) commissioned Astron and Alacran Environmental Science (Alacran) to undertake a second (wet-season) short-range endemic invertebrate (SRE) survey within the Hope Downs 2 Level 2 Survey Area (10,817.7 ha) located approximately 75 km WNW of Newman (the Study Area), Figure 2.1. These areas form part of the larger Hope Downs 1 Development Envelope.

This survey followed from an initial Level 2 survey undertaken in May 2018 (Here after referred to as "T1") which yielded a modest collection (110 specimens) comprising 11 SREs and potential SREs:

- two trapdoor spiders: *Gaius* sp. and *Nemesiidae* sp.;
- four pseudoscorpion taxa: *Austrohorus* sp., *Indolpium* sp., Olpiide sp. and *Tyrannochthonius aridus*.
- three scorpion taxa*: Lychas* 'bituberculatus complex', *Lychas* 'multipunctatus complex' and *Lychas* 'hope downs';
- one earth centipede (Geophilomorpha): *Sepedenophilus* sp.; and
- one isopod: *Buddelundia* sp.

In the time since that survey, two species can be removed from the list:

- the genus *Gaius* (Rix et al. 2018c) was revised subsequent to the report and *Gaius* sp. is now known to represent the species *Gaius tealei* which is widespread in the Pilbara;
- *Lychas* 'hope downs' is the same as *Lychas* 'harveyi complex' following examination of additional specimens of *Lychas* 'harveyi complex' obtained from the T2 survey. *Lychas* 'harveyi complex' is a widespread species in the Pilbara.

One of the primary limiting factors for that survey was the dry conditions during and preceding the survey, reflecting the suboptimal season for undertaking SRE surveys.

The present survey aimed to bolster the survey effort for SREs in the study area by surveying in March, in the latter half of the Pilbara wet season (EPA 2016). The present report combined the results from both surveys and therefore supersedes report No. 1807 (Alacran 2018).

The overall purpose of the survey was to gather additional biological information through a desktop study and intensive field surveys to enhance and contextualise the level of knowledge at the locality scale.

Alacran provided specialist support for the short-range endemic component of the survey by way of:

- recommending likely field locations within the Study Area to undertake SRE sampling (T1 and T2),
- guided SRE field survey (T2),
- undertaking a desktop assessment including area searches of relevant W. A. Museum databases,
- identification and SRE assessment of field samples (T1 and T2),
- coordinating DNA sequencing and analyses of target samples.

OVERVIEW

1.1.1 Short-range endemism

Short-range endemics are organisms with small geographic distributions (Harvey 2002b; Ponder and Colgan 2002), nominally less than 10,000 km^2(Harvey 2002b). These organisms are typically characterised by one or more of the following characteristics:

- limited dispersal capabilities,
- seasonal activity (cooler or wetter periods),
- slow growth, and
- low levels of fecundity.

Their limited dispersal capabilities result in small populations being isolated from each other by inhospitable geographic features such as rivers, rocky ridges or plains. Prolonged isolation between populations eventually results in speciation, with each population becoming genetically and morphologically distinct. Two types of short-range endemism have been recognised: Relictual Endemism and Habitat Specialist Endemism (Harvey 2002b; Ponder and Colgan 2002).

Relictual SREs result when speciation occurs following the fragmentation of continuous habitat into two or more refugia. In Australia, the primary driver of this over the last 65 million years has been aridification, which acted to isolate formerly widespread species living in mesic forests to small patches of mesic refugia. Relictual SREs include scorpions in the genus *Aops* (Volschenk and Prendini 2008), pseudoscorpions in the genera *Tyrannochthonius* (Harvey 1991; Edward and Harvey 2008), *Indohya* (Harvey 1993b; Harvey and Volschenk 2007) and *Idioblothrus* (Muchmore 1982; Harvey 1993a; Harvey and Leng 2008b) and millipedes in the genus *Antichiropus* (Car et al. 2013; Car and Harvey 2014). Troglobites (obligate subterranean species) are thought to be extreme examples of relictual SREs; most troglobites from the Pilbara have surface dwelling relatives living in the more mesic forests of northern Australia (Harvey 2002b; Ponder and Colgan 2002).

Habitat specialist SREs are species that have adapted to very specific environment types, including those found in arid environments (e.g. rocky outcrops or isolated dune systems). These habitats are often relatively young (<10 million years) and therefore are not refugial. Examples of habitat specialist SREs include spiders in the family Selenopidae and pseudoscorpions in the genera *Synsphyronus* (Harvey 2011b, 2012) and *Feaella* (Harvey 1989; Harvey and Volschenk 2007), and scorpions in the genera *Lychas* and *Urodacus*.

2 METHODS

2.1 DEFINING SHORT-RANGE ENDEMISM

Assessment of short-range endemism can be challenging when data for evaluation are absent or limited. Limitations may include any of the following:

- **Poor survey coverage,** e.g. the fauna of an area has not been sampled extensively enough to enable assessment of species distributions. The absence of a species from survey records may not mean that it is absent from the area.
- **Poor taxonomic resolution,** e.g. a species has not been subject to systematic investigation, and/or the identity is either difficult or impossible to determine. Good taxonomic resolution does not necessarily need to be in the form of published revisions, as it can be facilitated by any of the following:
  - a researcher actively working on the group who can authorise identifications,
  - a publicly accessible reference collection, and/or;
  - assessment of species boundaries using genomic methods such as DNA barcoding (Hebert et al. 2003a; Hebert et al. 2003b).
- **Identification issues**, e.g. surveys sampled life stages of SREs that are impossible to identify based on morphological characters. Examples of relevant taxa include juvenile or female millipedes, mygalomorph spiders and *Urodacus* scorpions. Genomic methods have great potential to overcome this type of limitation.

There are no published systems for assessing the SRE potential for a species. The W. A. Museum previously employed the following system to assess SRE-status of invertebrates:

- **Confirmed SRE:** This category applies when the identity of the taxon is unambiguous, and its distribution is less than 10 000km^2 based on publicly available vouchered records. Supporting data can be either genomic (from DNA sequences) or morphological, ideally both.
- **Potential SRE:** This category applies to situations where there are knowledge gaps for the taxon. The following sub-categories further elucidate this status:
  - **Data Deficiency (DD):** This category covers taxa for which there is insufficient data available to determine SRE status. Factors that fall under this category include:
    - insufficient geographic information,
    - insufficient taxonomic information, and/or
    - inappropriate life stages prevent identification to species level.
  - **Habitat Indicators (H):** This category employs habitat characteristics to evaluate SRE status when habitats are known to support SRE taxa. For example, many species sampled from subterranean habitats are known to be range restricted; a new species discovered from such habitat therefore has greater potential to be range restricted (i.e. an SRE) than widespread.
  - **Morphological Evidence (M):** This category uses one or more morphological characters that are characteristic of SRE taxa inhabiting restricted environments, e.g. the specialised morphological features of animals adapted to subterranean habitats, including body markings that are absent or significantly paler than surface dwelling relatives, eyes that are absent or significantly reduced, and/or longer appendages (legs and antennae) than surface relatives.
  - **Unpublished Research & Expertise (U):** This category relies on unpublished research or expertise to develop SRE status.

These categories of potential SRE may be helpful in developing conservation priorities; however, each taxon should be assessed on its merit and in accordance with the *Precautionary Principle* (EPA 2002):

> "*where there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason to postpone measures to prevent environmental degradation*".

— **Widespread (not an SRE)**: This category applies when vouchered evidence demonstrates a distribution greater than 10,000 km^2.

2.2 TAXONOMY

The taxonomic nomenclature of invertebrates follows the references detailed in Table 2.1. Morphospecies designations follow the parataxonomy of the scientist(s) working on the group; these informal names are written between single quotation marks rather than being italicised as they are not valid under the International Code of Zoological Nomenclature (1999).

Alacran follows the "Phylogenetic Species Concept" (Cracraft 1983) when delineating species or morphospecies:

> "A species is the smallest diagnosable cluster of individual organisms within which there is a parental pattern of ancestry and descent."

2.2.1 Identification

For this report, Dr Simon Judd contributed information about isopod distributions, SRE assessment and specimen identification. The remaining identifications (spiders, pseudoscorpions, scorpions, millipedes, centipedes, silverfish and snails) were carried out by the Dr Erich Volschenk. The references used for species determination are summarised in Table 2.1.

Where morphological identification was not possible, attempts were made to assess the identity of the specimen using DNA Barcoding of the gene COI (Cytochrome C oxidase subunit I). The DNA barcoding study for this survey is detailed in Appendix 3.

Table 2.1. The following 'general' references and collections were used to assist with morphospecies designations

Order	Taxonomic reference	Morphospecies and reference collection
Araneae	(Raven et al. 2002; Crews and Harvey 2011; Harvey et al. 2012; Crews 2013; World Spider Catalog 2014; Castalanelli et al. 2017; Rix et al. 2017a; Rix et al. 2017b; Harrison et al. 2018; Harvey et al. 2018; Rix et al. 2018a; Rix et al. 2018b; Rix et al. 2018c)	Reference collection at the W. A. Museum
Pseudoscorpiones	(Harvey 1992; Harvey and Volschenk 2007; Edward and Harvey 2008; Harvey and Leng 2008a; Murienne et al. 2008; Harvey 2011a, 2012, 2013b; Alexander et al. 2014; Harrison et al. 2014; Harvey et al. 2016)	Reference collection at the W. A. Museum
Scorpiones	(Glauert 1925b, a; Acosta 1990; Kovařík 1997; Fet et al. 2000; Volschenk et al. 2000; Volschenk and Prendini 2008; Volschenk et al. 2010)	Morphospecies designation by Dr Erich S Volschenk. Reference collection at the W. A. Museum and with Dr Erich S. Volschenk.
Chilopoda	(Colloff et al. 2005)	Reference collection at the W. A. Museum
Diplopoda	(Car and Harvey 2013; Car et al. 2013; Car and Harvey 2014)	Reference collection at the W. A. Museum
Isopoda	(Judd and Horwitz 2003; Schmalfuss 2003; Judd 2004; Schmidt and Leistikow 2004; Schotte et al. 2008; Judd and Perina 2013)	Morphospecies designation by Dr Simon Judd. Reference collection at the W. A. Museum and with Dr Simon Judd.
Gastropoda	(Solem 1985, 1997; Johnson et al. 2004; Johnson et al. 2012; Whisson and Köhler 2012; Johnson et al. 2013; Whisson and Kirkendale 2014; Stanasic et al. 2017)	Reference collection at the W. A. Museum

2.2.2 Specimen Lodgement and Data Access

In accordance with *EPA Guidance Statement 20* (2009), specimens submitted to Alacran for taxonomic identification will be offered to the W. A. Museum for inclusion in their biological collections.

Supporting data are attached as appendices:

Appendix 1. Short-range endemic records from an area search by the W. A. Museum.
Appendix 2. Short-range endemic and target group records from the field survey.
Appendix 3. Targeted DNA barcoding of Invertebrates from the Hope Downs 2 Project Area.

2.3 DESKTOP ASSESSMENT

2.3.1 Database search

2.3.1.1 Search area

For this report, the Search Area is defined as the area investigated for SREs surrounding the Study Area. Based on the nominal area threshold for SRE distributions, <10,000 km^2 (Harvey 2002b), a square area was generated using "Google™ Earth Pro", centring on the Study Area and extended approximately 100 km north, south east and west from it. The following corner coordinates of the Search Area was used when undertaking searches from within the W. A. Museum's databases: Top left corner (North West): -22.175902°, 118.070211°; Bottom right corner (South East): -23.956909°, 120.008080°. The total area searched was approximately 40,000 km^2 (a square with 200 km sides) (Figure 2.1).

2.3.1.2 Search area data edits and filtering

At the time when the area searches were requested from the W. A. Museum, limited taxonomic support was provided for database searches with **limited** screening for SREs or subterranean fauna from the department of Arachnids and Myriapods. Database search results constituted data 'dumps' of ALL records from within the Search Area requested. Database search results were edited prior to screening for SREs to enforce consistency between the different departmental databases. The following edits and filtering were applied to the combined data:

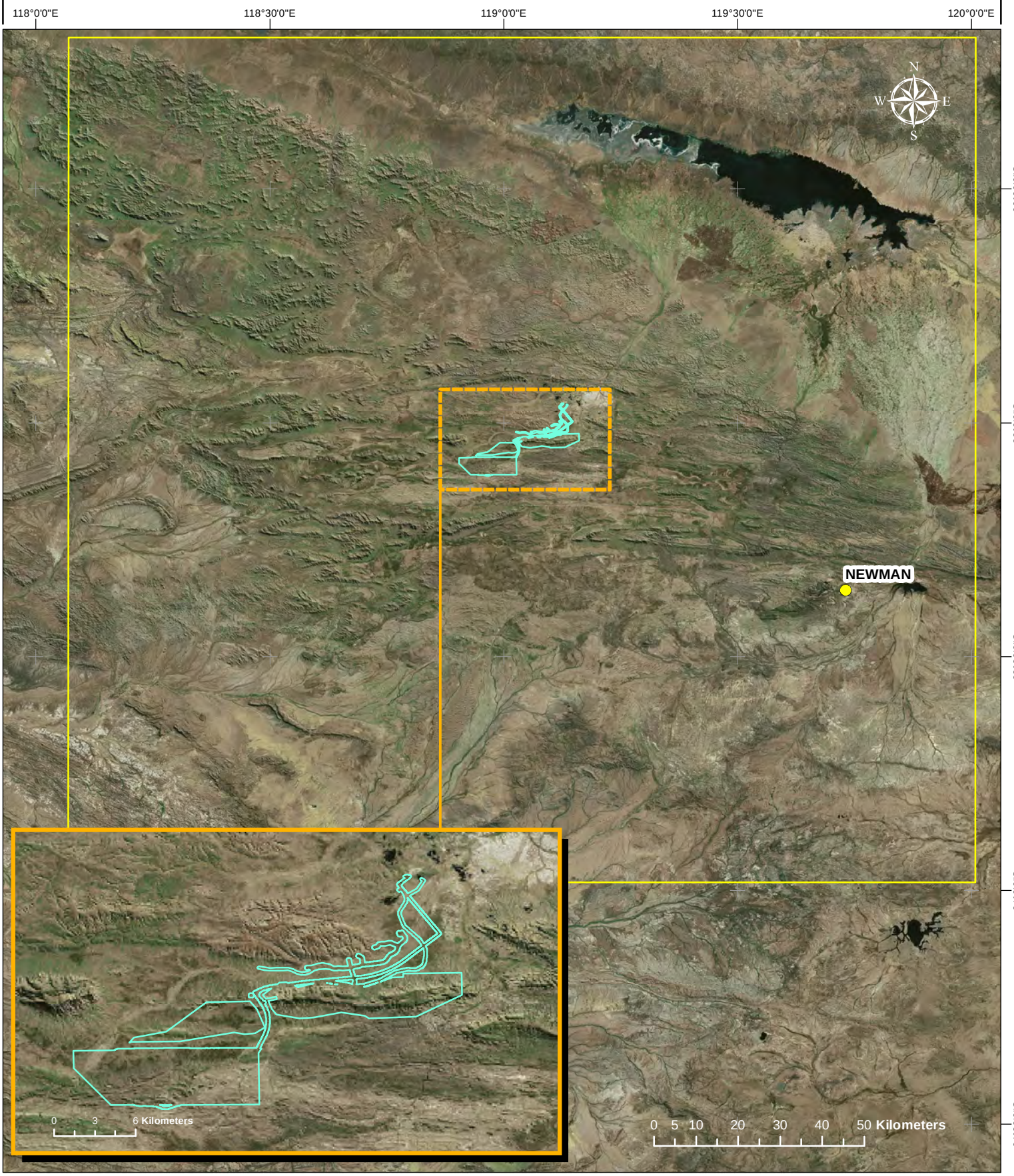
1. A new field "Binomial" was created, into which the Genus and Species field values were concatenated, *e.g.* Genus [Lychas] + Species [`gracilimanus`] → Binomial [Lychas 'gracilimanus']
    a. Where the genus field was empty or contained the values "Unknown" or "gen. nov.", the family rank name was used instead of genus.
    b. Where both family and genus fields were empty, unknown, the order rank was used in place of the genus.
    c. all unidentified 'species' in the 'Binomial' field (*e.g.* "sp. indet.", "sp. indet. (juvenile)", "sp?", "unknown") were renamed to "sp."
    d. All Binomial morphospecies names ending in "sp. n." were renamed without that suffix, *e.g.* "*Rhagada* 'pannawonica' sp. n." was renamed to *Rhagada* 'pannawonica'.

2. Another field was created called "Ecotype", into which the ecotype of the species was manually recorded, based on taxon and/or sampling methods:
    a. **Epigean**: all species obtained through terrestrial survey methods or belonging to taxa only known to be epigean in W. A., *e.g.* trapdoor spiders.
    b. **Subterranean, Troglobite** or **stygobite**: 'named' species or morphospecies obtained using subterranean sampling methods or from taxa known predominantly from subterranean habitats, *e.g.* schizomids.
    c. **?Epigean**: unidentified species from subterranean survey methods of groups known to contain epigean SREs in the Pilbara, *e.g.* Centipedes from the order Geophilomorpha or family Cryptopidae.

d. **?troglobite**: Unidentified species obtained from subterranean fauna survey methods of orders or families rarely sampled in SRE surveys in the Pilbara, *e.g.* Millipede families Haplodesmidae and Dalodesmidae.
e. **Marine** and **Aquatic**: marine and freshwater species respectively.

3 The data were filtered for records with ecotypes of either “epigean” or “?epigean”.
4 The SRE status of each species present in the filtered data was assessed according to the SRE categories previously used by the W. A. Museum Taxonomic Service and described in **2.1**.

Figure 2.1 Eastern and central Pilbara showing the location of the Study Area (inset) and the Search Area used to interrogate the Western Australian Museum's Terrestrial Invertebrates, Crustaceans and Molluscs databases



Project: Short-range Endemic Invertebrate asessment for the Hope Downs 2 Level 2 Survey Area
Client: Astron (Rio Tinto)

Coordinate System: GCS WGS 1984
Projection: Transverse Mercator

Author: E.S. Volschenk
Date: 1 Oct 2019

Alacran Environmental Science
www.alacranenvironmental.com

Towns
Study Area
Database Search Area



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3 RESULTS

3.1 LITERATURE REVIEW

This review focusses on the data obtained from the W. A. Museum invertebrate departments as these are based on vouchered reference specimens. Numerous invertebrate surveys have been undertaken in (or partly in) the Search Area and many of these are not publicly available. The specimen records from all these surveys are however accessible from the W. A. Museum. Species referred to in reports that were not lodged in the W. A. Museum are of questionable value since their relevance to any subsequently collected specimens cannot be assessed. References to informative literature are made in the "Justification" column of the taxon summary tables.

3.2 W. A. MUSEUM DATABASE SEARCH

The Area Searches yielded a total of 12,376 records. After applying the SRE data edits and filters (**2.3.1.2 search area data edits and filtering**), that number was reduced to 4,335 records of SRE and Potential SRE species. These were represented by 282 taxa of which eight (2.8%) were named species, 182 (64.5%) were morphospecies and 92 (32.6%) were undetermined taxa, e.g. *Tyrannochthonius* sp. and Chthoniidae sp. The majority (260) of these taxa were potential SRE and 24 were confirmed SRE.

These results are summarised by Order in Table 3.1. The corresponding data file is embedded within this file as Appendix 1.

Table 3.1. Summary of W. A. Museum database search results for SRE and potential SRE taxa.

Order	Named species	Morphospecies	Un-named taxa ("sp.")	Totals
Araneae: Araneomorphae (modern spiders)	2	5	3	**10**
Araneae: Mygalomorphae (trapdoor spiders)	2	78	21	**101**
Opiliones (harvestmen)	0	0	2	**2**
Pseudoscorpiones (pseudoscorpions)	3	31	18	**52**
Schizomida (short-tailed whip scorpions)	0	1	0	**1**
Scorpiones (scorpions)	0	19	6	**25**
Geophilomorpha (earth centipedes)	0	1	9	**10**
Scolopendromorpha (centipedes)	0	0	3	**3**
Polydesmida (flat-back millipedes	0	18	4	**22**
Polyzoniida (sucking millipedes)	0	0	1	**1**
Spirobolida (millipedes)	1	2	5	**8**
Symphyla	0	0	1	**1**
Isopoda (Slaters)	0	25	9	**34**
Eupulmonata (land snails)	0	2	10	**12**
Totals	**8**	**182**	**92**	**282**

3.3 FIELD SURVEY

The field survey yielded a total of 202 samples, representing 66 taxa belonged to SRE groups. Of those 67 taxa, one was an SRE, 48 were either likely SRE or potential SRE and 18 were widespread; Table 3.2, Figure 3.1, Figure 3.2 and Figure 3.3. The summary of SRE species records per site is given in Table 3.3.

Table 3.2. Taxonomy and SRE status of field survey records with SRE category taxa shaded green.

Class	Order	Family	Species	SRE status
Arachnida	Araneae	Selenopidae	*Karaops banyjima* DNA	SRE
Arachnida	Araneae	Selenopidae	*Karaops* 'AEA001'	Potential SRE: DD
Arachnida	Araneae	Actinopodidae	*Missulena rutraspina*	Widespread
Arachnida	Araneae	Barychelidae	*Aurecocrypta* 'MYG315' DNA	Potential SRE: DD
Arachnida	Araneae	Barychelidae	*Aurecocrypta* 'HD1' DNA	Potential SRE: DD
Arachnida	Araneae	Barychelidae	*Synothele* 'MYG309' DNA	Potential SRE: DD
Arachnida	Araneae	Barychelidae	*Synothele* 'MYG311' DNA	Potential SRE: DD
Arachnida	Araneae	Barychelidae	*Synothele* sp.	Potential SRE: DD
Arachnida	Araneae	Barychelidae	*Synothele* 'xkarara'	Widespread
Arachnida	Araneae	Idiopidae	*Gaius tealei*	Widespread
Arachnida	Araneae	Nemesiidae	*Aname mellosa*	Widespread
Arachnida	Araneae	Nemesiidae	*Aname* 'MYG004'	Widespread
Arachnida	Araneae	Nemesiidae	*Aname* sp.	Potential SRE: DD
Arachnida	Araneae	Nemesiidae	*Yilgarnia* 'MYG197'	Potential SRE: DD
Arachnida	Araneae	Nemesiidae	Nemesiidae sp.	Potential SRE: DD
Arachnida	Pseudoscorpiones	Atemnidae	*Anatemnus* sp.	Potential SRE: DD
Arachnida	Pseudoscorpiones	Atemnidae	*Oratemnus* sp.	Widespread
Arachnida	Pseudoscorpiones	Chernetidae	*Sundochernes* sp.	Potential SRE: DD
Arachnida	Pseudoscorpiones	Chthoniidae	*Tyrannochthonius* 'HD1' DNA	Potential SRE: DD
Arachnida	Pseudoscorpiones	Chthoniidae	*Tyrannochthonius* 'HD2' DNA	Potential SRE: DD
Arachnida	Pseudoscorpiones	Olpiidae	*Austrohorus* 'HD5' DNA	Potential SRE: DD
Arachnida	Pseudoscorpiones	Olpiidae	*Beierolpium* '8/4 small'	Widespread
Arachnida	Pseudoscorpiones	Olpiidae	*Beierolpium* 'HD1' DNA	Potential SRE: DD
Arachnida	Pseudoscorpiones	Olpiidae	*Beierolpium* 'HD2' DNA	Potential SRE: DD
Arachnida	Pseudoscorpiones	Olpiidae	Beierolpium '8/4' DNA	Widespread
Arachnida	Pseudoscorpiones	Olpiidae	*Euryolpium* 'HD6' DNA	Potential SRE: DD
Arachnida	Pseudoscorpiones	Olpiidae	*Euryolpium* 'HD7' DNA	Potential SRE: DD
Arachnida	Pseudoscorpiones	Olpiidae	*Euryolpium* sp.	Potential SRE: DD
Arachnida	Pseudoscorpiones	Olpiidae	'Genus 7/4 PSE118' DNA	Potential SRE: DD
Arachnida	Pseudoscorpiones	Olpiidae	'PSEAAA HD4' DNA	Potential SRE: DD
Arachnida	Pseudoscorpiones	Olpiidae	*Indolpium* sp.	Potential SRE: DD
Arachnida	Pseudoscorpiones	Olpiidae	Olpiidae sp.	Potential SRE: DD
Arachnida	Scorpiones	Buthidae	*Isometroides* 'pilbara 1'	Widespread

Class	Order	Family	Species	SRE status
Arachnida	Scorpiones	Buthidae	*Lychas* 'bituberculatus complex'	Potential SRE: DD
Arachnida	Scorpiones	Buthidae	*Lychas* 'hairy tail complex'	Potential SRE: DD
Arachnida	Scorpiones	Buthidae	*Lychas* 'harveyi complex'	Widespread
Arachnida	Scorpiones	Buthidae	*Lychas* 'multipunctatus complex'	Potential SRE: DD
Arachnida	Scorpiones	Buthidae	*Lychas* 'pilbara 1'	Widespread
Arachnida	Scorpiones	Urodacidae	*Urodacus* 'pilbara 12'	Widespread
Arachnida	Scorpiones	Urodacidae	*Urodacus* 'HD1' DNA	Potential SRE: DD
Chilopoda	Geophilomorpha	Chilenophilidae	*Sepedonophilus* 'HD1' DNA	Potential SRE: DD
Chilopoda	Geophilomorpha	Chilenophilidae	*Sepedonophilus* 'HD2' DNA	Potential SRE: DD
Chilopoda	Geophilomorpha	Chilenophilidae	*Sepedonophilus* sp.	Potential SRE: DD
Chilopoda	Geophilomorpha	Geophilomorpha^	Geophilomorpha sp.	Potential SRE: DD
Chilopoda	Geophilomorpha	Mecistocephalidae	*Mecistocephalus* 'HD1' DNA	Potential SRE: DD
Chilopoda	Geophilomorpha	Mecistocephalidae	*Mecistocephalus* 'HD2' DNA	Potential SRE: DD
Chilopoda	Geophilomorpha	Mecistocephalidae	*Mecistocephalus* 'HD3' DNA	Potential SRE: DD
Chilopoda	Geophilomorpha	Oryidae	*Orphnaeus* 'HD1' DNA	Potential SRE: DD
Chilopoda	Scolopendromorpha	Cryptopidae	*Cryptops* 'HD1'DNA.	Potential SRE: DD
Diplopoda	Polydesmida	Paradoxosomatidae	*Antichiropus* sp.	Potential SRE: DD
Diplopoda	Polydesmida	Paradoxosomatidae	*Antichiropus* 'wonmunna' DNA	Potential SRE: DD
Diplopoda	Spirobolida	Trigoniulidae	*Austrostrophus* 'Clade A' DNA	Potential SRE: DD
Diplopoda	Spirobolida	Trigoniulidae	*Austrostrophus* 'Clade E' DNA	Potential SRE: DD
Diplopoda	Spirobolida	Trigoniulidae	*Austrostrophus* sp.	Potential SRE: DD
Gastropoda	Eupulmonata	Pupillidae	*Gastrocopta* sp.	Widespread
Gastropoda	Eupulmonata	Pupillidae	*Pupoides* sp.	Widespread
Gastropoda	Eupulmonata	Subulinidae	*Eremopeas interioris*	Widespread
Gastropoda	Eupulmonata	Subulinidae	Subulinidae sp.	Widespread
Malacostraca	Isopoda	Armadillidae	*Buddelundia* '10ma'	Potential SRE: DD
Malacostraca	Isopoda	Armadillidae	*Buddelundia* '15'	Widespread
Malacostraca	Isopoda	Armadillidae	*Buddelundia* '16'	Widespread
Malacostraca	Isopoda	Armadillidae	*Buddelundia* '77'	Potential SRE: DD
Malacostraca	Isopoda	Armadillidae	*Buddelundia* sp.	Potential SRE: DD
Malacostraca	Isopoda	Armadillidae	Buddelundiinae sp.	Potential SRE: DD
Malacostraca	Isopoda	Armadillidae	*Pseudodiploexochus* sp.	Potential SRE: DD
Malacostraca	Isopoda	Armadillidae	*Troglarmadillo* sp.	Likely SRE
Malacostraca	Isopoda	Philosciidae	Philosciidae sp.	Potential SRE: DD

DNA putative species recognised with DNA barcoding.

Table 3.3. Number of specimens of SRE category invertebrates from each site.

Species	Bl01	Op01	SRE01	SRE02	SRE04	SRE08	SRE09	SRE10	SRE11	SRE12	SRE13	SRE14	SRE15	SRE16	SRE17	SRE18	SRE19	SRE20	SRE21	SRE22	SRE23	TS04	TS05	TS14	TS15	TS16	TS17	TS18	**Total No. specimens**	**Total No. Sites count**
Aurecocrypta 'HD1'															1														**1**	**1**
Aurecocrypta 'MYG315'																				1									**1**	**1**
Synothele 'MYG309'																												1	**1**	**1**
Synothele 'MYG311'																												1	**1**	**1**
Synothele sp.										1																			**1**	**1**
Aname sp.														1											1				**2**	**2**
Yilgarnia 'MYG197'																								1					**1**	**1**
Nemesiidae sp.									1																				**1**	**1**
Karaops banyjima																2	1		1										**4**	**3**
Karaops 'ARA001'																1													**1**	**1**
Anatemnus sp.												1																	**1**	**1**
Sundochernes sp.																					1								**1**	**1**
Tyrannochthonius 'HD1'												1																	**1**	**1**
Tyrannochthonius 'HD2'				1																									**1**	**1**
Austrohorus 'HD5'			1																										**1**	**1**
Beierolpium 'HD1'												1																	**1**	**1**
Beierolpium 'HD2'																								1					**1**	**1**
Euryolpium 'HD6'									2																				**2**	**1**
Euryolpium 'HD7'							1																						**1**	**1**
Euryolpium sp.								1										1											**2**	**2**
'Genus 7/4 PSE118'				4	1			2											2										**9**	**4**
'PSEAAA HD4'														1															**1**	**1**
Indolpium sp.			5																										**5**	**1**

Olpiidae sp.			1																									**1**	**1**
Lychas 'bituberculatus complex'	1																				1		1		2	1		**6**	**5**
Lychas 'hairy tail complex'																										1		**1**	**1**
Lychas 'multipunctatus complex'	3					1																	4			3		**11**	**4**
Urodacus 'HD1'											1																	**1**	**1**
Sepedonophilus 'HD1'		1													2		3											**6**	**3**
Sepedonophilus 'HD2'																				1								**1**	**1**
Sepedonophilus sp.			1														1											**2**	**2**
Geophilomorpha sp.														1														**1**	**1**
Mecistocephalus 'HD1'											1								1	2								**4**	**3**
Mecistocephalus 'HD2'																				1								**1**	**1**
Mecistocephalus 'HD3'													2															**2**	**1**
Orphnaeus 'HD1'																				1								**1**	**1**
Cryptops 'HD1'													3															**3**	**1**
Antichiropus sp.													1							2								**3**	**2**
Antichiropus 'wonmunna'													2							12								**14**	**2**
Austrostrophus 'Clade A'																		2										**2**	**1**
Austrostrophus 'Clade E'													1							1			4				1	**7**	**4**
Austrostrophus sp.											1		5	1	1	1	1											**10**	**6**
Buddelundia '10ma'									1												2	6						**9**	**3**
Buddelundia '77'													2		1		4			1	2							**10**	**5**
Buddelundia sp.																					1							**1**	**1**
Buddelundiinae sp.																					1		2					**3**	**2**
Pseudodiploexochus sp.															1													**1**	**1**
Troglarmadillo sp.											1																	**1**	**1**
Philosciidae sp.																	5						1					**6**	**2**
Total No. taxa per site	**2**	**1**	**4**	**2**	**1**	**1**	**1**	**2**	**3**	**1**	**5**	**3**	**7**	**4**	**5**	**2**	**6**	**2**	**3**	**3**	**10**	**2**	**1**	**7**	**1**	**1**	**3**	**3**	

Araneae

Araneomorphae

- *Karaops banyjima* (3)
- *Karaops* 'ARA001' (1)

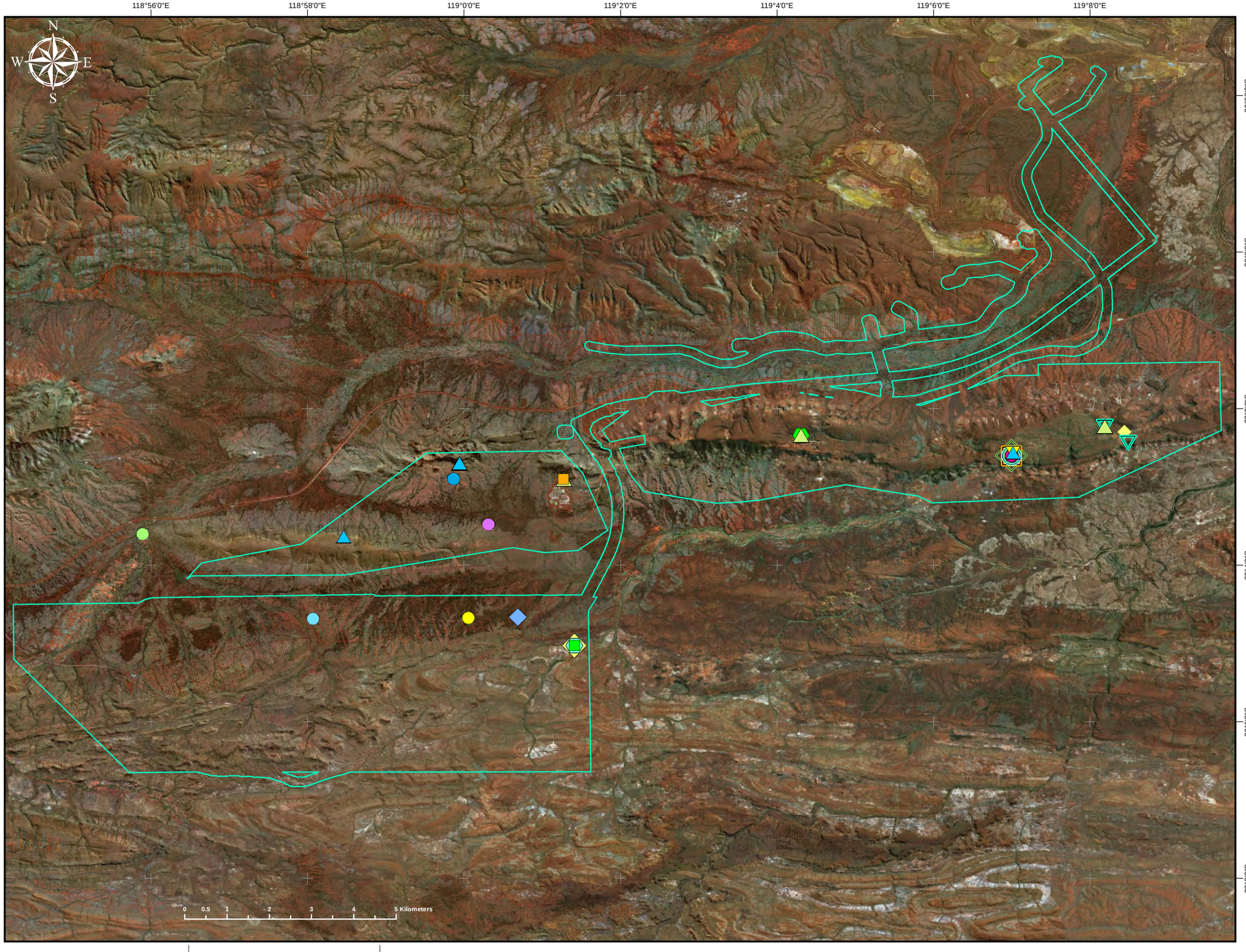
Mygalomorphae

- Nemesiidae sp. (1)
- *Aurecocrypta* 'MYG315' (1)
- *Austrohorus* 'HD5' (1)
- *Synothele* 'MYG309' (1)
- *Synothele* 'MYG311' (1)
- *Synothele* sp. (1)
- *Yilgarnia* 'MYG197' (1)

Pseudoscorpiones

- *Anatemnus* sp. (1)
- *Austrohorus* 'HD5' (1)
- Olpiidae sp. (1)
- *Beierolpium* 'HD1' (1)
- *Beierolpium* 'HD2' (1)
- *Euryolpium* 'HD6' (1)
- *Euryolpium* 'HD7' (1)
- *Euryolpium* sp. (2)
- 'PSEAAA HD4' (1)
- *Indolpium* sp. (2)
- 'Genus 7/4 PSE118' (4)
- *Sundochernes* sp. (1)
- *Tyrannochthonius* 'HD1' (1)
- *Tyrannochthonius* 'HD2' (1)

Study Area





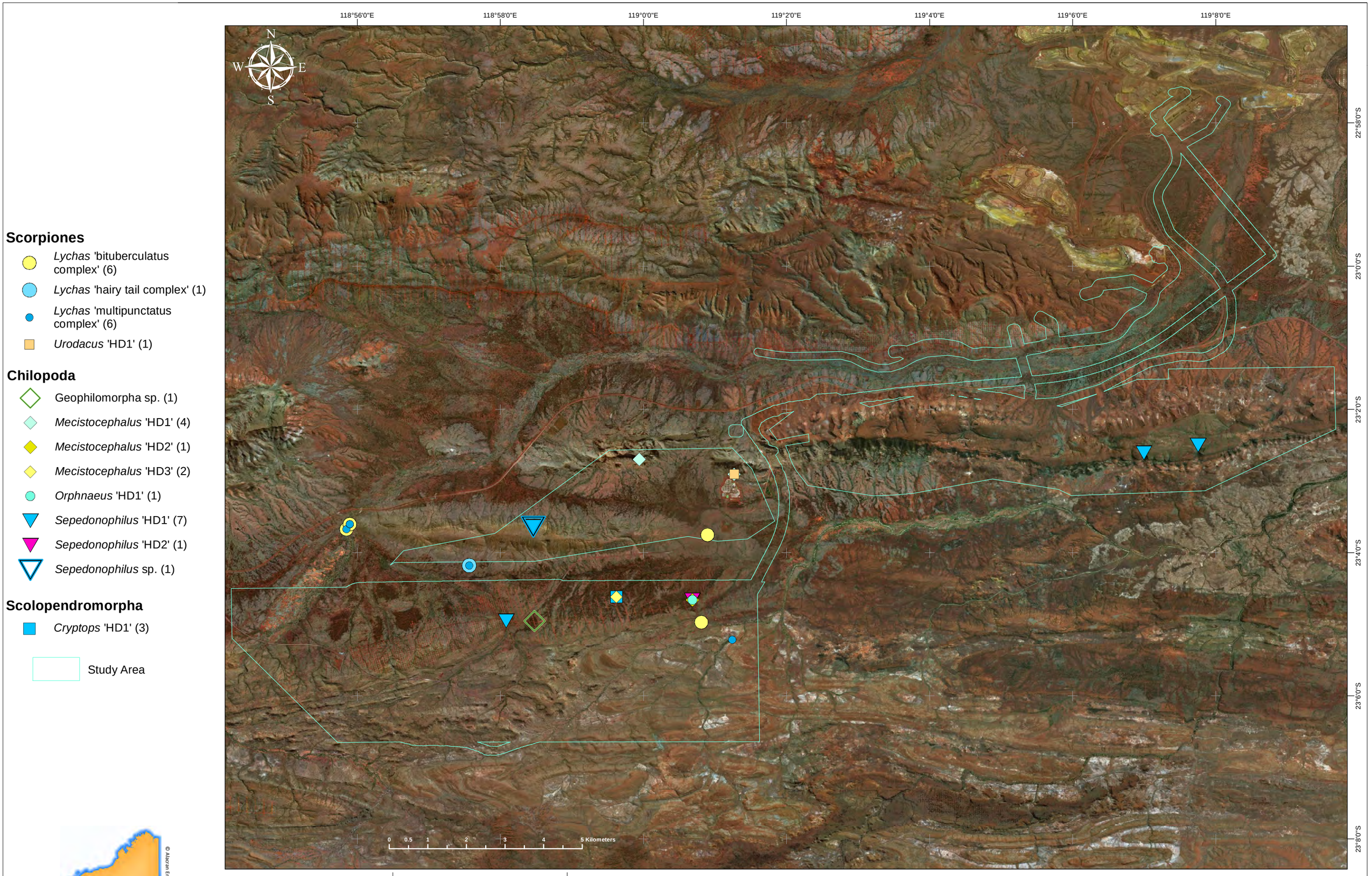
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Coordinate System: GCS WGS 1984
Projection: Transverse Mercator
Author: E.S. Volschenk
Date: 5 Dec 2019

Figure 3.1. Distribution of SRE and potential SRE spider and pseudoscorpion records from the field surveys.



Scorpiones

- *Lychas* 'bituberculatus complex' (6)
- *Lychas* 'hairy tail complex' (1)
- *Lychas* 'multipunctatus complex' (6)
- *Urodacus* 'HD1' (1)

Chilopoda

- Geophilomorpha sp. (1)
- *Mecistocephalus* 'HD1' (4)
- *Mecistocephalus* 'HD2' (1)
- *Mecistocephalus* 'HD3' (2)
- *Orphnaeus* 'HD1' (1)
- *Sepedonophilus* 'HD1' (7)
- *Sepedonophilus* 'HD2' (1)
- *Sepedonophilus* sp. (1)

Scolopendromorpha

- *Cryptops* 'HD1' (3)

Study Area



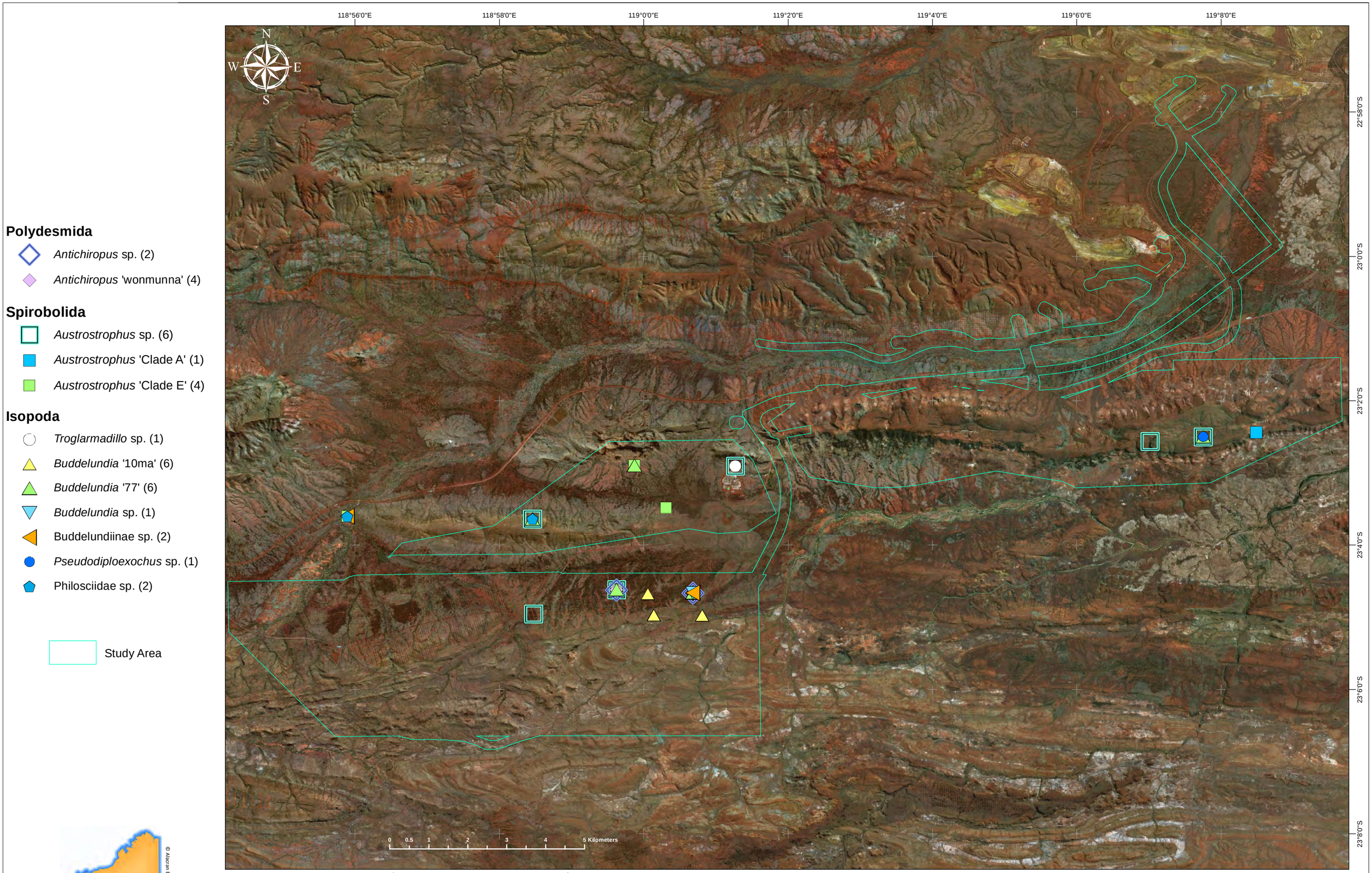
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Figure 3.2. Distribution of SRE and potential SRE scorpion and centipede records from the field surveys.



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Figure 3.3. Distribution of SRE and potential SRE millipede and slater records from the field surveys.

4 DISCUSSION

4.1 ARACHNIDA

Among the classes containing SREs, the arachnids stand out with the number of orders and families that contain SREs. With the exception of most modern spiders, and some pseudoscorpions and mites, most arachnids have relatively poor dispersal capabilities and are therefore significant candidates for exhibiting short-range endemism (Harvey 2002a; Harvey et al. 2011).

4.1.1 Araneae (spiders)

Spiders are instantly recognisable arachnids. In Australia, there are thought to be between 15,000 and 20,000 species, although only approximately 4,000 are currently named (White and Anderson 2017). Australia's spiders are broadly divided into two groups, the Araneomorphae (modern spiders) and the Mygalomorphae (trapdoor spiders). Most modern spiders are widely distributed and achieve this through 'ballooning'; a process where a spiderling creates and releases a long strand of silk into the wind. The silk strand eventually becomes long enough to 'catch the wind' like a kite and lift the spiderling into the wind to be deposited elsewhere, potentially many kilometres from its 'take-off' site. In the Pilbara, the modern spiders currently considered to contain SREs are members of the family *Selenopidae* (wall crab spiders) (Crews and Harvey 2011; Crews 2013).

Most of W.A's SRE spiders are trapdoor spiders. In W. A., nine trapdoor spider species are currently listed in the *Wildlife Conservation* (Specially Protected Fauna) *Notice* 2016 (Western Australian Government 2017); however, none of these are known from the Pilbara region. In the Pilbara, trapdoor spiders are represented by seven families: Actinopodidae, Barychelidae, Halonoproctidae, Dipluridae, Idiopidae, Nemesiidae and Theraphosidae, of which all except Theraphosidae are known to contain representatives with confirmed or potential short-range distributions (Harvey et al. 2012; Castalanelli et al. 2014; Rix et al. 2017b; Rix et al. 2018c).

The Search Area contained 111 SRE category spider taxa, of which four were named species, 83 were morphospecies and 24 were unidentified taxa (Table 4.1 and Figure 4.2-Figure 4.5). Four of these taxa are SREs and the remainder are potential SRE (DD) (Table 4.1).

The Search Area included several potential SRE (DD) spider taxa from within the Study Area:

- *Synothele* sp. (Figure 4.2): T116849, T116852; Mudlark, 87 km WNW. of Newman
- *Idiosoma* sp. (Figure 4.4): T116854, T116851; Mudlark, 87 km WNW. of Newman;
- *Aname* sp. (Figure 4.5): T116850; Mudlark, 87 km WNW. of Newman;
- *Kwonkan* 'MYG339' (Figure 4.5): T116853; Mudlark, 87 km WNW. of Newman.

Additional species were also revealed to the north and south of the Study Area, suggesting that a greater diversity of trapdoor spiders might be expected than the survey yielded. It is likely that survey conditions or methods were not optimal for sampling the broader diversity of trapdoor spiders in the area. Morphological identification of trapdoor spiders relies on characteristics of the adult male morphology and male trapdoor spiders are generally most active shortly after good summer or winter rains, when they leave their burrows and search for mates. Pitfall trapping (wet or dry) appears to be the most efficient way to sample these

spiders; however, since the males are wandering from their burrows, the specific microhabitat supporting these spiders may be difficult to determine. Wet pitfall traps are generally active for longer periods and have the greatest chance of being active during rainfall events.

Table 4.1. Table of SRE category Araneae identified from the area search of the W. A. Museum's Terrestrial Invertebrates Database

Infraorder	Family	Binomial	SRE Category	Justification
Araneomorphae	Selenopidae	*Karaops* 'ARA001'	Potential SRE: DD	W. A. Museum data
Araneomorphae	Selenopidae	*Karaops* 'ARA002'	Potential SRE: DD	W. A. Museum data
Araneomorphae	Selenopidae	*Karaops* 'ARA003'	Potential SRE: DD	W. A. Museum data
Araneomorphae	Selenopidae	*Karaops* 'ARA005'	Potential SRE: DD	W. A. Museum data
Araneomorphae	Selenopidae	*Karaops banyjima*	SRE	(Crews 2013)
Araneomorphae	Selenopidae	*Karaops* 'BD1'	Potential SRE: DD	(Phoenix 2011)
Araneomorphae	Selenopidae	*Karaops feedtime*	SRE	(Crews 2013)
Araneomorphae	Selenopidae	*Karaops* sp.	Potential SRE: DD	Genus contains SREs and potential SREs
Araneomorphae	Selenopidae	Selenopidae sp.	Potential SRE: DD	Family contain SREs and potential SREs
Mygalomorphae		Mygalomorphae sp.	Potential SRE: DD	Infraorder contains SREs and potential SREs
Mygalomorphae	Actinopodidae	*Missulena faulderi*	SRE	(Harms and Framenau 2013)
Mygalomorphae	Actinopodidae	*Missulena langlandsi*	SRE	(Harms and Framenau 2013)
Mygalomorphae	Actinopodidae	*Missulena* 'marillana'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Actinopodidae	*Missulena* 'MYG252'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Actinopodidae	*Missulena* sp.	Potential SRE: DD	Genus contains SREs and potential SREs
Mygalomorphae	Barychelidae	*Aurecocrypta* 'MYG057'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Barychelidae	*Aurecocrypta* 'MYG246'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Barychelidae	*Aurecocrypta* 'MYG315'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Barychelidae	*Aurecocrypta* 'MYG316'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Barychelidae	*Aurecocrypta* 'MYG317'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Barychelidae	*Aurecocrypta* sp.	Potential SRE: DD	Genus known to contain SREs and or potential SREs
Mygalomorphae	Barychelidae	*Barychelidae* 'bark door bary'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Barychelidae	*Barychelidae* sp.	Potential SRE: DD	Family contains SREs and potential SREs
Mygalomorphae	Barychelidae	*Idiommata* 'MYG128'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Barychelidae	*Idiommata* 'MYG247'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Barychelidae	*Idiommata* sp.	Potential SRE: DD	Genus contains SREs and

Infraorder	Family	Binomial	SRE Category	Justification
				potential SREs
Mygalomorphae	Barychelidae	*Synothele* 'MYG055'	potential SRE: DD	W. A. Museum data
Mygalomorphae	Barychelidae	*Synothele* 'MYG309'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Barychelidae	*Synothele* 'MYG311'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Barychelidae	*Synothele* 'MYG334'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Barychelidae	*Synothele* sp.	Potential SRE: DD	Genus contains SREs or potential SREs
Mygalomorphae	Dipluridae	*Cethegus* 'Cloudbreak sp. 1'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Dipluridae	*Cethegus* 'MYG299'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Dipluridae	*Cethegus* sp.	Potential SRE: DD	Genus contains SREs and potential SREs
Mygalomorphae	Halonoproctidae	*Conothele* 'MYG002'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Halonoproctidae	*Conothele* 'MYG279'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Halonoproctidae	*Conothele* 'MYG281'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Halonoproctidae	*Conothele* 'MYG282'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Halonoproctidae	*Conothele* 'MYG293'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Halonoproctidae	*Conothele* 'MYG333'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Halonoproctidae	*Conothele* 'MYG385'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Halonoproctidae	*Conothele* 'MYG525'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Halonoproctidae	*Conothele* 'MYG526'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Halonoproctidae	*Conothele* 'MYG527'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Halonoproctidae	*Conothele* 'MYG528'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Halonoproctidae	*Conothele* 'MYG533'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Halonoproctidae	*Conothele* 'MYG534'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Halonoproctidae	*Conothele* 'MYG537'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Halonoproctidae	*Conothele* 'MYG538'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Halonoproctidae	*Conothele* 'MYG539'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Halonoproctidae	*Conothele* 'MYG558'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Halonoproctidae	*Conothele* 'MYG574'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Halonoproctidae	*Conothele* sp.	Potential SRE: DD	Genus contains SREs and potential SREs
Mygalomorphae	Idiopidae	*Eucyrtops* 'B04'	Potential SRE: DD	Genus contains SREs and potential SREs
Mygalomorphae	Idiopidae	*Eucyrtops* sp.	Potential SRE: DD	Genus contains SREs and potential SREs
Mygalomorphae	Idiopidae	Idiopidae sp.	Potential SRE: DD	Family contains SREs and potential SREs
Mygalomorphae	Idiopidae	*Idiosoma* 'Cloudbreak sp. 1'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Idiopidae	*Idiosoma* 'MYG083'	Potential SRE: DD	W. A. Museum data

Infraorder	Family	Binomial	SRE Category	Justification
Mygalomorphae	Idiopidae	*Idiosoma* 'MYG085'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Idiopidae	*Idiosoma* 'MYG086'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Idiopidae	*Idiosoma* 'MYG126'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Idiopidae	*Idiosoma* 'MYG233'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Idiopidae	*Idiosoma* 'MYG300'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Idiopidae	*Idiosoma* 'MYG303'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Idiopidae	*Idiosoma* 'MYG305'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Idiopidae	*Idiosoma* 'MYG306'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Idiopidae	*Idiosoma* 'MYG384'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Idiopidae	*Idiosoma* sp.	Potential SRE: DD	Genus contains SREs and potential SREs
Mygalomorphae	Nemesiidae	*Aname* 'marillana group'	potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Aname* 'MYG035'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Aname* 'MYG104'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Aname* 'MYG321'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Aname* 'MYG340'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Aname* 'MYG341'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Aname* 'MYG377'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Aname* 'MYG378'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Aname* sp.	Potential SRE: DD	Genus contains SREs and potential SREs
Mygalomorphae	Nemesiidae	*Kwonkan* 'MYG006'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Kwonkan* 'MYG033'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Kwonkan* 'MYG088'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Kwonkan* 'MYG098'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Kwonkan* 'MYG101'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Kwonkan* 'MYG195'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Kwonkan* 'MYG197'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Kwonkan* 'MYG323'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Kwonkan* 'MYG324'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Kwonkan* 'MYG325'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Kwonkan* 'MYG336'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Kwonkan* 'MYG337'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Kwonkan* 'MYG338'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Kwonkan* 'MYG339'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Kwonkan* 'MYG340'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Kwonkan* 'MYG379'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Kwonkan* 'MYG380'	Potential SRE: DD	W. A. Museum data

Infraorder	Family	Binomial	SRE Category	Justification
Mygalomorphae	Nemesiidae	*Kwonkan* 'MYG433'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Kwonkan* 'MYG484'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Kwonkan* 'MYG524'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Kwonkan* sp.	Potential SRE: DD	Genus contains SREs and potential SREs
Mygalomorphae	Nemesiidae	Nemesiidae 'N140'	potential SRE: DD	W. A. Museum Data
Mygalomorphae	Nemesiidae	Nemesiidae 'N43'	Potential SRE: DD	W. A. Museum Data
Mygalomorphae	Nemesiidae	Nemesiidae sp.	Potential SRE: DD	Family contains SREs and potential SREs
Mygalomorphae	Nemesiidae	*Swolnpes* 'MYG234'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Teyl* 'MYG027'	Potential SRE: DD	W. A. Museum data
Mygalomorphae	Nemesiidae	*Teyl* sp.	Potential SRE: DD	Genus contains SREs or potential SREs
Mygalomorphae	Nemesiidae	*Yilgarnia* sp.	Potential SRE: DD	Genus contains SREs and potential SREs

Fourteen spider taxa were collected during these surveys, representing the families Selenopidae, Actinopodidae, Barychelidae, Idiopidae and Nemesiidae. Five of these represented widespread taxa, eight species were potential SRE owing to data deficiency (*Aurecocrypta* 'HD1', *Aurecocrypta* 'MYG315', *Synothele* 'MYG309', *Synothele* 'MYG311', *Synothele* sp., *Aname* sp., *Yilgarnia* 'MYG197', Nemesiidae sp.) and one species was a known SRE (*Karaops banyjima*). The identity of *Karaops banyjima, Aurecocrypta* 'HD1', *Aurecocrypta* 'MYG315', *Synothele* 'MYG309' and *Synothele* 'MYG311' were verified with DNA barcoding (Appendix 3).

4.1.1.1 Selenopidae (wall crab spiders or flatties)

Karaops banyjima. Four samples of *Karaops* were obtained, of which three were identified as *Karaops banyjima* using Crews (2013). This species is an SRE and the type locality is 19.2 km north of the centre of the study area (Figure 4.2). *Karaops banyjima* was sampled from sites SRE18, SRE19 and SRE21 (Figure 3.1).

A COI sequence from this species (AES190099) was obtained to confirm its relationship with this species. The barcoding study undertaken by Alacran (Appendix 3) found this sample to be most similar to the Genbank sequence of *Karaops banyjima*. Assessment by the W.A. Museum (Appendix 4); however, assigned *Karaops nyangumarta* to this sequence, not *Karaops banyjima*. In order to resolve the issue of species identity, a third opinion was requested from Dr Sarah Crews, who is an authority on the global systematics of Selenopidae and the author of both *Karaops banyjima* and *Karaops nyangumarta* (Crews 2013). On the basis of the photographs provided (Figure 4.1) Dr Crews identified this species as *Karaops banyjima* and this identification is followed here.

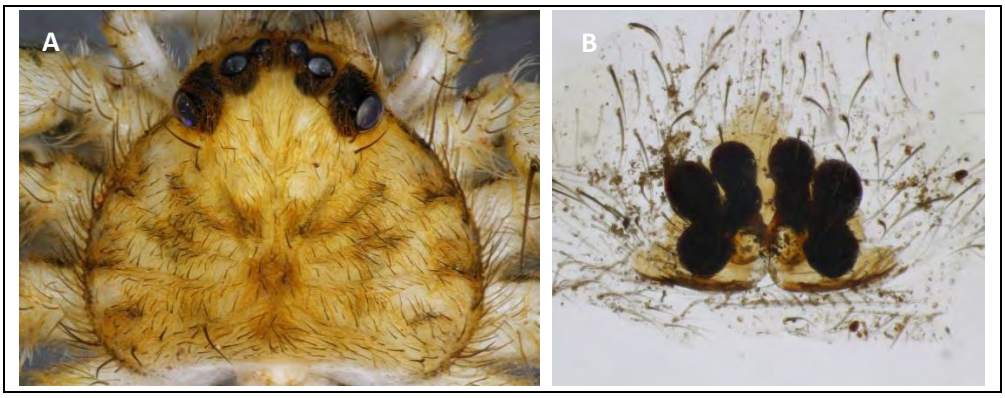


Figure 4.1 Photographs used to confirm the identity of *Karaops banyjima* (AES190099): A, carapace; B, epigynum morphology.

***Karaops* 'ARA001'.** This species was represented by a juvenile specimen and identified using DNA barcoding of COI. The W. A. Museum identified this sample as *Karaops* 'ARA001', a potential SRE species owing to data deficiency concerning its taxonomy and distribution limits.

4.1.1.2 Actinopodidae (mouse spiders)

***Missulena rutraspina*.** Two samples of *Missulena rutraspina* were obtained from site TS18. This species is widespread in the Pilbara (DBCA 2019).

4.1.1.3 Barychelidae (brush footed trapdoor spiders)

***Aurecocrypta* 'MYG315'**. This species was identified from a single juvenile specimen from site SRE22. This specimen was identified with DNA barcoding (Appendix 3). *Aurecocrypta* 'MYG315' was also recorded from the Search Area (Figure 4.2) and is a potential SRE owing to data deficiency regarding its distribution limits. The species appears to have a relatively wide distribution, within the constraints of an SRE, with records occurring from the north west of the Search Area to just north of Newman (Figure 4.2). This project is therefore unlikely to present a significant threat to this species.

***Aurecocrypta* 'HD1'**. This species was represented by a single female specimen from site SRE17. While DNA sequences were obtained from this specimen, no matches could be found by either Alacran or W. A. Museum barcoding studies (Appendix 3 and Appendix 4). *Aurecocrypta* 'HD1' is a potential SRE owing to data deficiency regarding its distribution limits.

***Synothele* 'xkarara'**. Four samples of this species were tentatively identified to *Synothele* 'xkarara', from sites TS07 and TS18. This morpho-species is extremely similar to *Synothele karara* and both have widespread distributions.

***Synothele* 'MYG309'.** A single sample of this species was represented by a juvenile specimen from site TS18 (Table 3.3 and Figure 3.1). The identity of the species was confirmed with DNA barcoding, Appendix 3. This species was represented by 25 samples at 10 different localities within the Search Area. The distribution of this species suggests that it is restricted to the Eastern Hammersley range, but that its distribution extends outside of the project area, Table 4.1 and Figure 4.2. This project is therefore unlikely to significantly threaten this species.

***Synothele* 'MYG311'**. A single sample of this species was represented by a female from site TS18 (Table 3.3 and Figure 3.1). The identity of the species was confirmed with DNA barcoding, Appendix 3. This species was represented by seven samples at six different localities within the Search Area. This species also appears to be restricted to the Eastern Hamersley range, but its distribution extends outside of the Study Area, Table 4.1 and Figure 4.2. This project is therefore unlikely to significantly threaten this species.

***Synothele* sp.** This taxon was represented by three samples, obtained from sites SRE12, SRE17 and SRE22 (Table 3.3 and Figure 3.1). These samples were either female or juvenile, so species level identification was not possible using morphology. Attempts to amplify COI sequences from these samples were unsuccessful. These samples are potential SREs owing to data deficiency concerning their species identity. The genus *Synothele* contains many SRE morphospecies and four are known from the search area (Table 4.1).

4.1.1.4 Idiopidae (spiny trapdoor spiders)

Gaius tealei. This species was represented by females and juveniles, from five sites SRE03, SRE16, SRE23, TS14 and TS18. During the T1 survey, this species was identified as *Gaius* sp.; however, since that survey, the genus was revised and *Gaius tealei* described (Rix et al. 2018c). *Gaius tealei* is the only known representative of this genus in the Pilbara where it is widespread (Rix et al. 2018c).

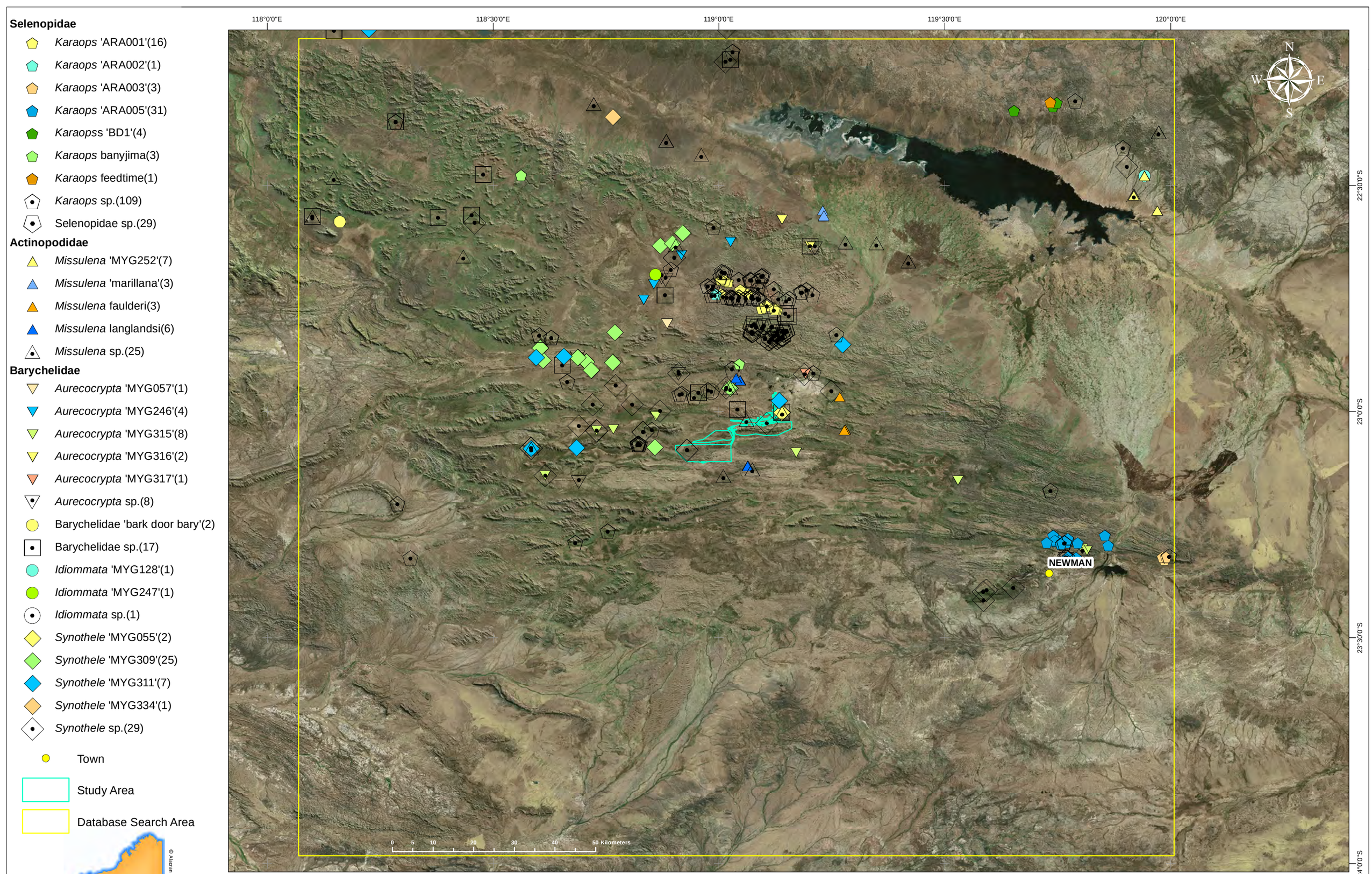
4.1.1.5 Nemesiidae (open-holed trapdoor spiders)

***Aname mellosa*.** *Aname mellosa* was represented by 27 samples from sites TS14, TS16-18, SRE16, SRE18, Bl01 and Hope Downs Village (camp). This species is widespread in the Pilbara (DBCA 2019).

***Aname* 'MYG004'.** A single sample of this morphospecies was collected from site TS17. This species is widespread in the Pilbara (Table 4.1).

***Yilgarnia* 'MYG197'.** Despite being an adult male, this specimen could not be clearly matched with any of the W. A. Museum voucher morphospecies. The identity if this species was confirmed using DNA sequences (Appendix 3). This species is a potential SRE since *Yilgarnia* contains potential SRE species (Table 4.1 and Figure 4.2).

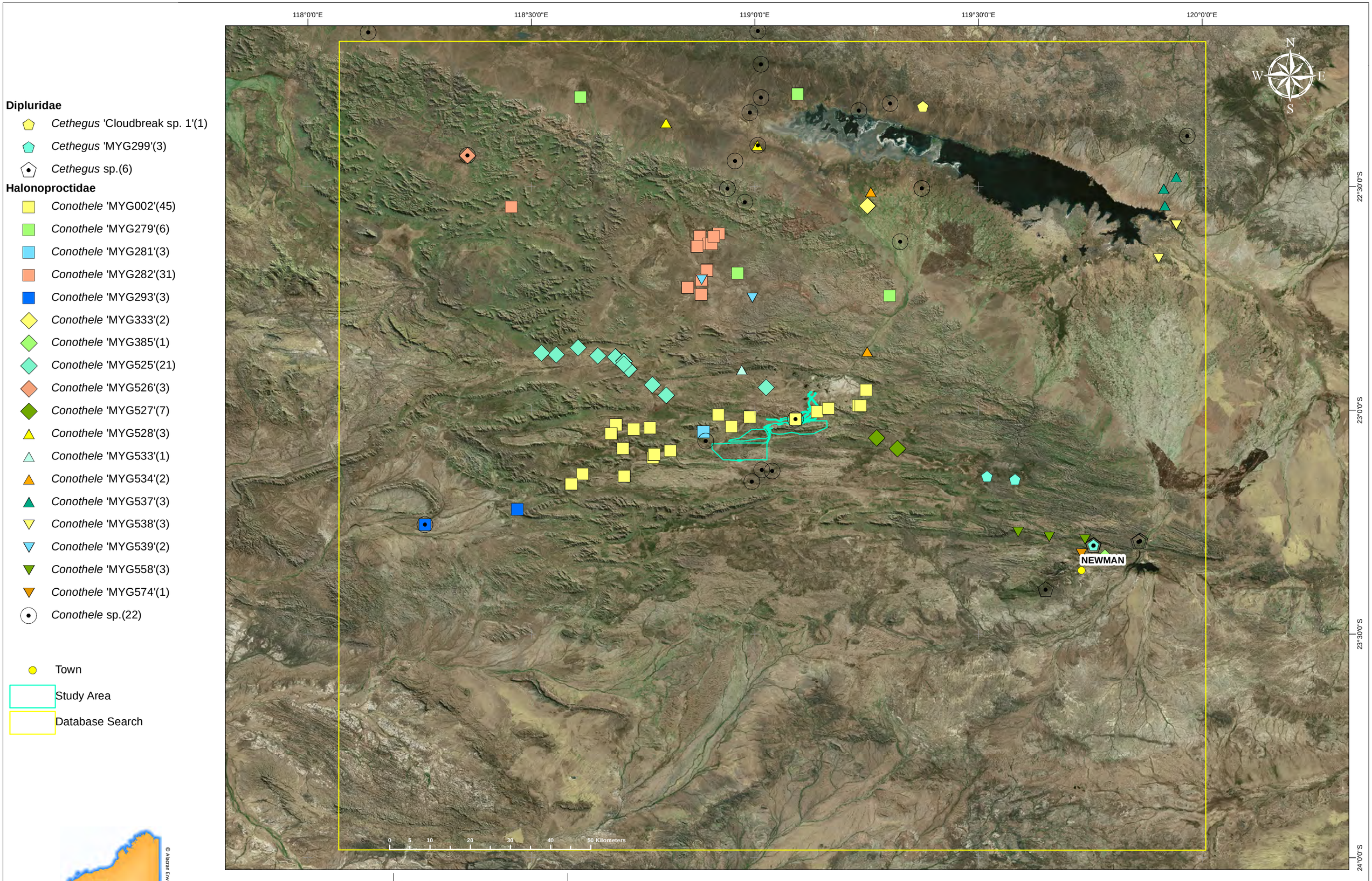
Nemesiidae sp. This taxon was represented by a single female sample from site SRE11. This specimen could not be identified to genus or species as adult males are needed to do this (Harvey et al. 2018). Attempts to amplify COI sequences from this specimen were unsuccessful. The family Nemesiidae contains numerous potential SRE morphospecies and while the identity of this specimen is ambiguous it is a potential SRE owing to taxonomic data deficiency.



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Projection: Transverse Mercator
Author: E.S. Volschenk
Date: 2 Oct 2019

Figure 4.2. Central and eastern Pilbara showing the distribution of SRE category spider records from the database Search Area: families Selenopidae, Actinopodidae and Barychelidae. Number of records in Parentheses.



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Date: 1 Oct 2019

Figure 4.3. Central and eastern Pilbara showing the distribution of SRE category spider records from the database Search Area: families Dipluridae and Halonoproctidae. Number of records in Parentheses.

Idiopidae

- *Eucyrtops* 'B04'(1)
- *Eucyrtops* sp.(26)
- *Gaius* 'MYG286'(7)
- *Gaius* sp.(5)
- Idiopidae sp.(14)
- *Idiosoma* 'Cloudbreak sp.
- *Idiosoma* 'MYG083'(24)
- *Idiosoma* 'MYG085'(9)
- *Idiosoma* 'MYG086'(6)
- *Idiosoma* 'MYG126'(4)
- *Idiosoma* 'MYG233'(3)
- *Idiosoma* 'MYG300'(6)
- *Idiosoma* 'MYG303'(4)
- *Idiosoma* 'MYG305'(2)
- *Idiosoma* 'MYG306'(3)
- *Idiosoma* 'MYG384'(12)
- *Idiosoma* sp.(124)

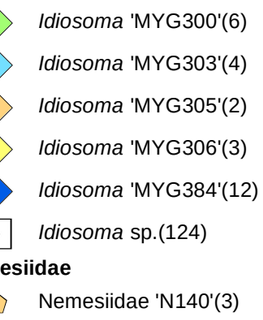
Nemesiidae

- Nemesiidae 'N140'(3)
- Nemesiidae 'N43'(5)
- Nemesiidae sp.(67)
- *Swolnpes* 'MYG234'(3)
- *Teyl* 'MYG027'(4)
- *Teyl* sp.(6)
- *Yilgarnia* 'MYG197'(3)
- *Yilgarnia* sp.(8)

Town

Study Area

Database Search Area



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Projection: Transverse Mercator
Author: E.S. Volschenk
Date: 2 Oct 2019

Figure 4.4. Central and eastern Pilbara showing the distribution of SRE category spider records from the database Search Area: families Idiopidae and Nemesiidae (part 1). Number of records in Parentheses.

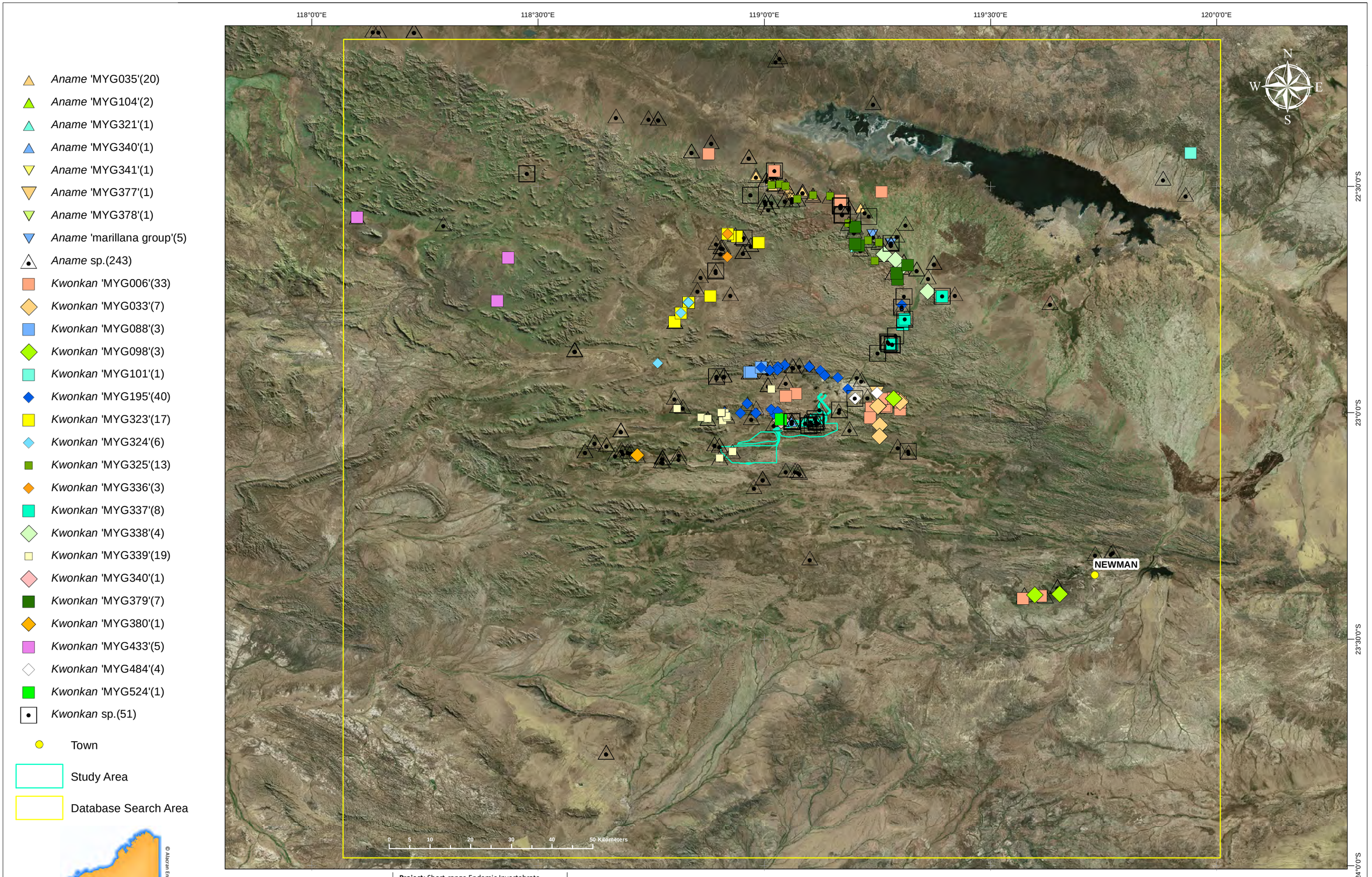


Figure 4.p0 Central and eastern Pilbara showing the distribution of SRE category spider records from the database Search Area: family Nemesiidae (part 2). Number of records in Parentheses.

4.1.2 Opiliones (harvestmen)

Opiliones appear superficially similar to small spiders, but differ from them by lacking a clearly defined division (constriction) between the cephalothorax and abdomen, as well as in numerous other aspects (Pinto-da-Rocha et al. 2007). In Australia, 11 families are recorded (ALA 2017). Some members of this order are SREs while others have wider distribution patterns (Harvey 2002b). The Pilbara diversity of Opiliones is poorly known but appears to be dominated by the genus *Dampetrus* (Assamiidae) (DPaW 2017), a diverse but poorly resolved genus confined to northern Australia (Shear 2001).

The Search Area contained two Opiliones taxa: Opiliones sp. and Assamiidae sp. (Figure 4.6). Both were considered Potential SRE: DD owing to their need for more mesic microhabitats. The field survey yielded no Opiliones and none of the Search Area records were within the Study Area. The absence of Opiliones was difficult to interpret as conditions leading up to both surveys was quite dry and if they are present, the rain experienced during the T2 survey may not have been sufficient to bring them out from their retreats. If present, they are likely to be in the rocky gorges and gullies in Bedded Hilltop and Wonmunna areas.

4.1.3 Pseudoscorpions (pseudoscorpions)

Pseudoscorpions superficially resemble scorpions, but they are not closely related to them. They are generally much smaller than most scorpions and lack the distinctive tail-like abdomen and stinging telson for which scorpions are infamous. In W. A. pseudoscorpions are represented by 19 families (Harvey 2013a). They occur on most undisturbed terrestrial habitats but are seldom noticed owing to their small size and cryptic behaviour (Harvey 1992). The Pilbara pseudoscorpion fauna is generally poorly known with only a few groups receiving taxonomic attention over the last decade and these are primarily focussed on troglobites (Harvey and Edwards 2007; Harvey and Volschenk 2007; Edward and Harvey 2008; Harvey and Leng 2008c). The epigean taxa flagged as SREs or Potential SREs are largely undescribed.

The Search Area contained 52 SRE category pseudoscorpion taxa, of which three are named species, 31 were morphospecies and 18 were unidentified taxa (Table 4.2, Figure 4.6 and Figure 4.7). Two species are SREs and the remaining taxa are Potential SRE (DD) (Table 4.2).

Table 4.2. Table of SRE category Pseudoscorpiones identified from the area search of the W. A. Museum's Terrestrial Invertebrates Database

Family	Binomial	SRE-Category	Justification
	Panctenata sp.	Potential SRE: DD	Infraorder contains SREs and potential SREs
	Pseudoscorpiones sp.	Potential SRE: DD	Order contains SREs and potential SREs
Atemnidae	*Paratemnoides* sp.	Potential SRE: DD	Genus likely to contain SREs and potential SREs
Chernetidae	Chernetidae sp.	Potential SRE: DD	Family contains SREs and potential SREs
Chernetidae	*Cordylochernes* 'cf. dingo'	Potential SRE: DD	W. A. Museum data
Chernetidae	*Haplochernes* '1'	Potential SRE: DD	Genus contains SREs and potential SREs

Family	Binomial	SRE-Category	Justification
Chernetidae	*Haplochernes* '2'	Potential SRE: DD	Genus contains SREs and potential SREs
Chernetidae	*Haplochernes* sp.	Potential SRE: DD	Genus contains SREs and potential SREs
Chernetidae	*Nesidiochernes* sp.	Potential SRE: DD	Genus likely to contain SREs and potential SREs
Chernetidae	*Sundochernes* 'PSE090'	Potential SRE: DD	W. A. Museum data
Chernetidae	*Troglochernes* 'PSE072'	Potential SRE: DD	
Chernetidae	*Troglochernes* sp.	Potential SRE: DD	Presence of SRE or potential SRE species in this genus
Chthoniidae	*Austrochthonius* sp.	Potential SRE: DD	Genus likely to contain SREs and potential SREs
Chthoniidae	Chthoniidae sp.	Potential SRE: DD	Family contains SREs and potential SREs
Chthoniidae	*Tyrannochthonius aridus*	Potential SRE: DD	See discussion
Chthoniidae	*Tyrannochthonius* 'aridus?'	Potential SRE: DD	See discussion
Chthoniidae	*Tyrannochthonius* sp.	Potential SRE: DD	Presence of SRE species in this genus (Edward and Harvey 2008)
Feaellidae	*Feaella callani*	SRE	(Harvey et al. 2016)
Garypidae	*Synsphyronus gracilis*	SRE	W. A. Museum data
Garypidae	*Synsphyronus* 'PSE006'	Potential SRE: DD	W. A. Museum data
Garypidae	*Synsphyronus* 'PSE014'	Potential SRE: DD	W. A. Museum data
Garypidae	*Synsphyronus* 'PSE085'	Potential SRE: DD	W. A. Museum data
Garypidae	*Synsphyronus* 'PSE086'	Potential SRE: DD	W. A. Museum data
Garypidae	*Synsphyronus* sp.	Potential SRE: DD	Genus contains SREs or potential SREs
Garypinidae	*Solinus* sp.	Potential SRE: DD	Genus contains SREs and potential SREs
Hyidae	*Indohya* 'Mt Meharry'	Potential SRE: DD	W. A. Museum data
Olpiidae	*Austrohorus* '1 (big)'	Potential SRE: DD	W. A. Museum data
Olpiidae	*Austrohorus* 'M1'	Potential SRE: DD	W. A. Museum data
Olpiidae	*Austrohorus* 'M2'	Potential SRE: DD	W. A. Museum data
Olpiidae	*Austrohorus* 'PSE119'	Potential SRE: DD	W. A. Museum data
Olpiidae	*Austrohorus* 'PSE120'	Potential SRE: DD	W. A. Museum data
Olpiidae	*Austrohorus* 'PSE121'	Potential SRE: DD	W. A. Museum data
Olpiidae	*Austrohorus* 'PSE122'	Potential SRE: DD	W. A. Museum data
Olpiidae	*Austrohorus* sp.	Potential SRE: DD	Genus likely to contain SREs and potential SREs
	Beierolpium 'PSE126'	Potential SRE: DD	W. A. Museum data
	Genus 7/4 *'PSE118'*	Potential SRE: DD	W. A. Museum data
Olpiidae	*Indolpium* '1'	Potential SRE: DD	W. A. Museum data
Olpiidae	*Indolpium* '2'	Potential SRE: DD	W. A. Museum data
Olpiidae	*Indolpium* 'PSE123'	Potential SRE: DD	W. A. Museum data

Family	Binomial	SRE-Category	Justification
Olpiidae	*Indolpium* 'PSE124'	Potential SRE: DD	W. A. Museum data
Olpiidae	*Indolpium* 'PSE125'	Potential SRE: DD	W. A. Museum data
Olpiidae	*Indolpium* 'long chelal hand'	Potential SRE: DD	W. A. Museum data
Olpiidae	*Indolpium* sp.	Potential SRE: DD	Genus contains SREs and potential SREs
Olpiidae	*Linnaeolpium* sp.	Potential SRE: DD	Genus contains SREs and Potential SREs
Olpiidae	Olpiidae sp.	Potential SRE: DD	Family contains SREs and potential SREs
Olpiidae	'PSEAAA' sp.	Potential SRE: DD	W. A. Museum data
Olpiidae	*Xenolpium* '1'	Potential SRE: DD	W. A. Museum data
Olpiidae	*Xenolpium* '2'	Potential SRE: DD	W. A. Museum data
Olpiidae	*Xenolpium* 'PSE033'	Potential SRE: DD	W. A. Museum data
Olpiidae	*Xenolpium* sp.	Potential SRE: DD	Genus contains SREs and potential SREs

The field survey sampled eight pseudoscorpion taxa from four families: Atemidae, Chernetidae, Chthoniidae and Olpiidae (Table 3.2).

4.1.3.1 Atemidae

***Anatemnus* sp.** A single adult female specimen of *Anatemnus* sp. was obtained from site SRE10. This species is very unusual by being eyeless and having relatively pale body colour colouration. These features closely resemble those seen in the troglobitic *Anatemnus subvastus*, the only described species in this genus from the Pilbara (Alexander et al. 2014). The placement of this species into *Anatemnus* is also tentative owing to the uncertain relationship between this genus and several other genera in Atemnidae (Alexander et al. 2014). This sample represents the first epigean representative of *Anatemnus* from the Pilbara. This species is a potential SRE owing to data deficiency regarding its taxonomy and distribution limits.

***Oratemnus* sp.** Specimens of *Oratemnus* sp. were sampled from three sites: SRE03 SRE11, SRE13 and SRE23. This taxon has been collected widely throughout the Pilbara and is not an SRE.

4.1.3.2 Chernetidae

***Sundochernes* sp.** A single sample of this species was collected from site SRE23. Species in this genus are occasionally sampled in Pilbara surveys; however, they are seldom collected in large numbers or from more than two or three sites. They are potential SREs owing to data deficiency regarding their distribution and taxonomy.

4.1.3.3 Chthoniidae

Tyrannochthonius aridus is the only named epigean species in this genus from the Pilbara where it has been recorded across a wide distribution. The distribution of *Tyrannochthonius aridus* is inconsistent with that of the subterranean species, which are all SREs. The type locality for *Tyrannochthonius aridus* is Barrow Island

(Edward and Harvey 2008). Preliminary investigation into this species indicates the presence of more than one species in the Pilbara. The only two COI sequences for *Tyrannochthonius aridus* in GenBank (Benson et al. 2012) are KJ659959 from Wodgina Mine, 21.1790°S 118.6463°E and KJ659960 from Boodarie Stockyard, 20.4752°S 118.5071°E. The genetic divergence between these samples is 11.1%, suggesting that they represent different species. For this reason, the identity of all epigean *Tyrannochthonius* should be verified using molecular data.

This survey obtained two samples of *Tyrannochthonius*. The barcoding study undertaken by Alacran (Appendix 3) regarded these as different species owing to them being 13.13% divergent from one another. While confirming a similar genetic divergence (13%) the study undertaken by W. A. Museum did not consider these as clearly different species, but rather took the position that based on this genetic divergence "does not allow a conclusion about whether the two are conspecific or not" (Appendix 4). In this instance the more definitive and defensible approach of Alacran's report (Appendix 3) is adopted and the two species recognised are: ***Tyrannochthonius* 'HD1'** from site SRE14 and ***Tyrannochthonius* 'HD2'** from site SRE02 (Appendix 3). Both species represent potential SRE's owing to data deficiency regarding their distribution limits.

4.1.3.4 Olpiidae

In the Pilbara, epigean Olpiidae constitute species of *Austrohorus*, *Beierolpium*, *Euryolpium*, *Indolpium*, *Xenolpium* and 'Genus 7/4'. The constituent species of these genera have been problematic to assess using morphology alone. *Austrohorus* and *Indolpium* are suspected to contain numerous species; however, there is no morphological framework for identifying Pilbara species. *Beierolpium* has a basic taxonomic framework; however, it has not been tested with either robust morphological assessment or with DNA based species delimitation. A recent molecular investigation (Alacran, unpublished data) into the diversity of a small group of Pilbara Olpiidae revealed the presence of nine putative species from four genera. Independent assessment of those sequences by the W. A. Museum confirmed these identifications and all are potential SREs. That study was not exhaustive, either by way of sample intensity or survey area, and it seems likely that many more species of Olpiidae are present in the in the Pilbara.

In this study, representatives of unresolved (using morphology) putative olpiid taxa from each sample sites were assessed using DNA barcoding.

***Austrohorus* 'HD5'.** A single record of this species was sampled from site SRE01. While this species was distinct, its generic placement was ambiguous with an unresolved polytomy of *Austrohorus*, 'Genus 7/4' and *Nanolpium* (Appendix 3). The study undertaken by the W. A. Museum placed this species in *Austrohorus* but did not recognise this as a novel species, despite being 14.46% divergent from the most similar species in that analysis. The species delimitation presented by Alacran (Appendix 3) is followed here owing to the clear and testable framework for species delimitation.

***Beierolpium* '8/4 small'.** This survey recorded one sample of *Beierolpium* '8/4 small' from site SRE19. Attempts to sequence this sample were unsuccessful. *Beierolpium* '8/4 small' is thought to be widespread in the Pilbara.

Three putative species of *Beierolpium* were recognised by Alacran (Appendix 3) using DNA barcoding. The W. A. Museum indicated the presence of two species (Appendix 4). Where Alacran recognised two different species, based on 11% sequence divergence between samples AES190331 and AES190341, the W. A. Museum, based on similar sequence divergence, recognised one species and neither analyses could apply a name to these samples. For the purpose of this report, Alacran's analysis is followed as it offers a clear and published rationale for delimitation between species using sequences of COI: >8% COI sequence divergence based (Hebert et al. 2003b). The study undertaken by the W. A. Museum offered no rationale for species delimitation.

The three species of *Beierolpium* identified here are ***Beierolpium* 'HD1'** from site SRE14, potential SRE owing to data deficiency; ***Beierolpium* 'HD2'** from site TS14, a potential SRE owing to data deficiency, and ***Beierolpium* '8/4'** from site SRE13, a widespread species in the Pilbara.

Both barcoding studies (Appendix 3 and Appendix 4) recognised two putative species of *Euryolpium*: ***Euryolpium* 'HD6'** was identified from site SRE6 and ***Euryolpium* 'HD7'** from site SRE09. Representatives of both species are juveniles and were initially thought to be species of *Beierolpium*; however, the phylogenetic analyses used to assess relationships between these sequences placed both samples in monophyletic *Euryolpium* clade.

Prior to this study, the genus *Euryolpium* was thought to be represented by a single widespread species (undescribed) in the Pilbara and was not identified to a morphospecies. *Euryolpium* can be difficult to diagnose with morphology since the distinguishing characteristics are only distinctive in adult females.

Two samples were identified to ***Euryolpium* sp.** for sites SRE10 and SRE20. The relationship of these with the two genetic species is not known. With the discovery *Euryolpium* 'HD6' and *Euryolpium* 'HD7', both potential SREs, unresolved *Euryolpium* sp. can no longer be regarded as widespread and are here considered to be potential SRE owing to taxonomic data deficiency.

'Genus 7/4 PSE118'. Four specimens belonging to this species were identified from sites SRE02, SRE04 and SRE10. The identity of all four specimens was confirmed with DNA barcoding (Appendix 3). This species is currently regarded as a potential SRE owing to limited knowledge about its distribution. Area Search records included a single representative of this species in the northern portion of the Search Area (Figure 4.7).

'PSEAAA HD4'. This species was sampled from site SRE16 and was identified using DNA barcoding (Appendix 3 and Appendix 4). The study undertaken by the W. A. Museum assigned this sample to an undescribed species and genus of Olpiidae: 'PSEAAA' sp.; however, that relationship was based on a 13.61% sequence divergence with a voucher sequence of 'PSEAAA' sp.. Alacran (Appendix 3) identified this species as belonging to *Indolpium*; however, that study did not include representative sequences of the genus 'PSEAAA'. The species identity of 'PSEAAA HD4' follows the findings of the W. A. Museum and uses the species delimiting threshold >8% sequence divergence to recognise this as a novel species.

***Indolpium* sp.** was recorded from site SRE01 and represents an ambiguous identification. Recent DNA barcoding studies (Alacran, unpublished) identified three undescribed species (*Indolpium* 'PSE123',

Indolpium 'PSE124' and *Indolpium* 'PSE125') from this region of the Pilbara (Figure 4.7). All three are potential SREs and because of this, unresolved *Indolpium* species identifications are potential SRE.

Olpiidae sp. was represented by a single sample from site SRE01. Attempts to obtain DNA sequences from this specimen were unsuccessful. In the absence of a species level identification, Olpiidae sp is a potential SRE because the family contains numerous potential SRE species.

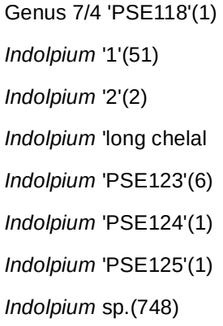
Opiliones

- Assamiidae sp.(8)
- Opiliones sp.(1)

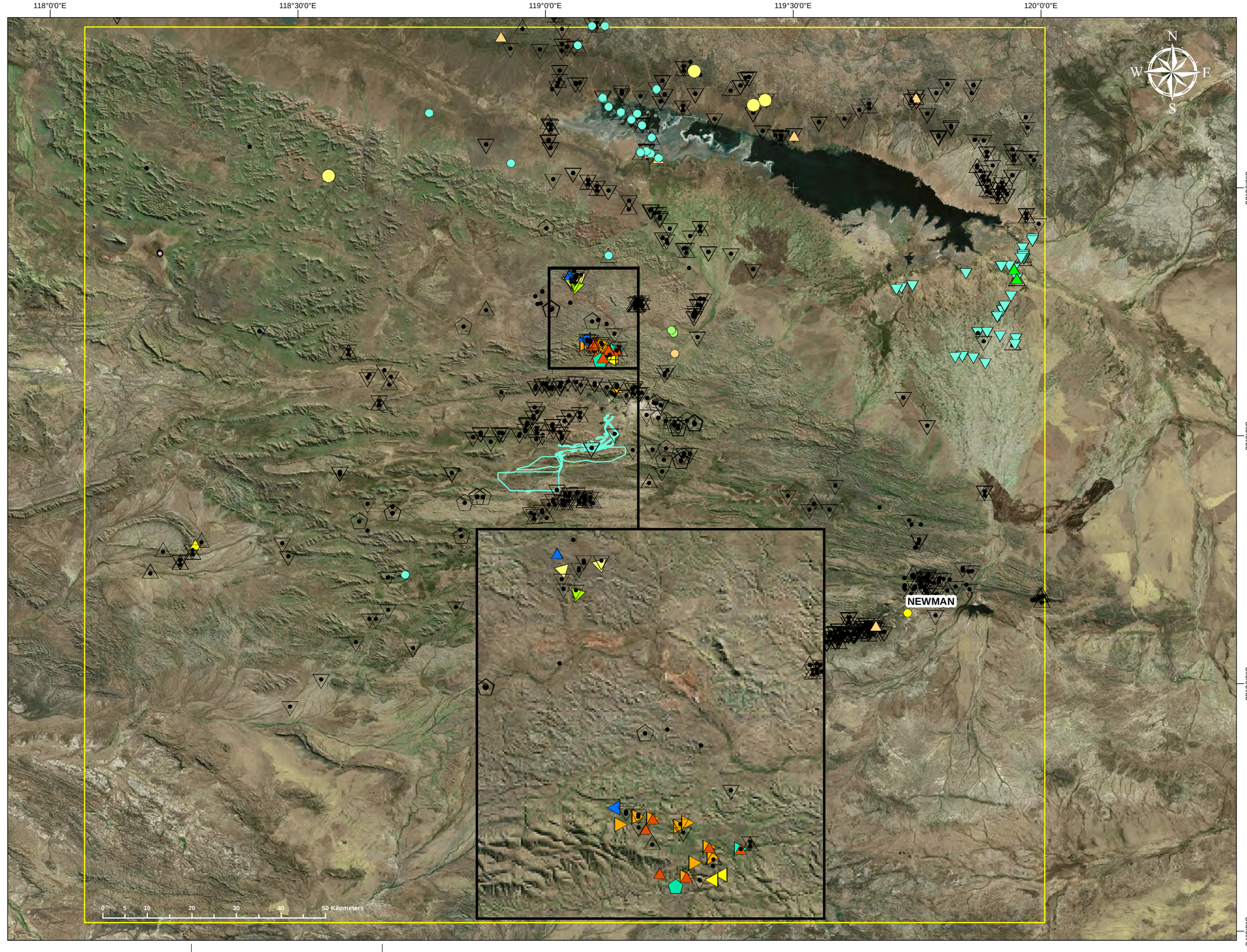
Pseudoscorpiones

- *Austrohorus* 'M1'(2)
- *Austrohorus* 'M2'(1)
- *Austrohorus* 'PSE119'(9)
- *Austrohorus* 'PSE120'(1)
- *Austrohorus* 'PSE121'(1)
- *Austrohorus* 'PSE122'(2)
- *Austrohorus* '1 (big)'(1)
- *Austrohorus* sp.(128)
- Genus 7/4 'PSE118'(1)
- *Indolpium* '1'(51)
- *Indolpium* '2'(2)
- *Indolpium* 'long chelal
- *Indolpium* 'PSE123'(6)
- *Indolpium* 'PSE124'(1)
- *Indolpium* 'PSE125'(1)
- *Indolpium* sp.(748)
- *Linnaeolpium* sp.(7)
- 'PSEAAA' sp.(38)
- *Xenolpium* '1'(4)
- *Xenolpium* '2'(1)
- *Xenolpium* 'PSE033'(5)
- *Xenolpium* sp.(67)
- Olpiidae sp.(129)

- Town
- Study Area
- Database Search Area



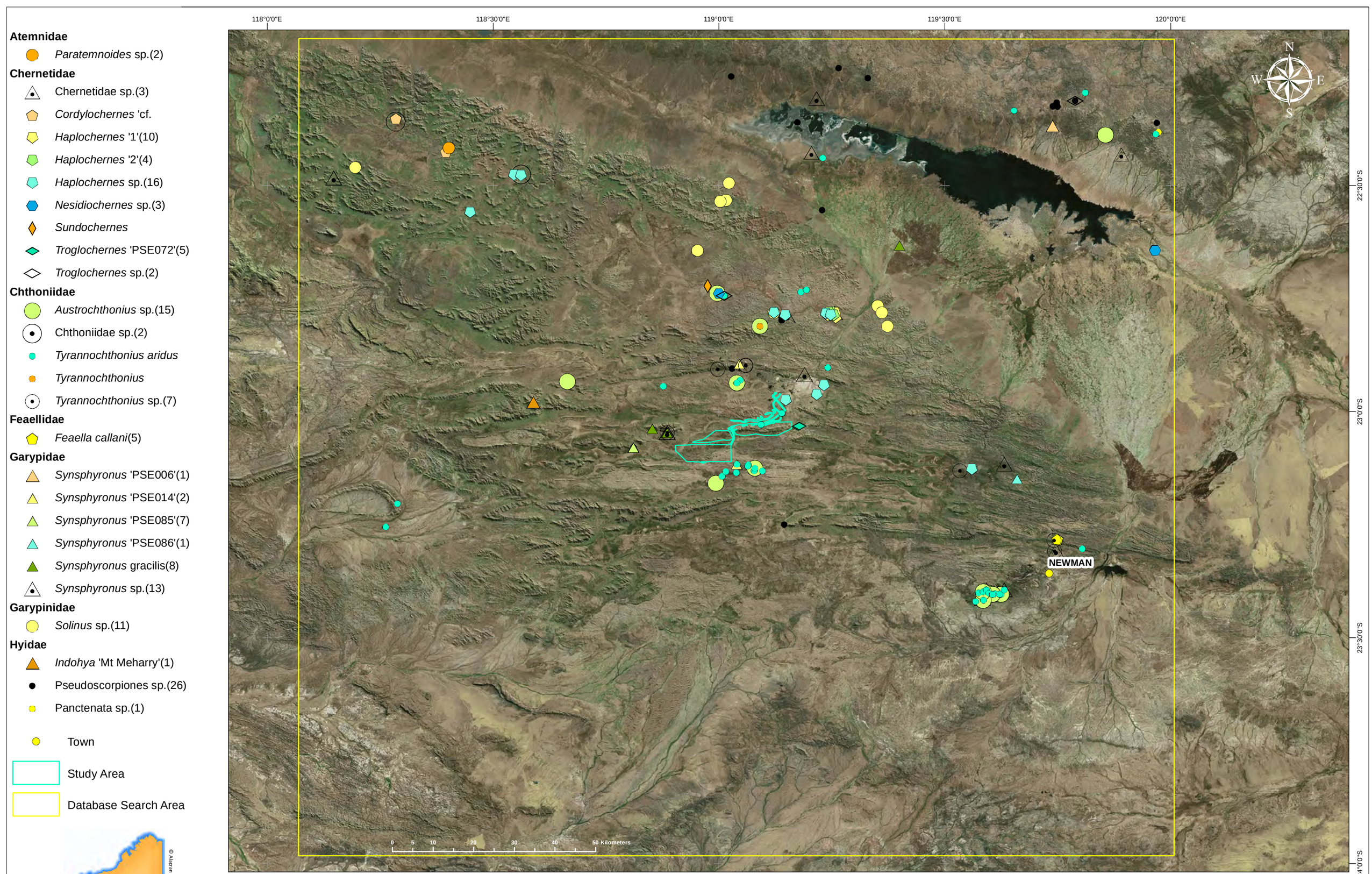
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Figure 4.c. Central and eastern Pilbara showing the distribution of SRE category Opiliones and Pseudoscorpiones (part 1: Olpiidae) records from the database Search Area. Number of records in Parentheses.



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Figure 4.T. Central and eastern Pilbara showing the distribution of SRE category Pseudoscorpiones (part 2) records from the database Search Area: families Atemnidae, Chthoniidae, Chernetidae, Feaellidae, Garypidae, Garypinidae and Hyidae. Number of records in Parentheses

4.1.4 Schizomida (short-tailed whip scorpions)

Schizomida is an order of Arachnida that vaguely resemble small spiders, but are not related to them. They are more closely related to Uropygi (Wheeler and Hayashi 1998) which are not known from Australia. Australian schizomids are relatively well studied taxonomically (Harvey 2002b; Harvey et al. 2008; Abrams and Harvey 2015); however, numerous undescribed species are known. All Pilbara schizomids show very high levels of endemism and are all considered SREs.

The only known epigean schizomid from the Pilbara is an undescribed species: *Draculoides* 'SCH053' and is only known from deep shaded gorges of Karijini National Park (Figure 4.8). None of the survey samples contained schizomids. It is also unlikely for epigean schizomids to occur within the Study Area because the study area lacks very deep shaded gorges such as those that support this species in Karijini National Park.

4.1.5 Scorpiones (scorpions)

Scorpions are instantly recognisable arachnids and are represented by four families in W. A. Short-range endemic species are known from the families Buthidae, Urodacidae and Hormuridae. The Australian scorpion fauna is very poorly described with as much as 85% suspected of being undescribed (Volschenk et al. 2000; Volschenk 2008; Volschenk et al. 2010; Volschenk et al. 2012; Harvey 2014).

Species delineation in scorpions varies in complexity: species from the family Buthidae can be identified from all but 1st and 2nd instars; however, species identification of Bothriuridae, Urodacidae and Hormuridae is usually heavily dependent on characteristics only present in adult males. The families Buthidae and Urodacidae also contain several species complexes containing cryptic species, which can only be currently identified using DNA barcoding methods.

In W. A., the family Buthidae is represented by three genera, *Lychas*, *Isometroides* and *Isometrus*. Representatives of *Lychas* are frequently collected in surveys of W. A. and current investigations on the genus *Lychas* (W. A. Museum) indicates the presence of several species complexes, some of which appear to contain SREs.

The family Urodacidae is represented by two genera, *Urodacus* and *Aops*, the latter *Aops oncodactylus* is only known from a single specimen from Barrow Island (Volschenk and Prendini 2008). Most species of *Urodacus* appear to be relatively widespread but are often patchily distributed (Volschenk et al. 2010), meaning that their "distribution does not equate to their area of occupation". Several *Urodacus* species are also known to be SREs including the described species *Urodacus planimanus* and *Urodacus koolanensis* as well as several undescribed species from the Pilbara.

The Search Area contained 25 scorpion taxa, of which none were named, 21 were morphospecies and four were unidentified taxa (Table 4.3 and Figure 4.6). One species is an SRE and the remaining 24 taxa are Potential SRE (DD) (Table 4.3).

Table 4.3. Table of SRE category Scorpiones identified from the area search of the W. A. Museum's Terrestrial Invertebrates Database

Family	Binomial	SRE-Category	Justification
	Scorpiones sp.	Potential SRE: DD	Order contains SREs and potential SREs
Buthidae	Buthidae sp.	Potential SRE: DD	Family contains SREs and potential SREs
Buthidae	*Isometroides* sp.	Potential SRE: DD	Genus contains SREs and potential SREs
Buthidae	*Lychas* 'aitkeni complex'	Potential SRE: DD	rare scorpions, unresolved species complex likely to contain SREs
Buthidae	*Lychas* 'annulatus complex'	Potential SRE: DD	molecular evidence indicates several cryptic species involved, some of which appear to be SRE
Buthidae	*Lychas* 'bituberculatus complex'	Potential SRE: DD	molecular evidence indicates several cryptic species involved, some of which appear to be SRE
Buthidae	*Lychas* 'gracilimanus'	Potential SRE: DD	rare species with very disjunct distribution pattern, may contain cryptic species
Buthidae	*Lychas* 'hairy tail complex'	Potential SRE: DD	molecular evidence indicates several cryptic species involved, some of which appear to be SRE
Buthidae	*Lychas* 'Iron Valley'	Potential SRE: DD	W. A. Museum data
Buthidae	*Lychas* 'marandoo 1'	Potential SRE: DD	W. A. Museum data
Buthidae	*Lychas* 'mjobergi?'	Potential SRE: DD	W. A. Museum data
Buthidae	*Lychas* 'paraburdoo'	Potential SRE: DD	W. A. Museum data
Buthidae	*Lychas* 'Pilbara sp. 2'	Potential SRE: DD	W. A. Museum data
Buthidae	*Lychas* 'racing stripe'	Potential SRE: DD	W. A. Museum data
Buthidae	*Lychas* sp.	Potential SRE: DD	Genus contains SREs and potential SREs
Urodacidae	*Urodacus* 'cloudbreak'	Potential SRE: DD	W. A. Museum data
Urodacidae	*Urodacus* 'fat hands'	Potential SRE: DD	W. A. Museum data
Urodacidae	*Urodacus* 'firetail'	Potential SRE: DD	W. A. Museum data
Urodacidae	*Urodacus* 'megamastigus complex'	Potential SRE: DD	W. A. Museum data
Urodacidae	*Urodacus* 'micros'	SRE	W. A. Museum data
Urodacidae	*Urodacus* 'pale complex'	Potential	W. A. Museum data

Family	Binomial	SRE-Category	Justification
		SRE: DD	
Urodacidae	*Urodacus* 'Pilbara 5'	Potential SRE: DD	W. A. Museum data
Urodacidae	*Urodacus* 'SCO022'	Potential SRE: DD	W. A. Museum data
Urodacidae	*Urodacus* sp.	Potential SRE: DD	Genus contains SREs and potential SREs

The field survey yielded eight species of scorpions from the families Buthidae and Urodacidae, of which four are potential SREs.

4.1.5.1 Buthidae (narrow handed scorpions)

***Isometroides* 'pilbara 1'.** This species was recorded from sites TS14, TS16, TS17 and TS18. This species is rarely sampled during invertebrate fauna surveys but is occasionally sampled in the dry pitfall traps of vertebrate fauna surveys. This species is widespread in the Pilbara.

***Lychas* 'pilbara 1'.** This widespread species was recorded from site TS04. It is not an SRE.

***Lychas* 'bituberculatus complex'.** This scorpion was sampled from sites TS04, TS14, TS16, TS17 and Bl01. This taxon represents an unresolved species complex involving several cryptic species, some of which are suspected to be SREs. Until this group is resolved this taxon is a potential SRE owing to taxonomic data deficiency.

***Lychas* 'hairy tail complex'.** This species was sampled from site TS17. This taxon is similar in many ways to *Lychas* 'bituberculatus complex' in that it represents an unresolved species complex, suspected of containing SRE species. Until this group is resolved this taxon is a potential SRE owing to taxonomic data deficiency. Further resolution to the identity of this species may be possible using DNA barcoding methods.

***Lychas* 'harveyi complex'.** This species was sampled from sites TS14 and TS18. This taxon represents an unresolved species complex involving several cryptic species, however in this case they appear to be widespread.

Lychas 'Hope Downs' was identified by Alacran (2018); however, following examination of additional samples obtained during the second survey, that identification appears to have been erroneous and that specimen is here regarded as *Lychas* 'harveyi complex'.

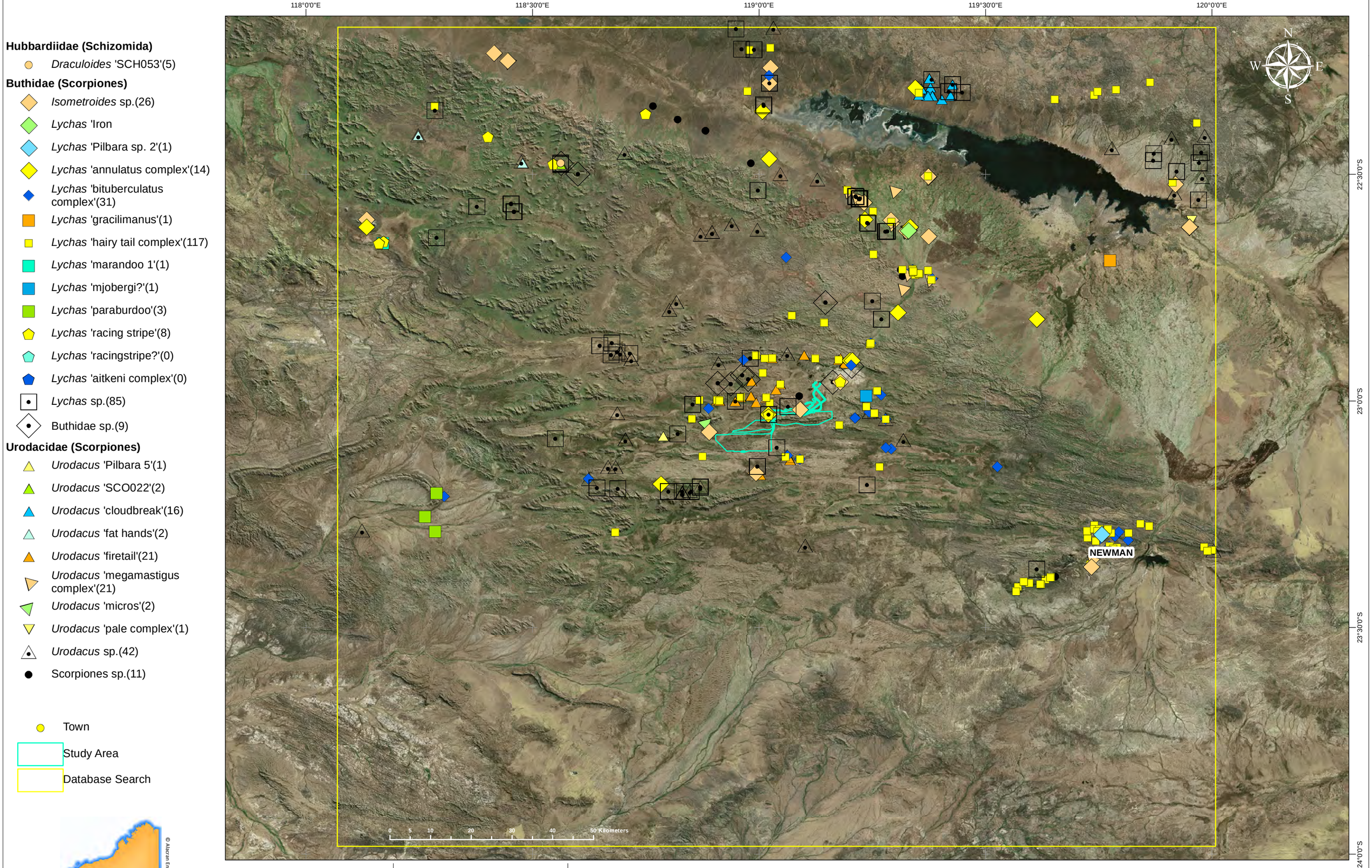
***Lychas* 'multipunctatus complex'.** *Lychas* 'multipunctatus complex' was sampled from sites SRE08, TS14, TS17 and BL01. Like *Lychas* 'bituberculatus complex', this taxon represents an unresolved species complex and appears to contain SRE species. Until this group is resolved this taxon is a potential SRE owing to taxonomic data deficiency.

Assessment of *Lychas* 'bituberculatus complex' and *Lychas* 'multipunctatus complex' was undertaken by both Alacran and W. A. Museum; however, no additional information could be obtained from these studies to assist placing these samples within their respective species complexes.

4.1.5.2 Urodacidae (burrowing scorpions)

***Urodacus* 'pilbara 12'.** This scorpion was sampled from site SRE12. This is a widespread species in the Pilbara.

***Urodacus* 'HD1'.** This scorpion was represented by a juvenile from site SRE13. Since adult males are usually required for morphological identification, DNA barcoding was used to try and place this sample. Patterning on the body of this specimen, suggests that it may represent a different species to *Urodacus* 'Pilbara 12', with the latter species being generally devoid of darker patterns. Barcoding analyses by both Alacran and W. A. Museum could not match this species to any sequenced species (Appendix 3 and Appendix 4).



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Figure 4.y. Central and eastern Pilbara showing the distribution of SRE category Schizomida and Scorpiones records from the database Search Area. Number of records in Parentheses.

4.2 CHILOPODA (CENTIPEDES)

Two orders of centipedes from the Pilbara are known to contain SREs: Geophilomorpha (Soil Centipedes) and members of the order Scolopendromorpha, mostly from the family Cryptopidae. Both geophilomorphs and cryptopids are blind and strongly associated with rocky environments, surface soil and deep leaf litter microhabitats. They are usually encountered when turning over rocks or larger pieces of fallen wood/logs and from leaf litter sifting samples. Members of both groups are also frequently collected in subterranean fauna surveys where their presence as troglofauna or soil fauna is often debated. Regardless of their specific ecophysiological requirements, preliminary genetic studies indicate high incidence of local endemism (Phoenix 2014a, b).

The Search Area contained 13 centipede taxa, of which none were named species, two were morphospecies and 11 were unidentified taxa (Table 4.4 and Figure 4.9). All were considered Potential SRE (DD) (Table 4.4). None of the Search Area records fell within the Study Area; however, a large cluster of records of Mecistocephalidae sp. and *Sepedenophilus* sp. records were recorded from the area immediately south east of the Study Area (Figure 4.9).

Table 4.4. Table of SRE category Chilopoda identified from the area search of the W. A. Museum's Terrestrial Invertebrates Database

Order	Family	Binomial	Justification
Geophilomorpha		Geophilomorpha sp.	Order contains SREs and potential SREs
Geophilomorpha	Ballophilidae	Ballophilidae sp.	Family contains SREs and potential SREs
Geophilomorpha	Chilenophilidae	Chilenophilidae sp.	Family contains SREs and potential SREs
Geophilomorpha	Chilenophilidae	*Sepedenophilus* sp.	Genus likely to contain SREs and potential SREs
Geophilomorpha	Geophilidae	Geophilidae sp.	Family may contain SREs and potential SREs
Geophilomorpha	Mecistocephalidae	Mecistocephalidae sp.	Family contains SREs and potential SREs
Geophilomorpha	Mecistocephalidae	*Mecistocephalus* sp.	Genus contains SREs and potential SREs
Geophilomorpha	Oryidae	Oryidae sp.	Family likely to contain SREs and potential SREs
Geophilomorpha	Schendylidae	*Australoschendyla* 'cf. capensis'	ALA, W. A. Museum Data
Geophilomorpha	Schendylidae	*Schendylidae* sp.	Family likely to contain SREs and potential SREs
Scolopendromorpha	Cryptopidae	Cryptopidae sp.	Family contains SREs and potential SREs
Scolopendromorpha	Cryptopidae	*Cryptops* sp.	Genus contains SREs and potential SREs
Scolopendromorpha	Scolopendridae	*Cormocephalus* 'long anal legs'	W. A. Museum data

The field surveys yielded 21 Centipede samples representing the orders Scolopendromorpha (Family Cryptopidae) and Geophilomorpha (families Chilenophilidae, Mecistocephalidae and Oryidae). All Geophilomorpha and Cryptopidae are very poorly known in W. A. While keys to genera and families of Geopholomorpha are available (Colloff et al. 2005), there is no workable morphological framework for

species level identifications. For this reason, all identifications used in this report are based on DNA barcoding.

4.2.1 Geophilomorpha

Members of this order of centipedes are commonly referred to as Soil Centipedes. Unlike most centipedes, they have short legs and cannot move fast. They are adapted for burrowing through soil and leaf litter rather than rapid movement over the soil surface. Geophilomorpha is the most speciose of centipede orders with an estimated 8000 species (Adis and Harvey 2000). The combination of high species diversity and low vagility suggests that this order may support SREs. There are no specialists working on W. A. Soil Centipedes and none have been described from the Pilbara. For this reason, the entire taxonomic framework for W. A. Geophilomorpha used by Alacran relies on DNA barcoding of COI sequences.

Geophilomorpha sp. A single tiny specimen could not be identified using morphology and attempts to obtain COI sequences from this specimen were unsuccessful. Owing to the presence of numerous potential SREs within the Order Geophilomorpha, this taxon is a potential SRE owing to uncertainty about its identity.

4.2.1.1 Chilenophilidae

Two species were identified belonging to the family Chilenophilidae: ***Sepedonophilus* 'HD1'** from sites Op01, SRE01, SRE17 and SRE19, and ***Sepedonophilus* 'HD2'** from site SRE23. Both of these species are new and are potential SREs owing to uncertainty about their distribution limits.

***Sepedenophilus* sp.** represents a specimen for which COI sequences were unsuccessful. This sample was from site SRE19. This specimen may be conspecific with *Sepedenophilus* 'HD1', which was also found at this site. As an ambiguous identification, *Sepedenophilus* sp. is a potential SRE since the genus contains numerous suspected SREs.

Mecistocephalidae

Three species were identified from the family Mecistocephalidae: ***Mecistocephalus* 'HD1'** from sites SRE13, SRE21 and SRE23, ***Mecistocephalus* 'HD2'** from site SRE23 and ***Mecistocephalus* 'HD3'** from site SRE15. All three species are new and are potential SREs owing to uncertainty about their distribution limits.

4.2.1.2 Oryidae

One species was identified from the family Oryidae: ***Orphnaeus* 'HD1'** from site SRE23.This is a new species and is a potential SRE owing to limited data about its distribution limits.

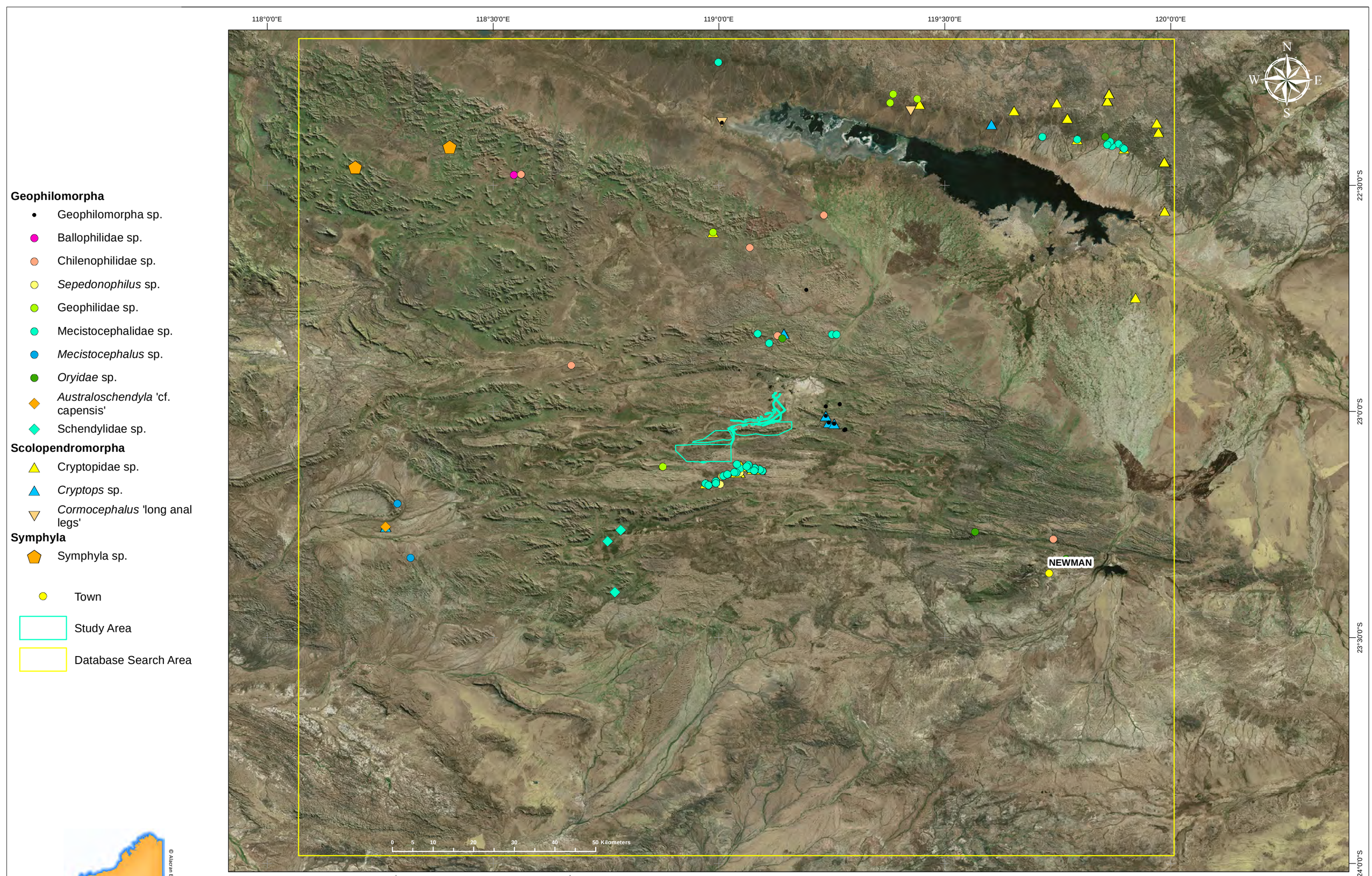
4.2.2 Scolopendromorpha

This order of centipedes contains the families Scolopendridae and Cryptopidae. Species in the family Scolopendridae have been relatively well studied taxonomically in Australia (Koch 1982b; Koch 1982a; Koch 1982c; Koch 1983c, b, a); however, the taxonomy of the family Cryptopidae is largely unstudied.

4.2.2.1 Cryptopidae

This family of centipedes is very poorly known in Australia and in the Pilbara, most species appear to be SREs. Most Pilbara Cryptopidae are represented by troglobites, and epigean records are uncommon. Species delimitation studies of epigean (surface dwelling) cryptopids suggests a significant diversity is present and most appear to be SREs. There is no taxonomic framework for Pilbara cryptopids, and all species assessments are currently based on comparisons using DNA sequences.

***Cryptops* 'HD1'.** This taxon was sampled from site SRE11 and was represented by three specimens. Alacran undertook DNA Barcoding of these samples (Appendix 3); however, this species could not be placed among those within Alacran's database of DNA sequences. This taxon is a potential SRE owing to uncertainty about its identity.



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Figure 4.ϕ. Central and eastern Pilbara showing the distribution of SRE category Chilopoda and Symphyla records from the database Search Area. Number of records in parentheses.

4.3 DIPLOPODA (MILLIPEDES)

Diplopoda is a diverse class and in the Pilbara, it is represented by five orders: Polydesmida, Polyxenida, Polyzoniida, Spirobolida and Spirostreptida. Of these, only the order Polyxenida (pincushion millipedes) has mostly widespread epigean species (Short and Huynh 2011, 2013); however, molecular data (unpublished) indicates several troglobitic species are SREs. The orders Polyzoniida (sucking millipedes) and Spirostreptida are very poorly known from the Pilbara; however, based on investigations of the fauna of SW Australia (Harvey 2002b; Moir et al. 2009; Edward and Harvey 2010; Harvey et al. 2011), it seems likely that most Pilbara representatives will be SREs.

The Search Area contained 30 millipede taxa, of which one was a named species, 20 were morphospecies and nine were unidentified taxa (Table 4.5 and Figure 4.11). Seventeen of these species were SREs and the remainder were potential SRE (DD) (Table 4.5).

Table 4.5. Table of SRE category Diplopoda identified from the area search of the W. A. Museum's Terrestrial Invertebrates Database

Order	Family	Binomial	SRE-Category	Justification
		Diplopoda sp.	Potential SRE: DD	Class contains SREs and potential SREs
Polydesmida		Polydesmida sp.	Potential SRE: DD	Order contains SREs and potential SREs
Polydesmida	Dalodesmidae	Dalodesmidae sp.	Potential SRE: DD	Genus contains SREs and potential SREs
Polydesmida	Paradoxosomatidae	*Antichiropus* 'DIP004'	SRE	W. A. Museum data
Polydesmida	Paradoxosomatidae	*Antichiropus* 'DIP006'	SRE	W. A. Museum data
Polydesmida	Paradoxosomatidae	*Antichiropus* 'DIP007'	SRE	W. A. Museum data
Polydesmida	Paradoxosomatidae	*Antichiropus* 'DIP013'	SRE	W. A. Museum data
Polydesmida	Paradoxosomatidae	*Antichiropus* 'DIP014'	SRE	W. A. Museum data
Polydesmida	Paradoxosomatidae	*Antichiropus* 'DIP015'	SRE	W. A. Museum data
Polydesmida	Paradoxosomatidae	*Antichiropus* 'DIP028'	SRE	W. A. Museum data
Polydesmida	Paradoxosomatidae	*Antichiropus* 'DIP029'	SRE	W. A. Museum data
Polydesmida	Paradoxosomatidae	*Antichiropus* 'DIP031'	SRE	W. A. Museum data
Polydesmida	Paradoxosomatidae	*Antichiropus* 'DIP032'	SRE	W. A. Museum data
Polydesmida	Paradoxosomatidae	*Antichiropus* 'DIP035'	SRE	W. A. Museum data
Polydesmida	Paradoxosomatidae	*Antichiropus* 'DIP036'	SRE	W. A. Museum data
Polydesmida	Paradoxosomatidae	*Antichiropus* 'DIP047'	SRE	W. A. Museum data
Polydesmida	Paradoxosomatidae	*Antichiropus* 'DIP048'	SRE	W. A. Museum data
Polydesmida	Paradoxosomatidae	*Antichiropus* 'DIP075'	SRE	W. A. Museum data
Polydesmida	Paradoxosomatidae	*Antichiropus* 'DIP173'	SRE	W. A. Museum data
Polydesmida	Paradoxosomatidae	*Antichiropus* 'DNA06'	SRE	W. A. Museum data
Polydesmida	Paradoxosomatidae	*Antichiropus* sp.	Potential SRE: DD	Genus contains numerous SRE taxa: (Harvey 2002b; Car and

Order	Family	Binomial	SRE-Category	Justification
				Harvey 2013; Car et al. 2013; Car and Harvey 2014)
Polydesmida	Paradoxosomatidae	*Antichiropus* 'Wonmunna'	SRE	W. A. Museum data
Polydesmida	Paradoxosomatidae	Paradoxosomatidae sp.	Potential SRE: DD	Family contains numerous SRE taxa: (Harvey 2002b; Car and Harvey 2013; Car et al. 2013; Car and Harvey 2014)
Polyzoniida		Polyzoniida sp.	Potential SRE: DD	Order contains SREs and potential SREs
Spirobolida	`Family indet.`	Spirobolida sp.	Potential SRE: DD	Order contains SREs and potential SREs
Spirobolida	Trigoniulidae	*Austrostrophus* 'DIP018'	Potential SRE: DD	W. A. Museum data
Spirobolida	Trigoniulidae	*Austrostrophus* 'DIP053'	Potential SRE: DD	W. A. Museum data
Spirobolida	Trigoniulidae	*Austrostrophus* sp.	Potential SRE: DD	Genus likely to contain SREs and potential SREs
Spirobolida	Trigoniulidae	*Austrostrophus stictopygus*	Potential SRE: DD	Species currently under investigation with molecular data, likely to contain one or more SREs
Spirobolida	Trigoniulidae	Trigoniulidae sp.	Potential SRE: DD	Presence of SRE or potential SRE species in this family

The field survey yielded numerous millipede samples belonging to the orders Spirobolida (family Trigoniulidae) and Polydesmida (family Paradoxosomatidae).

4.3.1 Polydesmida

The order Polydesmida (flatback millipedes) has received significant attention over recent years, particularly the family Paradoxosomatidae (Car and Harvey 2013; Car et al. 2013; Car and Harvey 2014). In the Pilbara, Paradoxosomatidae are represented by two described genera *Antichiropus* and *Boreohesperus*, both of which contain SRE representatives.

4.3.1.1 Paradoxosomatidae

A single species was identified from the family Paradoxosomatidae: *Antichiropus* 'wonmunna' from sites SRE15 (three samples) and SRE23 (one sample). These samples were matched with tissue obtained from a sample of *Antichiropus* 'wonmunna' (T118101) from the W. A. Museum. *Antichiropus* 'wonmunna' was represented by five samples (three different locations) in the Search Area and all are within 10 km of sites SRE15 and SRE23 (Figure 4.10). This species is a potential SRE owing to limited information about its distribution.

***Antichiropus* sp.** was also recorded from sites SRE11 and SRE23. These samples are likely to represent *Antichiropus* 'wonmunna'; however, there is also a chance that one or more may represent different species since multiple species of Paradoxosomatidae have been collected from the same locality (Car and Harvey 2013).

4.3.2 Spirobolida

4.3.2.1 Trigoniulidae

In the Pilbara, Spirobolida is represented by the family Trigoniulidae and the genera *Austrostrophus* and *Speleostrophus*. All epigean species belong to *Austrostrophus* which is represented by a single described species, *Austrostrophus stictopygus*. Molecular studies of this species at the W. A. Museum indicate significant variation between some Pilbara populations that are consistent with species level differences (W. A. Museum, unpublished data). *Austrostrophus stictopygus* therefore appears to represent a complex of species, some of which may be SREs.

Species delimitation by Alacran and the W. A. Museum indicated the presence of two putative species (Appendix 3 and Appendix 4) and the designations applied by the W. A. Museum are adopted here: ***Austrostrophus* 'Clade A'** from site SRE20 and ***Austrostrophus* 'Clade E'** from sites SRE15, SRE22, TS14 and TS18. Both are regarded as potential SREs owing to uncertainty about their distribution limits.

***Austrostrophus* sp.** represents specimens that were not sequenced and were found at sites SRE13, SRE15, SRE16, SRE17, SRE18 and SRE19. In the absence of clear unambiguous identification, this taxon is regarded as a potential SRE owing to data limitation regarding species identity.

4.4 SYMPHYLA (GARDEN CENTIPEDES)

Symphylans are tiny, less than 1 cm, centipede-like arthropods. Like centipedes, they have a multi-segmented body with one pair of legs per segment. They differ from centipedes in several ways, but most notably by the absence of the modified first pair of legs into poison claws, which is characteristic of all true centipedes. This group is poorly known and literature on the Australian species is very limited.

In the Pilbara, nearly all symphylans are recorded from subterranean habitats, where they are frequently SREs. In the absence of a workable taxonomy for Pilbara symphylans, species identification is heavily dependent on DNA sequencing methods. While epigean records of symphylans from the Pilbara are very scarce, it is plausible for them to be present in deep gorges that retain moist soil and leaf litter throughout most of the year.

The database search identified one Symphyla record which was not identified beyond the rank of Class: Symphyla sp. Insufficient data were available to assess whether these were sampled from subterranean habitats or not, therefore they are tentatively considered to be epigean and potential SRE: DD (Figure 4.11).

No symphylans were sampled during this survey; however, they may be present in south-facing gullies and scree slopes in the north west of the Study Area.

Polydesmida

- Dalodesmidae sp.(1)
- *Antichiropus* 'DIP004'(1)
- *Antichiropus* 'DIP006'(20)
- *Antichiropus* 'DIP007'(25)
- *Antichiropus* 'DIP013'(6)
- *Antichiropus* 'DIP014'(15)
- *Antichiropus* 'DIP015'(2)
- *Antichiropus* 'DIP028'(1)
- *Antichiropus* 'DIP029'(2)
- *Antichiropus* 'DIP031'(5)
- *Antichiropus* 'DIP032'(1)
- *Antichiropus* 'DIP035'(1)
- *Antichiropus* 'DIP036'(1)
- *Antichiropus* 'DIP047'(5)
- *Antichiropus* 'DIP048'(3)
- *Antichiropus* 'DIP075'(1)
- *Antichiropus* 'DIP173'(1)
- *Antichiropus* 'DNA06'(1)
- *Antichiropus* 'Wonmunna'(5)
- *Antichiropus* sp.(34)
- Paradoxosomatidae sp.(19)
- Polydesmida sp.(3)

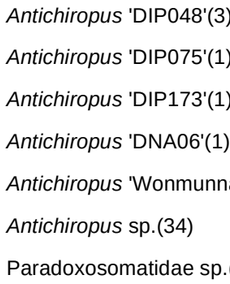
Polyzoniida

- Polyzoniida sp.(1)

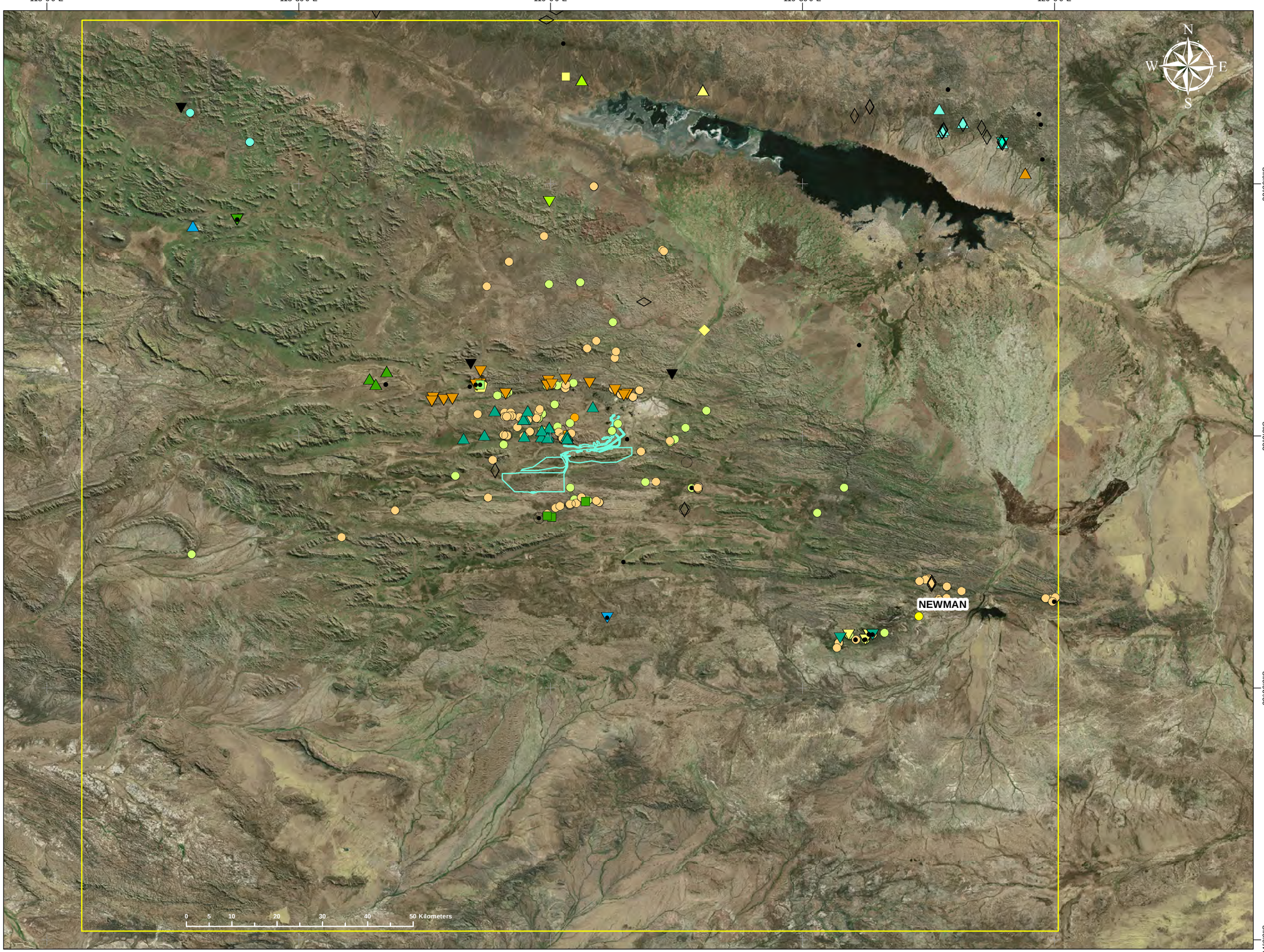
Spirobolida

- Spirobolida sp.(1)
- Trigoniulidae sp.(10)
- *Austrostrophus*
- *Austrostrophus* sp.(103)
- *Austrostrophus* 'DIP053'(4)
- *Austrostrophus* 'DIP018'(4)
- Diplopoda sp.(3)

- Townc
- Study Area
- Database Search Area



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Figure 4.мл. Central and eastern Pilbara showing the distribution of SRE category Diplopoda records from the database Search Area. Number of records in Parentheses.

4.5 ISOPODA (SLATERS OR WOOD LICE)

Isopoda represent the only order of epigean crustaceans known to contain SREs. The suborder Oniscidae represents terrestrial and secondarily aquatic isopods with approximately 190 species described in Australia (Martin et al. 2011). The W. A. terrestrial isopod fauna is largely undescribed and is diverse (Judd and Horwitz 2003; Judd and Perina 2013). Isopods have poor dispersal capabilities and often have specific habitat preferences, making them target SRE taxa in W. A.

The Search Area contained 34 isopod taxa, of which none were named species, 25 were morphospecies and nine were unidentified taxa (Table 4.6 and Figure 4.9). These taxa were potential SRE (DD) (Table 4.6).

Table 4.6. Table of SRE category terrestrial Isopoda from the area search of the W. A. Museum's Crustacea Database

Family	Binomial	SRE-Category	Justification
	Isopoda sp.	Potential SRE: DD	Order contains SREs and potential SREs
Armadillidae	*Acanthodillo* '6'	Potential SRE: DD	assessment by Dr Simon Judd
Armadillidae	*Acanthodillo* sp.	Potential SRE: DD	Genus contains SREs and potential SREs
Armadillidae	*Armadillidae* 'ISO001'	Potential SRE: DD	W. A. Museum assessment
Armadillidae	*Armadillidae* sp.	Potential SRE: DD	Family contains SREs and potential SREs
Armadillidae	*Barrowdillo* '1'	Potential SRE: DD	W. A. Museum Data and assessment by Dr Simon Judd assessment
Armadillidae	*Buddelundia* '10'	Potential SRE: DD	assessment by Dr Simon Judd
Armadillidae	*Buddelundia* '12'	Potential SRE: DD	assessment by Dr Simon Judd
Armadillidae	*Buddelundia* '13'	Potential SRE: DD	assessment by Dr Simon Judd
Armadillidae	*Buddelundia* '14'	Potential SRE: DD	assessment by Dr Simon Judd
Armadillidae	*Buddelundia* '14cr'	Potential SRE: DD	assessment by Dr Simon Judd
Armadillidae	*Buddelundia* '14fm'	Potential SRE: DD	assessment by Dr Simon Judd
Armadillidae	*Buddelundia* '20'	Potential SRE: DD	assessment by Dr Simon Judd
Armadillidae	*Buddelundia* '26'	Potential SRE: DD	assessment by Dr Simon Judd
Armadillidae	*Buddelundia* '47'	Potential SRE: DD	assessment by Dr Simon Judd
Armadillidae	*Buddelundia* '48'	Potential SRE: DD	assessment by Dr Simon Judd
Armadillidae	*Buddelundia* '49'	Potential SRE: DD	assessment by Dr Simon Judd
Armadillidae	*Buddelundia* '54'	Potential SRE: DD	assessment by Dr Simon Judd
Armadillidae	*Buddelundia* 'B47'	Potential SRE: DD	(Ecologia 2014)
Armadillidae	*Buddelundia* 'B49'	Potential SRE: DD	(Ecologia 2014)
Armadillidae	*Buddelundia* 'B50'	Potential SRE: DD	(Ecologia 2014)
Armadillidae	*Buddelundia* 'B52'	Potential SRE: DD	(Ecologia 2014)
Armadillidae	*Buddelundia* 'B53'	Potential SRE: DD	(Ecologia 2014)
Armadillidae	*Buddelundia* 'B54'	Potential SRE: DD	(Ecologia 2014)
Armadillidae	*Buddelundia* 'ISO002'	Potential SRE: DD	W. A. Museum assessment
Armadillidae	*Buddelundia* sp.	Potential SRE: DD	Genus contains SREs and potential SREs
Armadillidae	Buddelundiinae sp.	Potential SRE: DD	Tribe contains SREs and potential SREs, previously *Buddelundia* '19', Assessment by

Family	Binomial	SRE-Category	Justification
			Dr Simon Judd
Armadillidae	*Spherillo* sp.	Potential SRE: DD	Genus contains SREs and potential SREs
Philosciidae	*Laevophiloscia* 'PES4394'	Potential SRE: DD	assessment by Dr Simon Judd
Philosciidae	*Laevophiloscia* sp.	Potential SRE: DD	assessment by Dr Simon Judd
Philosciidae	*Laevophiloscia* 'Wonmunna A'	Potential SRE: DD	assessment by Dr Simon Judd
Philosciidae	*Laevophiloscia* 'Wonmunna B'	Potential SRE: DD	assessment by Dr Simon Judd
Philosciidae	Philosciidae sp.	Potential SRE: DD	All Philosciidae in the Pilbara are considered potential SREs.

4.5.1.1 Armadillidae

***Buddelundia* '10ma'.** This species was sampled from sites SRE11, TS4 and TS5. This species was only sampled during the T1 survey. The *Buddelundia* '10' species group contains several species, including this one. This taxon has been previously collected from the Marillana and West Angelas areas and is regarded as an SRE. The records of the W. A. Museum have not been updated to distinguish *Buddelundia* '10' from Buddelundia '10ma'; therefore, the latter species is not specifically represented in Figure 4.11. The distribution of *Buddelundia* '10' is mapped and some of these will be representatives of *Buddelundia* '10ma'.

***Buddelundia* '15'.** This isopod was sampled from sites SRE14, SRE15, SRE19 and SRE23. This is a relatively widespread Pilbara species.

***Buddelundia* '16'.** This species was sampled from sites SRE17 and SRE19. This is a relatively widespread Pilbara species complex.

***Buddelundia* '77'.** This species was sampled from five sites: SRE15, SRE17, SRE19, SRE22 and SRE23. This species has a distinct disjunct distribution. It's is a small, likely cryptic species of *Buddelundia* and the isolated populations may be different species. This species is a potential SRE owing to taxonomic uncertainty and highly disjunct populations.

Buddelundiinae sp. This taxon was sampled from sites SRE23 and TS14. It belongs to an undescribed genus closely related to *Buddelundia*. This genus is mostly found in the Pilbara region and lacks the morphological characters used to determine *Buddelundia*. Morphospecies are difficult to define in this group and there is a general lack of sequences with which to make comparisons. They are all potential SRE species.

***Pseudodiploexochus* sp.** This unusual isopod was sampled from SRE17. This is the second record of this genus from the Pilbara. The only other record of this genus in the Pilbara is from the West Angelas area (23°07'26.83"S 118°53'09.08"E), approximately 25 km SW of the locality where it was sampled in this survey. That sample is part of the S. Judd Isopod collections and is therefore not present in the W. A. Museum data records. Further comparisons between these samples should be undertaken using DNA barcoding methods since the taxonomy of this group is also very poor in W. A.

Members of this genus do not have the well-developed lungs present in most terrestrial Armadillidae. For this reason, they are far more susceptible to desiccation and are nearly always considered to be SRE in arid or semi-arid environments. *Pseudodiploexochus* is therefore likely to represent an SRE but in the absence of additional taxonomic or distributional data, it is a potential SRE.

***Troglarmadillo* sp.** This unusual isopod was sampled from site SRE13. This tiny specimen could not be unambiguously identified; however, it showed closest affinity to *Troglarmadillo*, a genus almost entirely represented by troglobites in the Pilbara. Despite the genus name, the species sampled possesses well developed eyes and has faint body patterning, suggesting that it is not a troglobite. Subterranean *Troglarmadillo* species are nearly always SRE and it is likely that this species will be as well. In the absence of more resolved taxonomic and distributional data, this species is a Potential SRE. While there are a number of sources for sequences for Pilbara *Troglarmadillo* species, all of them are from troglobites; therefore, sequencing this specimen is unlikely to be of much use until more specimens are obtained.

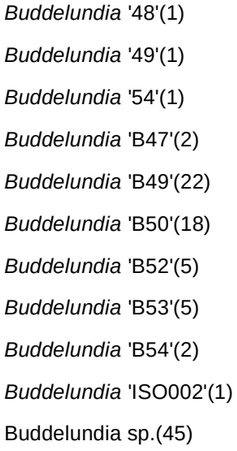
4.5.1.2 Family Philosciidae

The taxonomy of the Philosciidae is unknown in W. A. They are rarely collected in the Pilbara and are generally considered to be potential SREs.

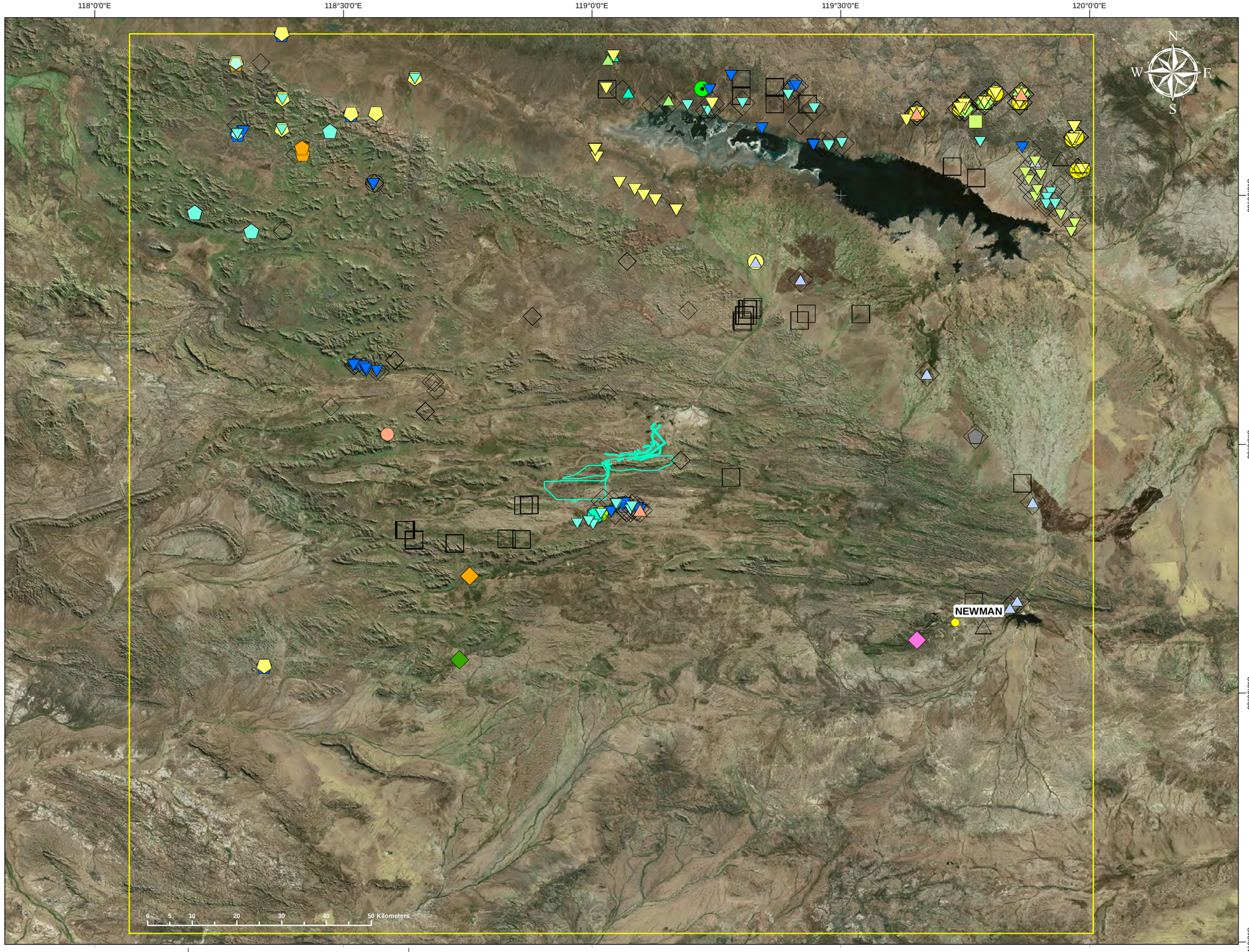
Philosciidae sp. This taxon was collected at SRE19 and TS14. Several attempts were made to amplify COI sequences from these samples; however, all samples failed to yield useful sequences. In the absence of unambiguous species identification, this taxon is a potential SRE owing to data deficiency about its identity.

- *Acanthodillo* '6'(4)
- *Acanthodillo* sp.(6)
- Armadillidae sp.(1)
- *Barrowdillo* '1'(1)
- *Buddelundia* '10'(101)
- *Buddelundia* '12'(11)
- *Buddelundia* '13'(36)
- *Buddelundia* '14'(58)
- *Buddelundia* '14cr'(8)
- *Buddelundia* '14fm'(3)
- *Buddelundia* '20'(2)
- *Buddelundia* '26'(3)
- *Buddelundia* '47'(1)
- *Buddelundia* '48'(1)
- *Buddelundia* '49'(1)
- *Buddelundia* '54'(1)
- *Buddelundia* 'B47'(2)
- *Buddelundia* 'B49'(22)
- *Buddelundia* 'B50'(18)
- *Buddelundia* 'B52'(5)
- *Buddelundia* 'B53'(5)
- *Buddelundia* 'B54'(2)
- *Buddelundia* 'ISO002'(1)
- Buddelundia sp.(45)
- Buddelundiinae sp.(90)
- Isopoda sp.(49)
- *Spherillo* sp.(3)
- *Laevophiloscia* 'Wonmunna
- *Laevophiloscia* 'Wonmunna
- *Laevophiloscia*
- *Laevophiloscia* sp.(2)
- Philosciidae sp.(2)

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Figure 4.1M. Central and eastern Pilbara showing the distribution of SRE category Isopoda records from the database Search Area. Number of records in Parentheses.

4.6 EUPULMONATA, MOLLUSCA (LAND SNAILS)

Land snails are a diverse group of invertebrates and most of Australia's snail fauna is endemic (Beesley et al. 1998). Their limited dispersal capabilities, often combined with specific habitat requirements, makes them one of the SRE target groups in W. A. (Harvey 2002b; EPA 2009). In the Pilbara region of W. A., the families Camaenidae, Bothriembryonitidae and Succineidae are significant in containing SREs and potential SREs; however, much of the diversity is cryptic and dependent on molecular investigations to verify species boundaries (Johnson et al. 2012; Johnson et al. 2013; Whisson and Kirkendale 2014).

The Search Area contained 12 SRE category snail taxa, of which one was a named species, four were morphospecies and seven were unidentified taxa (Table 4.7 and Figure 4.12). All were considered potential SRE (DD) (Table 4.7).

Table 4.7. Table of SRE category Eupulmonata from the area search of the W. A. Museum's Mollusca Database

Family	Binomial	SRE-Category	Justification
Camaenidae	Camaenidae 'Mount Robinson'	Potential SRE: DD	W. A. Museum data
Camaenidae	Camaenidae sp.	Potential SRE: DD	(Whisson and Kirkendale 2014)
Camaenidae	cf. *Quistrachia* sp.	Potential SRE: DD	Genus contains SREs and potential SREs
Camaenidae	*Quistrachia* cf. turneri	Potential SRE: DD	W. A. Museum data
Camaenidae	*Quistrachia* 'Marandoo'	Potential SRE: DD	W. A. Museum data
Camaenidae	Quistrachia sp.	Potential SRE: DD	Genus contains SREs and potential SREs (Whisson and Kirkendale 2014)
Camaenidae	*Rhagada* sp.	Potential SRE: DD	Genus contains SREs and potential SREs (Whisson and Kirkendale 2014)
Charopidae	*Discocharopa* sp.	Potential SRE: DD	W. A. Museum data
Planorbidae	*Bayardella* sp.	Potential SRE: DD	W. A. Museum data
Planorbidae	*Leichhardtia sisurnius*	Potential SRE: DD	W. A. Museum data
Planorbidae	*Leichhardtia* cf. sisurnius	Potential SRE: DD	W. A. Museum data
Punctidae	*Paralaoma* sp.	Potential SRE: DD	W. A. Museum data

The field survey yielded three species of land snails: *Gastrocopta* sp., *Pupoides* sp. and *Eremopeas interioris*, all of which are widespread in the Pilbara (Table 3.2). The absence of SRE snails from the Study Area is difficult to assess. Among SRE groups, snails can be extremely difficult to find, making their absence in surveys difficult to interpret. Optimal conditions for surveying SRE snails (rainy nights) are often logistically

challenging for surveys in the Pilbara. When inactive, most species burrow into the ground or seal themselves against rocks deep in rock piles and remain inactive until rains return.

4.7 HABITAT ASSESSMENT

The Mulga Woodlands in the study area supported eight of the nine centipede taxa and both millipede taxa. Of note in these groups is the presence of the millipede genus *Antichiropus* and the centipede genus *Cryptops*. All Pilbara morphospecies and species of *Antichiropus* are SREs and all epigean *Cryptops* are potential SRE.

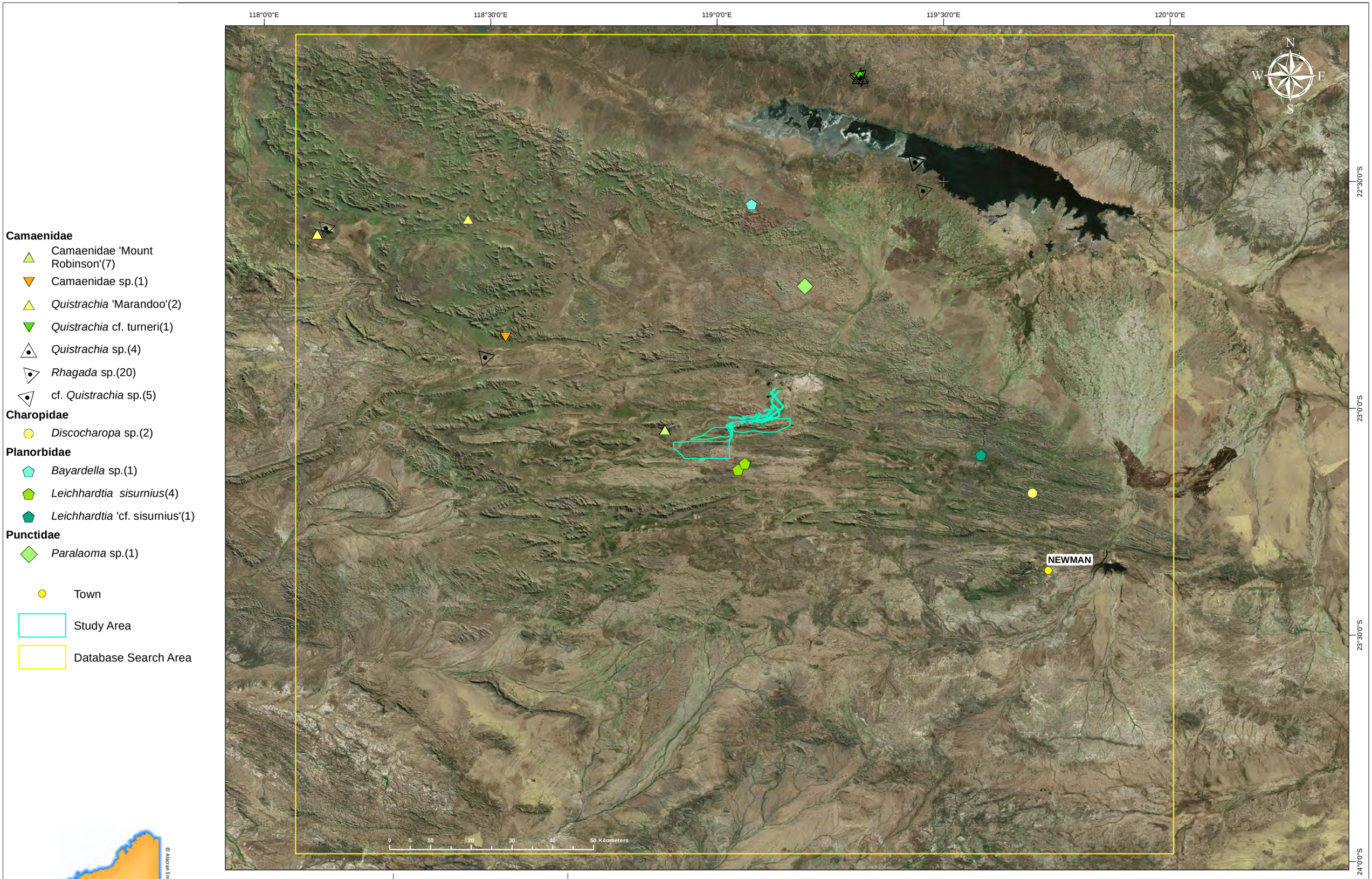
Hill slope gullies supported Philosciidae sp, *Troglarmadillo* sp. and *Pseudodiploexochus* sp. which, while being ambiguously defined, represent likely SREs. The latter two taxa represent forms that are very rarely sampled from epigean habitats in the Pilbara and are not arid adapted. The presence of arid sensitive taxa in these habitats indicates that SRE habitats are present. Additional SRE species are likely to occur in these habitats.

The pseudoscorpion *Anatemnus* sp. is enigmatic in that it has all of the features of a troglobite (blind and pale) and the only other Pilbara record of this genus is troglobitic. One specimen was sampled from riparian leaf litter of a dry creek line (SRE10). There is a small chance that this species is troglobitic and in rare cases, troglobites have been observed at the entrance of caves during very humid conditions. In the Pilbara, troglobitic *Nocticola* have been sampled from creak gravels (Volschenk personal observations) indicating that this is potential habitat for troglobitic taxa. The presence of this species from the subterranean fauna surveys of this area may offer evidence that this is a troglobite.

Several SRE category invertebrates sampled during this study were found in multiple habitat types, suggesting that they may be less specialised with respect to their habitat preferences:

- *Lychas* 'bituberculatus complex', from stony hills and eucalypt woodland;
- *Sepedenophilous* 'HD1', from rocky slopes and gullies, and mulga woodland;
- *Mecistocephalus* 'HD1', from rocky slopes and gullies, and mulga woodland;
- *Austrostrophus* 'HD2', from mulga woodland and open eucalypt woodland;
- *Antichiropus* 'wonmunna', from mulga woodland in this study area, but from gully slopes and riparian vegetation outside of this study area.

Habitat mapping was undertaken by Astron and while all of the habitats have the potential to support SREs, five habitats stand out as being conducive to relictual SREs: Breakaways, Mulga Woodland, Minor Drainage lines, Gorges and Gullies, and Rocky Hills. Most of these latter habitats are associated with an isolated ridge running in an east-west direction, so most of the breakaways and rocky slopes are south-facing and therefore conducive to SREs (Harvey 2002b).



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Figure 4.1H. Central and eastern Pilbara showing the distribution of SRE category Eupulmonata records from the database Search Area. Number of records in Parentheses.

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APPENDICES

The following appendices are embedded within this document:

Appendix 1. Short-range endemic records from an area search by the W. A. Museum.
Appendix 2. Short-range endemic and target group records from the field survey.
Appendix 3. Targeted DNA barcoding of Invertebrates from the Hope Downs 2 Project Area.
Appendix 4. WAM-MSU-476: Molecular identification of terrestrial arthropods from north west of Newman, Western Australia (project 1912).



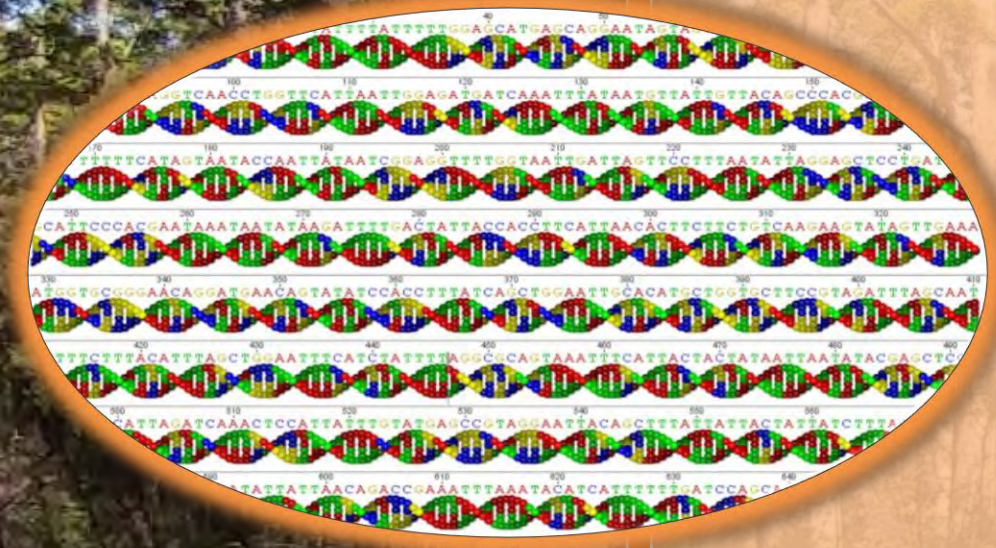
Alacran Environmental Science

Report 1912

DNA-Barcoding report for invertebrates from Hope Downs



Prepared for **Astron**



Stylised DNA sequence of *Aname mellosa*

ABN 33577027061
www.alacranenvironmental.com

SUMMARY

This study aimed to verify the identity of 60 samples of invertebrates from an invertebrate survey undertaken at Hope Downs using molecular barcoding techniques. Standard sanger sequencing methods were employed to amplify a DNA fragment of the gene Cytochrome C oxidase subunit I (COI).

Of the 60 samples assessed, 53 yielded useable DNA sequences, which were analysed using Bayesian phylogenetic reconstruction methods. Thirty (30) species and morphospecies were identified from the study. Ten (10) of these taxa represent species or morphospecies previously known from the Pilbara:

- *Karaops banyjima*: (AES190099, AES190069), a potential SRE: DD;
- *Aurecocrypta* 'MYG315' (AES190347), a potential SRE: DD;
- *Synothele* 'MYG311' (AES190039), a potential SRE: DD;
- *Synothele* 'MYG309' (AES190063), a potential SRE: DD;
- *Gaius tealei* (AES190072, AES190101), a widespread species;
- *Yilgarnia* 'MYG197' (AES190050), potential SRE: DD;
- 'Genus 7/4 PSE118' (T146562, T146561, T146559, AES190079), potential SRE: DD;
- *Lychas* 'bituberculatus cmplx' (AES190065), potential SRE: DD;
- *Lychas* 'multipunctatus cmplx' (AES190080), potential SRE: DD, and
- *Antichiropus* 'wonmunna' (AES190321, AES190104, AES190067, AES190040), potential SRE: DD.

Twenty-two (20) taxa could not be matched with available sequences:

- *Aurecocrypta* 'HD1' (AES190082), a brush-footed trapdoor spider (Barychelidae);
- *Beierolpium* 'HD1' (AES190331), a pseudoscorpion (Olpiidae);
- *Beierolpium* 'HD2' (AES190341), a pseudoscorpion (Olpiidae);
- *Beierolpium* 'HD3' (AES190012), a pseudoscorpion (Olpiidae);
- *Indolpium* 'HD4'(AES190014), a pseudoscorpion (Olpiidae);
- *Austrohorus* 'HD5' (T146556), a pseudoscorpion (Olpiidae);
- *Euryolpium* 'HD6' (T146557), a pseudoscorpion (Olpiidae);
- *Euryolpium* 'HD7' (T146564), a pseudoscorpion (Olpiidae);
- *Tyrannochthonius* 'HD1' (T146555), a pseudoscorpion (Chthoniidae);
- *Tyrannochthonius* 'HD2' (AES190330), a pseudoscorpion (Chthoniidae);
- *Urodacus* 'HD1' (AES190076), a burrowing scorpion (Urodacidae);
- *Mecistocephalus* 'HD1' (AES190336, AES190335, AES190308, AES190338), an earth centipede (Mecistocephalidae);
- *Mecistocephalus* 'HD2' (AES190337), an earth centipede (Mecistocephalidae);
- *Mecistocephalus* 'HD3' (AES190313, AES190322), an earth centipede (Mecistocephalidae);
- *Sepedenophilous* 'HD1' (AES190305, AES190306, AES190077, AES190006, T146570, AES190007, AES190106), an earth centipede (Chilenophilidae);
- *Sepedenophilus* 'HD2' (AES190061), an earth centipede (Chilenophilidae);
- *Orphnaeus* 'HD1' (AES190103), an earth centipede (Oryidae);
- *Cryptops* 'HD1' (AES190315, AES190318, AES190319),
- *Austrostrophus* 'HD1' (AES190092), a millipede (Trigoniulidae), and

- *Austrostrophus* 'HD2' (AES190028, AES190344, AES190074, AES190083), a millipede (Trigoniulidae).

These 19 taxa all have distribution and taxonomic characteristics that make them potential SREs.

1 AIMS

The aim of this study was to assess the species boundaries of eight groups of invertebrates from the Hope Downs area and surrounds, in the Pilbara region of Western Australia:

- spiders from the genus *Karaops* (family Selenopidae)
- brush-footed trapdoor spiders (Barychelidae)
- spiny trapdoor spiders (Idiopidae)
- pseudoscorpions (Olpiidae and Chthoniidae);
- *Lychas* scorpions;
- *Urodacus* scorpions;
- Earth centipedes (Chilenophilidae, Mecistocephalidae and Oryidae);
- Cryptic centipedes (Cryptopidae)
- millipedes in the genus *Austrostrophus* (family Trigoniulidae).
- wood lice (isopods from the family Philosciidae);

These samples were obtained during invertebrate surveys by Astron and Alacran Environmental Science (Alacran) and reported on in Alacran (2019). This report is intended as a supplement to Alacran (2019).

2 METHODS

Sequences and tissue samples were obtained from the following sources:

- Western Australian Museum (tissues and comparative sequences): codes beginning with “T” and followed by a string of numbers
- Alacran Environmental Science (comparative sequences and tissues): samples predating 2019 begin with “ESV” and later samples beginning with “AES”
- Genbank (comparative sequences): codes beginning with two letters and followed by six numbers.
- Erich Volschenk scorpion research (comparative sequences): codes beginning with “EVR”.

All of the target samples were sourced from field collected specimens detailed in a report provided to Astron by Alacran Environmental Science (Alacran), (Alacran 2019).

Sequences of the gene COI were amplified from muscle tissues obtained from specimens preserved in >95% (WA Museum tissue collection) or *ca.* 70%->95% ethanol (wet collections of WA Museum and Simon Judd). Sequence generation from tissues was undertaken by Xytogen Pty Ltd (https://xytogen.com.au/) and AGRF Perth (http://www.agrf.org.au).

Sequence contigs were assembled from forward and reverse amplicons using Geneious R7 version 7.1.9 and were subsequently edited and pruned by eye, prior to consensus sequences being created. Primers were removed from the consensus sequences which were then assessed for contamination using the NCBI Nucleotide Blast tool (https://blast.ncbi.nlm.nih.gov).

For analyses and alignment, additional sequences of species were obtained from Genbank or from Alacran (unpublished sequences) to better guide alignments and assessment of species boundaries. Species pairs were

selected from taxa within the same genus or family of the taxa under investigation and more than 400 bases long.

Phylogenetic analyses and Sequence alignments were performed with Geneious R7. For each analysis sequences were assembled and aligned using ClausalW or the Geneious alignment tool, implementing the following variable settings: Global alignment with free ends; Cost matrix, 70% similarity (IUB); Open gap penalty, 70; Gap extension penalty, 10; refinement iterations, 4.

Phylogenetic analyses were implemented using Geneious R7 and MrBayes (Huelsenbeck and Ronquist 2001; Ronquist et al. 2012). Outgroups were selected from (in order of preference): sister genus-, sister family- or sister order- to the group under investigation. Species delimitation was based on an 8% sequence divergence threshold (Hebert et al. 2003a; Hebert et al. 2003b; Barrett and Hebert 2005; Robinson et al. 2009) unless otherwise stated. Most of the analyses undertaken here were comprised of representatives of the same family; however, sequences were grouped at the Class level for Diplopoda, and order for Geophilomorpha and Pseudoscorpiones.

2.1 ANALYSES

Eight separate analyses were undertaken here, with each analysis aiming to assess the identification of the target taxa for the respective group.

Composition of the analyses are listed for each analysis as follows:

- Selenopidae - Table 1,
- Barychelidae - Table 2,
- Idopidae - Table 3,
- Nemesiidae - Table 4
- Pseudoscorpiones - Table 5,
- *Lychas* (Scorpiones, Buthidae) - Table 6,
- *Urodacus* (Scorpiones, Urodacidae) - Table 7,
- Geophilomorpha - Table 8,
- Cryptopidae - Table 9,
- Diplopoda - Table 10.

Table 1. Sample composition for the Selenopidae analysis

Sample type	Samples
Target samples	*Karaops* sp., AES190069; *Karaops banyjima* AES190099
Reference samples	*Karaops martamarta* (T124805, T124806) and four additional *Karaops* haplotypes: *Karaops* 'DNA01' (T124901, T128055), *Karaops* 'DNA02' (T124815, T124818), *Karaops* 'DNA03' (T124816, T124817), *Karaops* 'DNA04' (T124792) *Karaops* 'DNA05' (T128008, T128011, T128002) and *Karaops* sp. (T134092, T134104, T139710, T139711, T139718, T139720, T139722, T139723, T139724, T139730).
Outgroup	*Liphistius laoticus* (KP229896), *Anyphops barnardi* (HM575911, HM575912), *Garcorops* 'madagascar' (HM575917) and *Selenops submaculosus* (HM575844)

Table 2. Sample composition for the Barychelidae analysis

Sample type	Samples
Target samples	*Synothele* sp.: AES190063, AES190039, AES190082, AES190347
Reference samples	*Aurecocrypta* 'MYG246' (KJ744784, KJ744805), *Aurecocrypta* 'MYG314' (KJ744682), *Aurecocrypta* 'MYG315' (KJ744636, KJ744575), *Aurecocrypta* 'MYG316' (KJ744667, KJ745033), *Aurecocrypta* 'MYG317' (KJ744547), *Aurecocrypta* 'MYG318' (KJ744660), *Aurecocrypta* 'MYG319' (KJ745481), *Idiommata blackwalli* (KJ745197), *Idiommata* 'MYG247' (KJ745462, KJ745116), *Idiommata* 'MYG254' (KJ745103), *Idiommata* 'MYG320' (KJ745100, KJ745205), *Synothele arrakis* (KY017602), *Synothele* 'xkarara' (KJ744439, KJ745125, KJ745214, KJ745438), *Synothele* '01' (T128031, T128171, T128044), *Synothele* '02' (T118332), *Synothele* '03' (T124724), *Synothele* '04' (T124722), *Synothele* '05' (T126826, T128057), *Synothele* 'WM1' (ESV18:0841), *Synothele* 'WM2' (ESV18:0933), *Synothele* 'MYG127' (KJ745104, KJ745113), *Synothele* 'MYG179' (KJ744405), *Synothele* 'MYG309' (KJ744894, KJ744794 KJ745344), *Synothele* 'MYG310' (KJ744594, KJ744595), *Synothele* 'MYG311' (KJ744654, KJ745445, KJ744869, KJ745034), *Synothele* 'MYG312' (KJ745212) and *Synothele* 'MYG313' (KJ745433).
Outgroup	*Liphistius laoticus* (KP229896).

Table 3. Sample composition for the Idiopidae analysis

Sample type	Samples
Target samples	Idiopidae sp. (AES190072, AES190101)
Reference samples	*Arbanitis longipes* (KY295347), *Arbanitis robertcollinsi* (KY295308), *Blakistonia aurea* (KY295304), *Blakistonia bassi* (MH491250), *Blakistonia birksi* (MH491279), *Blakistonia mainae* (MH491281), *Blakistonia maryae* (MH491199), *Blakistonia nullarborensis* (MH491284), *Bungulla bella* (MG516838), *Bungulla bertmaini* (MG516831), *Bungulla biotai* (MG516828), *Bungulla disrupta* (MG516840), *Bungulla gibba* (MG516839), *Bungulla yeni* (MG516835), *Cataxia barrettae* (KY485320), *Cataxia bolganupensis* (KY295345), *Cataxia colesi* (KY485343), *Cataxia maculata* (KY295235), *Cataxia melindae* (KY485348), *Cataxia pallida* (KY295300), *Cataxia pulleinei* (KY295295), *Cataxia sandsorum* (KY485338), *Cataxia spinipectoris* (KY295296), *Cataxia* sp. (KY295229, KY295294, KY295297, KY295299), *Cataxia stirlingi* (KY485328, KY485332), *Cataxia victoriae* (KY295302), *Eucyrtops eremaeus* (KY295252), *Eucyrtops latior* (KY295256), *Euoplos annulipes* (KY295283), *Euoplos inornatus* (KT598258), *Euoplos mcmillani* (KY295245, KY295273), *Euoplos* 'MYG307' (KJ745207), *Euoplos ornatus* (KY295342), *Euoplos similaris* (KY295263), *Euoplos spinnipes* (KY295237), *Euoplos tasmanicus* (KY295267), *Euoplos variabilis* (KY295341), *Gaius austini* (MG652494), *Gaius cooperi* (MG652496), *Gaius humphreysi* (MG652497), *Gaius mainae* (KY295313), *Gaius tealei* (KJ745055), *Gaius villosus* (KJ745514), *Idiopidae* sp. (KY295250, KY295306), *Idiosoma arenaceum* (MH144662, MH144666), *Idiosoma castellum* (KY295247), *Idiosoma clypeatum* (MH144640), *Idiosoma cupulifex* (KY295337), *Idiosoma dandaragan* (MH144626), *Idiosoma formosum* (MH144628), *Idiosoma intermedium* (MH144611), *Idiosoma jarrah* (MH144614), *Idiosoma kopejtkaorum* (MH144654), *Idiosoma kwongan* (MH144660), *Idiosoma mcclementsorum* (MH144624), *Idiosoma mcnamarai* (MH144631), *Idiosoma* 'MYG014' (KJ745420), *Idiosoma* 'MYG015' (KJ745427), Idiosoma 'MYG019' (KJ745428), *Idiosoma* 'MYG085' (KJ745369), *Idiosoma* 'MYG256' (KJ745099), *Idiosoma* 'MYG260' (KJ745101), *Idiosoma* 'MYG300' (KJ745123), *Idiosoma* 'MYG303' (KJ745062), *Idiosoma* 'MYG304' (KJ745109), *Idiosoma* 'MYG305' (KJ745148), *Idiosoma nigrum* (KY295317, MH144634), *Idiosoma schoknechtorum* (MH144638), *Idiosoma sigillatum* (KJ745098), *Idiosoma smeatoni* (KY295348), *Idiosoma* sp. (KY295228, KY295233, KY295240, KY295244, KY295246, KY295249, KY295262, KY295271, KY295274, KY295291, KY295292, KY295307, KY295310, KY295312, KY295314, KY295315, KY295316, KY295318, KY295319, KY295320, KY295321, KY295322, KY295323, KY295326, KY295327, KY295328, KY295329, KY295330, KY295332, KY295338, KY295349, MH144664)), *Idiosoma subtristis* (KY295282), *Idiosoma subtristis* (KY295334), *Misgolas gracilis* (KY295281), *Misgolas hubbardi* (KY017758), Misgolas rapax (KY295239), *Misgolas robertsi* (KY295286), *Misgolas villosus* (KY295339).
Outgroup	*Liphistius laoticus* (KP229896)

Table 4. Sample composition for the Nemesiidae analysis

Sample type	Samples
Target samples	*Kwonkan* sp. (AES190050)
Reference samples	*Aname aragog* (JQ772136), *Aname ellenae* (JQ772137), *Aname mainae* (KJ745198), *Aname mellosa* (JQ772125), *Aname* 'MYG001' (KJ744409), *Aname* 'MYG004 (KJ744436), *Aname* 'MYG034' (KJ745375), *Aname* 'MYG067' (KJ745435), *Aname* 'MYG079' (KJ744406), *Kwonkan* 'MYG006' (KJ744608), *Kwonkan* 'MYG006' (KJ744607), *Kwonkan* 'MYG088' (KJ745206), *Kwonkan* 'MYG172' (KJ744388), *Kwonkan* 'MYG175' (KJ744403), *Kwonkan* 'MYG195' (MG800177), *Kwonkan* 'MYG325' (KJ744834, KJ744665), *Kwonkan* 'MYG337' (KJ744962, KJ744959), *Kwonkan* 'MYG338' (KJ744840, KJ744666), *Kwonkan* 'MYG341' (KJ745190, KJ745188), *Kwonkan* 'MYG343' (KJ745210), *Kwonkan* 'MYG352' (KJ745255, KJ745238), *Kwonkan* 'MYG361' (KJ745281), *Kwonkan* 'MYG378' (KJ744782), *Kwonkan* 'MYG379' (KJ744832, KJ744831), *Kwonkan* 'MYG390' (MG800173), *Kwonkan* 'MYG392' (MG800175), *Kwonkan* 'MYG394' (MG800176), *Kwonkan* 'MYG599' (MH932614), *Pseudoteyl* 'MYG353' (KJ745272, KJ745278, KJ745277), *Teyl* 'MYG021' (KJ745381, KJ745380), *Teyl* 'MYG027' (KJ744759), *Teyl* 'MYG412' (MG800164), *Teyl* 'MYG455' (MG800147), *Yilgarnia* 'MYG164' (KJ745511), *Yilgarnia* 'MYG165' (KJ745513, KJ745512), *Yilgarnia* 'MYG197' (MG800166), *Yilgarnia* 'MYG324' (KJ744777, KJ744773), *Yilgarnia* 'MYG327' (KJ745015, KJ745013), *Yilgarnia* 'MYG374' (KJ744695), *Yilgarnia* 'MYG375' (KJ744709), *Yilgarnia* 'MYG376' (KJ744725), *Yilgarnia* 'MYG458' (MG800155)
Outgroup	*Liphistius laoticus* (KP229896)

Table 5. Sample composition for the Pseudoscorpiones analysis

Sample type	Samples
Target samples	**Olpiidae**: *Austrohorus* sp. (T146556), *Beierolpium* sp. (AES190012, AES190341, AES190331, T146557, AES190090), *Indolpium* sp. (T146562, T146561, T146559, T146563, AES190014, AES190079); **Unresolved samples**: Olpiidae sp. (1T146564, T146565); **Chthoniidae**: Tyrannochthonius sp. (T146555, AES190330).
Reference samples	**Olpiidae:** *Austrohorus* 'PSE119' (T139670, T139676, T139680, T139687, T139697, T139700, T139702, T139703); *Austrohorus* 'PSE121' (T139681); *Austrohorus* 'PSE122' (T139706, T139707); *Beierolpium* 'PSE126' (T139688); *Indolpium* 'PSE123' (T139678, T139683, T139705 , T139675, T139696, T139701); *Indolpium* 'PSE124' (T136334); 'Genus 7/4 PSE118' (T139690). **Additional Olpiid Genera:** *Xenolpium* 'JM (2008' (EU559539), *Apolpium parvum* (EU559541), *Pachyolpium* 'JM (2008' (EU559542), *Nanolpium* 'JM (2008' (EU559543), *Beierolpium bornemisszai*, (EU559545) and *Euryolpium* 'JM (2008' (EU559546); **Chthoniidae**: *Tyrannochthonius aridus* (KJ659960, KJ659959), sequence of *Tyrannochthonius garthhumphreysi* (KJ659948)
Outgroup	*Siro exilis* (AY639579), *Buthus occitanus* (GQ168524)

Table 6. Sample composition for the *Lychas* analysis

Sample type	Samples
Target samples	*Lychas* 'bituberculatus cmplx' (AES190065), *Lychas* 'multipunctatus cmplx' (AES190080).
Reference samples	*Lychas* 'adonis' (T101228, T85763), *Lychas* 'annulatus cmplx' (T114330, T124554, T99992), *Lychas* 'bituberculatus cmplx' (EVR7959, T101960, T91706, T97380), *Lychas* 'pilbara 1' (T126898, T126932), *Lychas* 'hairy tail cmplx' (T92146, T97507, T97518, T97522, T98280, T99692), *Lychas jonesae* (T101224, T118598, T94832, T99995), *Lychas* 'LC' (ESV18:0359), *Lychas* 'cf mjobergi' (T94832), *Lychas* 'multipunctatus cmplx' (EVR7974), *Lychas* 'nigrescens' (T83597), *Lychas* 'splendens' (T94760, T97774), *Lychas* sp. (T126899).
Outgroup	Siro exilis (AY639579), *Buthus occitanus* (GQ168524), *Cercophonius sulcatus* (KT447038), *Heterometrus laoticus* (JN018160), *Orthochirus innesi* (JQ514244) and *Parabuthus transvaalicus* (JQ514247).

Table 7. Sample composition for the *Urodacus* analysis

Sample type	Samples
Target samples	*Urodacus* sp., AES190076
Reference samples	*Urodacus* 'Biota 2' (EVR6974, EVR6985), *Urodacus* 'bullsbrook' (EVR8013), *Urodacus butleri* (T123092, T85115), *Urodacus* cf.hartmeyeri (EVR2122), *Urodacus* 'eddiei' (EVR2342), *Urodacus* 'gibson 2' (EVR7981), *Urodacus* 'gibson 4' (EVR7999), *Urodacus* 'gibson 5' (EVR8011), *Urodacus* 'glauerti' (T79950, *Urodacus* 'granifrons' (EVR9141), *Urodacus hoplurus* (T75099), *Urodacus* 'karara' (T77953), *Urodacus koolanensis* (T101952), *Urodacus* 'laverton 2' (EVR7979), *Urodacus* 'laverton 3' (EVR7976), *Urodacus* 'laverton 5' (EVR7994), *Urodacus* 'majerorum' (EVR2878), *Urodacus* 'maret' (EVR6988), *Urodacus mckenziei* (EVR2689), *Urodacus* 'megamastigus cmplx' (T100386, T100390), *Urodacus* 'mingenew' (T53929), *Urodacus novaehollandiae* (EVR1540, EVR7993), *Urodacus* 'pale cmplx' (EVR1553, EVR529, EVR6978, EVR1552, EVR527), *Urodacus planimanus* (EVR1661), *Urodacus similis* (T85018), *Urodacus* sp. (ESV18:0205, ESV18:0578, ESV18:0587), *Urodacus* 'telfer' (T114318, T114321), *Urodacus varians* (T37723), *Urodacus* 'woodwardii' (EVR1664), *Urodacus* 'yaschenkoi cmplx' (EVR6984, EVR8007), *Urodacus* 'yeelirrie' (T101241, T101243)
Outgroup	*Siro exilis* (AY639579) was used as the outgroup for this analysis, along with the following scorpions: *Buthus occitanus* (GQ168524), *Centruroides exilicauda* (AY649858), *Cercophonius michaelseni* (T41784) and *Cercophonius sulcatus* (T81521).

Table 8. Sample composition for the Geophilomorpha analysis

Sample type	Samples
Target samples	**Chilenophilidae:** *Sepedenophilus* sp. (AES190305, AES146570, AES190306, AES190006, AES190077, AES190007, AES190106, AES190061); **Mecistocephalidae**: Mecistocephalus sp. (AES190335, AES190336); **Oryidae**: *Orphnaeus sp.* (AES190103 and AES190322); **Unresolved Geophilomorpha**: Geophilomorpha sp. (AES190313, AES190308, AES190337)
Reference samples	**Chilenophilidae**: *Sepedenophilous*, representing eight species, were included in the analysis: *Sepedonophilus* '01' (T126608, T126604), *Sepedonophilus* '02' (T126607, T126772), *Sepedonophilus* '03' (T126781, T126778, T128035), *Sepedonophilus* '04' (T128075, T128080), *Sepedonophilus* '05' (T136340), *Sepedonophilus* 'G1' (ESV18:1010), *Sepedonophilus* 'G2' (ESV18:1050), *Sepedonophilus* 'G3' (ESV18:0519); **Mecistocephalidae**: *Mecistocephalus* '02' (T126693), *Mecistocephalus* '03' (T126697, T128034), *Mecistocephalus* '04' (T128174), *Mecistocephalus* '05' (T128180), *Mecistocephalus* '06' (T126739, T128041), *Mecistocephalus* '07' (T126733), *Mecistocephalus* '08' (T128073, T128076), *Mecistocephalus* '09' (T128060, T136342, T136341), *Mecistocephalus* '10' (T128063, T128077), *Mecistocephalus* '11' (T126845); **Oryidae**: *Orphnaeus* 'WM1' (ESV18:0997), *Orphnaeus brevilabiatus* (T128175, T128176, AB608780).
Outgroup	*Lamyctes africanus* (KC688312)

Table 9. Sample composition for the Cryptopidae analysis

Sample type	Samples
Target samples	*Cryptops* sp. (AES190315, AES190318, AES190319)
Reference samples	*Cryptops anomalans* (KU497151, JN266283), *Cryptops doriae* (KF676500), *Cryptops hortensis* (KU497145, KU497144), *Cryptops indicus* (KF676505), *Cryptops japonicus* (AB610777), *Cryptops lamprethus* (JX422663, JF273305), *Cryptops parisi* (KU497140, KF676502), *Cryptops japonicus* (AB610778), *Cryptops niuensis* (JF273296, JF273294), *Cryptops pictus* (JF273264, JF273262), *Cryptops punicus* (KF676503), *Cryptops sarasini* (JF273306), *Cryptops trisulcatus* (KF676504), *Cryptops* sp. (T128039, T126647), *Cryptops* '06' (T136352, T136353, T128042, T128032, T128069), *Cryptops* '07' (T126644, T126674), *Cryptops* '13' (T112190), *Cryptops* '15' (T124753, T124750), *Cryptops* '16' (T124748, T126657), *Cryptops* '17' (T118071, T126662), *Cryptops* '18' (T136354), *Cryptops* 'K1' (ESV181007), *Cryptops* 'G1' (T149105, T149106)
Outgroup	*Lithobius agilis* (JN306649)

Table 10. Sample composition for the Diplopoda analysis

Sample type	Samples
Target samples	**Trigoniulidae** (**Spirobolida**)**:** *Austrostrophus* sp. (AES190083, AES190344, AES190028, AES190074, AES190092); **Paradoxosomatidae** (**Polydesmida**)**:** *Antichiropus* sp. (AES190104, AES190040, AES190321, AES190067).
Reference samples	**Trigoniulidae** (**Spirobolida**)**:** *Austrostrophus* sp. (T101121, T101128); **Paradoxosomatidae** (**Polydesmida**)**:** *Antichiropus anguinus* (MK735847), *Antichiropus apricus* (MK735886, MK735892), *Antichiropus cirratus* (MK735904, MK735906, MK735861), *Antichiropus cunicularis* (MK735862, MK735889), *Antichiropus* DIP019 (T128169), *Antichiropus* DIP174 (MH932612), *Antichiropus forcipatus* (MK735872, MK735882), *Antichiropus* G1 (ESV18:0003), *Antichiropus* 'G2' (ESV18:0434), *Antichiropus nimbus* (MK735887), *Antichiropus pendiculus* (MK735849, MK735923), *Antichiropus simmonsi* (MK735891), *Antichiropus sloanae* (MK735877, MK735888), *Antichiropus* sp. (ESV18:0440, ESV18:0449), *Antichiropus uvulus* (MK735848, MK735893), *Antichiropus variabilis* (JN637337, JN637362), *Antichiropus verutus* (MK735851, MK735860), *Antichiropus* 'wonmunna' (T118101), *Antichiropus whistleri* (JN637364, JN637365).
Outgroup	*Polyzonium germanicum* (JQ350463), order Polyzoniida

3 RESULTS

3.1 SELENOPIDAE (ARANEOMORPHAE)

Karaops banyjima (Figure 1)**.** The two target samples of *Karaops* differed from each other by 4.6% sequence divergence, indicating that they are likely to be conspecific Figure 1. These samples grouped with other samples also likely to represent *Karaops banyjima* but not previously identified (T134092, T134104, T139710, T139711, T139718, T139720, T139722, T139723, T139724, T139730). These samples differed from each other by 2.3% - 7.59%. These sampled differed from all other samples in the analysis by 7.56% or more sequence divergence.

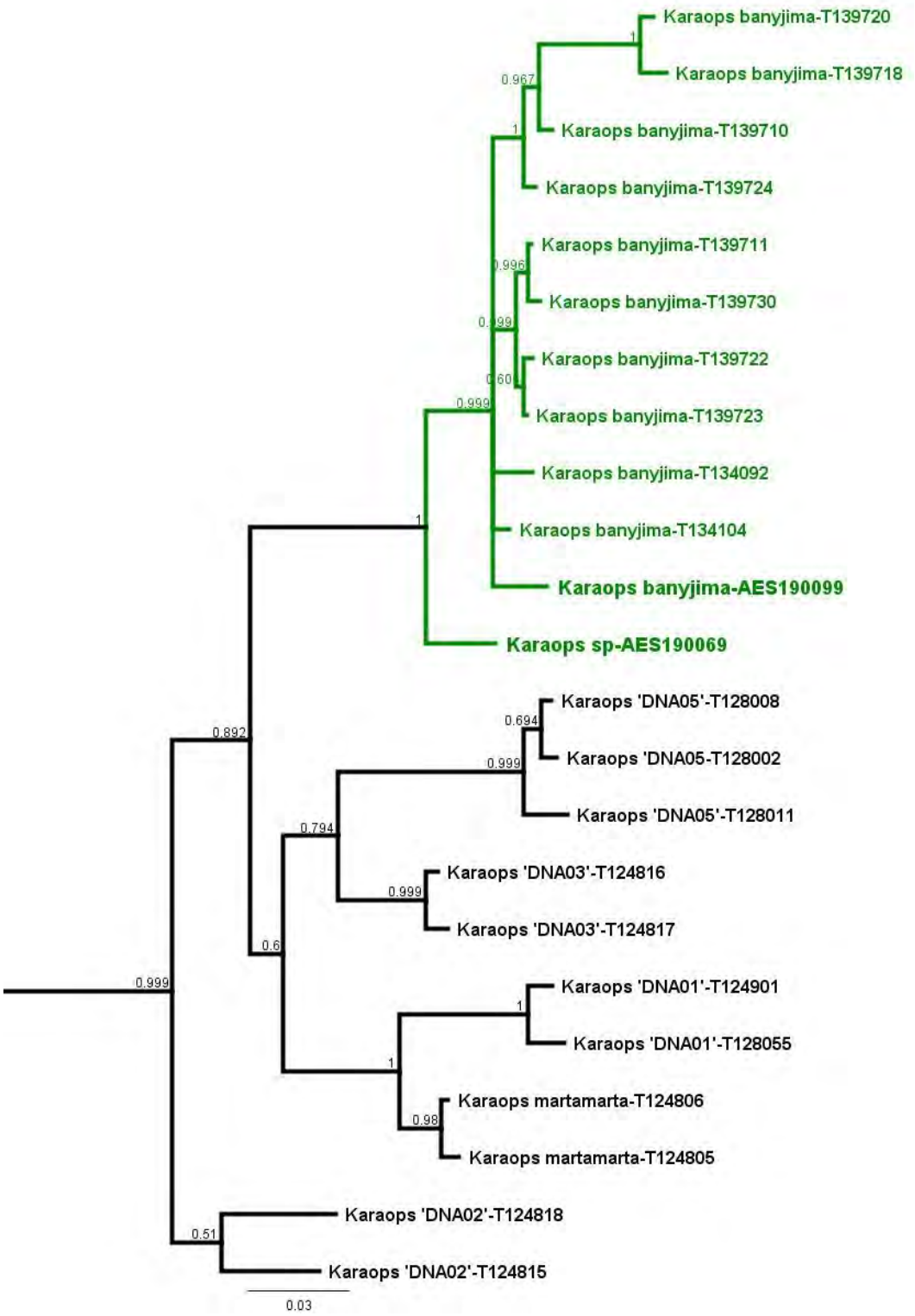


Figure 1 Phylogenetic relationships between *Karaops* samples analysed based on COI DNA sequences: *Karaops banyjima* clade in green, branch labels represent posterior probabilities; scale bar represents substitutions per site.

3.2 BARYCHELIDAE (MYGALOMORPHAE)

The analysis yielded a poorly resolved phylogeny with none of the ingroup genera being monophyletic (Figure 2)

***Synothele* 'MYG309'** (Figure 2)**.** Sample AES190063 was most similar to *Synothele* 'MYG309' (KJ744894, KJ744794) and differed from these samples by 2.66% and 9.19% sequence divergence respectively, indicating that they are likely to represent the same species. These three samples differed from all others included in this study by 9.57% or more sequence divergence.

***Synothele* 'MYG311'** (Figure 2)**.** Sample AES190039, grouped with four samples of *Synothele* 'MYG311' (KJ744654, KJ745445, KJ744869, KJ745034) and differed from these samples by 1.37% - 2.79% sequence divergence, indicating that they are conspecific. These five samples differed from all other samples in the analysis by 12.46% or more sequence divergence.

***Aurecocrypta* 'HD1'** (Figure 2)**.** Sample AES190082 differed from all other samples in the analysis by 9.75% or more sequence divergence indicating that it may not be conspecific with any of the species included in the analysis. The phylogenetic analysis placed this species as a sister to *Aurecocrypta* 'MYG317' (KJ744547) from which it differed by 11.03% sequence divergence. Sample AES190082 was placed in a clade comprising nine other samples of *Aurecocrypta* therefore it is cautiously regarded as a representative of this genus and is here referred to as *Aurecocrypta* 'HD1'.

***Aurecocrypta* 'MYG315'** (Figure 2)**.** Sample AES190347 grouped with two samples of *Aurecocrypta* 'MYG315' (KJ744636, KJ744575) and differed from these samples by 0.46% and 7.29% sequence divergence respectively. This sample therefore represents *Aurecocrypta* 'MYG315' and these three samples differed from all others in the analysis by 11.09% or more sequence divergence.

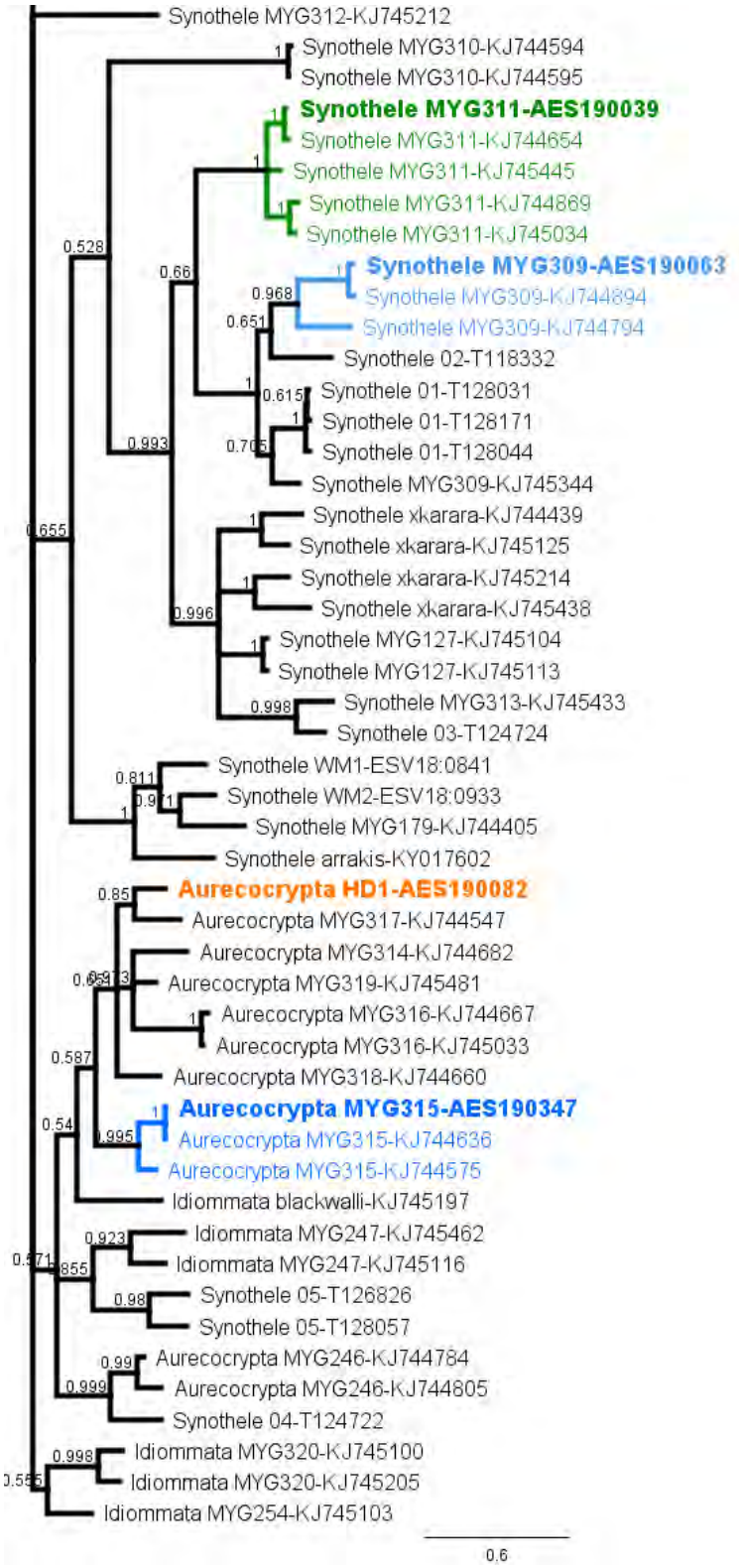


Figure 2 Phylogenetic relationships between samples of Barychelidae based on the analysis of COI DNA sequences: shaded clades represent target taxa and conspecific samples; taxa in bold text; branch labels represent posterior probabilities; scale bar represents substitutions per site.

3.3 IDIOPIDAE (MYGALOMORPHAE)

Gaius tealei (Figure 3)**.** The target samples AES190072 and AES190101 differed from one another by 0.15% sequence divergence, indicating that they are representatives of the same species. The phylogenetic analysis grouped them with *Gaius tealei* (KJ745055), from which they differed by 3.05% sequence divergence, indicating that they are likely to belong to this species (Figure 3). These samples differed from all others in the analysis by more than 15.42% sequence divergence or more.

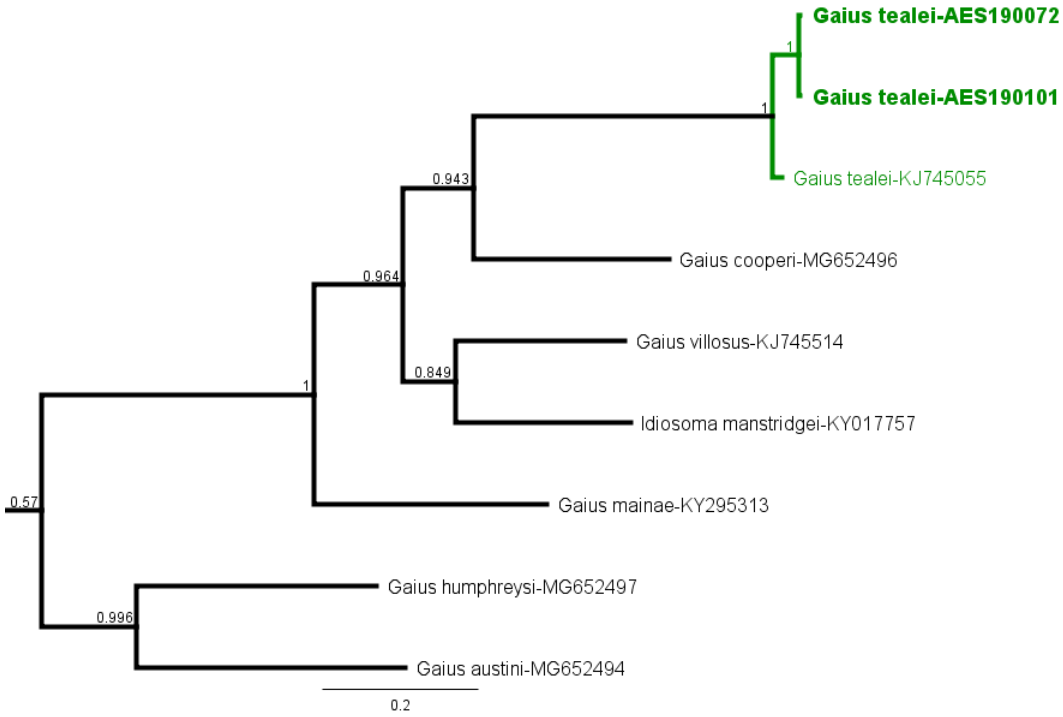


Figure 3 Subclade from the phylogeny of Idiopidae showing relationships between the targeted samples: target taxa in bold text; green clade, *Gaius tealei* branch labels represent posterior probabilities; scale bar represents substitutions per site.

3.4 NEMESIIDAE (MYGALOMORPHAE)

***Yilgarnia* 'MYG197'.** Sample AES190050 matched with a sample of *Yilgarnia* 'MYG197' and differed from it by 4.86% COI sequence divergence, indicating that they are conspecific. *Yilgarnia* 'MYG197' was placed in a clade dominated by other *Yilgarnia* sequences (Figure 4) indicating that the original placement of this sample into *Kwonkan* was incorrect and that *Yilgarnia* is the correct genus.

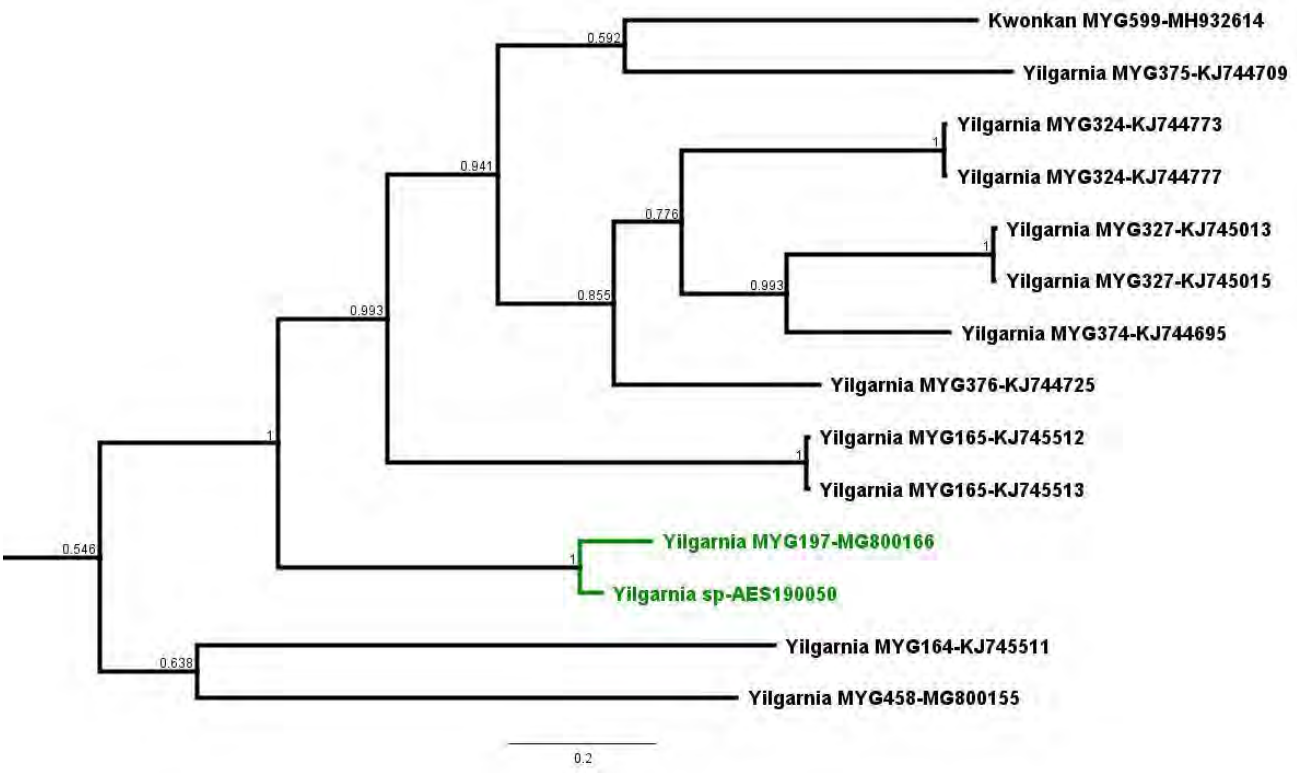


Figure 4. Clade of mostly *Yilgarnia* from the analysis of target Nemesiidae: branch labels represent posterior probabilities; scale bar represents substitutions per site.

3.5 OLPIIDAE AND CHTHONIIDAE (PSEUDOSCORPIONES)

***Beierolpium* 'HD1'** (Figure 5)**.** Sample AES190331 differed from all other samples in the analysis by 11% or more sequence divergence, indicating that is unlikely to be conspecific with any of the species included in this study. The most similar species was represented by sample AES190341.

***Beierolpium* 'HD2'** (Figure 5)**.** Sample AES190341 differed from all other samples in the analysis by 11% or more sequence divergence, indicating that is unlikely to be conspecific with any of the species included in this study.

***Beierolpium* 'HD3'** (Figure 5)**.** Sample AES190012 differed from all other samples in the analysis by 19.92% or more sequence divergence, indicating that is unlikely to be conspecific with any of the species included in this study.

In this analysis, *Beierolpium* was monophyletic, supporting the placement of these samples in this genus.

***Indolpium* 'HD4'** (Figure 5)**.** Sample AES190014 differed from all other samples in the analysis by 15.29% or more sequence divergence, indicating that it is unlikely to be conspecific with any of the species included in this study. This sample was placed basely on a monophyletic *Indolpium* clade confirming its placement within this genus.

***Austrohorus* 'HD5'** (Figure 5)**.** Sample T146556 differed from all other samples in the analysis by 15.29% or more sequence divergence, indicating that is unlikely to be conspecific with any of the species included in this

study. This sample was not monophyletic with the remaining *Austrohorus* samples in the analysis. This taxon is grouped in a polytomy with *Apolpium*, *Austrohorus* and (*Xenolpium* + 'Genus 7/4') making assignment to genus problematic. For the purpose of this study, the sample is regarded as a representative of *Austrohorus* and additional data will need to be included to resolve the placement of this taxon.

'Genus 7/4 PSE118' (Figure 5)**.** Four samples (T146559, T146561, AES190079 and T146562) differed from one another by 1.18% (6.63% sequence divergence indicating that they are likely to represent a single taxon. These samples differed from 'Genus 7/4 PSE118' (T139690) by 7.04% (7.44% sequence divergence, indicating that they are conspecific with this taxon. These samples of 'Genus 7/4 PSE118' differed from all other samples in the analysis by 15.65% or more sequence divergence. Samples AES146559, AES146561, AES190079 and AES146562 were previous incorrectly regarded as species of *Indolpium* (Alacran 2019).

***Euryolpium* 'HD6'** (Figure 5). Sample AES146557 differed from all other samples in the analysis by 15.04% or more sequence divergence, indicating that is unlikely to be conspecific with any of the species included in this study. This sample was previously not assigned to *Beierolpium* (Alacran 2019); however this study placed the sample in a clade containing a species of *Euryolpium*. This taxon is therefore regarded as a representative of the genus *Euryolpium*.

***Euryolpium* 'HD7'** (Figure 5). Sample AES146564 differed from all other samples in the analysis by 15.04% or more sequence divergence, indicating that is unlikely to be conspecific with any of the species included in this study. This sample was previously not assigned to any genus (Alacran 2019); however this study placed the sample in a clade containing a species of *Euryolpium*. This taxon is therefore regarded as a representative of the genus *Euryolpium*.

***Tyrannochthonius* 'HD1'**, AES146555) and ***Tyrannochthonius* 'HD2'**, AES190330 (Figure 5). The two target samples differed from one another by 13.13% sequence divergence, indicating that they are unlikely to be conspecific. These samples also differed from all other samples in the analysis by 17% or more sequence divergence, indicating that they are not conspecific with the two samples of *Tyrannochthonius aridus* from Genbank.

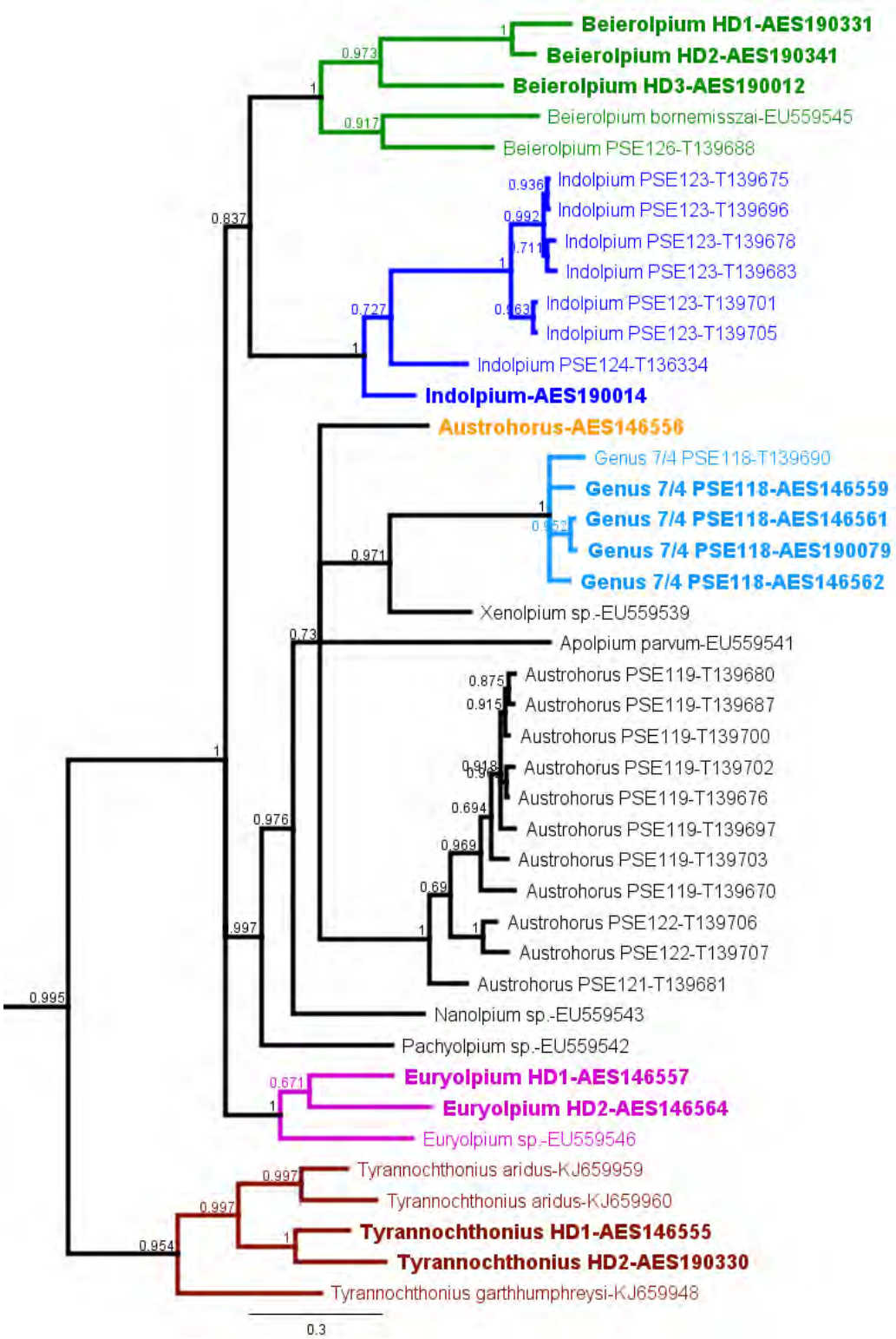


Figure 5. Phylogeny of pseudoscorpions included in this study with monophyletic clades shaded, target samples in bold; branch labels represent posterior probabilities; scale bar represents substitutions per site.

3.6 BUTHIDAE (SCORPIONES)

The phylogenetic analysis of these species produced a very poorly structured phylogeny (Figure 6).

***Lychas* 'bituberculatus cmplx'** (Figure 6)**.** Sample AES190065 was most similar to T91706 and differed from it by 0.94% sequence divergence, confirming that these belonging to the same species, thus supporting the placement of this species within this species complex. These two samples differed from other species in this complex (EVR7959, T97380, T91706) by between 10.03% and 10.53% sequence divergence. These five samples differed from all others in the analysis by 8.81% or more sequence divergence, further highlighting the confusing relationships between species in this genus.

***Lychas* 'multipunctatus cmplx'** (Figure 6)**.** Sample AES190080 was most similar to EVR7974 and differed from it by 1.82% sequence divergence, confirming that these belonging to the same species, thus supporting the placement of this species within this species complex. These two samples differed from all others in the analysis by 8.81% or more sequence divergence.

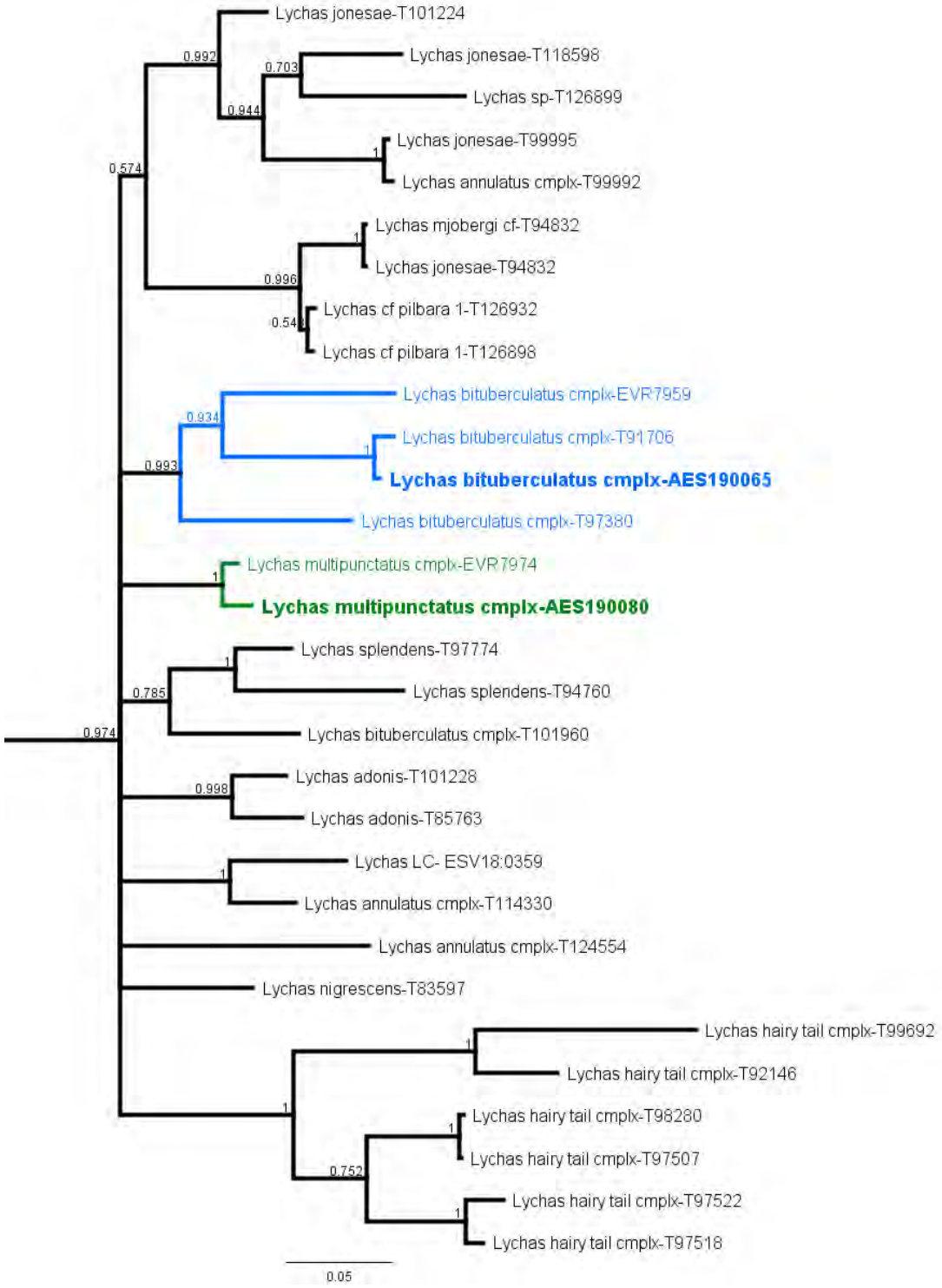


Figure 6. Phylogeny of *Lychas* species included in this study with monophyletic clades shaded, target samples in bold; branch labels represent posterior probabilities; scale bar represents substitutions per site.

3.7 URODACIDAE (SCORPIONES)

***Urodacus* 'HD1'** (Figure 7). Sample AES190076 showed no clear relationship with any of the samples included in the analysis Figure 7 and differed from all of them by 8.05% or more sequence divergence. The average divergence between this species and all other *Urodacus* samples in this study was 9.9% suggesting that the species delimiting threshold is likely to be less than 9% sequence divergence. Of the unambiguous species pairs analyses in this study, *Urodacus novaehollandiae* (EVR1540, EVR7993) showed the greatest divergence between specimens at 7.48% sequence divergence, suggesting that this may represent a more appropriate delimiting threshold for species of *Urodacus*. Sample AES190076 is here referred to as *Urodacus* 'HD1'.

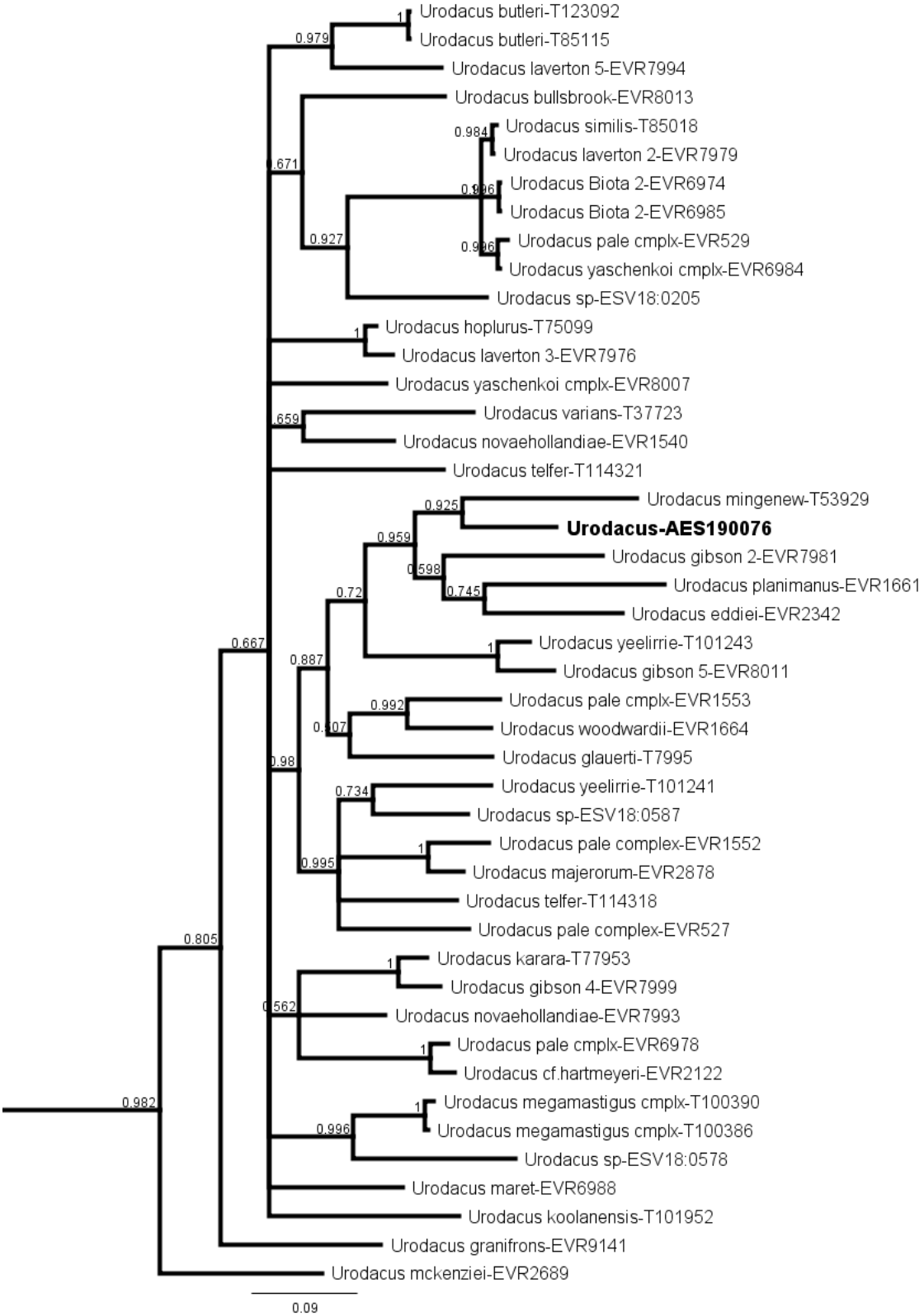


Figure 7. Phylogeny of *Urodacus* species and morphospecies included in this study: target sample in bold; branch labels represent posterior probabilities; scale bar represents substitutions per site.

3.8 CHILENOPHILIDAE, MECISTOCEPHALIDAE AND ORYIDAE (GEOPHILOMORPHA)

***Sepedenophilous* 'HD1'** (Figure 9)**.** Seven target taxa grouped together (AES190305, T146570, AES190306, AES190006, AES190077, AES190007, AES190106) with 0% - 7.34% sequence divergences. These samples differed from all others in the analysis by 12.23% or more sequence divergence.

***Sepedenophilus* 'HD2'** (Figure 9)**.** Sample AES190061 differed from all other samples in the analysis by 19.44% sequence divergence, therefore this species is not conspecific with any in the analysis. The sample was placed within a monophyletic clade of *Sepedenophilous* samples and is here referred to ad *Sepedenophilous* 'HD2'.

***Mecistocephalus* 'HD1'** (Figure 9)**.** Four samples (AES190338, AES190335, AES190336, AES190308) grouped together and differed from one another by 0.16% - 1.1% sequence divergence, indicating that they are conspecific. These samples differed from all other samples in the analysis by 10.97% or more sequence divergence. This species is here referred to as *Mecistocephalus* 'HD1'. Among the samples identified to this taxon, was one that was previously misidentified as a species of *Sepedenophilous* (AES190338) and one sample that could not be identified, Geophilomorpha sp. (AES190308) (Alacran 2019)

***Mecistocephalus* 'HD2'** (Figure 9). Sample (AES190337) differed from all others in the analysis by 10.97% or more sequence divergence. This sample could originally not be placed in a family or genus but was here placed in a monophyletic clade of *Mecistocephalus*. This species is here referred to as *Mecistocephalus* 'HD2'.

***Mecistocephalus* 'HD3'** (Figure 9)**.** Sample AES190322 grouped closely with AES190313 0.31% sequence divergence indicating that they are conspecific. These samples differed from all other sin the analysis by 18.03% or more sequence divergence. These samples were placed in a monophyletic clade of *Mecistocephalus*. These two samples are here referred to as *Mecistocephalus* 'HD3'. Sample AES190322 was originally misidentified as a species of *Orphnaeus* and sample AES190313 could not be identified to family or genus (Alacran 2019).

***Orphnaeus* 'HD1'** (Figure 9)**.** Sample AES190103 differed from all samples in the analysis by 15.09% or more sequence divergence, indicating that it is not conspecific with any of those species. This species was placed in a clade containing was placed in monophyletic clade of *Orphnaeus*, thus supporting its placement in this genus. This species is here referred to as *Orphnaeus* 'HD1'.

3.9 CRYPTOPIDAE (SCOLOPENDROMORPHA)

***Cryptops* 'HD1'** (**Figure 8**)**.** The three target taxa grouped together (AES190315, AES190318, AES190319) with 2.81% - 3.5% sequence divergences between them. These samples differed from all others in the analysis by 19.04% or more sequence divergence, indicating that they represent a unique taxon relative to those included in this study. This species is here referred to as *Cryptops* 'HD1'.

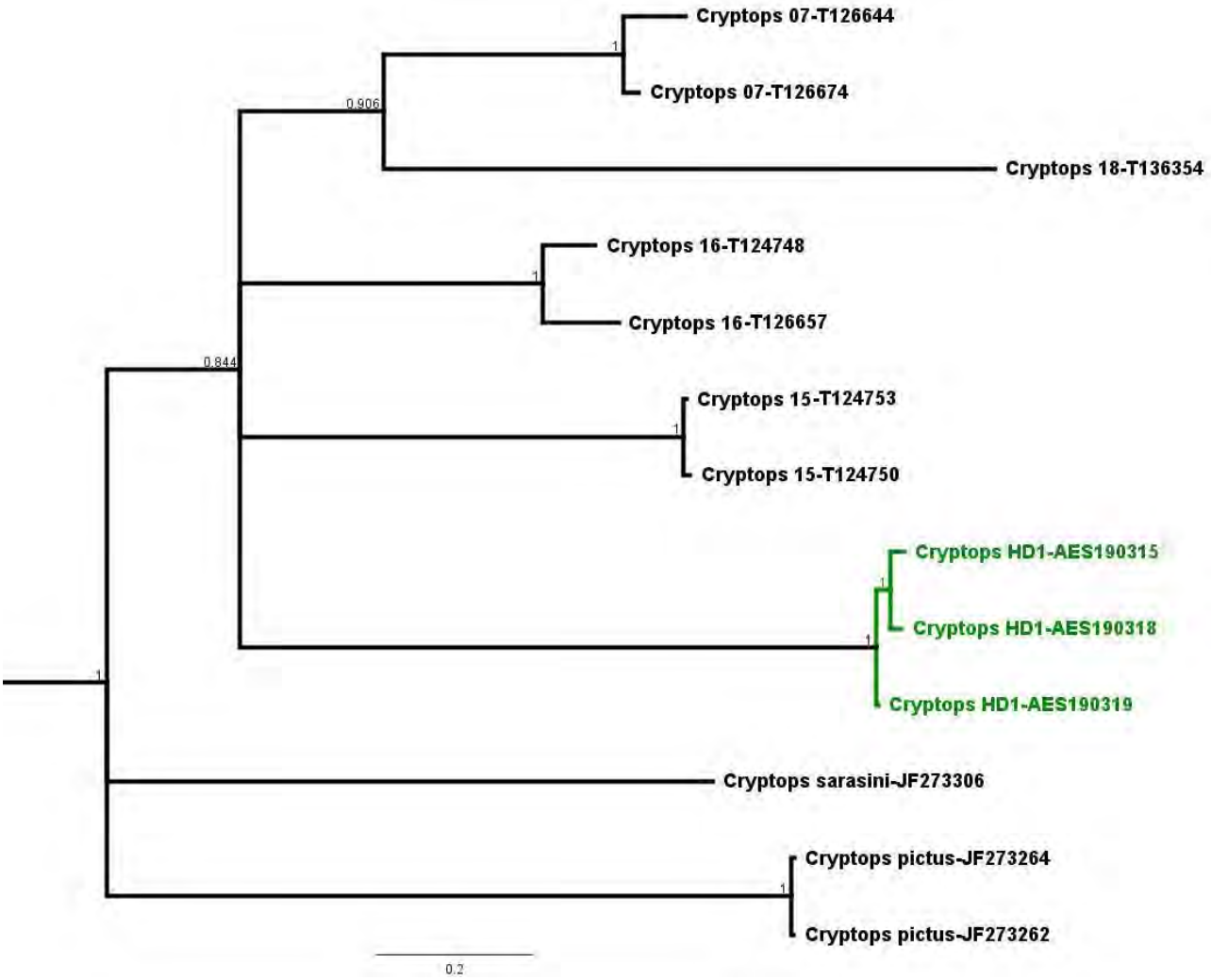


Figure 8. Sub-clade of the Cryptopidae phylogeny: target sample in green; branch labels represent posterior probabilities; scale bar represents substitutions per site.

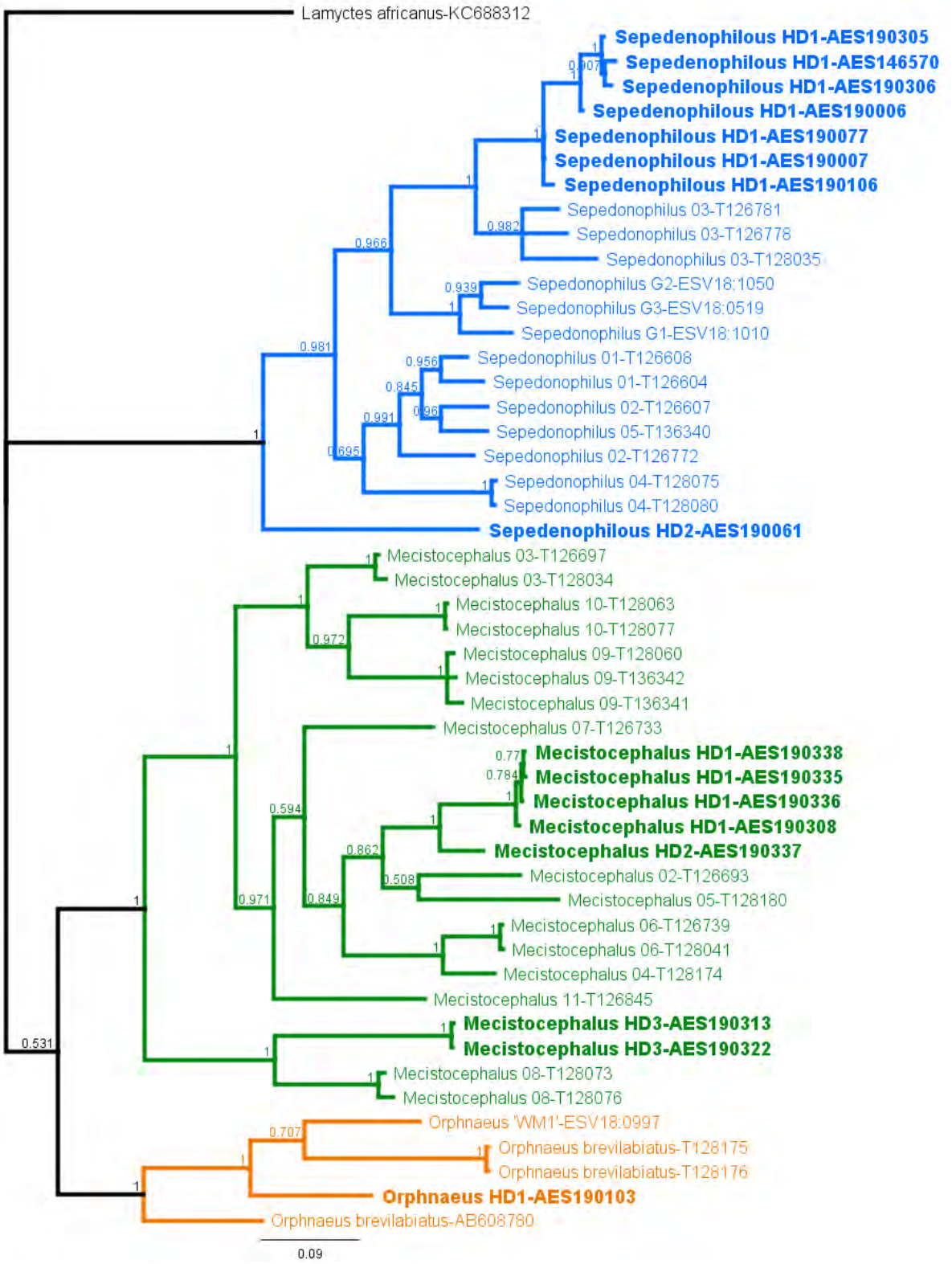


Figure 9. Phylogeny of Geophilomorpha: blue, *Sepedenophilus* clade; green, *Mecistocephalus* clade; orange, *Orphnaeus* clade; target samples in bold; branch labels represent posterior probabilities; scale bar represents substitutions per site.

3.10 TRIGONIULIDAE (SPIROBOLLIDA)

***Austrostrophus* 'HD1'** (Figure 10), was represented by three samples (T101128, T101121, AES190092) which differed from each other by 0.76% - 3.81% sequence divergence.

***Austrostrophus* 'HD2'** (Figure 10), was represented by four samples (AES190083, AES190028, AES190344, AES190074) which differed from each other by 0% - 0.46% sequence divergence.

Austrostrophus 'HD1' and *Austrostrophus* 'HD2' differed from each other by 7.7% - 8.38% sequence divergence with an average of 8.04% sequence divergence. The level of sequence divergence within the two groups was substantially less than the variation between these groups, indicating the likely hood that two lineages are present.

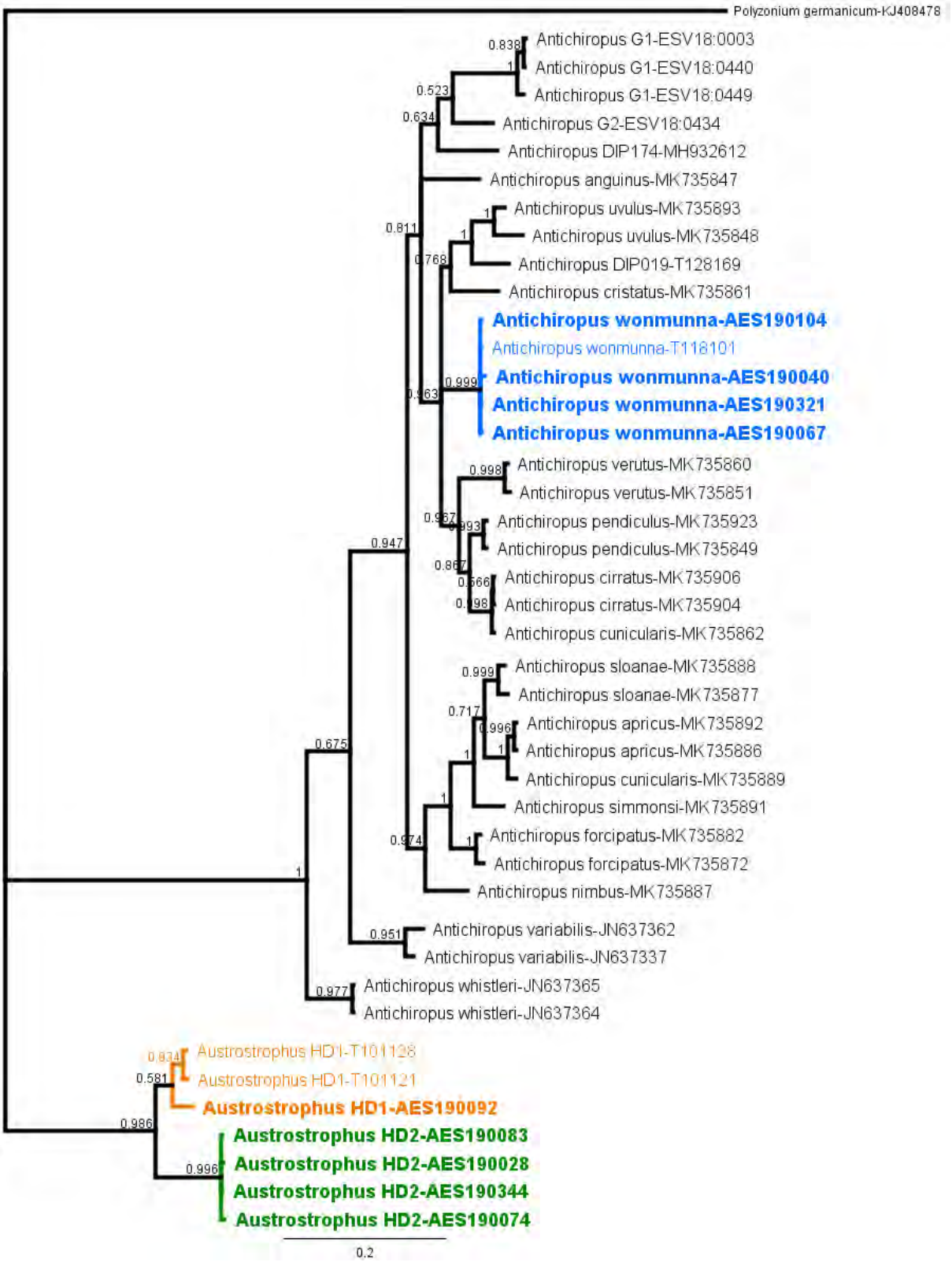


Figure 10. Phylogeny of millipedes included in this study with monophyletic clades shaded: target samples in bold; branch labels represent posterior probabilities; scale bar represents substitutions per site.

3.11 PARADOXOSOMATIDAE (POLYDESMIDA)

***Antichiropus* 'wonmunna'** (Figure 10)**.** The target samples differed from one another by 0% - 0.46% sequence divergence. These samples grouped with the sample of *Antichiropus* 'wonmunna' (T118101) and differed from it by between 0% - 0.45% sequence divergence, indicating that they are conspecific. These samples differed from all other *Antichiropus* samples in the analysis by 6.5% or more sequence divergence.

4 DISCUSSION

This study identified 30 species form 53 samples, of which 10 taxa represent species or morphospecies previously known from the Pilbara:

- *Karaops banyjima*: (AES190069, AES190099), a potential SRE: DD;
- *Aurecocrypta* 'MYG315' (AES190347), a potential SRE: DD;
- *Synothele* 'MYG311' (AES190039), a potential SRE: DD;
- *Synothele* 'MYG309' (AES190063), a potential SRE: DD;
- *Gaius tealei* (AES190072, AES190101), widespread;
- *Yilgarnia* 'MYG197' (AES190050), potential SRE: DD;
- 'Genus 7/4 PSE118' (T146562, T146561, T146559, AES190079), potential SRE: DD;
- *Lychas* 'bituberculatus cmplx' (AES190065), potential SRE: DD;
- *Lychas* 'multipunctatus cmplx' (AES190080), potential SRE: DD;
- *Antichiropus* 'wonmunna' (AES190321, AES190104, AES190067, AES190040), potential SRE: DD.

Twenty-two taxa identified here could not be matched with available sequences:

- *Aurecocrypta* 'HD1' (AES190082),
- *Beierolpium* 'HD1' (AES190331),
- *Beierolpium* 'HD2' (AES190341),
- *Beierolpium* 'HD3' (AES190012),
- *Indolpium* 'HD4'(AES190014),
- *Austrohorus* 'HD5' (T146556),
- *Euryolpium* 'HD6' (T146557),
- *Euryolpium* 'HD7' (T146564),
- *Tyrannochthonius* 'HD1' (T146555),
- *Tyrannochthonius* 'HD2'(AES190330),
- *Urodacus* 'HD1' (AES190076),
- *Mecistocephalus* 'HD1' (AES190336, AES190335, AES190308, AES190338),
- *Mecistocephalus* 'HD2' (AES190337),
- *Mecistocephalus* 'HD3' (AES190313, AES190322),
- *Sepedenophilous* 'HD1' (AES190305, AES190306, AES190077, AES190006, T146570, AES190007, AES190106),
- *Sepedenophilus* 'HD2' (AES190061),
- *Orphnaeus* 'HD1' (AES190103),
- *Cryptops* 'HD1' (AES190315, AES190318, AES190319),

- *Austrostrophus* 'HD1' (AES190092),
- *Austrostrophus* 'HD2' (AES190028, AES190344, AES190074, AES190083).

These taxa all have distribution and taxonomic characteristics that make them potential SREs. There is potential for the WA Museum to have sequences that could provide additional information regarding the relationships of the following taxa: *Aurecocrypta* 'HD1', *Beierolpium* 'HD1' (AES190331), *Beierolpium* 'HD2', *Beierolpium* 'HD3', *Indolpium* 'HD4', *Austrohorus* 'HD5', *Euryolpium* 'HD6', *Euryolpium* 'HD7', *Tyrannochthonius* 'HD1', and *Tyrannochthonius* 'HD2'.

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APPENDICES

Appendix 1 - DNA sequences generated 1912.

Attached as “Appendix 1 - DNA sequences generated 1912.txt”

Molecular identification of terrestrial arthropods from north west of Newman, Western Australia (project 1912)

Report to *Alacran Environmental Science*

11 October 2019

Nerida Wilson, Joel Huey, Mark Harvey

Molecular Systematics Unit & Department of Terrestrial Zoology,
Western Australian Museum,
Locked Bag 49, Welshpool DC, Western Australia 6986, Australia



Although identifications in this report were consistent with the best available information and current scientific thinking at the time of identification the use of this report is at the risk of the user. Any liability to users of this report for loss of any kind arising out of the use of this report or the information and identifications it contains is expressly disclaimed.

Summary

Alacran Environmental Science requested identification of mitochondrial COI sequences from specimens of terrestrial invertebrates from the Pilbara region of Western Australia. This comprised of 19 sequences from Barychelidae, Buthidae, Chthoniidae, Olpiidae, Selenopidae, Trigoniulidae and Urodacidae (see Table 1 and Appendix 1 for sequence and specimen details). The main objectives of the WA Museum's Molecular Systematics Unit (MSU) were to use these sequences to determine the taxonomic identity of the specimens.

Provided DNA sequences were each BLASTED against publically accessible sequences in GenBank and with data sets derived from current research projects at WA Museum. The top 20 blast hits for each major taxon were gathered, duplicates removed, and analysed with a Maximum Likelihood phylogenetic analysis using a GTR+G model of evolution and 100 bootstraps (RAxML). Distances were calculated via tree-based estimates of identical bases in Geneious Prime 2019.2.1.

A summary of sequences queried is in Table 1.

Table 1. Summary of queried sequences supplied to WA Museum.

FAMILY	Total no. sequences
Barychelidae	1
Buthidae	2
Chthoniidae	2
Olpiidae	7
Selenopidae	2
Trigoniulidae	4
Urodacidae	1

Results

The sequencing was undertaken by Xytogen at the request of Alacran and reconciled sequences were passed on to WAM for analysis. COI DNA barcodes were compared to existing data held by the Western Australian Museum, and the publically accessible GenBank database. A summary of the comparison (BLAST results) is provided in Table 2. Excised relevant parts of the resulting Maximum Likelihood trees are provided in Appendix 2 for visualisation of genetic relationships. The raw sequence data is supplied for reference in Appendix 3.

Table 2. Summary of identifications of queried specimens.

REGNO (FIELD NO)	FAMILY	SPECIES DESIGNATION	SUMMARY OF RESULTS
AES190082	Barychelidae	*Aurecocrypta* sp. indet.	This specimen forms a basal grade to many other *Aurecocrypta* species. It shares 89.60% genetic pairwise similarity with *Aurecocrypta* MYG317. It either represents a newly discovered species or a not-yet-sequenced species. It can be given a MYG code once registered at WAM
AES190065	Buthidae	*Lychas* `bituberculatus' complex	This specimen falls into a well-supported clade known as the *L. 'bituberculatus*' complex, which has not yet been resolved taxonomically. It shares 99.85% genetic pairwise similarity with WAMT91703.
AES190080	Buthidae	*Lychas* `multipunctatus' complex	This specimen falls into a well-supported clade known as the *L. 'multipunctatus*' complex, which has not yet been resolved taxonomically. It shares 99.70% genetic pairwise similarity with WAMT97367.

AES190330	Chthoniidae	*Tyrannochthonius* sp. indet.	This specimen forms a sister relationship with T146555. The pair share 87.00% genetic pairwise similarity, which does not allow a conclusion about whether the two are conspecific or not. Further work on the group is needed to establish even a code-based system of names. It either represents a newly discovered taxon or a not-yet-sequenced taxon.
T146555	Chthoniidae	*Tyrannochthonius* sp. indet.	This specimen forms a well-supported sister relationship with AES190330. The pair share 87.00% genetic pairwise similarity, which does not allow a conclusion about whether the two are conspecific or not. Further work on the group is needed to establish even a code-based system of names. It either represents a newly discovered taxon or a not-yet-sequenced taxon.
T146556	Olpiidae	*Austrohorus* sp. indet.	This specimen's nearest relative in the tree is WAMT132648. The pair share 85.54% genetic pairwise similarity, which does not allow a conclusion about whether the two are conspecific or not. The identity of WAMT132648 is PSE099.
AES190012	Olpiidae	*Beierolpium* sp. 8/4	This specimen is highly supported as conspecific with WAMT132648. The pair share 99.79% genetic pairwise similarity. The identity of WAMT122168 is sp. 8/4.

AES190331 AES190341	Olpiidae	*Beierolpium sp. indet.*	These two specimens are highly supported as sister taxa. They share 88.57% genetic pairwise similarity and are likely conspecific. These either represent a newly discovered species or a not-yet-sequenced species.
T146557	Olpiidae	*Euryolpium* sp. indet.	This specimen is highly supported as conspecific with WAMT127762. The pair share 96.86% genetic pairwise similarity. The identity of WAMT127762 is unknown, as it represents a juvenile from West Angelas.
T146564	Olpiidae	*Euryolpium* sp. indet.	This specimen's nearest relative in the tree is WAMT135503. The pair share 84.40% genetic pairwise similarity. It either represents a newly discovered taxon or a not-yet-sequenced taxon.
AES190014	Olpiidae	*Genus PSEAAA* sp. indet.	This specimen is poorly supported as sister to WAMT113765. The pair share 86.39% genetic pairwise similarity, which does not allow a conclusion about whether the two are conspecific or not. The identity of WAMT113765 is an undescribed genus *PSEAAA* sp. indet.
AES190099	Selenopidae	*Karaops nyangumarta*	This specimen is highly supported as conspecific with WAMT134063 (and others). The pair share 98.88% genetic pairwise similarity. The identity of WAMT134063 is *Karaops nyangumarta.*

AES190069	Selenopidae	*Karaops* sp 'ARA001'	This specimen is highly supported as conspecific with WAMT130402 (and others). The pair share 97.29% genetic pairwise similarity. The identity of WAMT130402 is *Karaops 'ARA001'.*
AES190074 AES190028 AES190083	Trigoniulidae	*Austrostrophus* clade E	This specimen is highly supported as conspecific with WAMT100768 (and others). The pair share 99.54% genetic pairwise similarity. The identity of WAMT100768 is *Austrostrophus* clade E.
AES190092	Trigoniulidae	*Austrostrophus* clade A	This specimen is supported as conspecific with WAMT122166 (and others). The pair share 99.09% genetic pairwise similarity. The identity of WAMT122166 is *Austrostrophus* clade A.
AES190076	Urodacidae	*Urodacus* sp. indet.	This specimen is highly supported as sister taxon to WAMT91922 (and others). The pair share 93.49% genetic pairwise similarity, which does not yet allow a conclusion about whether they are conspecific or not. The closely related specimens are also unidentified at present.

Conclusions

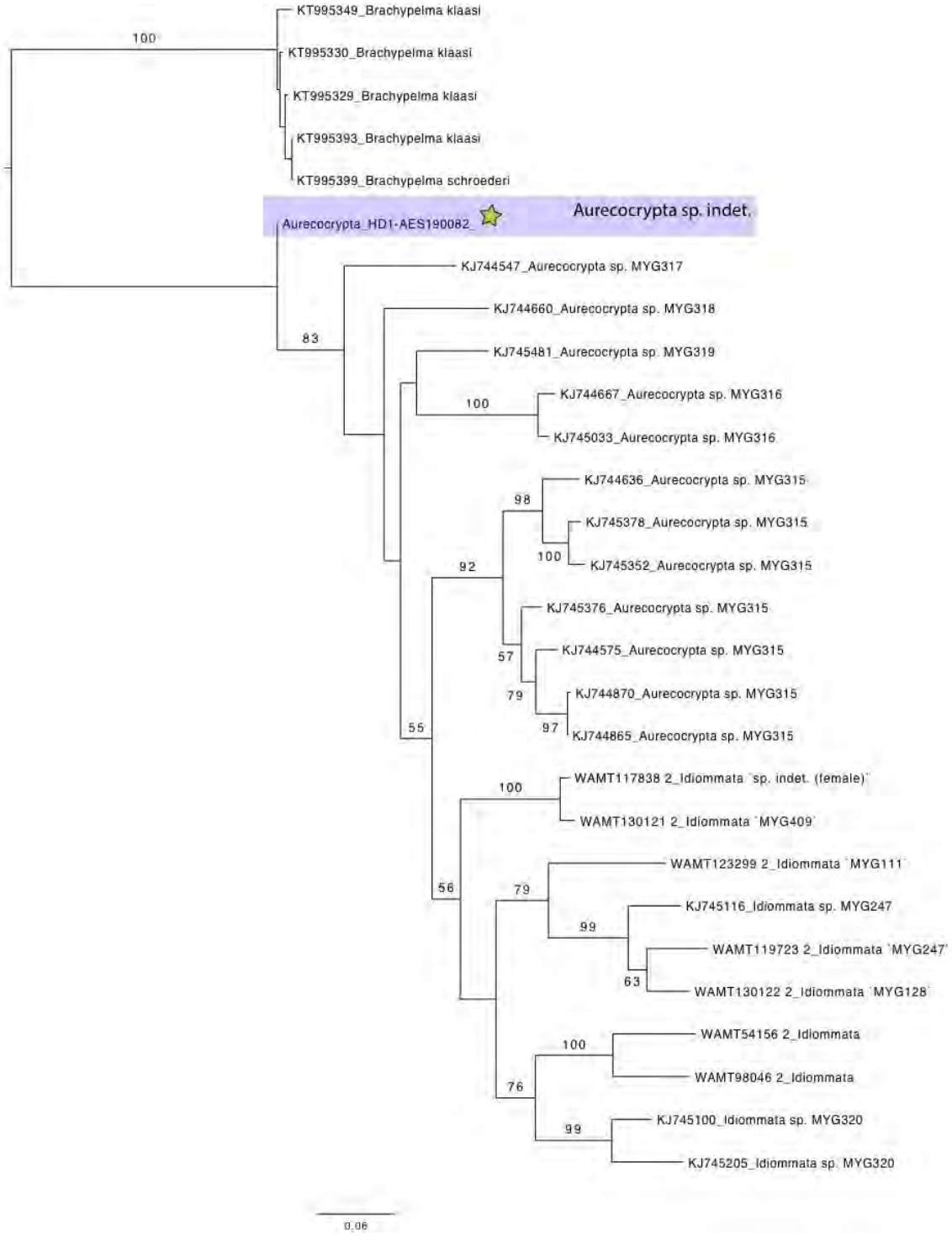
The 19 sequences supplied represent sixteen different taxa, from ten different genera. Fifteen of those species are currently undescribed. Only one specimen can be identified to a valid species name. Many others belong to known but unnamed taxa, and many remain to be clarified at the species-level, which would rely on further research in the respective taxonomic groups.

Appendix 1. Specimen data for all specimens.

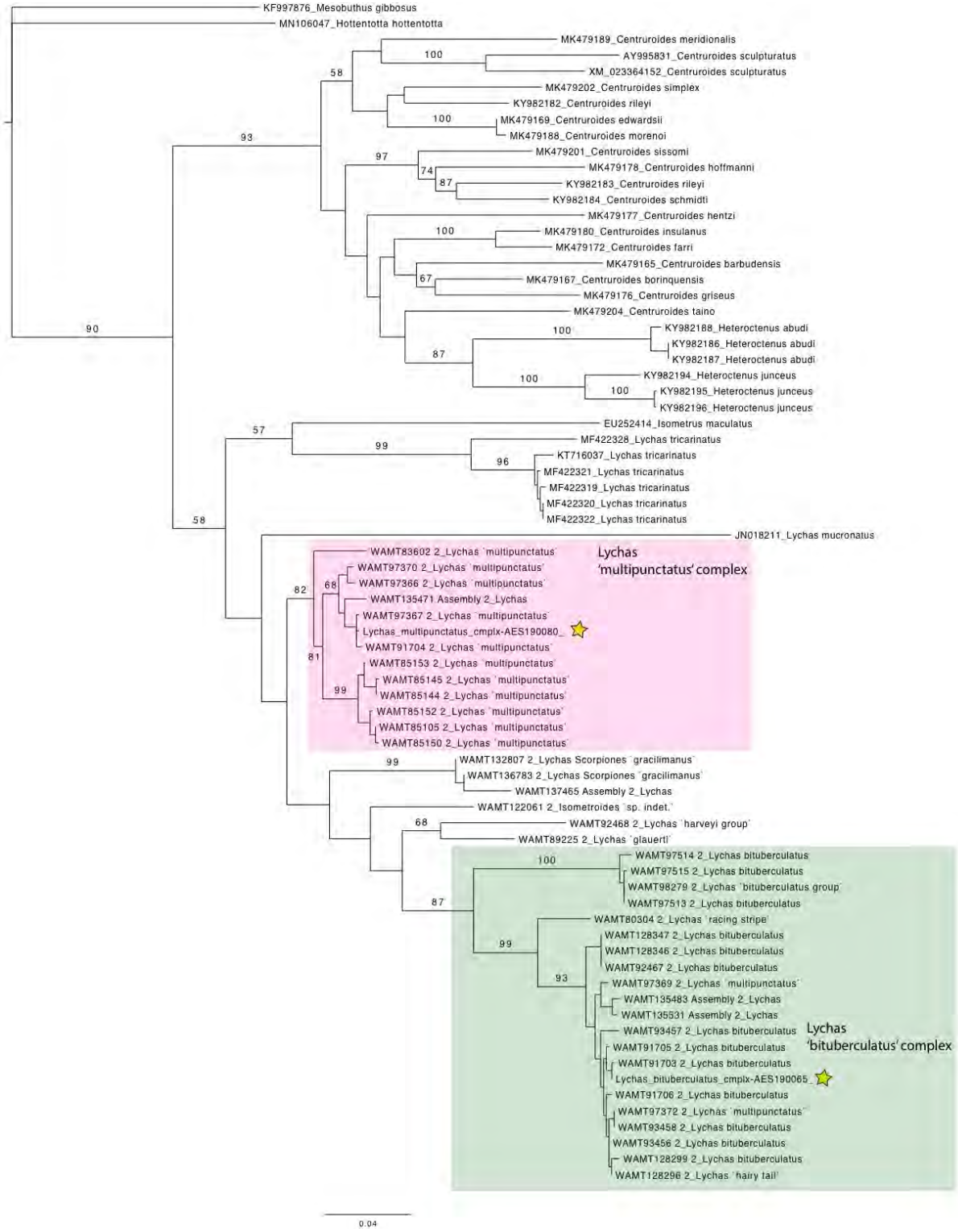
FIELD NO (WAM NUMBER)	FAMILY	GENUS	SPECIES (ALACRAN)	SPECIES (NEW ID)	SITE	LATITUDE	LONGITUDE
AES190082	Barychelidae	Aurecocrypta	`HD1`	sp. indet.	70.8 km NW of Newman	23°02'30.05"S	119°07'45.24"E
AES190065	Buthidae	Lychas	`bituberculatus complex`	`bituberculatus complex`	85.2 km NW of Newman	23°04'10.94"S	118°57'33.81"E
AES190080	Buthidae	Lychas	`multipunctatus complex`	`multipunctatus complex`	88.2 km NW of Newman	23°03'36.24"S	118°55'53.61"E
AES190330	Chthoniidae	Tyrannochthonius	`HD2`	sp. indet.	78.5 km NW of Newman	23°05'01.74"S	119°01'24.61"E
T146555	Chthoniidae	Tyrannochthonius	`HD1`	sp. indet.	Hope Downs 1 mine, 76.2 km NW of Newman	23°02'20.77"S	119°04'18.43"E
T146556	Olpiidae	Austrohorus	`HD5`	sp. indet.	Hope Downs 1 mine, 81.8 km NW of Newman	23°02'36.48"S	119°06'59.89"E
AES190012	Olpiidae	Beierolpium	`HD3`	sp. 8/4	80.3 km NW of Newman	23°02'54.36"S	119°01'16.11"E
AES190331	Olpiidae	Beierolpium	`HD1`	sp. indet.	78.5 km NW of Newman	23°05'01.74"S	119°01'24.61"E
AES190341	Olpiidae	Beierolpium	`HD2`	sp. indet.	88.2 km NW of Newman	23°03'36.24"S	118°55'53.61"E
T146557	Olpiidae	Euryolpium	`HD6`	sp. indet.	Hope Downs 1 mine, 80.9 km NW of Newman	23°04'40.65"S	119°00'03.37"E
T146564	Olpiidae	Euryolpium	`HD7`	sp. indet.	Hope Downs 1 mine, 70 km NW of Newman	23°02'18.05"S	119°08'26.42"E

AES190014	Olpiidae	Indolpium	`HD4`	Genus = *PSEAAA* sp. indet.	83.2 km NW of Newman	23°04'57.16"S	118°58'28.48"E
AES190099	Selenopidae	Karaops	banyijama	nyangumarta	82.5 km NW of Newman	23°02'42.13"S	118°59'56.60"E
AES190069	Selenopidae	Karaops	sp.	sp. 'ARA001'	71.9 km NW of Newman	23°02'33.97"S	119°07'00.94"E
AES190074	Trigoniulidae	Austrostrophus	`HD2`	Clade E	82.5 km NW of Newman	23°02'53.96"S	118°59'52.21"E
AES190092	Trigoniulidae	Austrostrophus	`HD1`	Clade A	69.8 km NW of Newman	23°02'26.57"S	119°08'28.01"E
AES190028	Trigoniulidae	Austrostrophus	`HD2`	Clade E	81.6 km NW of Newman	23°04'37.22"S	118°59'37.32"E
AES190083	Trigoniulidae	Austrostrophus	`HD2`	Clade E	18.4 km NW of Newman	23°03'29.00"S	119°00'18.75"E
AES190076	Urodacidae	Urodacus	HD1`	sp. indet.	80.3 km NW of Newman	23°02'54.36"S	119°01'16.11"E

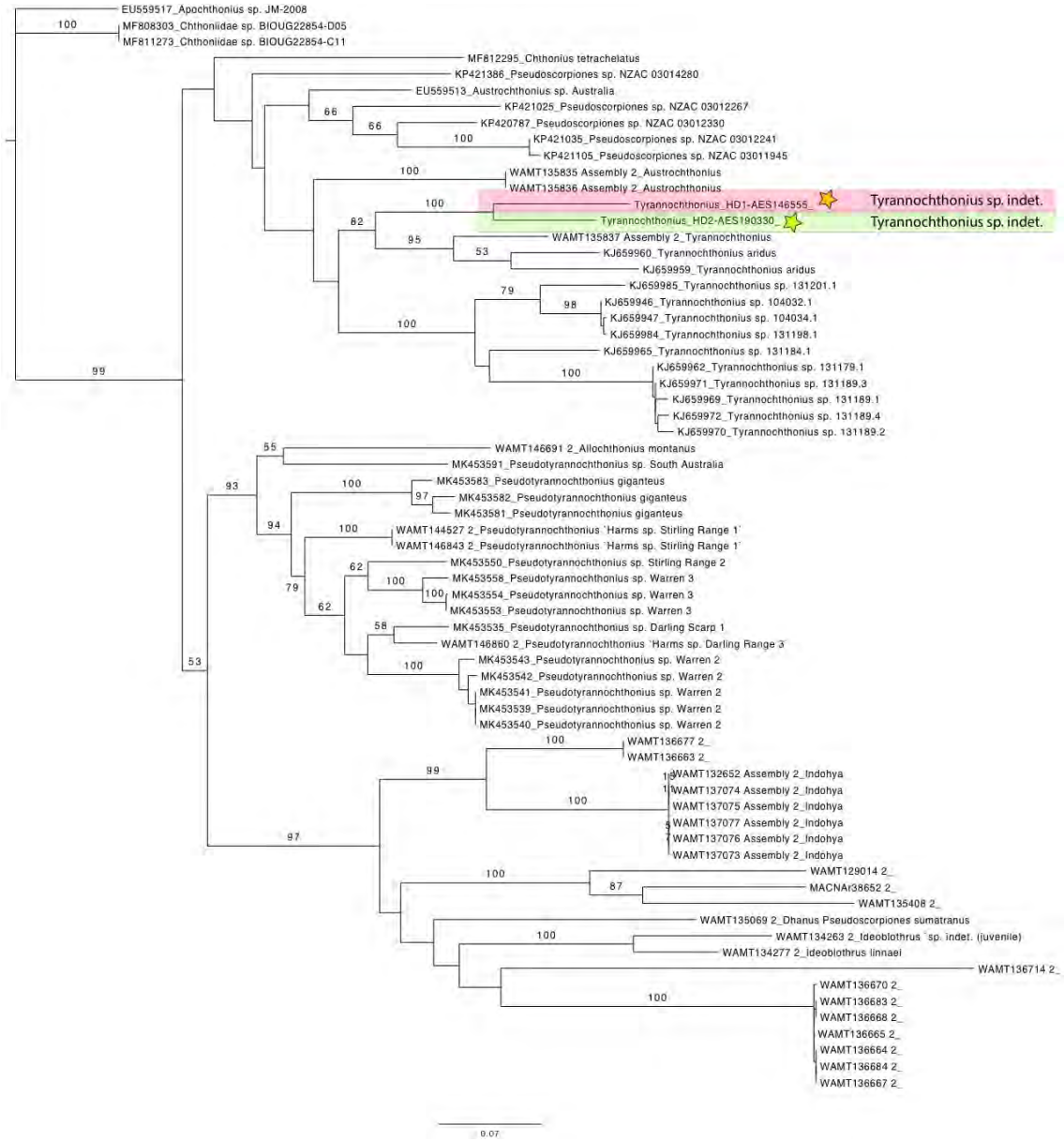
Appendix 2a. Excerpt from Maximum Likelihood tree of Barychelidae COI, to be used *ONLY* for visualisation of relationships. Bootstrap values less than 50 and some interior node support were removed.



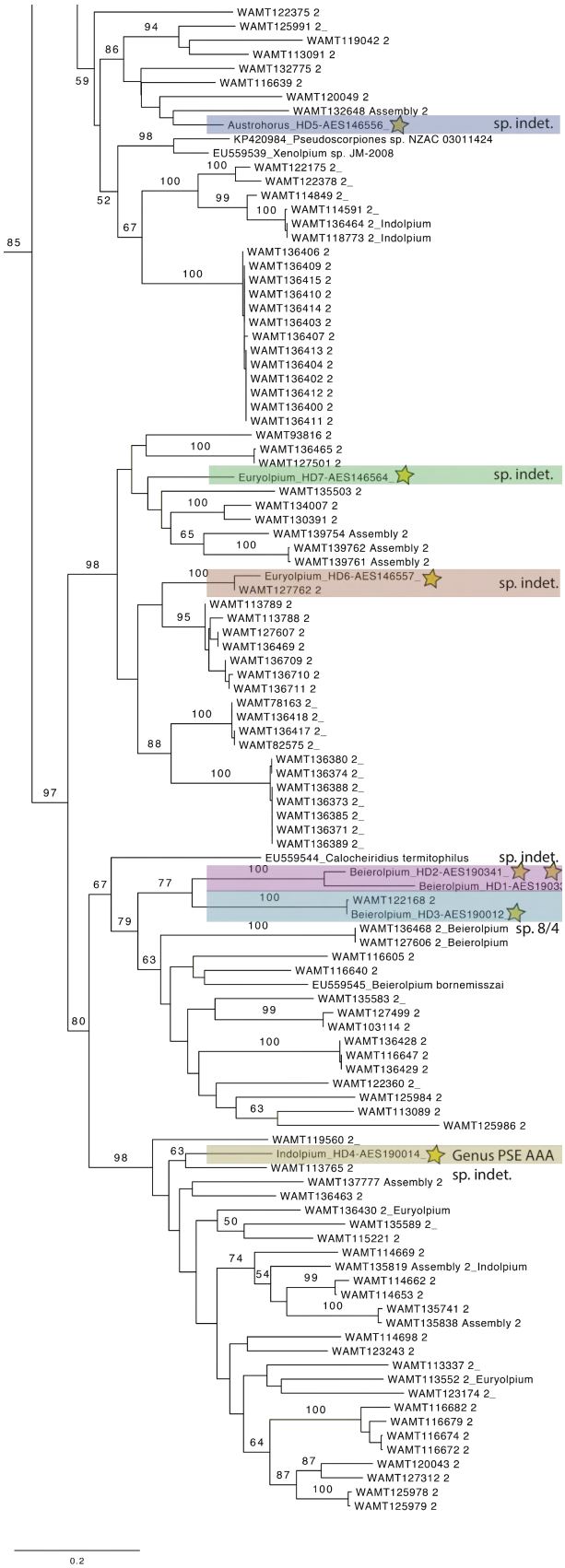
Appendix 2b. Excerpt from Maximum Likelihood tree of Buthidae COI, to be used *ONLY* for visualisation of relationships. Bootstrap values less than 50 and some interior node support were removed.



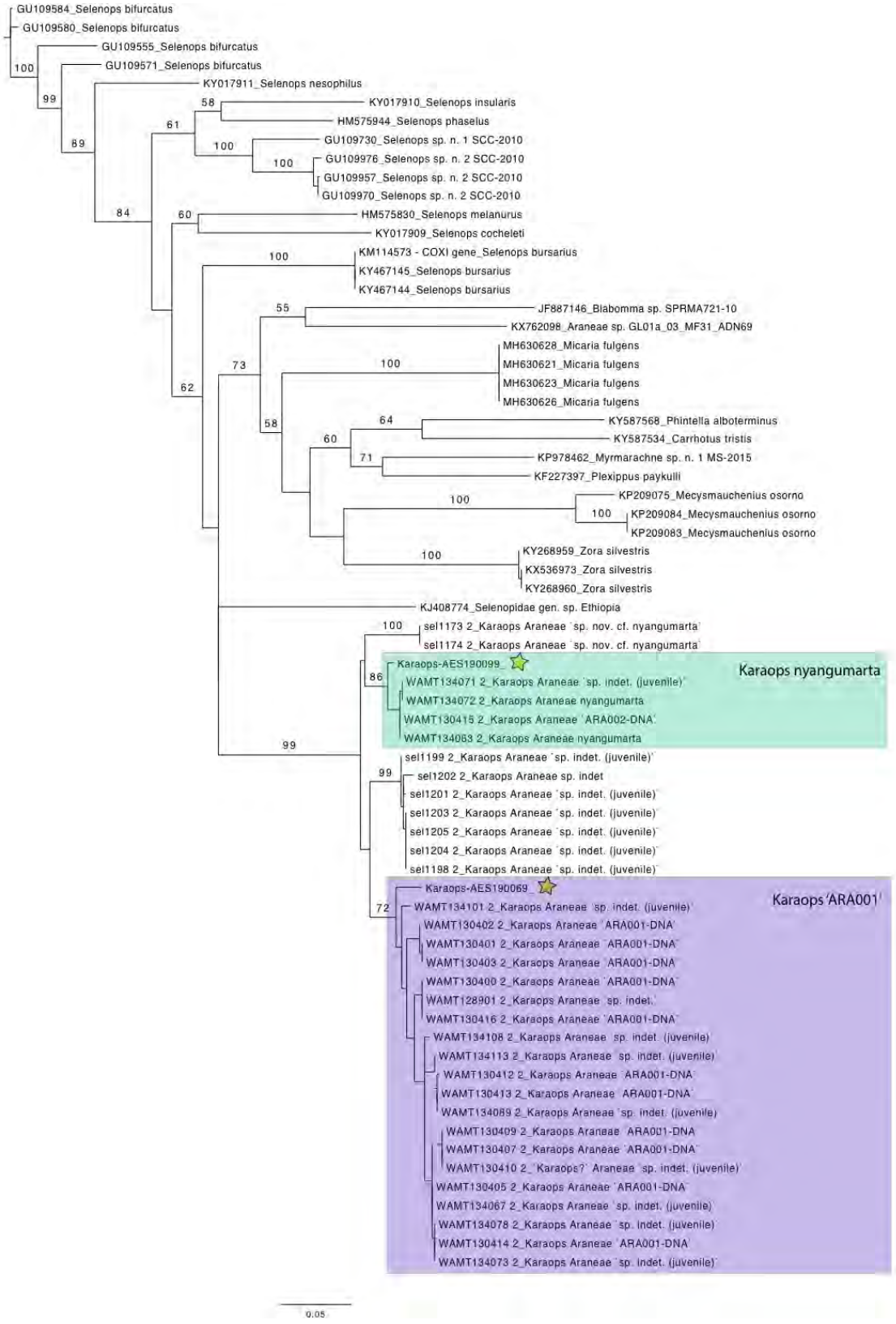
Appendix 2c. Excerpt from Maximum Likelihood tree of Chthoniidae COI, to be used *ONLY* for visualisation of relationships. Bootstrap values less than 50 and some interior node support were removed.



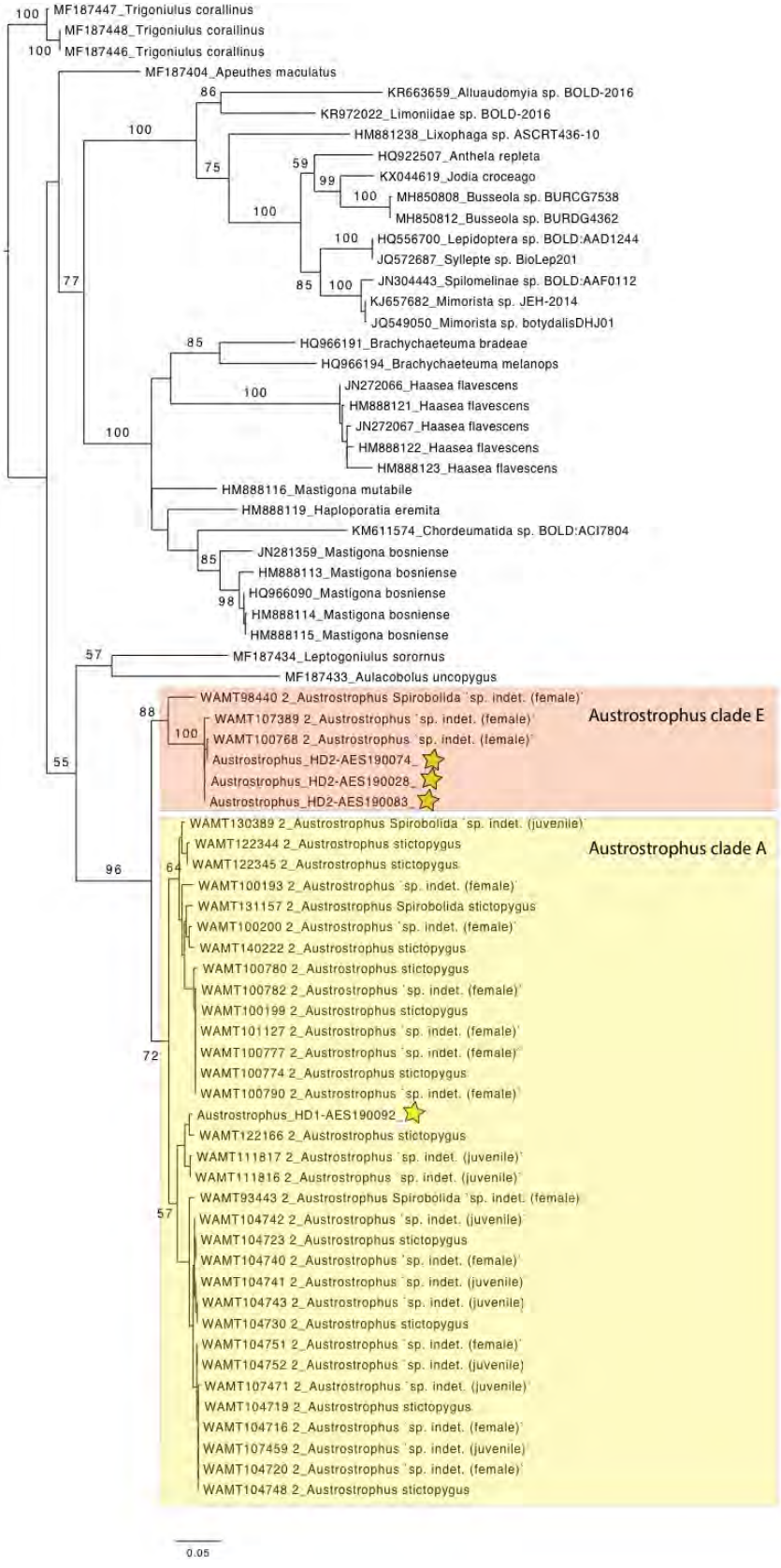
Appendix 2d. Excerpt from Maximum Likelihood tree of Olpiidae COI, to be used *ONLY* for visualisation of relationships. Bootstrap values less than 50 and some interior node support was removed.



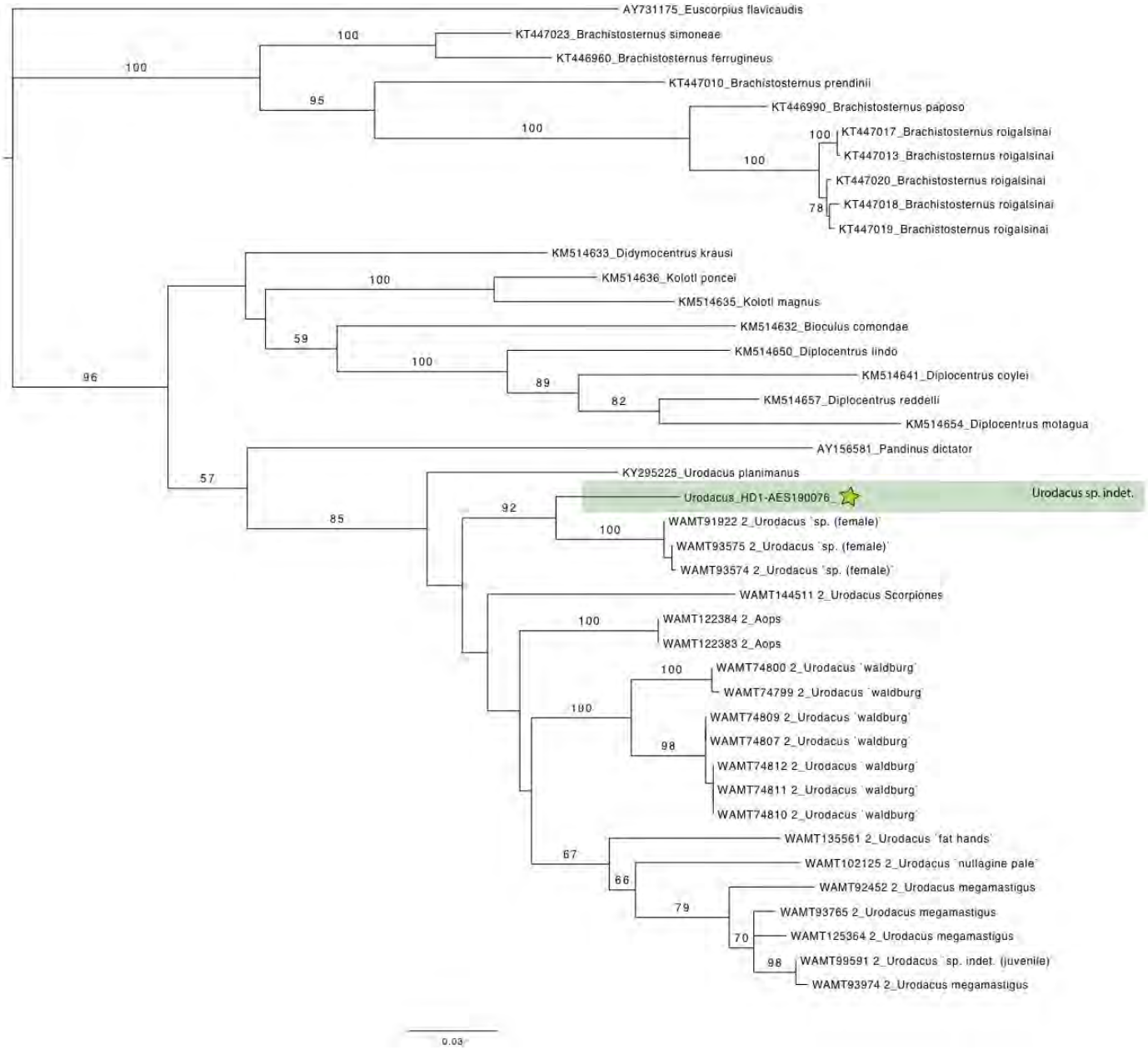
Appendix 2e. Excerpt from Maximum Likelihood tree of Selenopidae COI, to be used *ONLY* for visualisation of relationships. Bootstrap values less than 50 and some interior node support were removed.



Appendix 2f. Excerpt from Maximum Likelihood tree of Trigoniulidae COI, to be used *ONLY* for visualisation of relationships. Bootstrap values less than 50 and some interior node support were removed.



Appendix 2g. Excerpt from Maximum Likelihood tree of Urodacidae COI, to be used *ONLY* for visualisation of relationships. Bootstrap values less than 50 and some interior node support were removed.



Appendix 3. COI DNA sequence data queried in this report

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>Urodacus_HD1-AES190076

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Appendix E: Fauna Species Lists

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Table E.1: Amphibian species list – results of database searches, literature reviews and Astron survey results.

Scientific name	Common name	Introduced	Conservation codes			NatureMap / DBCA	EPBC PMST	Previous surveys	Phase 1 survey	Phase 2 survey	Phase 3 survey
			EPBC Act	BC Act	DBCA						
HYLIDAE											
Cyclorana maini	Sheep Frog					X		X			X
Cyclorana platycephala	Water-holding Frog					X					
Litoria rubella	Little Red Tree Frog					X			X	X	X
LIMNODYNASTIDAE											
Neobatrachus aquilonius	Northern Burrowing Frog					X					
Neobatrachus sutor	Shoemaker Frog					X					
MYOBATRACHIDAE											
Pseudophryne douglasi	Gorge Toadlet					X					
Uperoleia russelli	Northwest Toadlet					X					
Uperoleia saxatilis	Pilbara Toadlet					X					

Table E.2: Reptile species list – results of database searches, literature reviews and Astron survey results.

Scientific name	Common name	Introduced	Conservation codes			Nature Map / DBCA	EPBC PMST	Previous surveys	Phase 1 survey	Phase 2 survey	Phase 3 survey
			EPBC Act	BC Act	DBCA						
CHELUIDAE											
Chelodina steindachneri	Flat-shelled Turtle					X					
AGAMIDAE											
Gowidon longirostris						X		X	X	X	X
Ctenophorus caudicinctus	Ring-tailed Dragon					X		X	X	X	X
Ctenophorus isolepis	Military Dragon					X				X	
Ctenophorus nuchalis	Central Netted Dragon					X					
Ctenophorus reticulatus	Western Netted Dragon					X		X			
Diporiphora amphiboluroides	Mulga Dragon							X			
Diporiphora valens	Southern Pilbara Tree Dragon					X		X			
Pogona minor						X		X	X	X	
Tympanocryptis cephalus	Pebble Dragon					X		X			
DIPLODACTYLIDAE											
Crenadactylus ocellatus	Clawless Gecko					X					
Diplodactylus conspicillatus	Fat-tailed Gecko					X					
Diplodactylus granariensis rex						X					
Diplodactylus pulcher						X		X	X		
Diplodactylus savagei	Southern Pilbara Beak-faced Gecko					X		X			
Lucasium stenodactylum						X		X	X		X
Lucasium wombeyi						X		X	X		
Oedura fimbria	Marbled Velvet Gecko					X		X	X	X	X
Rhynchoedura ornata	Western Beaked Gecko					X		X	X		X
Strophurus elderi						X		X	X		
Strophurus jeanae						X					
Strophurus wellingtonae						X		X	X	X	X
CARPHODACTYLIDAE											
Nephrurus wheeleri cinctus						X		X		X	X

Scientific name	Common name	Introduced	Conservation codes			Nature Map / DBCA	EPBC PMST	Previous surveys	Phase 1 survey	Phase 2 survey	Phase 3 survey
			EPBC Act	BC Act	DBCA						
Underwoodisaurus seorsus	Pilbara Barking Gecko				P2	X		X			
GEKKONIDAE											
Gehyra pilbara						X					
Gehyra punctata						X		X	X	X	X
Gehyra purpurascens						X					
Gehyra variegata						X		X	X	X	X
Heteronotia binoei	Bynoe's Gecko					X		X		X	X
Heteronotia spelea	Desert Cave Gecko					X		X	X	X	
PYGOPODIDAE											
Delma butleri											X
Delma elegans						X		X			
Delma haroldi						X					
Delma nasuta						X		X	X		X
Delma pax						X		X	X	X	X
Delma tincta						X		X			
Lialis burtonis						X		X	X		X
Pygopus nigriceps						X		X			X
SCINCIDAE											
Carlia munda						X		X	X	X	X
Carlia triacantha						X		X			
Cryptoblepharus buchananii						X		X			
Cryptoblepharus plagiocephalus						X					
Cryptoblepharus ustulatus						X		X	X	X	
Ctenotus duricola						X		X			
Ctenotus grandis						X			X		X
Ctenotus hanloni						X					
Ctenotus helenae						X		X	X		
Ctenotus leonhardii						X					
Ctenotus pallasotus	Western Pilbara Lined Ctenotus								X		X

Scientific name	Common name	Introduced	Conservation codes			Nature Map / DBCA	EPBC PMST	Previous surveys	Phase 1 survey	Phase 2 survey	Phase 3 survey
			EPBC Act	BC Act	DBCA						
Ctenotus pantherinus	Leopard Ctenotus					X		X	X	X	X
Ctenotus robustus						X		X			
Ctenotus rubicundus						X					
Ctenotus rutilans						X		X	X		
Ctenotus saxatilis	Rock Ctenotus					X		X	X	X	X
Ctenotus schomburgkii						X		X	X	X	
Ctenotus serventyi						X					
Ctenotus uber						X		X			X
Cyclodomorphus melanops	Slender Blue-tongue					X		X			
Egernia cygnitos	Western Pilbara Spiny-tailed Skink					X					
Egernia depressa	Southern Pygmy Spiny-tailed Skink					X					
Egernia formosa						X			X	X	X
Eremiascincus pallidus	Western Narrow-banded Skink					X					
Eremiascincus richardsonii	Broad-banded Sand Swimmer					X					
Lerista bipes						X					
Lerista labialis						X					
Lerista macropisthopus remota					P2	X					X
Lerista muelleri						X		X	X		
Lerista neander						X		X	X		
Lerista timida						X		X			
Lerista verhmens						X		X			
Lerista zietzi						X		X			
Menetia greyii						X		X		X	X
Menetia surda						X		X			
Morethia ruficauda exquisita						X		X		X	X
Proablepharus reginae						X					

Scientific name	Common name	Introduced	Conservation codes			Nature Map / DBCA	EPBC PMST	Previous surveys	Phase 1 survey	Phase 2 survey	Phase 3 survey
			EPBC Act	BC Act	DBCA						
Tiliqua multifasciata	Central Blue-tongue					X		X	X		X
VARANIDAE											
Varanus acanthurus	Spiny-tailed Monitor					X		X	X	X	X
Varanus brevicauda	Short-tailed Pygmy Monitor					X		X	X		
Varanus bushi	Pilbara Mulga Monitor					X		X	X		
Varanus caudolineatus						X			X		
Varanus eremius	Pygmy Desert Monitor					X					
Varanus gouldii	Bungarra or Sand Monitor					X			X		
Varanus giganteus	Perentie					X		X			X
Varanus hamersleyensis	Southern Pilbara Rock Goanna					X					
Varanus panoptes	Yellow-spotted Monitor					X		X	X	X	X
Varanus pilbarensis	Pilbara Rock Monitor					X					
Varanus tristis tristis	Racehorse Monitor					X		X	X		X
TYPHLOPIDAE											
Anilios ammodytes									X		
Anilios ganei					P1	X					
Anilios grypus								X	X		
Anilios hamatus								X	X		X
Anilios waitii								X			
BOIDAE											
Antaresia perthensis	Pygmy Python					X		X			
Antaresia stimsoni	Stimson's Python					X					
Aspidites melanocephalus	Black-headed Python					X					
Liasis olivaceus barroni	Pilbara Olive Python		VU	VU		X	X				
ELAPIDAE											
Acanthophis wellsi	Pilbara Death Adder					X		X	X		
Brachyurophis approximans						X		X	X		

Scientific name	Common name	Introduced	Conservation codes			Nature Map / DBCA	EPBC PMST	Previous surveys	Phase 1 survey	Phase 2 survey	Phase 3 survey
			EPBC Act	BC Act	DBCA						
Demansia psammophis cupreiceps	Yellow-faced Whipsnake					X		X			X
Demansia rufescens	Rufous Whipsnake					X		X			
Furina ornata	Moon Snake					X		X		X	
Parasuta monachus						X		X			
Pseudechis australis	Mulga Snake					X		X		X	X
Pseudonaja mengdeni	Western Brown Snake					X		X			
Pseudonaja modesta	Ringed Brown Snake					X		X			
Pseudonaja nuchalis	Gwardar; Northern Brown Snake					X				X	
Suta fasciata	Rosen's Snake					X		X			
Suta punctata	Spotted Snake					X					
Vermicelli snelli	Pilbara Bandy Bandy					X		X			

Table E.3: Bird species list – results of database searches, literature reviews and Astron survey results.

Scientific name	Common name	Introduced	Conservation codes			Nature Map / DBCA	EPBC PMST	Birdata	Previous surveys	Phase 1 survey	Phase 2 survey	Phase 3 survey
			EPBC Act	BC Act	DBCA							
CASUARIIDAE												
Dromaius novaehollandiae	Emu					X		X	X		X	
PHASIANIDAE												
Coturnix ypsilophora	Brown Quail					X		X	X	X	X	
ANATIDAE												
Dendrocygna eytoni	Plumed Whistling-Duck					X		X				
Cygnus atratus	Black Swan							X				
Anas gracilis	Grey Teal							X				
Anas superciliosa	Pacific Black Duck					X		X				
Chenonetta jubata	Australian Wood Duck							X				
COLUMBIDAE												
Phaps chalcoptera	Common Bronzewing					X		X	X		X	X
Ocyphaps lophotes	Crested Pigeon					X		X	X	X	X	X
Geophaps plumifera	Spinifex Pigeon					X		X	X	X	X	X
Geopelia cuneata	Diamond Dove					X		X	X	X	X	X
Geopelia striata	Peaceful Dove					X		X				
PODARGIDAE												
Podargus strigoides	Tawny Frogmouth					X		X	X			X
EUROSTOPODIDAE												
Eurostopodus argus	Spotted Nightjar					X		X	X		X	X
AEGOTHELIDAE												
Aegotheles cristatus	Australian Owlet-nightjar					X		X	X	X		
APODIDAE												
Apus pacificus	Fork-tailed Swift		IA	IA		X			X			
ANHINGIDAE												
Anhinga novaehollandiae	Australasian Darter					X		X				
PHALACROCORACIDAE												
Microcarbo melanoleucos	Little Pied Cormorant							X				

Scientific name	Common name	Introduced	Conservation codes			Nature Map / DBCA	EPBC PMST	Birdata	Previous surveys	Phase 1 survey	Phase 2 survey	Phase 3 survey
			EPBC Act	BC Act	DBCA							
Phalacrocorax varius	Pied Cormorant					X						
Phalacrocorax sulcirostris	Little Black Cormorant					X		X				
PELECANIDAE												
Pelecanus conspicillatus	Australian Pelican					X		X				
ARDEIDAE												
Ardea pacifica	White-necked Heron							X				
Ardea modesta	Eastern Great Egret						X	X				
Ardea ibis	Cattle Egret						X					
Egretta novaehollandiae	White-faced Heron					X		X	X			
THRESKIORNITHIDAE												
Threskiornis spinicollis	Straw-necked Ibis					X		X	X		X	
ACCIPITRIDAE												
Elanus axillaris	Black-shouldered Kite					X			X	X	X	
Elanus scriptus	Letter-winged Kite				P4						X	
Haliastur sphenurus	Whistling Kite					X		X	X	X	X	X
Lophoictinia isura	Square-tailed Kite					X		X	X			
Milvus migrans	Black Kite					X		X				
Accipiter fasciatus	Brown Goshawk					X		X	X	X		X
Accipiter cirrocephalus	Collared Sparrowhawk					X		X	X			
Circus assimilis	Spotted Harrier					X		X	X	X	X	X
Hamirostra melanosternon	Black-breasted Buzzard					X		X	X		X	
Aquila audax	Wedge-tailed Eagle					X		X	X		X	
Hieraaetus morphnoides	Little Eagle					X		X	X	X		
FALCONIDAE												
Falco cenchroides	Nankeen Kestrel					X		X	X	X	X	
Falco berigora	Brown Falcon					X		X	X	X	X	X
Falco subniger	Black Falcon							X				
Falco longipennis	Australian Hobby					X		X	X		X	
Falco hypoleucos	Grey Falcon			VU		X						

Scientific name	Common name	Introduced	Conservation codes			Nature Map / DBCA	EPBC PMST	Birdata	Previous surveys	Phase 1 survey	Phase 2 survey	Phase 3 survey
			EPBC Act	BC Act	DBCA							
Falco peregrinus	Peregrine Falcon			OS		X		X				
RALLIDAE												
Gallirallus philippensis	Buff-banded Rail							X				
Porzana tabuensis	Spotless Crake					X						
OTIDIDAE												
Ardeotis australis	Australian Bustard					X		X	X	X	X	
BURHINIDAE												
Burhinus grallarius	Bush Stone-curlew					X		X	X			
RECURVIROSTRIDAE												
Himantopus himantopus	Black-winged Stilt					X		X				
CHARADRIIDAE												
Charadrius veredus	Oriental Plover		IA	IA			X					X
Elseyornis melanops	Black-fronted Dotterel					X		X				
Erythrogonys cinctus	Red-kneed Dotterel					X		X				
ROSTRATULIDAE												
Rostratula australis	Australian Painted Snipe		EN	EN			X					
SCOLOPACIDAE												
Tringa hypoleucos	Common Sandpiper		IA	IA			X					
Tringa nebularia	Common Greenshank		IA	IA		X						
Calidris melanotos	Pectoral Sandpiper		IA	IA			X					
Calidris acuminata	Sharp-tailed Sandpiper		IA	IA			X					
Calidris ferruginea	Curlew Sandpiper		CR	VU/ IA			X					
TURNICIDAE												
Turnix velox	Little Button-quail					X		X	X	X	X	X
CACATUIDAE												
Cacatua roseicapilla	Galah					X		X	X	X		
Cacatua sanguinea	Little Corella					X		X	X	X		X
Nymphicus hollandicus	Cockatiel					X		X	X	X		
PSITTACIDAE												

Scientific name	Common name	Introduced	Conservation codes			Nature Map / DBCA	EPBC PMST	Birdata	Previous surveys	Phase 1 survey	Phase 2 survey	Phase 3 survey
			EPBC Act	BC Act	DBCA							
Platycercus zonarius	Australian Ringneck					X		X	X	X	X	X
Melopsittacus undulatus	Budgerigar					X		X	X	X	X	X
Neophema bourkii	Bourke's Parrot					X		X		X		
Platycercus varius	Mulga Parrot					X		X	X	X		
Pezoporus occidentalis	Night Parrot		EN	CR			X					
CUCULIDAE												
Centropus phasianinus	Pheasant Coucal							X				
Chrysococcyx basalis	Horsfield's Bronze-Cuckoo					X		X	X		X	X
Chrysococcyx osculans	Black-eared Cuckoo							X	X			
Cacomantis pallidus	Pallid Cuckoo					X		X	X		X	X
STRIGIDAE												
Ninox connivens	Barking Owl					X			X			
Ninox boobook boobook	Southern Boobook							X	X	X		
TYTONIDAE												
Tyto javanica	Eastern Barn Owl					X		X	X			
HALCYONIDAE												
Dacelo leachii	Blue-winged Kookaburra					X		X		X	X	
Todiramphus pyrrhopygius	Red-backed Kingfisher					X		X	X	X	X	X
Todiramphus sanctus	Sacred Kingfisher					X		X	X	X	X	
MEROPIDAE												
Merops ornatus	Rainbow Bee-eater					X	X	X		X	X	X
PTILONORHYNCHIDAE												
Ptilonorhynchus maculatus guttatus	Western Bowerbird					X		X	X	X	X	X
MALURIDAE												
Malurus leucopterus	White-winged Fairy-wren					X		X	X		X	X
Malurus lamberti assimilis	Variegated Fairy-wren					X		X	X	X	X	X
Stipiturus ruficeps	Rufous-crowned Emu-wren					X		X	X	X	X	X
Malurus splendens	Splendid Fairy-wren					X		X	X			
Amytornis striatus whitei	Striated Grasswren					X		X	X	X	X	X

Scientific name	Common name	Introduced	Conservation codes			Nature Map / DBCA	EPBC PMST	Birdata	Previous surveys	Phase 1 survey	Phase 2 survey	Phase 3 survey
			EPBC Act	BC Act	DBCA							
ACANTHIZIDAE												
Pyrrholaemus brunneus	Redthroat					X		X	X			
Smicrornis brevirostris	Weebill					X		X	X	X	X	X
Gerygone fusca	Western Gerygone					X		X	X	X	X	X
Acanthiza robustirostris	Slaty-backed Thornbill					X		X	X	X		
Acanthiza chrysorrhoa	Yellow-rumped Thornbill					X		X	X			
Acanthiza uropygialis	Chestnut-rumped Thornbill					X		X	X		X	X
Acanthiza apicalis	Inland Thornbill					X		X	X	X	X	X
Aphelocephala nigricincta	Banded Whiteface							X				
Aphelocephala leucopsis	Southern Whiteface					X		X				
PARDALOTIDAE												
Pardalotus rubricatus	Red-browed Pardalote					X		X			X	
Pardalotus striatus	Striated Pardalote					X		X	X		X	
MELIPHAGIDAE												
Gavicalis virescens	Singing Honeyeater					X		X	X	X	X	X
Ptilotula keartlandi	Grey-headed Honeyeater					X		X	X	X	X	X
Ptilotula penicillata	White-plumed Honeyeater							X	X		X	X
Purnella albifrons	White-fronted Honeyeater					X			X			
Manorina flavigula	Yellow-throated Miner					X		X	X	X	X	X
Melithreptus gularis	Black-chinned Honeyeater					X		X	X			
Acanthagenys rufogularis	Spiny-cheeked Honeyeater					X		X	X	X	X	X
Conopophila whitei	Grey Honeyeater					X		X	X			
Epthianura tricolor	Crimson Chat					X		X	X			
Certhionyx variegatus	Pied Honeyeater					X		X				
Sugomel niger	Black Honeyeater							X				
Lichmera indistincta	Brown Honeyeater					X		X	X		X	X
POMATOSTOMIDAE												
Pomatostomus temporalis	Grey-crowned Babbler					X		X	X	X	X	X
Pomatostomus superciliosus	White-browed Babbler					X		X	X			

Scientific name	Common name	Introduced	Conservation codes			Nature Map / DBCA	EPBC PMST	Birdata	Previous surveys	Phase 1 survey	Phase 2 survey	Phase 3 survey
			EPBC Act	BC Act	DBCA							
EUPATRIDAE												
Cinclosoma castaneothorax	Chestnut-breasted Quail-thrush					X		X				
Psophodes occidentalis	Chiming Wedgebill							X			X	
NEOSITTIDAE												
Daphoenositta chrysoptera	Varied Sittella					X		X				
CAMPEPHAGIDAE												
Coracina novaehollandiae	Black-faced Cuckoo-shrike					X		X	X	X	X	X
Coracina maxima	Ground Cuckoo-shrike					X		X	X			
Lalage tricolor	White-winged Triller					X		X	X	X	X	X
PACHYCEPHALIDAE												
Pachycephala rufiventris	Rufous Whistler					X		X	X	X		X
Colluricincla harmonica	Grey Shrike-thrush					X		X	X	X	X	X
Oreoica gutturalis	Crested Bellbird					X		X	X	X	X	X
ARTAMIDAE												
Artamus personatus	Masked Woodswallow					X		X	X			X
Artamus cinereus	Black-faced Woodswallow					X		X	X	X	X	X
Artamus minor	Little Woodswallow					X		X	X	X	X	
Cracticus torquatus	Grey Butcherbird					X		X	X	X	X	X
Cracticus tibicen	Australian Magpie					X		X	X	X	X	X
Cracticus nigrogularis	Pied Butcherbird					X		X	X	X	X	X
RHIPIDURIDAE												
Rhipidura albiscapa	Grey Fantail					X		X	X	X	X	X
Rhipidura leucophrys	Willie Wagtail					X		X	X	X	X	X
CORVIDAE												
Corvus bennetti	Little Crow					X		X	X		X	
Corvus orru	Torresian Crow					X		X	X	X	X	X
MONARCHIDAE												
Grallina cyanoleuca	Magpie-lark					X		X	X	X	X	X

Scientific name	Common name	Introduced	Conservation codes			Nature Map / DBCA	EPBC PMST	Birdata	Previous surveys	Phase 1 survey	Phase 2 survey	Phase 3 survey
			EPBC Act	BC Act	DBCA							
PETROICIDAE												
Petroica goodenovii	Red-capped Robin					X		X	X		X	
Melanodryas cucullata	Hooded Robin					X		X	X		X	X
ALAUDIDAE												
Mirafra javanica	Horsfield's Bushlark					X		X	X		X	
ACROCEPHALIDAE												
Acrocephalus australis	Australian Reed-Warbler					X		X				
MEGALURIDAE												
Cincloramphus mathewsi	Rufous Songlark							X	X	X		X
Cincloramphus cruralis	Brown Songlark							X	X			
Eremiornis carteri	Spinifexbird					X		X	X	X		X
HIRUNDINIDAE												
Cheramoeca leucosterna	White-backed Swallow							X				
Hirundo rustica	Barn Swallow		IA	IA			X					
Hirundo neoxena	Welcome Swallow					X		X				
Petrochelidon ariel	Fairy Martin					X		X		X		
Petrochelidon nigricans	Tree Martin					X		X	X	X		
NECTARINIIDAE												
Dicaeum hirundinaceum	Mistletoebird					X		X	X			
ESTRILDIDAE												
Taeniopygia guttata	Zebra Finch					X		X	X	X	X	X
Neochmia ruficauda	Star Finch					X		X				
Emblema pictum	Painted Finch					X		X	X	X	X	X
MOTACILLIDAE												
Anthus novaeseelandiae	Australasian Pipit					X		X	X		X	
Motacilla flava	Yellow Wagtail		IA	IA			X					
Motacilla cinerea	Grey Wagtail		IA	IA			X					

Table E.4: Mammal species list – results of database searches, literature reviews and Astron survey results.

Scientific name	Common name	Introduced	Conservation codes			NatureMap / DBCA	EPBC PMST	Previous surveys	Phase 1 survey	Phase 2 survey	Phase 3 survey
			EPBC Act	BC Act	DBCA						
TACHYGLOSSIDAE											
Tachyglossus aculeatus	Short-beaked Echidna								X	X	
DASYURIDAE											
Dasycercus blythi	Brush-tailed Mulgara				P4	X					
Dasykaluta rosamondae	Little Red Kaluta					X		X		X	X
Dasyurus hallucatus	Northern Quoll		EN	EN		X	X	X	X	X	X
Ningaui timealeyi	Pilbara Ningaui					X		X	X	X	X
Planigale ingrami	Long-tailed Planigale					X					
Planigale sp. 1'	Pilbara Planigale								X		X
Pseudantechinus roryi	Rory's Pseudantechinus					X					
Pseudantechinus woolleyae	Woolley's Pseudantechinus					X		X			
Sminthopsis macroura	Stripe-faced Dunnart					X		X	X	X	
Sminthopsis ooldea	Ooldea Dunnart					X		X			X
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart					X					
THYLACOMYIDAE											
Macrotis lagotis	Bilby, Dalgyte		VU	VU		X	X				
MACROPODIDAE											
Macropus robustus erubescens	Euro, Biggada					X		X	X	X	X
Macropus rufus	Red Kangaroo, Marlu					X		X	X		X
Petrogale rothschildi	Rothschild's Rock-wallaby					X		X	X	X	X
MEGADERMATIDAE											
Macroderma gigas	Ghost Bat		VU	VU		X	X	X	X	X	X
HIPPOSIDERIDAE											
Rhinonicteris aurantia (Pilbara form)	Pilbara Leaf-nosed Bat		VU	VU		X	X	X		X	
EMBALLONURIDAE											

Scientific name	Common name	Introduced	Conservation codes			NatureMap / DBCA	EPBC PMST	Previous surveys	Phase 1 survey	Phase 2 survey	Phase 3 survey
			EPBC Act	BC Act	DBCA						
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat					X		X	X	X	X
Taphozous georgianus	Common Sheathtail-bat					X		X	X	X	X
Taphozous hilli	Hill's Sheathtail-bat					X		X	X	X	
VESPERTILIONIDAE											
Chalinolobus gouldii	Gould's Wattled Bat					X		X	X	X	X
Chalinolobus morio	Chocolate Wattled Bat					X					
Nyctophilus daedalus	Northwestern Long-eared Bat					X					
Nyctophilus geoffroyi	Lesser Long-eared Bat					X		X	X	X	
Scotorepens greyii	Little Broad-nosed Bat					X		X	X	X	X
Vespadelus finlaysoni	Finlayson's Cave Bat					X		X	X	X	X
MOLOSSIDAE											
Chaerephon jobensis	Northern Freetail-bat					X		X	X	X	X
Mormopterus beccarii	Beccari's Freetail-bat							X			
Ozimops lumsdenae	Northern Freetail-bat					X		X	X	X	X
Austronomus australis	White-striped Freetail-bat							X		X	
MURIDAE											
Leggadina lakedownensis	Short-tailed Mouse				P4	X					
Mus musculus	House Mouse	*				X	X	X		X	
Notomys alexis	Spinifex Hopping-mouse					X					
Pseudomys chapmani	Western Pebble-mound Mouse				P4	X		X	X		X
Pseudomys delicatulus	Delicate Mouse					X		X			
Pseudomys desertor	Desert Mouse					X		X	X	X	
Pseudomys hermannsburgensis	Sandy Inland Mouse					X		X	X	X	
Pseudomys nanus	Western Chestnut Mouse					X					
Zyzomys argurus	Common Rock-rat					X		X	X	X	
LEPORIDAE											

Scientific name	Common name	Introduced	Conservation codes			NatureMap / DBCA	EPBC PMST	Previous surveys	Phase 1 survey	Phase 2 survey	Phase 3 survey
			EPBC Act	BC Act	DBCA						
Oryctolagus cuniculus	Rabbit	*				X	X	X	X	X	X
CANIDAE											
Canis familiaris dingo	Dingo, Dog	*				X	X	X	X	X	X
Vulpes vulpes	Red Fox	*					X				
FELIDAE											
Felis catus	Cat	*				X	X	X	X	X	X
EQUIDAE											
Equus asinus	Donkey	*				X	X			X	
Equus caballus	Horse	*				X	X				
CAMELIDAE											
Camelus dromedarius	Dromedary, Camel	*				X	X		X	X	
BOVIDAE											
Bos taurus	European Cattle	*				X			X	X	X

Previous surveys

Biota Environmental Sciences (2006) Hope Downs Rail Corridor (Juna Downs Section) Fauna Survey

Biota Environmental Sciences (2009) Hope Downs Section 45C Targeted Fauna Review

Biota Environmental Sciences (2011) Hope Downs Project Life of Mine Targeted Fauna Survey

Biota Environmental Sciences (2014) Hope Downs South West Marra Mamba Development Targeted Fauna Survey

Ecologia Environment (2014) Greater West Angelas Terrestrial Fauna Assessment

Ninox Wildlife Consulting (2009a) A Vertebrate Fauna Survey of the Proposed Hope Downs 4 Infrastructure Corridor Option 1 Near Newman Western Australia

Ninox Wildlife Consulting (2009b) A Vertebrate Fauna Survey of the Proposed Hope Downs 4 Infrastructure Corridor Option 1 Near Newman Western Australia

Table E.5: Amphibian species recorded during the current surveys. Numbers are those recorded in Phase 1, Phase 2 and Phase 3. X = the trap sites were not opened during that particular phase of fauna surveying.

Species name	TS01	TS02	TS03	TS04	TS05	TS06	TS07	TS08	TS09	TS10	TS11	TS12	TS13	TS14	TS15	TS16	TS17	TS18	TS19	Other
HYLIDAE																				
Cyclorana maini														x, x, 4						
Litoria rubella						1, 0, x	0, 2, x							x, x, 1						0, 11, 4

Table E.6: Reptile species recorded during the current surveys. Numbers are those recorded in Phase 1, Phase 2 and Phase 3. X = the trap sites were not opened during that particular phase of fauna surveying.

Species name	TS01	TS02	TS03	TS04	TS05	TS06	TS07	TS08	TS09	TS10	TS11	TS12	TS13	TS14	TS15	TS16	TS17	TS18	TS19	Other
AGAMIDAE																				
Gowidon longirostris						0, 1, x	0, 1, x													2, 0, 1
Ctenophorus caudicinctus	0, 1, x			3, 2, x	0, 3, x							0, 1, x			x, x, 1					2, 2, 0
Ctenophorus isolepis					0, 2, x															
Pogona minor			1, 0, x	0, 1, x																1, 0, 0
CARPHODACTYLIDAE																				
Nephrurus wheeleri cinctus	0, 1, x													x, x, 4						0, 0, 1
DIPLODACTYLIDAE																				
Diplodactylus pulcher	5, 0, x		5, 0, x																	
Lucasium stenodactylum				5, 0, x		3, 0, x										x, x, 1	x, x, 3			0, 0, 1
Lucasium wombeyi				1, 0, x		2, 0, x	1, 0, x													1, 0, 0
Oedura fimbria																				13, 3, 1
Rhynchoedura ornata				1, 0, x		2, 0, x										x, x, 3				
GEKKONIDAE																				
Gehyra punctata																				6, 2, 1
Gehyra variegata			1, 0, x			1, 0, x								x, x, 1						3, 2, 1
Heteronotia binoei																				0, 1, 1
Heteronotia spelea																				1, 1, 0
Strophurus elderi				1, 0, x																
Strophurus wellingtonae					1, 0, x															0, 1, 2
PYGOPODIDAE																				
Delma butleri															x, x, 1					
Delma nasuta							1, 0, x							x, x, 1						0, 0, 1
Delma pax						1, 0, x	0, 1, x									x, x, 1				
Lialis burtonis				2, 0, x			1, 0, x													1, 0, 1
Pygopus nigriceps														x, x, 1						
SCINCIDAE																				
Carlia munda	1, 0, x	5, 0, x			0, 1, x	6, 1, x	3, 5, x				1, 1, x			x, x, 3			x, x, 2	x, x, 1		
Cryptoblepharus ustulatus									1, 0, x											1, 1, 0
Ctenotus grandis	1, 0, x													x, x, 1		x, x, 1				
Ctenotus helenae				1, 0, x		3, 0, x														
Ctenotus pallasotus				2, 0, x													x, x, 1	x, x, 1		
Ctenotus pantherinus		2, 1, x		4, 0, x	6, 0, x	2, 0, x						0, 1, x			x, x, 2	x, x, 2				
Ctenotus rutilans					2, 0, x															
Ctenotus saxatilis							0, 1, x				1, 0, x		0, 2, x	x, x, 2	x, x, 3	x, x, 2	x, x, 3	x, x, 2		
Ctenotus schomburgkii	1, 0, x		1, 1, x																	0, 1, 0

Species name	TS01	TS02	TS03	TS04	TS05	TS06	TS07	TS08	TS09	TS10	TS11	TS12	TS13	TS14	TS15	TS16	TS17	TS18	TS19	Other
Ctenotus uber															x, x, 1	x, x, 1		x, x, 1		
Egernia formosa										1, 0, x	2, 1, x								x, x, 1	
Lerista macropisthopus remota																		x, x, 1		
Lerista muelleri	1, 0, x																			
Lerista neander	1, 0, x		1, 0, x																	
Menetia greyii							0, 3, x							x, x, 1			x, x, 1			
Morethia ruficauda exquisita					0, 1, x											x, x, 1				0, 0, 1
Tiliqua multifasciata				1, 0, x	1, 0, x											x, x, 3	x, x, 1	x, x, 2		
VARANIDAE																				
Varanus acanthurus				1, 0, x									0, 1, x		x, x, 2	x, x, 1				1, 0, 0
Varanus brevicauda					3, 0, x															
Varanus bushi																				1, 0, 0
Varanus caudolineatus																				1, 0, 0
Varanus giganteus																				0, 0, 1
Varanus gouldii																				1, 0, 0
Varanus panoptes	1, 0, x																			0, 1, 1
Varanus tristis tristis																				1, 0, 1
TYPHLOPIDAE																				
Anilios ammodytes					2, 0, x															
Anilios grypus				1, 0, x	1, 0, x															
Anilios hamatus				1, 0, x										x, x, 1						
ELAPIDAE																				
Acanthophis wellsi				1, 0, x																
Brachyurophis approximans						1, 0, x	1, 0, x													
Demansia psammophis																x, x, 1				
Furina ornata													0, 1, x							
Pseudechis australis																x, x, 1				0, 1, 0
Pseudonaja nuchalis												0, 1, x								

Table E.7: Bird species recorded during the current surveys. Numbers are those recorded in Phase 1, Phase 2 and Phase 3. X = the trap sites were not opened during that particular phase of fauna surveying.

Species name	TS01	TS02	TS03	TS04	TS05	TS06	TS07	TS08	TS09	TS10	TS11	TS12	TS13	TS14	TS15	TS16	TS17	TS18	TS19	Other
DROMAIIDAE																				
Dromaius novaehollandiae				0, 1, x																
PHASIANIDAE																				
Coturnix ypsilophora				1, 0, x		4, 0, x	1, 1, x													
COLUMBIDAE																				
Geopelia cuneata				3, 0, x								0, 1, x		x, x, 1						1, 1, 0
Geophaps plumifera										0, 1, x										1, 1, 2
Ocyphaps lophotes			0, 1, x	2, 3, x	1, 1, x	1, 0, x													x, x, 2	1, 1, 1
Phaps chalcoptera																			x, x, 1	0, 1, 2
CAPRIMULGIDAE																				
Eurostopodus argus																				0, 2, 3
AEGOTHELIDAE																				
Aegotheles cristatus											1, 0, x									4, 0, 0
THRESKIORNITHIDAE																				
Threskiornis spinicollis																				0, 1, 0
ACCIPITRIDAE																				
Elanus caeruleus axillaris																				1, 1, 0
Elanus scriptus																				0, 1, 0
Haliastur sphenurus						2, 0, x									x, x, 1					2, 4, 0
Accipiter fasciatus																				1, 0, 1
Circus assimilis	1, 0, x																			1, 2, 2
Aquila audax																				0, 2, 0
Hamirostra melanosternon																				0, 4, 0
Hieraaetus morphnoides																				1, 0, 0
FALCONIDAE																				
Falco cenchroides				1, 0, x		1, 0, x														0, 2, 0
Falco berigora				1, 0, x																0, 1, 1
Falco longipennis							0, 1, x													
OTIDIDAE																				
Ardeotis australis																				1, 1, 0
CHARADRIIDAE																				
Charadrius veredus																				0, 0, 1
TURNICIDAE																				
Turnix velox				1, 0, x		1, 1, x	1, 0, x						0, 2, x			x, x, 1				
CACATUIDAE																				
Cacatua roseicapillus				1, 0, x		1, 0, x														

Species name	TS01	TS02	TS03	TS04	TS05	TS06	TS07	TS08	TS09	TS10	TS11	TS12	TS13	TS14	TS15	TS16	TS17	TS18	TS19	Other
Cacatua sanguinea		1, 0, x					1, 0, x												x, x, 1	
Nymphicus hollandicus						1, 0, x														
PSITTACIDAE																				
Melopsittacus undulatus								2, 0, x												0, 1, 1
Neophema bourkii																				11, 0, 0
Platycercus varius																				2, 0, 0
Platycercus zonarius	1, 0, x		3, 0, x		1, 1, x	2, 0, x	1, 2, x		0, 1, x							x, x, 3	x, x, 1		x, x, 2	1, 4, 1
CUCULIDAE																				
Chrysococcyx basalis							0, 1, x		0, 2, x		0, 1, x					x, x, 1	x, x, 1	x, x, 1		
Cacomantis pallidus			0, 2, x						0, 1, x					x, x, 1			x, x, 1			0, 1, 0
STRIGIDAE																				
Ninox boobook boobook										1, 0, x	1, 0, x									2, 0, 0
Podargus strigoides																				0, 0, 1
ALCEDINIDAE																				
Dacelo leachii						2, 1, x														
Todiramphus pyrrhopygius																				1, 2, 1
Todiramphus sanctus		1, 0, x				4, 1, x														1, 0, 0
MEROPIDAE																				
Merops ornatus				1, 2, x	0, 1, x	0, 1, x								x, x, 1		x, x, 1		x, x, 1		1, 4, 2
PTILONORHYNCHIDAE																				
Ptilonorhynchus guttatus										1, 0, x										2, 3, 3
MALURIDAE																				
Amytornis striatus				0, 1, x						0, 2, x	0, 1, x									1, 2, 1
Malurus lamberti assimilis		2, 2, x		0, 2, x		1, 0, x	0, 3, x	0, 1, x						x, x, 2		x, x, 1				0, 0, 1
Malurus leucopterus		0, 1, x														x, x, 1		x, x, 1		0, 1, 1
Stipiturus ruficeps					2, 1, x								0, 1, x		x, x, 3	x, x, 3	x, x, 1			
ACANTHIZIDAE																				
Acanthiza apicalis	1, 0, x	1, 0, x						0, 2, x										x, x, 1		0, 0, 1
Acanthiza robustirostris	2, 0, x		1, 0, x																	
Acanthiza uropygialis									0, 1, x											0, 1, 1
Gerygone fusca	4, 0, x		1, 0, x															x, x, 1		0, 1, 1
Smicrornis brevirostris	1, 2, x	0, 2, x		2, 2, x	1, 2, x	1, 3, x	1, 4, x	1, 2, x	2, 6, x	1, 0, x	1, 1, x			x, x, 1		x, x, 1			x, x, 1	2, 7, 3
PARDALOTIDAE																				
Pardalotus rubricatus										0, 2, x										0, 1, 0
Pardalotus striatus								0, 1, x												
MELIPHAGIDAE																				
Acanthagenys rufogularis			1, 0, x	0, 4, x			0, 1, x				0, 1, x			x, x, 1		x, x, 2		x, x, 1		1, 3, 1

Species name	TS01	TS02	TS03	TS04	TS05	TS06	TS07	TS08	TS09	TS10	TS11	TS12	TS13	TS14	TS15	TS16	TS17	TS18	TS19	Other
Gavicalis virescens	2, 2, x	1, 2, x		3, 1, x	0, 1, x		4, 1, x	0, 2, x	0, 3, x	0, 3, x	0, 1, x			x, x, 2	x, x, 1	x, x, 2	x, x, 1	x, x, 3	x, x, 2	2, 1, 3
Lichmera indistincta							0, 1, x	0, 1, x										x, x, 2		0, 1, 1
Manorina flavigula					1, 0, x	2, 0, x		1, 0, x										x, x, 1	x, x, 2	2, 7, 3
Ptilotula keartlandi						1, 1, x	6, 0, x		0, 1, x	1, 4, x	5, 2, x									0, 1, 2
Ptilotula penicillata						0, 5, x	0, 2, x											x, x, 1		0, 3, 1
POMATOSTOMIDAE																				
Pomatostomus temporalis	1, 1, x	1, 2, x	5, 0, x		4, 0, x	1, 1, x	0, 4, x	1, 0, x	0, 2, x	1, 0, x				x, x, 2				x, x, 1		0, 4, 4
PSOPHODIDAE																				
Psophodes occidentalis																				0, 1, 0
CAMPEPHAGIDAE																				
Coracina novaehollandiae		0, 1, x		2, 0, x		1, 0, x	0, 1, x								x, x, 1	x, x, 4		x, x, 1		2, 1, 0
Lalage tricolor	1, 0, x	1, 0, x	1, 0, x	2, 0, x		0, 1, x								x, x, 2	x, x, 2	x, x, 1	x, x, 2			0, 1, 1
OREOICIDAE																				
Oreoica gutturalis	1, 1, x	1, 0, x		1, 0, x	2, 0, x															0, 1, 1
PACHYCEPHALIDAE																				
Cincloramphus mathewsi	1, 0, x	1, 0, x		2, 0, x		2, 0, x	1, 0, x													2, 0, 1
Colluricincla harmonica				1, 0, x		0, 1, x		0, 2, x	2, 0, x	1, 0, x	1, 1, x							x, x, 2		1, 4, 0
Pachycephala rufiventris	1, 0, x		2, 0, x	1, 0, x		1, 0, x		2, 0, x	1, 0, x								x, x, 1	x, x, 4	x, x, 1	0, 0, 1
ARTAMIDAE																				
Artamus cinereus		1, 0, x						1, 0, x				0, 3, x								1, 4, 1
Artamus minor											1, 0, x									2, 2, 0
Artamus personatus																		x, x, 1		
CRACTICIDAE																				
Cracticus nigrogularis				2, 0, x	2, 0, x	2, 0, x		1, 0, x			1, 0, x			x, x, 1			x, x, 2		x, x, 2	0, 3, 2
Cracticus tibicen		1, 0, x		1, 0, x	1, 0, x				0, 1, x								x, x, 1		x, x, 2	1, 2, 0
Cracticus torquatus	0, 1, x				2, 1, x	0, 1, x	0, 1, x	0, 1, x									x, x, 1			1, 4, 1
RHIPIDURIDAE																				
Rhipidura albiscapa	3, 0, x								0, 1, x		0, 1, x							x, x, 2	x, x, 1	
Rhipidura leucophrys	3, 0, x	2, 0, x	1, 0, x	2, 1, x	2, 0, x	2, 0, x	0, 2, x		1, 1, x	0, 1, x	1, 1, x					x, x, 3	x, x, 2	x, x, 1		2, 6, 4
CORVIDAE																				
Corvus bennetti								0, 1, x												
Corvus orru	1, 1, x			1, 0, x			0, 1, x	0, 1, x	1, 0, x	0, 1, x	0, 1, x		0, 1, x		x, x, 1	x, x, 3			x, x, 1	3, 4, 1
MONARCHIDAE																				
Grallina cyanoleuca						2, 0, x													x, x, 2	0, 3, 0
PETROICIDAE																				
Melanodryas cucullata	0, 1, x																			0, 1, 1
Petroica goodenovii				0, 1, x																

Species name	TS01	TS02	TS03	TS04	TS05	TS06	TS07	TS08	TS09	TS10	TS11	TS12	TS13	TS14	TS15	TS16	TS17	TS18	TS19	Other
ALAUDIDAE																				
Mirafra javanica																				0, 1, 0
LOCUSTELLIDAE																				
Eremiornis carteri														x, x, 1		x, x, 2	x, x, 1			1, 0, 0
HIRUNDINIDAE																				
Petrochelidon ariel																				1, 0, 0
Petrochelidon nigricans																				1, 0, 0
ESTRILDIDAE																				
Emblema pictum				0, 1, x		0, 1, x		1, 0, x	0, 1, x	2, 2, x	3, 1, x	0, 1, x								1, 4, 1
Taeniopygia guttata	0, 1, x			12, 3, x	10, 0, x	5, 4, x	1, 1, x		0, 1, x			0, 1, x		x, x, 2		x, x, 1				0, 1, 1
MOTACILLIDAE																				
Anthus australis																				0, 1, 0

Table E.8: Non-volant mammal species recorded during the current survey. Numbers are those recorded in Phase 1, Phase 2 and Phase 3. X = the trap sites were not opened during that particular phase of fauna surveying.

Species name	TS01	TS02	TS03	TS04	TS05	TS06	TS07	TS08	TS09	TS10	TS11	TS12	TS13	TS14	TS15	TS16	TS17	TS18	TS19	Other
TACHYGLOSSIDAE																				
Tachyglossus aculeatus acanthion																				1, 1, 0
DASYURIDAE																				
Dasykaluta rosamondae					0, 1, x	0, 1, x								x, x, 3	x, x, 4	x, x, 4	x, x, 16	x, x, 3		
Dasyurus hallucatus																				1, 12, 1
Ningaui timealeyi				2, 1, x	0, 3, x											x, x, 1	x, x, 1			
Planigale sp. 1'		1, 0, x					1, 0, x							x, x, 1						
Sminthopsis macroura		0, 2, x		1, 0, x		1, 0, x														
Sminthopsis ooldea																x, x, 1		x, x, 1		
MACROPODIDAE																				
Macropus robustus erubescens						1, 0, x														5, 3, 1
Macropus rufus																				2, 0, 1
Petrogale rothschildi																				11, 5, 1
MURIDAE																				
Mus musculus		0, 1, x				0, 1, x	0, 2, x													
Pseudomys chapmani															x, x, 2		x, x, 1			1, 0, 5
Pseudomys desertor		0, 1, x		2, 0, x	0, 2, x		4, 0, x						0, 2, x							
Pseudomys hermannsburgensis	6, 0, x		2, 1, x		1, 1, x															
Zyzomys argurus					0, 2, x			2, 2, x	1, 2, x	2, 2, x	1, 3, x	0, 2, x	0, 13, x							2, 3, 0
LEPORIDAE																				
Oryctolagus cuniculus				1, 0, x		0, 1, x														2, 2, 1
CANIDAE																				
Canis familiaris dingo						0, 3, x					1, 0, x								x, x, 1	3, 9, 0
FELIDAE																				
Felis catus																				3, 1, 1
EQUIDAE																				
Equus asinus																				0,1, 0
CAMELIDAE																				
Camelus dromedarius				0, 1, x																1, 0, 0
BOVIDAE																				
Bos taurus																				1, 1, 2

Table E.9: Volant mammal (bat) species recorded during the current surveys. BAT 1 – 12 (Phase 1); BAT 13 – 21 (Phase 2); Bat 23 – 26 (Phase 3).

Species name (Common name)	BAT01	BAT02	BAT03	BAT04	BAT05	BAT06	BAT07	BAT08	BAT09	BAT10	BAT12	BAT13	BAT14	BAT15	BAT16	BAT17	BAT19	BAT21	BAT23	BAT24	BAT25	BAT26	Other
MEGADERMATIDAE																							
Macroderma gigas				Low (2 calls)														Low (1 call)			Low (1 call)		Phase 3 (scat)
HIPPOSIDERIDAE																							
Rhinonicteris aurantia (Pilbara form)												Low (10 calls)				Low (2 calls)		Low (1 call)					
EMBALLONURIDAE																							
Saccolaimus flaviventris											x		x	x					x	x			
Taphozous georgianus		x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	
Taphozous hilli												x											
VESPERTILIONIDAE																							
Chalinolobus gouldii			x	x					x		x	x	x	x	x	x		x	x	x	x	x	
Nyctophilus geoffroyi											x		x										
Scotorepens greyii			x	x					x		x	x	x	x				x	x	x	x	x	
Vespadelus finlaysoni			x	x					x	x	x	x	x	x	x	x	x	x	x	x	x	x	
MOLOSSIDAE																							
Chaerephon jobensis	x	x	x	x	x	x	x	x			x	x	x	x	x	x	x	x	x	x	x	x	
Ozimops lumsdenae			x	x					x		x				x	x			x	x		x	
Austronomus australis												x	x	x	x	x	x	x					

Table E.10: Collected species in SRE target groups. SRE and potential SRE species are shaded grey.

SPECIES	SRE1	SRE2	SRE3	SRE4	SRE5	SRE6	SRE7	SRE8	SRE9	SRE10	SRE11	SRE12	SRE13	SRE14	SRE15	SRE16	SRE17	SRE18	SRE19	SRE20	SRE21	SRE22	SRE23	TS01	TS02	TS03	TS04	TS05	TS06	TS07	TS08	TS09	TS10	TS11	TS12	TS13	TS14	TS15	TS16	TS17	TS18	TS19	Other	Total
Araneae																																												
Aname mellosa																1		2																			4		10	8	9		2	**36**
Aname 'MYG004'																																								1				**1**
Aname sp.																1																						1						**2**
Aurecocrypta 'sp. indet. (AESHD1)'																	1																											**1**
Aurecocrypta 'MYG315'																						1																						**1**
Gaius tealei			1													1							1													1				3			**7**
Karaops banyjima																		1	1		1																						**3**
Karaops sp. 'ARA001'																		1																										**1**
Yilgarnia 'MYG197'																																					1						**1**
Missulena rutraspina																																									2			**2**
Nemesiidae sp.											1																																	**1**
Synothele sp.												1																																	**1**
Synothele 'MYG309'																																									1			**1**
Synothele 'MYG311'																																									1			**1**
Synothele xkarara																														1											3			**4**
Scorpiones																																												
Isometroides 'pilbara 1'																																					2		1	2	3			**8**
Lychas 'bituberculatus complex'																											1										1			1			1	**6**
Lychas 'hairy tail complex'																																								1				**1**
Lychas 'harveyi complex'																														1							2				1			**4**
Lychas 'multipunctatus complex'								1																													4			3			3	**11**
Lychas 'pilbara 1'																											1																	**1**
Urodacus 'pilbara 12'												1																																**1**
Urodacus 'HD1'													1																															**1**
Pseudoscorpiones																																												
Anatemnus sp.														1																															**1**
Austrohorus 'sp. indet. (AESHD5)'	1																																											**1**
Beierolpium '8/4 small'																			2																										**2**
Beierolpium '8/4'													1																															**1**
Beierolpium 'sp. indet. (AESHD1)'														1																															**1**
Beierolpium 'sp. indet. (AESHD2)'																																					1							**1**
Euryolpium 'sp. indet. (AESHD6)'										2																																		**2**
Euryolpium 'sp. indet. (AESHD7)'									1																																			**1**
Euryolpium sp.										1										1																									**2**
'Genus 7/4 PSE118'		4		1						2											2																								**9**
'*PSEAAA* sp. indet. (AESHD4)'																1																													**1**
Indolpium sp.	5																																												**5**
Olpiidae sp.	1																																												**1**

SPECIES	SRE1	SRE2	SRE3	SRE4	SRE5	SRE6	SRE7	SRE8	SRE9	SRE10	SRE11	SRE12	SRE13	SRE14	SRE15	SRE16	SRE17	SRE18	SRE19	SRE20	SRE21	SRE22	SRE23	TS01	TS02	TS03	TS04	TS05	TS06	TS07	TS08	TS09	TS10	TS11	TS12	TS13	TS14	TS15	TS16	TS17	TS18	TS19	Other	Total
Oratemnus sp.			1										2		8								4																					**15**
Sundochernes sp.																							1																					**1**
Tyrannochthonius 'sp. indet. (AESHD)1'														1																														**1**
Tyrannochthonius 'sp. indet. (AESHD2)'		1																																									**1**
Geophilomorpha																																												
Geophilomorpha sp.																1																													**1**
Mecistocephalus 'HD1'													1								1		2																					**4**
Mecistocephalus 'HD2'																							1																					**1**
Mecistocephalus 'HD3'															2																													**2**
Orphnaeus sp.																							1																					**1**
Sepedonophilus 'HD1'	1																2		3																								1	**7**
Sepedonophilus 'HD2'																							1																					**1**
Sepedonophilus sp.																			1																									**1**
Scolopendromorpha																																											
Cryptops 'HD1'															3																													**3**
Polydesmida																																												
Antichiropus sp.															1								2																					**3**
Antichiropus 'wonmunna'															2								12																					**14**
Spirobolida																																											
Austrostrophus 'Clade A'																				2																									**2**
Austrostrophus 'Clade E'															1							1																					4			**7**
Austrostrophus sp.													1		5	1	1	1	1																									**10**
Eupulmonata																																											
Gastrocopta sp.	30		1	1			2		2		3			2	2						6																					2			**51**
Pupoides sp.	3			1			1				1			4							1		1																			2			**14**
Eremopeas interioris														5	2		4		2																							5			**18**
Subulinidae sp.	20	1	1	1						1																																		**24**
Isopoda																																											
Buddelundia '10ma'											1																2	6																	**9**
Buddelundia '15'														2	2				1				5																					**10**
Buddelundia '16'																	3		8																									**11**
Buddelundia '77'															2		1		4			1	2																					**10**
Buddelundia sp.																							1																					**1**
Buddelundiinae sp.																							1																			2			**3**
Pseudodiploexochus sp.																	1																											**1**
Troglarmadillo sp.													1																															**1**
Philosciidae sp.																			5																							1			**6**
Total	**61**	**6**	**4**	**4**	**0**	**0**	**3**	**1**	**3**	**4**	**8**	**2**	**7**	**16**	**30**	**6**	**13**	**5**	**28**	**3**	**11**	**3**	**34**	**0**	**0**	**0**	**4**	**6**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**32**	**1**	**13**	**16**	**24**	**0**	**7**	**358**

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Appendix F: Threatened and Priority Fauna Species Likelihood of Occurrence within the Survey Area

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Table F.1: Likelihood of occurrence of conservation listed vertebrate fauna species listed as potentially occurring in the vicinity of the survey area.

Scientific name (common name)	Conservation codes			Preferred habitat	Likelihood of occurrence	
	EPBC Act	BC Act	DBCA		Pre-survey	Post-survey
Reptiles						
Underwoodisaurus seorsus (Pilbara Barking Gecko)			P2	Confined in the Pilbara to the Hamersley Ranges from Tom Price to Newman. Occurs in rocky areas with spinifex and low tree cover.	High	High
Lerista macropisthopus remota			P2	This subspecies occurs in woodlands and semi-arid shrublands where animals shelter under leaf litter. This species is generally found in the central interior particularly the Ashburton region.	High	**Recorded**
Anilios ganei			P1	Little information is available on this species but it is believed to be associated with moist gorges and gullies.	High	High
Liasis olivaceus barroni (Pilbara Olive Python)	VU	VU		Generally rocky habitats in close association to permanent and semi-permanent water sources.	High	High
Birds						
Apus pacificus (Fork-tailed Swift)	IA	IA		Largely aerial species independent of the terrestrial environment.	Moderate	Moderate
Elanus scriptus (Letter-winged Kite)			P4	The Letter-winged Kite is a bird of open country and grasslands in arid and semi-arid Australia, where there are tree-lined streams or water courses.	Low	**Recorded**
Falco hypoleucos (Grey Falcon)		VU		Open habitats: semi-deserts, grassy inland plains, timbered watercourses, pastoral lands.	Moderate	Moderate
Falco peregrinus (Peregrine Falcon)		OS		Cosmopolitan, will hunt in any habitat, soaring at height or from a perch; often near cliffs. Nests on rocky ledges in tall, vertical cliff faces and tall trees associated with drainage lines.	Moderate	Moderate
Charadrius veredus (Oriental Plover)	IA	IA		Breeding habitat includes arid grasslands, saltpans; non-breeding habitat includes grasslands, salt-fields, and coastal regions.	Moderate	**Recorded**

Scientific name (common name)	Conservation codes			Preferred habitat	Likelihood of occurrence	
	EPBC Act	BC Act	DBCA		Pre-survey	Post-survey
Rostratula australis (Australian Painted Snipe)	EN	EN		Inhabits shallow terrestrial freshwater wetlands, lakes, swamps and claypans. Also found in waterlogged grassland and saltmarsh. Typical sites include areas with emergent tussocks of grass, sedges or samphire; often scattered with clumps of lignum *Muehlenbeckia*, or canegrass or sometimes with tea-tree (*Melaleuca*).	Low	Low
Actitis hypoleucos (Common Sandpiper)	IA	IA		Non-breeding migrant to a wide variety of habitats, such as riverbanks, estuaries, freshwater seeps on coastal shores, tidal creeks, mangrove swamps and saltmarshes.	Low	Low
Tringa nebularia (Common Greenshank)	IA	IA		A variety of freshwater, marine and artificial wetlands, including swamps, open muddy or rocky shores of lakes and large rivers, sewerage farms, saltworks, muddy coastal flats, mangroves and estuaries.	Low	Low
Calidris melanotos (Pectoral Sandpiper)	IA	IA		Mainly swamps, lagoons, river pools, irrigation channels and sewerage ponds. Also in samphire flats around estuaries and salt lakes.	Low	Low
Calidris acuminata (Sharp-tailed Sandpiper)	IA	IA		Muddy edges of shallow fresh/brackish wetlands with emergent sedges, saltmarsh, grass and low vegetation.	Low	Low
Calidris ferruginea (Curlew Sandpiper)	CR/IA	VU/IA		This species mainly occurs on intertidal mudflats in sheltered coastal areas and also around non-tidal swamps, lakes and lagoons near the coast. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand.	Low	Low

Scientific name (common name)	Conservation codes			Preferred habitat	Likelihood of occurrence	
	EPBC Act	BC Act	DBCA		Pre-survey	Post-survey
Pezoporus occidentalis (Night Parrot)	EN	CR		Most habitat records are from *Triodia* grasslands and/or chenopod shrublands in the arid and semi-arid zones. *Astrebla* spp. (Mitchell grass), shrubby samphire and chenopod associations, scattered trees and shrubs, *Acacia aneura* (Mulga) woodland, treeless areas and bare gibber as associated with sightings of the species.	Low	Low
Hirundo rustica (Barn Swallow)	IA	IA		Coastal open country generally, especially near surface water and man-made structures such as bridges and power wires.	Low	Low
Motacilla cinerea (Grey Wagtail)	IA	IA		Damp short-grass flats, rice stubbles and edge of swamps, sewage ponds, bore overflows, grazed or mowed grass and irrigated areas.	Low	Low
Motacilla flava (Yellow Wagtail)	IA	IA		Mainly banks and rocks in fast-running freshwater habitats such as rivers, creeks, streams and around waterfalls.	Low	Low
Mammals						
Dasycercus blythi (Brush-tailed Mulgara)			P4	Common in a range of habitats – tussock/hummock grasslands and sparse shrubs and low open woodlands on ridge tops, cliffs, scree slopes, hills and valley floors.	Moderate	Low
Dasyurus hallucatus (Northern Quoll)	EN	EN		Northern Quoll habitat generally encompasses some form of rocky area for denning purposes with surrounding vegetated habitats used for foraging and dispersal.	High	**Recorded**
Macrotis lagotis (Greater Bilby, Dalgyte)	VU	VU		Sand or sandy-loam in hummock grassland (*Triodia* species) and or *Acacia* shrublands.	Low	Low

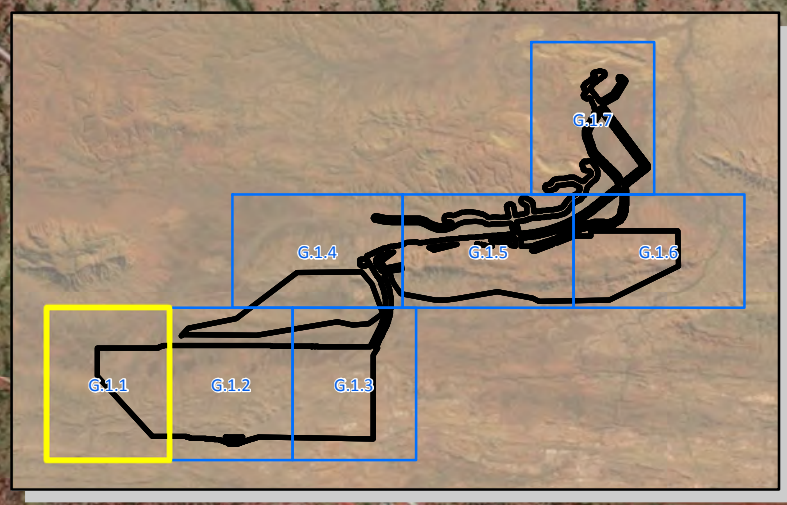
Scientific name (common name)	Conservation codes			Preferred habitat	Likelihood of occurrence	
	EPBC Act	BC Act	DBCA		Pre-survey	Post-survey
Macroderma gigas (Ghost Bat)	VU	VU		A wide range from rainforest, monsoon and vine scrub in the tropics to open woodlands and arid areas.	High	**Recorded**
Rhinonicteris aurantia (Pilbara form) (Pilbara Leaf-nosed Bat)	VU	VU		Roosts in deep warm, humid caves or rock cracks, especially in proximity to water pools. Forages while flying low along watercourses and gorges and over *Triodia* grassland.	High	**Recorded**
Leggadina lakedownensis (Short-tailed Mouse, Karekanga)			P4	Open tussock and hummock grassland, *Acacia* shrubland and savannah woodland on alluvial clay/sandy soils.	Moderate	Moderate
Pseudomys chapmani (Western Pebble-mound Mouse)			P4	Gentle rocky slopes, hills and spurs with small pebble surface cover and sparse vegetation.	High – previously recorded within survey area	**Recorded**

Appendix G: Fauna Habitat Mapping and Significant Areas

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694000 696000 698000

7448000 7446000 7444000 7442000



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Survey Area

Significant Areas

Cave

Fauna Habitat

Breakaway
Mulga Woodland
Low Hills and Slopes
Stony Plain
Alluvial Plain
Minor Drainage
Cleared

Cave 7

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Figure G.1.1: Vertebrate fauna habitat mapping and significant areas

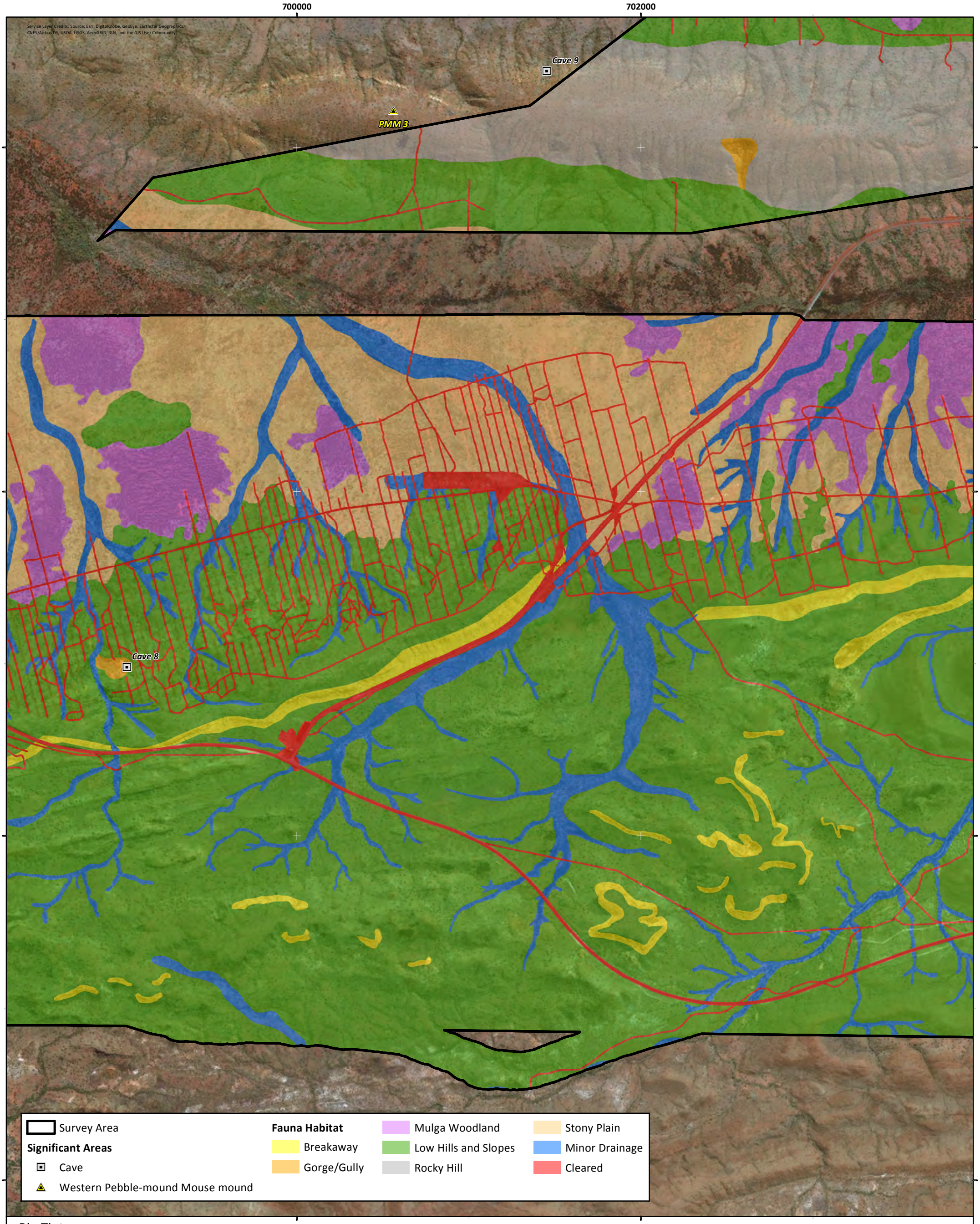
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Drawn: C. Dyde	Figure Ref: 14292B-19-BIDR-3Rev2_200131_P_FigG1

Coordinate System: GDA 1994 MGA Zone 50

0 200 400 600 800 1,000 Metres

N



Rio Tinto

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Figure G.1.2: Vertebrate fauna habitat mapping and significant areas

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Author: J. Johnston	Date: 31-01-2020	Coordinate System: GDA 1994 MGA Zone 50
Drawn: C. Dyde	Figure Ref: 14292B-19-BIDR-3Rev2_200131_P_FigG1	Metres 0 200 400 600 800 1,000 N

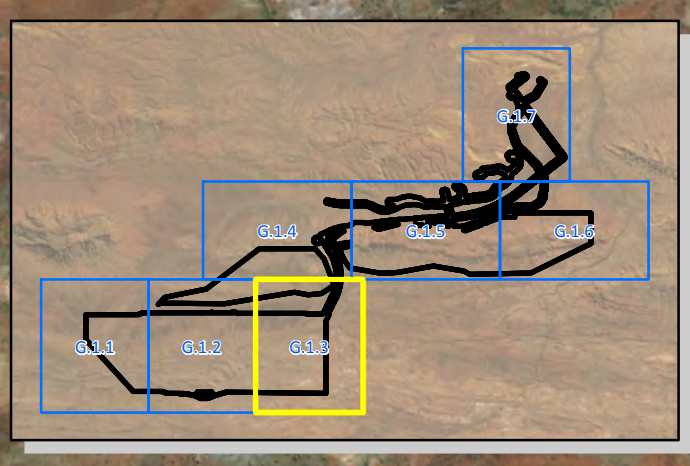
704000
706000
708000
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7446000
7444000
7442000

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Survey Area

Fauna Habitat

- Breakaway
- Mulga Woodland
- Low Hills and Slopes
- Rocky Hill
- Stony Plain
- Alluvial Plain
- Minor Drainage
- Cleared



Rio Tinto

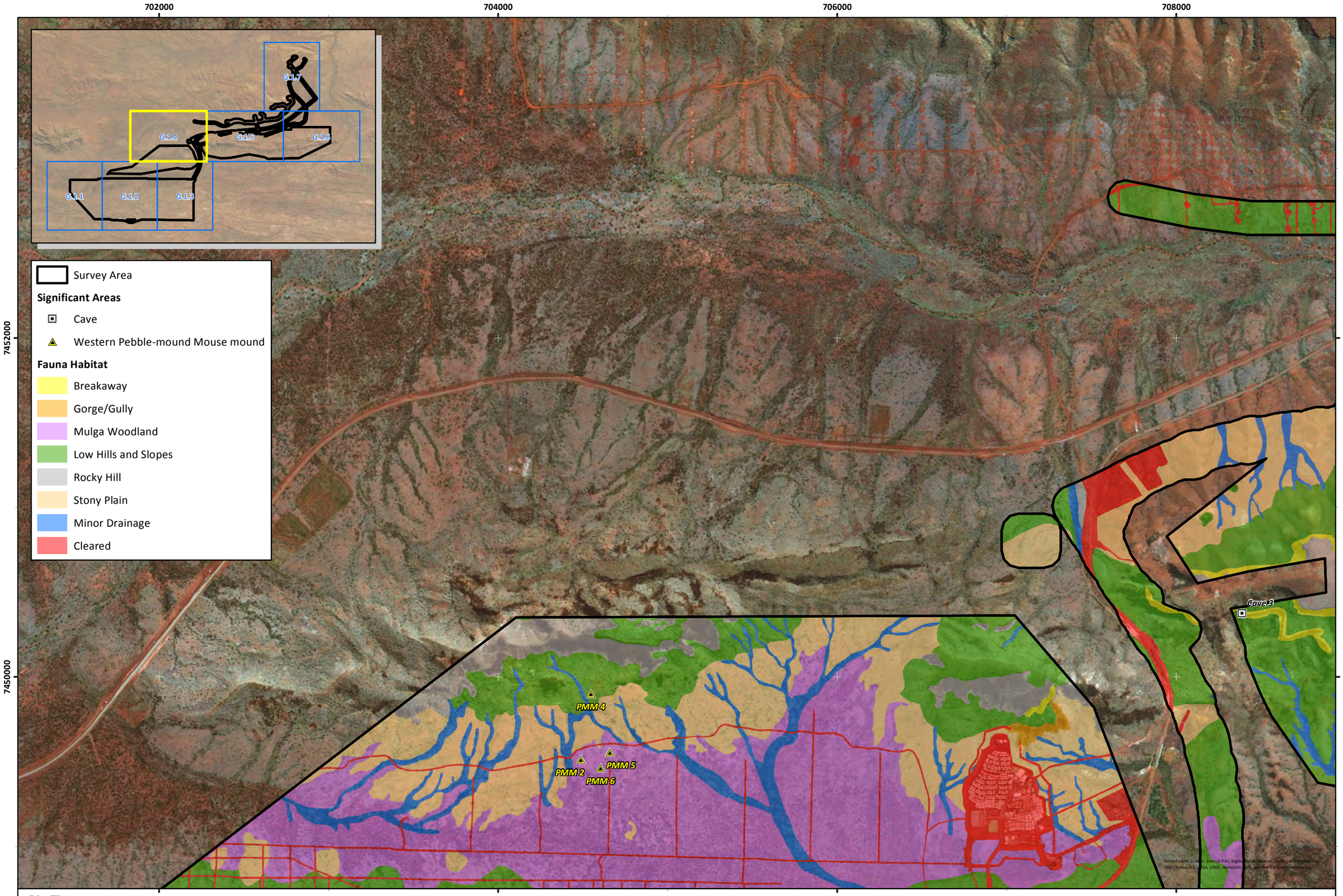
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Figure G.1.3: Vertebrate fauna habitat mapping

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Drawn: C. Dyde	Figure Ref: 14292B-19-BIDR-3Rev2_200131_P_FigG1	Metres 0 200 400 600 800 1,000

N



Rio Tinto

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Figure G.1.4: Vertebrate fauna habitat mapping and significant areas

Coordinate System: GDA 1994 MGA Zone 50

0 200 400 600 800 1,000 Metres

N

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Author: J. Johnston | Drawn: C. Dyde | Date: 31-01-2020 | Figure Ref: 14292B-19-BIDR-3Rev2_200131_LS_FigG1

710000 712000 714000 716000

7452000

7450000

Survey Area

Significant Areas

Cave

Western Pebble-mound Mouse mound

Fauna Habitat

Breakaway

Gorge/Gully

Mulga Woodland

Low Hills and Slopes

Rocky Hill

Stony Plain

Alluvial Plain

Minor Drainage

Cleared

Cave 4

Cave 6

Cave 5

Cave 1

PMM1

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Figure G.1.5: Vertebrate fauna habitat mapping and significant areas

Coordinate System: GDA 1994 MGA Zone 50

0 200 400 600 800 1,000 Metres

N

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718000
720000
722000
724000
7452000
7450000

G.1.1
G.1.2
G.1.3
G.1.4
G.1.5
G.1.6
G.1.7

Cave 2

Survey Area

Significant Areas

Cave

Fauna Habitat

Breakaway
Gorge/Gully
Mulga Woodland
Low Hills and Slopes
Rocky Hill
Stony Plain
Alluvial Plain
Minor Drainage
Cleared

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Figure G.1.6: Vertebrate fauna habitat mapping and significant areas

Coordinate System: GDA 1994 MGA Zone 50

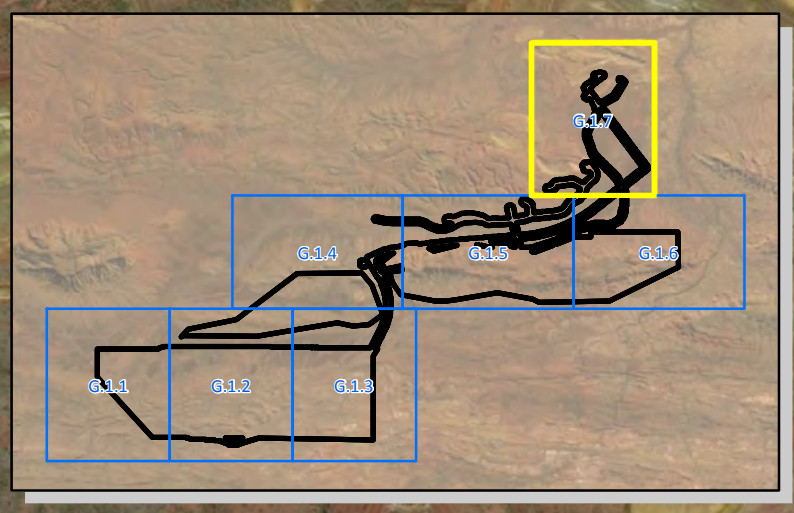
0 200 400 600 800 1,000 Metres

N

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716000
718000
720000
7460000
7458000
7456000
7454000



Survey Area

Fauna Habitat

- Mulga Woodland
- Low Hills and Slopes
- Rocky Hill
- Alluvial Plain
- Minor Drainage
- Cleared

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Figure G.1.7: Vertebrate fauna habitat mapping

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Author: J. Johnston	Date: 31-01-2020	Coordinate System: GDA 1994 MGA Zone 50
Drawn: C. Dyde	Figure Ref: 14292B-19-BIDR-3Rev2_200131_P_FigG1	0 200 400 600 800 1,000 Metres; N

700000

710000

720000

7460000

7450000

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Survey Area

Northern Quoll Habitat Suitability

- Probable shelter and foraging habitat
- Potential shelter and foraging habitat
- Suitable foraging and dispersal habitat
- Limited foraging and dispersal habitat

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Figure G.2: Northern Quoll habitat suitability mapping

Coordinate System: GDA 1994 MGA Zone 50

0 1 2 3 4 5 Kilometres

N

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Author: J. Johnston | Drawn: C. Dyde | Date: 31-01-2020 | Figure Ref: 14292B-19-BIDR-3Rev2_200131_FigG2_NQ

700000

710000

720000

7460000

7450000

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Survey Area

Pilbara Leaf-nosed Bat Habitat Suitability

Potential shelter and foraging habitat

Suitable foraging and dispersal habitat

Limited foraging and dispersal habitat

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Figure G.3: Pilbara Leaf-nosed Bat habitat suitability mapping

Coordinate System: GDA 1994 MGA Zone 50

0 1 2 3 4 5 Kilometres

N

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700000

710000

720000

7460000

7450000

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Survey Area

Ghost Bat Habitat Suitability

Potential shelter and foraging habitat

Suitable foraging and dispersal habitat

Limited foraging and dispersal habitat

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Figure G.4: Ghost Bat habitat suitability mapping

Coordinate System: GDA 1994 MGA Zone 50

0 1 2 3 4 5 Kilometres

N

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700000

710000

720000

7460000

7450000

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Survey Area

Night Parrot Habitat Suitability

Suitable foraging and dispersal habitat

Limited foraging and dispersal habitat

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Figure G.5: Night Parrot habitat suitability mapping

Coordinate System: GDA 1994 MGA Zone 50

0 1 2 3 4 5 Kilometres

N

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700000

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720000

7460000

7450000

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Survey Area

Pilbara Olive Python Habitat Suitability

Potential shelter and foraging habitat

Suitable foraging and dispersal habitat

Limited foraging and dispersal habitat

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Figure G.6: Pilbara Olive Python habitat suitability mapping

Coordinate System: GDA 1994 MGA Zone 50

0 1 2 3 4 5 Kilometres

N

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Author: J. Johnston | Drawn: C. Dyde | Date: 31-01-2020 | Figure Ref: 14292B-19-BIDR-3Rev2_200131_FigG6_POP

Table G.1: Location of significant areas recorded during the Astron surveys.

Site ID	MGA Zone 50 K		Reason	Photograph
	Easting (mE)	Northing (mE)		
Cave 1	712281	7450651	Cave that is likely to support Matters of National Environmental Significance (MNES) bat species and other conservation significant fauna species. Confirmed Ghost Bat nocturnal roost (possible diurnal roost).	
Cave 2	716905	7450075	Cave that is likely to support MNES bat species and other conservation significant fauna species.	
Cave 4	712487	7451071	Cave that is likely to support MNES bat species and other conservation significant fauna species. Confirmed Ghost Bat nocturnal roost (feed cave, five scats found).	No photo available

Site ID	MGA Zone 50 K		Reason	Photograph
	Easting (mE)	Northing (mE)		
Cave 5	710766	7450668	Cave that is likely to support MNES bat species and other conservation significant fauna species. Confirmed Ghost Bat nocturnal roost (possible diurnal roost).	
Cave 6	710715	7450850	Cave that is likely to support MNES bat species and other conservation significant fauna species.	No photo available
Cave 7	697235	7444586	Cave that is likely to support MNES bat species and other conservation significant fauna species. Confirmed Ghost Bat nocturnal roost (scats recorded)	

Site ID	MGA Zone 50 K		Reason	Photograph
	Easting (mE)	Northing (mE)		
Cave 8	699012	7444982	Cave that is likely to support MNES bat species and other conservation significant fauna species.	
PMM 1	713863	7450216	Active pebble mound that provides refuge for the Western Pebble-mound Mouse.	
PMM 2	704489	7449512	Inactive pebble mound that may provide refuge for the Western Pebble-mound Mouse.	

Site ID	MGA Zone 50 K		Reason	Photograph
	Easting (mE)	Northing (mE)		
PMM 4	704548	7449901	Active pebble mound that provides refuge for the Western Pebble-mound Mouse.	
PMM 5	704660	7449555	Active pebble mound that provides refuge for the Western Pebble-mound Mouse.	
PMM 6	704605	7449461	Recently inactive pebble mound that provides refuge for the Western Pebble-mound Mouse.	

Site ID	MGA Zone 50 K		Reason	Photograph
	Easting (mE)	Northing (mE)		
Cave 3*	708388	7450375	Cave that is likely to support MNES bat species and other conservation significant fauna species.	
Cave 9*	701453	7448445	Cave that is likely to support MNES bat species and other conservation significant fauna species. Confirmed Ghost feed cave (scats recorded)	
PMM 3*	700562	7448214	Recently inactive/active pebble mound that provides refuge for the Western Pebble-mound Mouse.	

*Recorded just outside the survey area due to post-survey boundary changes.

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Appendix H: Conservation Listed and SRE Fauna Locations

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695000 700000 705000 710000 715000

7455000

7450000

7445000

Conservation Significant Fauna - DBCA Database

Survey Area

Conservation Significant Fauna

- Ghost Bat *(Macroderma gigas)*
- Pilbara Leaf-nosed Bat *(Rhinonicteris aurantia)*
- *Lerista macropisthopus remota*
- Northern Quoll *(Dasyurus hallucatus)*
- Oriental Plover *(Charadrius veredus)*
- Western Pebble-mound Mouse *(Pseudomys chapmani)*

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Figure H.1: Previous and current conservation significant vertebrate fauna locations

Coordinate System: GDA 1994 MGA Zone 50

0 1 2 3 4 5 Kilometres

N

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Author: J. Johnston | Drawn: C. Dyde | Date: 31-01-2020 | Figure Ref: 14292B-19-BIDR-3Rev2_200131_FigH1_CSF

Table H.1 Locations of vertebrate conservation listed species recorded during the Astron surveys.

Species name (common name)	Status	Site ID	MGA Zone 50 K		Date	Observation type (number of records)	Habitat	Photograph
			Easting (mE)	Northing (mN)				
Reptiles								
Lerista macropisthopus remota	P2	TS18	705435	7448646	12/03/19	Individual caught in a pitfall trap	Mulga Woodland	
Birds								
Charadrius veredus (Oriental Plover)	IA/IA	Opp	706994	7449115	11/03/19	Individual sighting	Disturbed (Camp soccer pitch)	No photo available
Elanus scriptus (Letter-winged Kite)	P4	Opp	696225	7445906	20/05/18	Individual sighting	Drainage	No photo available
Mammals								
Dasyurus hallucatus (Northern Quoll)	EN/EN	CAM14	710747	7450853	25/11/17	Camera record	Breakaway	
		Q1	707086	7449680	26/05/18	Individual male caught in cage trap	Gorge/Gully	
		Opp	707084	7449675	23/05/18	Scat	Gorge/Gully	
		Opp	707107	7449900	25/05/18	Scat	Rocky Hill	

Species name (common name)	Status	Site ID	MGA Zone 50 K		Date	Observation type (number of records)	Habitat	Photograph
			Easting (mE)	Northing (mN)				
Dasyurus hallucatus (Northern Quoll)	EN/EN	Opp	710723	7450660	27/05/18	Scat	Breakaway	
		CAM25	710744	7450871	24/05/18	Camera record	Rocky Hill	
		CAM25	710744	7450871	25/05/18	Camera record	Rocky Hill	
		CAM17	716057	7450006	22/05/18	Camera record	Breakaway	
		CAM27	711120	7450982	23/05/18	Camera record	Gorge/Gully	
		CAM27	711120	7450982	24/05/18	Camera record	Gorge/Gully	
		CAM28	712309	7450614	22/05/18	Camera record	Gorge/Gully	
		CAM20	717463	7449927	20/05/18	Camera record	Gorge/Gully	
		CAM23	707082	7449669	23/05/18	Camera record	Gorge/Gully	
		CAM35	716150	7449991	14/03/19	Camera record	Breakaway	
Pseudomys chapmani (Western Pebble-mound Mouse)	P4	PMM 1	713863	7450216	27/11/17	Active pebble mound.	Rocky Hill	
		PMM 2	704489	7449512	18/03/19	Inactive pebble mound.	Stony Plain	

Species name (common name)	Status	Site ID	MGA Zone 50 K		Date	Observation type (number of records)	Habitat	Photograph
			Easting (mE)	Northing (mN)				
Pseudomys chapmani (Western Pebble-mound Mouse)	P4	PMM 4	704548	7449901	13/03/19	Active pebble mound.	Stony Plain	
		PMM 5	704660	7449555	14/03/19	Active pebble mound.	Stony Plain	
		PMM 6	704605	7449461	14/03/19	Recently inactive pebble mound.	Mulga Woodland	

Species name (common name)	Status	Site ID	MGA Zone 50 K		Date	Observation type (number of records)	Habitat	Photograph
			Easting (mE)	Northing (mN)				
Pseudomys chapmani (Western Pebble-mound Mouse)	P4	PMM 3*	700562	7448214	10/03/19	Recently inactive/active pebble mound.	Rocky Hill	
		TS15*	700605	7448201	12/03/19	Individual caught in an Elliot trap	Rocky Hill	
		TS15*	700605	7448201	13/03/19	Individual caught in an Elliot trap	Rocky Hill	No photo available

Species name (common name)	Status	Site ID	MGA Zone 50 K		Date	Observation type (number of records)	Habitat	Photograph
			Easting (mE)	Northing (mN)				
Pseudomys chapmani (Western Pebble-mound Mouse)	P4	TS17*	700743	7447421	16/03/19	Individual caught in a pitfall trap	Stony Plain	No photo available
Rhinonicteris aurantia (Pilbara Leaf-nosed Bat)	VU/VU	BAT13	710050	7450766	22/05/18	10 calls	Breakaway	No photo available
		BAT17	712383	7450606	23/05/18	2 calls	Gorge/Gully	
		BAT21	700067	7444800	21/05/18	1 call	Breakaway	
Macroderma gigas (Ghost Bat)	VU/VU	Opp	695856	7445499	25/11/17	Scats	Drainage	No photo available
		Opp (Cave 4)	712487	7451071	25/11/17	Scats	Breakaway	
		BAT4	712483	7451071	28/11/17	2 calls	Breakaway	
		Opp	700299	7444846	19/05/18	Individual sighting	Breakaway	
		Opp (Cave 5)	710755	7450673	18/05/18	Scats	Breakaway	
		Opp (Cave 1)	712281	7450651	22/05/18	Scats	Rocky Hill	
		Opp (Cave 7)	697235	7444586	26/11/17	Scats	Breakaway	
		BAT21	700067	7444800	21/05/18	1 call	Breakaway	
		BAT25	702192	7448397	15/03/19	1 call	Gorge/Gully	
		Opp (Cave 9)*	701453	7448445	11/03/19	Scats	Gorge/Gully	No photo available

*Recorded outside survey area due to post survey boundary changes.

695000 700000 705000 710000 715000 720000

7460000 7455000 7450000 7445000

Previously Recorded SRE Species - WAM database

Survey Area

SRE Order

- Araneae
- Geophilomorpha
- Isopoda
- Polydesmida
- Pseudoscorpiones
- Scolopendromorpha
- Scorpiones
- Spirobolida

Genus 7/4 PSE118'
Karoops banyjama
Mecistocephalus 'HD1'
Buddelundia '77'
Urodacus 'HD1'
Genus 7/4 PSE118'
Troglarmadillo sp.
Aurecocrypta 'MYG315'
Austrostrophus sp.
Austrostrophus Clade E
Buddelundiinae sp.
Philosciidae sp.
Beierolpium 'sp. indet. (AESHD2)'
Austrostrophus Clade E
Lychas 'bituberculatus complex'
Lychas 'multipunctatus complex'
Yilgarnia 'MYG197'
Lychas 'bituberculatus complex'
Lychas 'multipunctatus complex'
Austrostrophus sp.
Sepedenophilus 'HD1'
Sepedenophilus sp.
Karoops banyjama
Philosciidae sp.
Buddelundia '77'
Nemesiidae sp.
Synothele 'MYG309'
Synothele 'MYG311'
Austrostrophus Clade E
Lychas 'bituberculatus complex'
Lychas 'bituberculatus complex'
Lychas 'hairy tail complex'
Lychas 'multipunctatus complex'
Cryptops 'HD1'
Austrostrophus sp.
Antichiropus sp.
Buddelundia '77'
Mecistocephalus 'HD3'
Austrostrophus Clade E
Buddelundiinae sp.
Orphnaeus 'HD1'
Antichiropus sp.
Mecistocephalus 'HD1'
Mecistocephalus 'HD2'
Antichiropus 'wonmunna'
Buddelundia sp.
Sepedenophilus 'HD2'
Sundochernes sp.
Buddelundia '77'
Synothele sp.
Lychas 'hairy tail complex'
Sepedenophilus 'HD1'
Geophilomorpha sp.
Antichiropus 'wonmunna'
Mecistocephalus 'HD3'
Cryptops 'HD1'
Antichiropus 'wonmunna'
Euryolpium 'sp. indet. (AESHD6)'
PSEAAA sp. indet. (AESHD4)
Nemesiidae sp.
Buddelundia '10ma'
Nemesiidae sp.
Buddelundia '10ma'
Buddelundia '10ma'
Lychas 'bituberculatus complex'
Beierolpium 'sp. indet. (AESHD1)'
Tyrannochthonius 'sp. indet. (AESHD2)'
Anatemnus sp.
Lychas 'multipunctatus complex'
Tyrannochthonius 'sp. indet. (AESHD1)'
Genus 7/4 PSE118'
Austrostrophus sp.
Karoops sp. 'ARA001'
Karoops banyjama
Indolpium sp.
Austrohorus 'sp. indet. (AESHD5)'
Sepedenophilus 'HD1'
Olpiidae sp.
Genus 7/4 PSE118'
Euryolpium 'sp. indet. (AESHD7)'
Austrostrophus Clade A
Sepedenophilus 'HD1'
Aurecocrypta 'sp. indet. AESHD1'
Austrostrophus sp.
Buddelundia '77'
Pseudodiploexochus sp.

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Rio Tinto

Hope Downs 2 Proposal Fauna Survey

Figure H.2: Previous and current potential Short Range Endemic invertebrate fauna locations

Coordinate System: GDA 1994 MGA Zone 50

0 1 2 3 4 5 Kilometres

N

astron delivering environmental intelligence™

Author: J. Johnston | Drawn: C. Dyde | Date: 31-01-2020 | Figure Ref: 14292B-19-BIDR-3Rev2_200131_FigH2_SRE

Table H.2: Locations of Potential SRE species recorded during the Astron surveys.

SPECIES	SRE1	SRE2	SRE3	SRE4	SRE5	SRE6	SRE7	SRE8	SRE9	SRE10	SRE11	SRE12	SRE13	SRE14	SRE15	SRE16	SRE17	SRE18	SRE19	SRE20	SRE21	SRE22	SRE23	TS01	TS02	TS03	TS04	TS05	TS06	TS07	TS08	TS09	TS10	TS11	TS12	TS13	TS14	TS15	TS16	TS17	TS18	TS19	Other	Total
Araneae																																											
Aname sp.																1																						1						**2**
Aurecocrypta 'sp. indet. (AESHD1)'																	1																											**1**
Aurecocrypta 'MYG315'																					1																								**1**
Karaops banyjima																		1	1		1																								**3**
Karaops sp. 'ARA001'																		1																												**1**
Yilgarnia 'MYG197'																																					1								**1**
Nemesiidae sp.											1																																		**1**
Synothele sp.												1																																	**1**
Synothele 'MYG309'																																										1			**1**
Synothele 'MYG311'																																										1			**1**
Scorpiones																																												
Lychas 'bituberculatus complex'																											1										1		2	1			1	**6**
Lychas 'hairy tail complex'																																								1				**1**
Lychas 'multipunctatus complex'								1																													4			3			3	**11**
Urodacus 'HD1'													1																															**1**
Pseudoscorpiones																																												
Anatemnus sp.														1																															**1**
Austrohorus 'sp. indet. (AESHD5)'	1																																											**1**
Beierolpium 'sp. indet. (AESHD1)'														1																														**1**
Beierolpium 'sp. indet. (AESHD2)'																																					1							**1**
Euryolpium 'sp. indet. (AESHD6)'											2																																	**2**
Euryolpium 'sp. indet. (AESHD7)'									1																																			**1**
Euryolpium sp.										1											1																								**2**
'Genus 7/4 PSE118'		4		1						2											2																								**9**
'*PSEAAA* sp. indet. (AESHD4)'																1																													**1**
Indolpium sp.	5																																												**5**
Olpiidae sp.	1																																												**1**
Sundochernes sp.																							1																						**1**
Tyrannochthonius 'sp. indet. (AESHD1)'														1																														**1**
Tyrannochthonius 'sp. indet. (AESHD2)'		1																																										**1**
Geophilomorpha																																													
Geophilomorpha sp.																1																													**1**
Mecistocephalus 'HD1'													1								1		2																						**4**
Mecistocephalus 'HD2'																							1																						**1**
Mecistocephalus 'HD3'															2																														**2**
Orphnaeus sp.																							1																						**1**

SPECIES	SRE1	SRE2	SRE3	SRE4	SRE5	SRE6	SRE7	SRE8	SRE9	SRE10	SRE11	SRE12	SRE13	SRE14	SRE15	SRE16	SRE17	SRE18	SRE19	SRE20	SRE21	SRE22	SRE23	TS01	TS02	TS03	TS04	TS05	TS06	TS07	TS08	TS09	TS10	TS11	TS12	TS13	TS14	TS15	TS16	TS17	TS18	TS19	Other	Total
Sepedonophilus 'HD1'	1																2		3																								1	**7**
Sepedonophilus 'HD2'																							1																						**1**
Sepedonophilus sp.																			1																										**1**
Scolopendromorpha																																												
Cryptops 'HD1'															3																														**3**
Polydesmida																																												
Antichiropus sp.															1								2																						**3**
Antichiropus 'wonmunna'															2								12																						**14**
Spirobolida																																												
Austrostrophus 'Clade A'																				2																									**2**
Austrostrophus 'Clade E'															1							1																4				1			**7**
Austrostrophus sp.													1		5	1	1	1	1																									**10**
Isopoda																																												
Buddelundia '10ma'											1																2	6																	**9**
Buddelundia '77'															2		1		4			1	2																					**10**
Buddelundia sp.																							1																					**1**
Buddelundiinae sp.																							1															2						**3**
Pseudodiploexochus sp.																	1																											**1**
Troglarmadillo sp.													1																															**1**
Philosciidae sp.																			5																			1							**6**
Total	**8**	**5**	**0**	**1**	**0**	**0**	**0**	**1**	**1**	**3**	**4**	**1**	**4**	**3**	**16**	**4**	**6**	**3**	**15**	**3**	**4**	**3**	**24**	**0**	**0**	**0**	**3**	**6**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**14**	**1**	**2**	**5**	**3**	**0**	**5**	**148**

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Appendix I: Bat Call WA Pty Ltd Report

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Rio Tinto,
Hope Downs 2 and Bedded Hilltop,
Pilbara WA,

Acoustic Survey of Bat and Night Parrot Activity, phases 1 (November 2017), 2 (May 2018) and 3 (March 2019).

Prepared for Astron Environmental Services

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Issue 3
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Document Revision History

Issue	Date	Revision History
A	8 June 2018	Initial draft of Phase 1 and 2 prepared for Astron review
1	14 June 2018	First formal issue incorporating clients comments
2	15 June 2018	Second issue incorporating clients comments
3	27 March 2019	Third issue incorporating Phase 3 data

Summary
Bat and Night Parrot (*Pezoporus occidentalis*) presence is reported for 28 sites in the Hope Down 2 and Bedded Hilltop areas, in the Pilbara, WA. Astron Environmental Services (Astron) carried out an echolocation based survey in three phases in November 2017, May 2018 and March 2019. 24 sites were surveyed for all bats present including Ghost bat social and ultrasonic calls. Four were surveyed using acoustic detectors set to record Night Parrot and Ghost bat social calls. Bat Call WA has reviewed the recordings made and provided species lists and activity levels for the bats present.

Twelve species of echolocating bats were confirmed present including both EPBC Act listed species in the Pilbara, the Pilbara leaf-nosed bat (*Rhinonicteris aurantia*) (PLNb) and the Ghost bat (*Macroderma gigas*) (PGb). PLNb calls were detected in low numbers at three sites in May 2018. PGb were detected ultrasonically at three sites and their presence was confirmed by observation by Astron ecologists of either bats or middens in caves at a further seven.

PLNb calls were detected at three sites during May 2018 but were not detected in November 2017 or March 2019. The calls at all three sites were at least three hours after dusk and are not consistent with the presence of a permanent roost cave nearby.

PGb presence during all three phases is consistent with the known population and dispersal of PGb in the district. The number of observations recorded indicates that additional targeted survey work is required to fully define the usage and categorisation of caves in the area by this species.

No Night Parrot calls were detected.

Habitats
The sites for the survey were chosen by Astron. Details of the sites are presented in table 1. The bat sites included each type of habitat present in the study area including gorges, breakaways. drainage lines and stony plains. All the Night Parrot sites are on stony plains. The locations are shown in relation to local features in figures 1 and 2.

Timing, Moon Phase and Weather
The echolocation survey was conducted between 24th to 30th November 2017, 18th to 26th May 2018 and 11th to 17th March 2019.

The November sampling evenings were hot with minimum overnight temperatures between 20 and 25^{O}C. The moon in this period was first quarter to full. The May sampling evenings were cool to cold with minimum overnight temperatures between 5 and 15^{O}C. The moon in this period was first quarter. No rain fell during these survey periods. The March sampling evenings were hot and humid with minimum overnight temperatures between 25 and 30^{O}C typical of northern wet season. Some seasonal rain fell during this period. The moon was at first quarter.

Survey Team
Sites were chosen and detectors placed by Astron ecologists. Bob Bullen of Bat Call WA completed analysis of audio and echolocation recordings.

Sampling
The survey consisted of completing a total of forty overnight ultrasonic bat sound recordings in November, thirty seven in May and twenty four in March, beginning at twilight, at twenty four locations within the survey area. A total of eleven acoustic survey nights were completed at two sites for Night Parrot in May and a further twelve in March. The recordings were “continuous”

(Hyder *et al.* 2010) made using ultrasonic SM2BAT+ SongMeter and acoustic SM4A SongMeter (both by Wildlife Acoustics Inc., USA) detectors. The audio settings used followed the manufacturer's recommendations contained in the user manuals.

For the ultrasonic recordings, once reformatted as .wav files, COOL EDIT 2000 (now available as AUDITION from Adobe Systems Inc.) was used to display each sequence for identification. Calls were identified manually. Only good quality call sequences were used. Details of calls analysed are provided in Table 2 as recommended by Australasian Bat Society (ABS 2006). Reference data for the species identified are available in Bullen and McKenzie 2002, McKenzie and Bullen 2003 and McKenzie and Bullen 2009.

For the acoustic recordings, each was reviewed both manually and using an automatic scan technique for Night Parrot calls. Candidate calls were compared with the author's confirmed reference calls from two Western Australian arid zone locations.

Survey Limitations

The sites surveyed were accessible on foot and the detectors, using omnidirectional microphones, were set on the ground with the microphone horizontal. Species are unlikely to be under-represented as a result.

Bat species density away from cave or adit entrances is impossible to estimate from echolocation records. Bat activity is therefore substituted as an approximate guide to the relative numbers of each species using the study area.

Results of bat fauna survey

An assemblage of twelve echolocating bat species was confirmed as present at the study sites including both the PLNb and PGb, table 4. Species activity levels were low to very high, which is expected for the study area habitat and the times of year.

PLNb detections

PLNb were detected at three widespread locations, two breakaway sites and a gorges site, table 4 and figure 3. Call numbers at all three were low with the maximum number of calls being eight at BAT 13 on the 22nd May, figure 4. The temporal pattern of calls at all three sites, figure 4, is consistent with PLNb foraging away from their roost with timing gaps from civil twilight of approximately three hours and being wide spread. This result is consistent with author's unpublished data that indicates that PLNb are only active across the study area in autumn. The closest confirmed permanent diurnal roosts are over 55 km to the north, west and south and over 80 km to the east (author's unpublished data). These distances suggest that the PLNb are possibly using temporary or satellite roosts in the district, as their usual foraging range is under 30 km (Bullen 2013). However the pattern of the data, the three hour time gap together with the low number of calls, is inadequate to indicate whether any potential satellite is within or outside the study area boundary. A more probable suggestion is that bats from existing permanent colonies take advantage of the benign conditions in autumn and spread across the country temporarily in search of additional foraging and roosting opportunities.

PGb detections

Ghost bats were detected ultrasonically at three sites, Bat 4 in November, BAT 21 in May and BAT 25 in March, table 4, figure 5. Additional observations were made by the field survey team, Table 5. Five caves containing PGb middens were located and a foraging PGb was seen at an opportunistic site, Table 5. Also a scat pile was observed under a highway bridge at site BAT 9. Two caves were assessed by the team as potential diurnal roosts and the other three caves and the

bridge as nocturnal feeding sites. These records are consistent with the PGB being present on both the Hope Down 2 and Bedded Hilltops study area ridges year round. This result is consistent with the known presence of the PGb across the central Pilbara in general and on the major ridges immediately to the north of the study area and west of the Hope Downs 1 mining area.

Common bat species detections
Four common species, *Austronomus australis*, *Chaerephon jobensis*, *Chalinolobus gouldii, Taphozous georgianus* and *Vespadelus finlaysoni* dominated bat presence in the area. Both Taphozous species were detected

Taxonomy presented herein is after Reardon *et al.* (2014) and Jackson and Groves (2015).

Results of Night Parrot survey.

No Night Parrot calls were detected.

Recommendations.

PLNb
The results of the survey are consistent with the author's existing data on the autumn dispersal of this species from its permanent roosts. No further specific targeted survey effort is indicated by these results.

PGb
The results of the survey are consistent with the use of the ridge lines within the study areas by PGb on a year round basis. Additional targeted survey effort is recommended to confirm potential maternity roost caves, groupings of caves that are important for the persistence of PGb, and other important diurnal roosting sites.

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Table 1 Microbat site specific details. Coordinates are Zone 50K

	Date	Recording Time & SM2 unit	Habitat	Easting	Northing
Phase 1 Nov 2017					
BAT 1	24-27 Nov	Four overnight recordings using SM2 SN 4684 recording at 44.1 kbps	Gorge	718218	7450208
BAT 2	28-30 Nov	Three overnight recordings using SM2 SN 4684 recording at 44.1 kbps	Gorge	716514	7450015
BAT 3	24-27 Nov	Four overnight recordings using SM2 SN 4685 recording at 384 kbps	Gorge	713964	7450155
BAT 4	28-30 Nov	Three overnight recordings using SM2 SN 4685 recording at 384 kbps	Breakaway	712483	7451071
BAT 5	24-27 Nov	Four overnight recordings using SM2 SN 4698 recording at 44.1 kbps	Foot of slope	715766	7450509
BAT 6	28-30 Nov	Three overnight recordings using SM2 SN 4698 recording at 44.1 kbps	Gorge	719087	7450901
BAT 7	24-27 Nov	Four overnight recordings using SM2 SN 7982 recording at 44.1 kbps	Cave entrance	712290	7450636
BAT 8	28-30 Nov	Three overnight recordings using SM2 SN 7982 recording at 44.1 kbps	Gorge	710766	7450668
BAT 9	25-28 Nov	Four overnight recordings using SM2 SN 4685 recording at 384 kbps	Highway culvert	695851	74455001
BAT 10	29-30 Nov	Two overnight recordings using SM2 SN 4685 recording at 384 kbps	Cave entrance	599015	7444976
BAT 11	24-27 Nov	Four overnight recordings using SM2 SN 7634 recording at 384 kbps	Breakaway	708261	7446389
BAT 12	29-30 Nov	Two overnight recordings using SM2 SN 7634 recording at 384 kbps	Mulga woodland	699301	7446157
Phase 2 May 2018					
BAT 13	18-22 May	Five overnight recordings using SM2 SN 7634 recording at 384 kbps	Breakaway	710050	7450766
BAT 14	21-25 May	Five overnight recordings using SM2 SN 8027 recording at 384 kbps	Major drainage line	707275	7445721
BAT 15	21-24 May	Four overnight recordings using SM2 SN 11040 recording at 384 kbps	Breakaway	707097	7449888
BAT 16	18-26 May	Nine overnight recordings using SM4U04031 recording at 384 kbps	Gorge with caves present	710759	7450661
BAT 17	23-26 May	Four overnight recordings using SM2 SN 7634 recording at 384 kbps	Gorge	712383	7450606
BAT 19	20-24 May	Five overnight recordings using SM2 SN 11793 recording at 384 kbps	Gorge	711117	7450976
BAT 21	21-25 May	Five overnight recordings using SM2 SN 7768 recording at 384 kbps	Breakaway	700067	7444800

	Date	Recording Time & SM2 unit	Habitat	Easting	Northing
Phase 3 March 2019					
BAT 22	11-17 Mar	SM2 SN 7634 failed to operate	Gorge/gully	700620	7448043
BAT 23	13-17 Mar	Five overnight recordings using SM4U05349 recording at 384 kbps	Breakaway with overhangs	716260	7449988
BAT 24	11-17 Mar	Seven overnight recordings using SM4U05956 recording at 384 kbps	Gorge/gully	700803	7448400
BAT 25	11-17 Mar	Seven overnight recordings using SM4U05978 recording at 384 kbps	Gorge with caves present	702192	7448397
BAT 26	13-17 Mar	Five overnight recordings using SM4U04031 recording at 384 kbps	Breakaway with overhangs	704510	7450188

Table 2 Night Parrot site specific details.

	Date	Recording Time & SM2 unit	Habitat	Easting	Northing
Phase 2 May 2018					
AU 1	21-24 May	Four overnight recordings using SM4A04717	Stony plain	706071	7449544
AU 2	20-26 May	Seven overnight recordings using SM4A05295	Stony plain	717660	7449529
Phase 3 March 2019					
AU 3	11-17 Mar	Seven overnight recordings using SM4A08538	Stony plain	701069	7447576
AU 4	13-17 Mar	Five overnight recordings using SM4A08576	Stony plain	704512	7449271

Note 1: Coordinates are Zone 50K

Table 3: Summary of Echolocation call characteristics for microbat species present.

Genus species Authority	Common name	Typical F_{peak} kHz Note 1	Ave. Q Note 1	Typical Duration msec	Typical Call Shape
Austronomus australis (Gray 1838) Note 2	White-striped free-tailed bat	12	7	12 - 23	CF– shallow FM
Chaerephon jobensis (Miller 1902)	Northern free-tailed bat	22	5	8 - 15	Shallow FM
Chalinolobus gouldii (Grey 1841)	Gould's wattled bat	32	10	7 - 11	FM
Macroderma gigas (Dobson 1880)	Ghost bat	20 – 52 variable	2 – 20 variable	variable	Complex FM
Nyctophilus geoffroyi Leach 1821	Lesser long-eared bat	48	3	5	Steep FM
Ozimops lumsdenae Reardon *et al*.2014	Northern free-tailed bat	26	10	8 - 13	Shallow FM
Rhinonicteris aurantia (Gray 1845)	Pilbara leaf-nosed bat	120	30	5 - 8	CF
Saccolaimus flaviventris (Peters 1867)	Yellow-bellied sheath-tailed bat	18	9	12 - 21	CF - FM
Scotorepens greyii (Gray 1843)	Little broad-nosed bat	38	10	7 - 13	FM
Taphozous georgianus Thomas 1915	Common sheath-tailed bat	24.5	14	9 - 18	CF– shallow FM
Taphozous hilli Thomas 1915	Hills sheath-tailed bat	26	14	9 - 18	CF– shallow FM
Vespadelus finlaysoni (Kitchener, Jones and Caputi 1987)	Inland cave bat	55	14	4 - 8	FM

Note 1: Fpeak and Q are defined in McKenzie and Bullen 2003, 2009.
Note 2: Taxonomy follows Jackson and Groves (2015). *A. australis* was recently *Tadarida australis*. *O. lumsdenae* was recently *Mormopterus beccarii*.

Table 4. Survey microbat lists presented by site.

Site	*Austronomus australis*	*Chaerephon jobensis*	*Chalinolobus gouldii*	*Macroderma gigas*	*Nyctophilus geoffroyi*	*Ozimops lumsdenae*	*Rhinonicteris aurantia*	*Saccolaimus flaviventris*	*Scotorepens greyii*	*Taphozous spp.*	*Taphozous hilli*	*Vespadelus finlaysoni*
Phase 1 Nov 17												
BAT 1		Yes										
BAT 2		Yes								Yes		
BAT 3		Yes	Yes			Yes			Yes	Yes		Yes
BAT 4		Yes	Yes	Low (2 calls)		Yes			Yes	Yes		Yes
BAT 5		Yes										
BAT 6		Yes										
BAT 7		Yes								Yes		
BAT 8		Yes								Yes		
BAT 9			Yes			Yes			Yes	Yes		Yes
BAT 10										Yes		Yes
BAT 11		Yes	Yes					Yes	Yes	Yes	Yes	Yes
BAT 12		Yes	Yes		Yes	Yes		Yes	Yes	Yes		Yes
Phase 2 May 18												
BAT 13	Yes	Yes	Yes				Low (10 calls)		Yes	Yes	Yes	Yes
BAT 14	Yes	Yes	Yes		Yes			Yes	Yes	Yes		Yes
BAT 15	Yes	Yes	Yes					Yes	Yes	Yes		Yes
BAT 16	Yes	Yes	Yes			Yes				Yes		Yes
BAT 17	Yes	Yes	Yes			Yes	Low (2 calls)			Yes		Yes
BAT 19	Yes	Yes								Yes		Yes
BAT 21	Yes	Yes	Yes	Low (1 call)			Low (1 call)		Yes	Yes		Yes

Site	*Austronomus australis*	*Chaerephon jobensis*	*Chalinolobus gouldii*	*Macroderma gigas*	*Nyctophilus geoffroyi*	*Ozimops lumsdenae*	*Rhinonicteris aurantia*	*Saccolaimus flaviventris*	*Scotorepens greyii*	*Taphozous spp.*	*Taphozous hilli*	*Vespadelus finlaysoni*
Phase 3 March 19												
BAT 23		Yes	Yes			Yes		Yes	Yes	Yes		Yes
BAT 24		Yes	Yes			Yes		Yes	Yes	Yes		Yes
BAT 25		Yes	Yes	Low (1 call)					Yes	Yes		Yes
BAT 26		Yes	Yes			Yes			Yes	Yes		Yes

Note: Both *Taphozous* species were detected. The majority of calls were *T. georgianus. T hilli* calls were identified at sites BAT 11 and '13

Table 5 Ghost bat opportunistic observations.

	Observation	Easting	Northing
Cave 1	Cave assessed as a potential PGb diurnal roost	712281	7450651
Cave 4	Cave assessed as a nocturnal roost containing PGb scats	742487	7451071
Cave 5	Cave assessed as a potential PGb diurnal roost	710766	7450668
Cave 7	Cave assessed as a nocturnal roost containing PGb scats	697235	7444586
Cave 9	Cave assessed as a nocturnal roost containing PGb scats	701453	7448445
Opp1	PGb sighted foraging	700299	7444845

Note 1: Coordinates are Zone 50K

Figure 1. Western survey sites in relation to features in the study area. The orange pins denote sites where PLNb were detected. PLNb call numbers and timing of the closest calls to civil twilight are also noted. Pink pins denote sites where PGb ultrasonic calls and opportunistic observations were recorded. Yellow pins denote sites where microbat calls were recorded but no PLNb or PGb were detected. Green pins denote sites where acoustic detectors were placed to record Night Parrot and Ghost bat social calls.

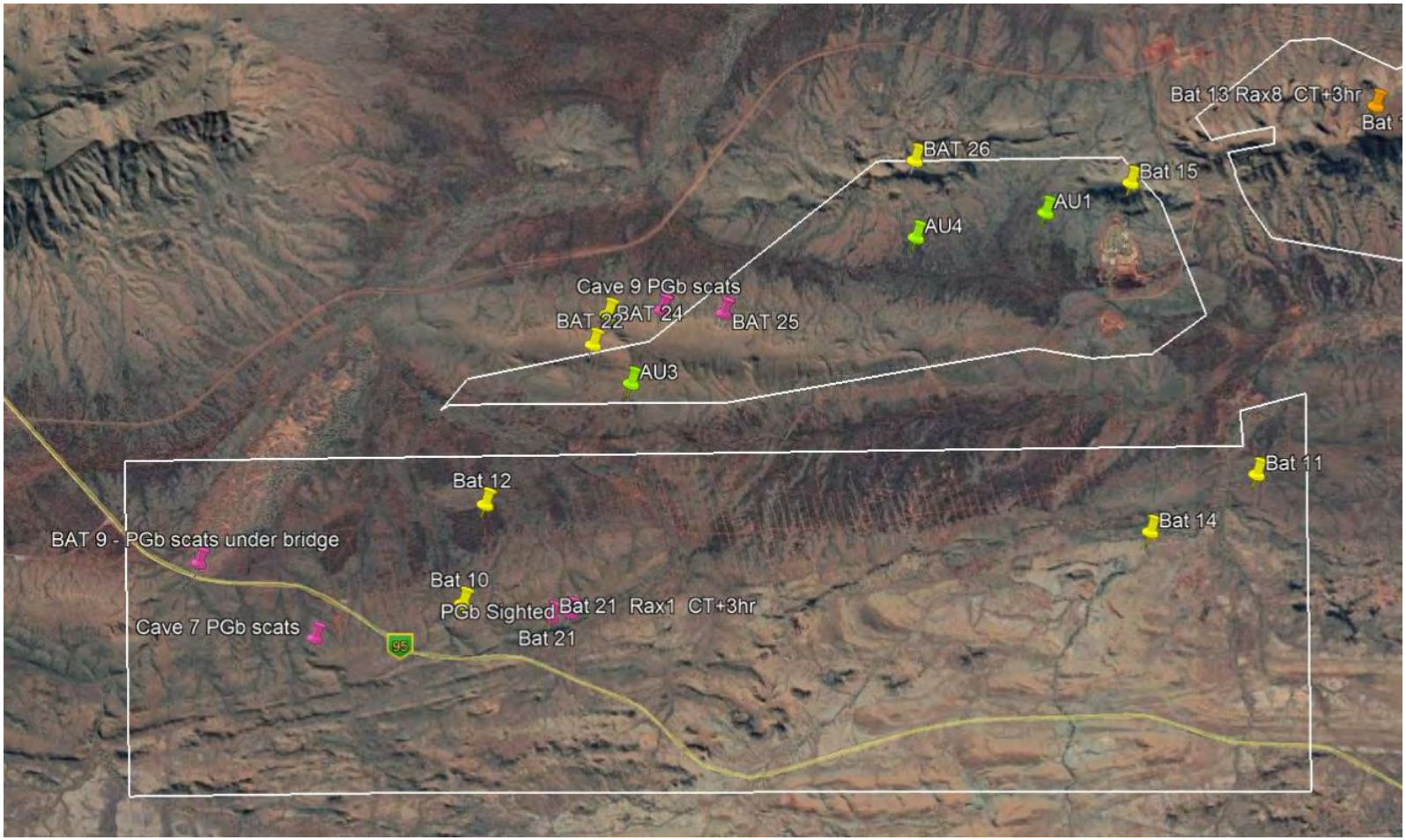


Figure 2. Eastern survey sites in relation to features in the study area. Pin colours are from figure 1.

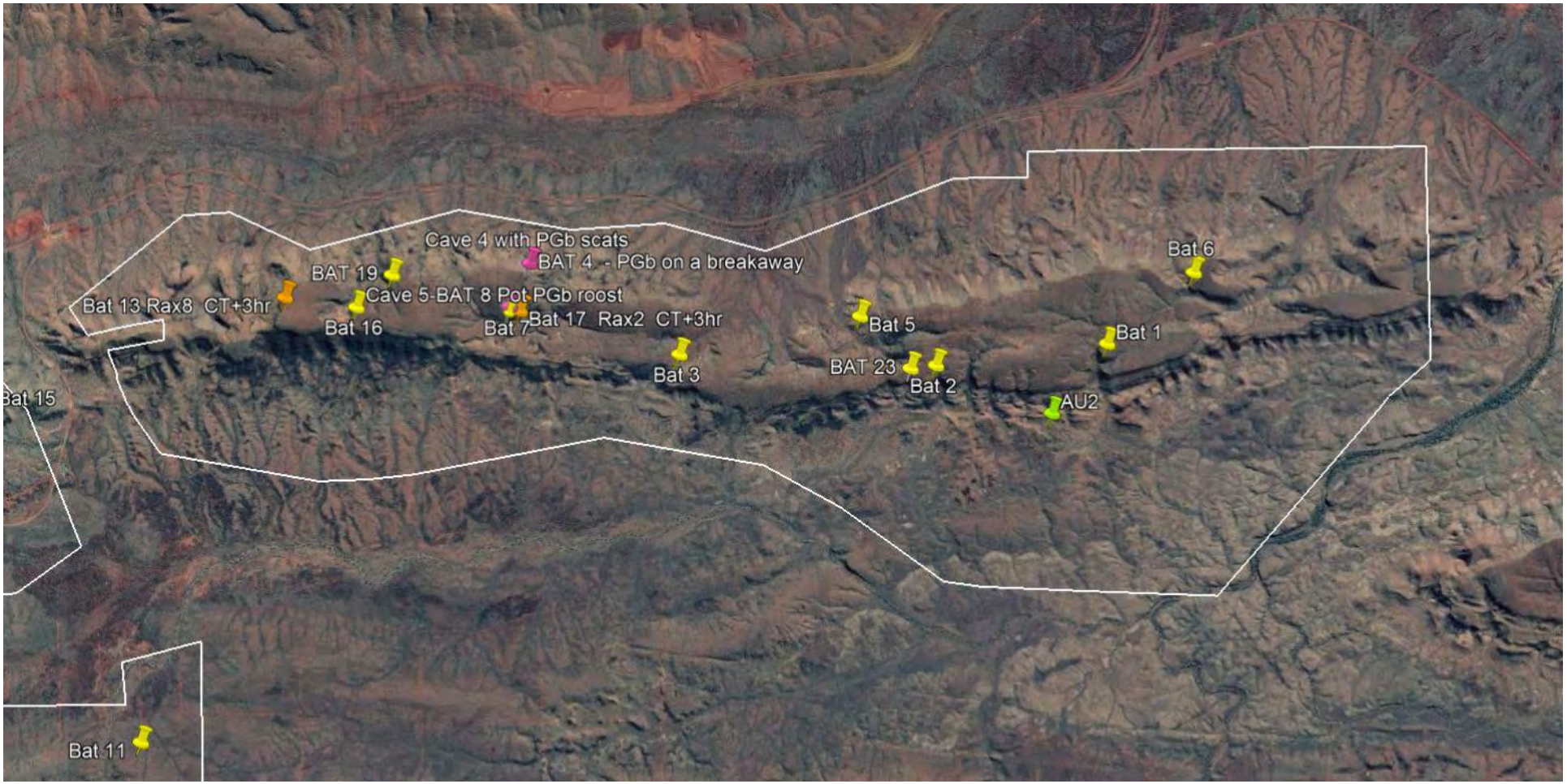


Figure 3. Survey sites where PLNb were detected in May 2018.

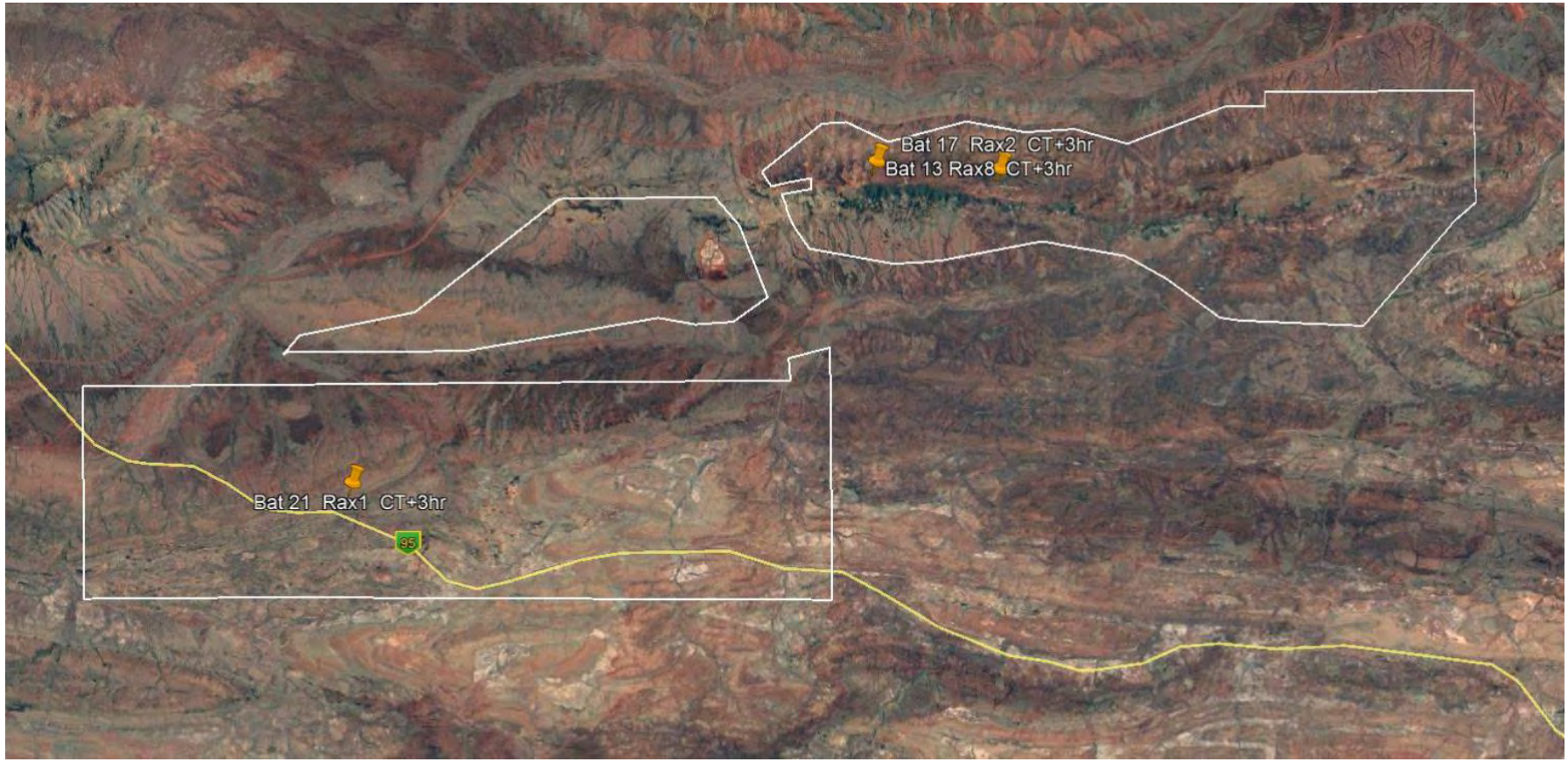


Figure 4. Temporal patterns of PLNb calls detected

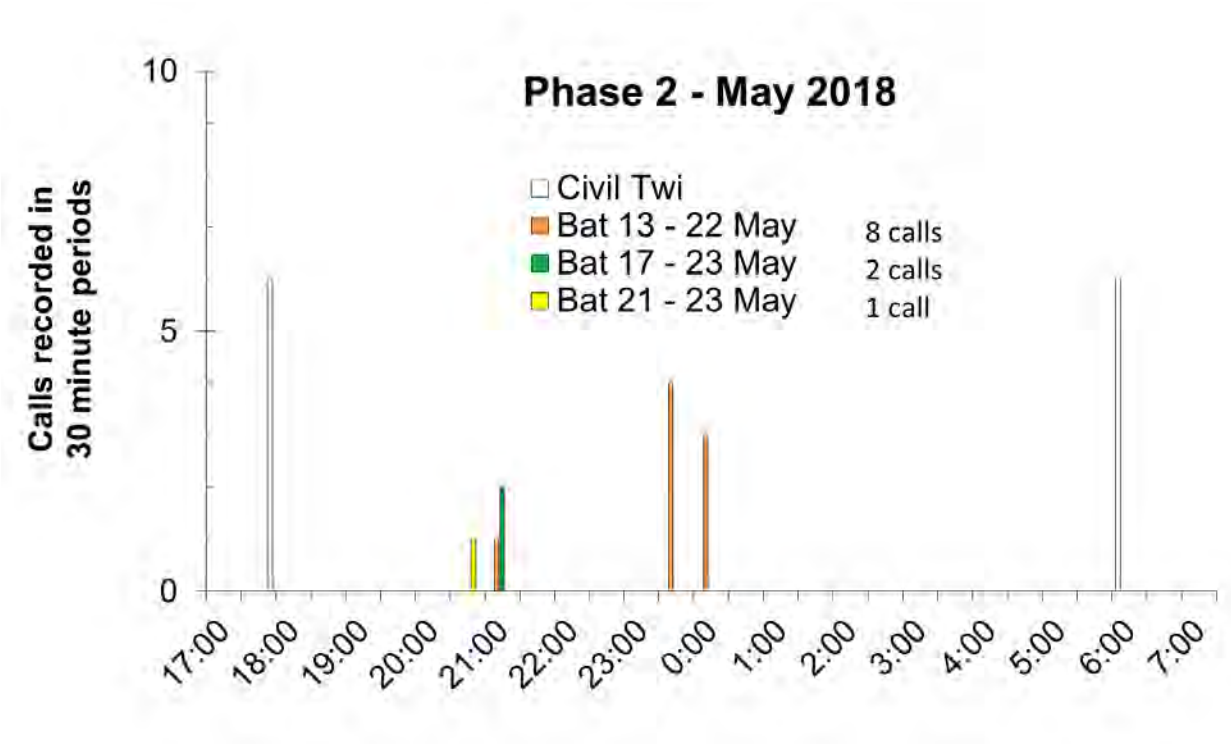
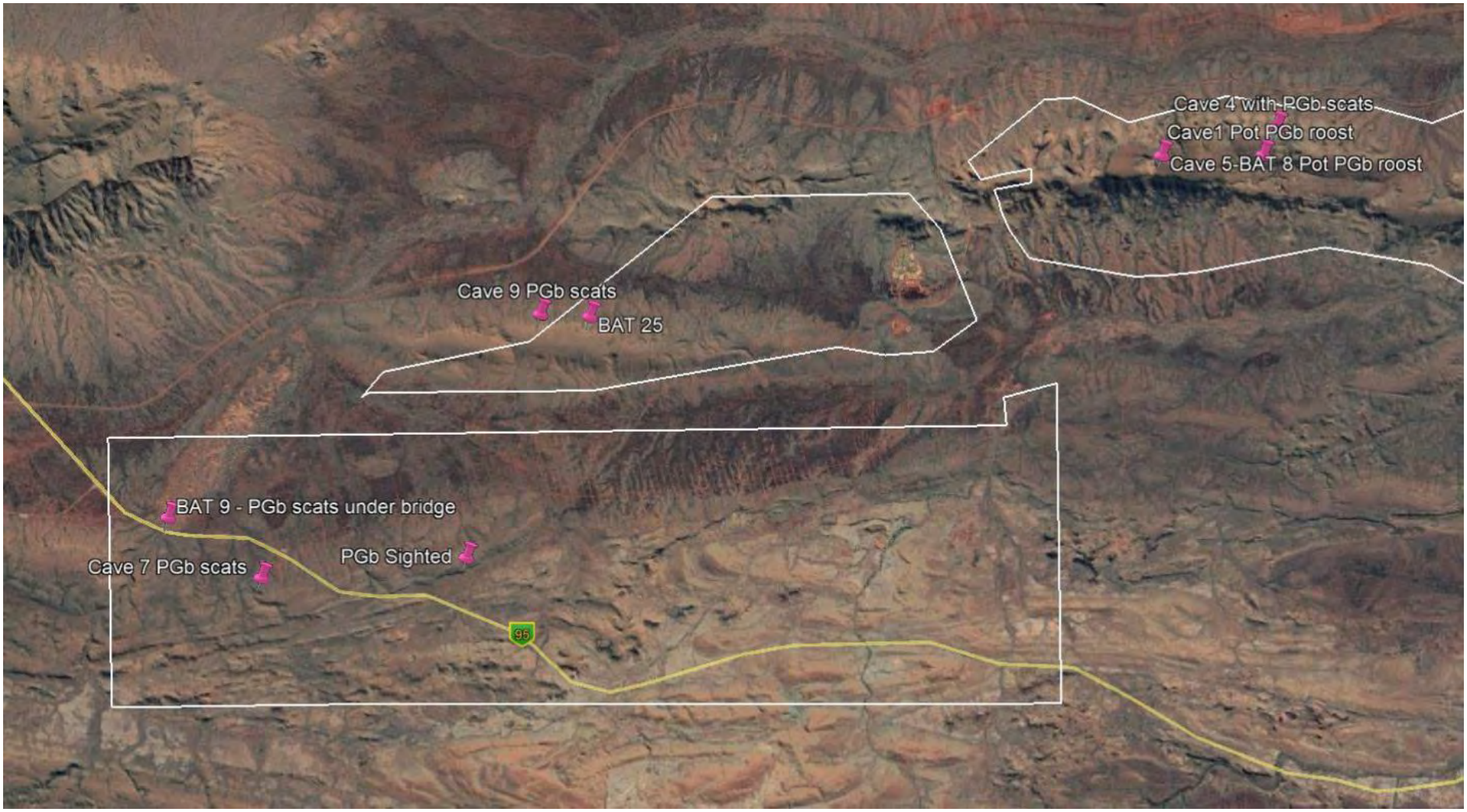


Figure 5. Survey sites where PGb were detected



Appendix J: List of Specimens Lodged with the Western Australian Museum

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Table J.1: List of specimens submitted to the Western Australian Museum.

Species	Site	Coordinates (Zone 50K)		Number of specimens	Collecting date	WAM registration number
		Easting (mE)	Northing (mN)			
Lerista macropisthopus remota	TS18	705435	7448646	1	12/03/2019	R179612
Synothele 'xkarara'	TS07	696251	7445929	1	19/05/2018	T146551
Gaius tealei	SRE03	704413	7446421	1	25/05/2018	T146552
Nemesiidae sp.	SRE11	704970	7446447	1	25/05/2018	T146553
Oratemnus sp.	SRE03	704413	7446421	1	25/05/2018	T146554
Tyrannochthonius 'HD2'	SRE02	712291	7450649	1	22/05/2018	T146555
Austrohorus 'HD5'	SRE01	716881	7450100	1	22/05/2018	T146556
Euryolpium 'HD6'	SRE11	704970	7446447	2	25/05/2018	T146557
Euryolpium 'HD7'	SRE09	719353	7450631	1	24/05/2018	T146564
Euryolpium sp.	SRE10	718923	7450760	1	24/05/2018	T146558
Indolpium sp.	SRE01	716881	7450100	2	22/05/2018	T146560
Indolpium sp.	SRE01	716881	7450100	3	22/05/2018	T146563
Olpiidae 'PSE118'	SRE02	712291	7450649	4	22/05/2018	T146559
Olpiidae 'PSE118'	SRE04	707098	7449693	1	25/05/2018	T146561
Olpiidae 'PSE118'	SRE10	718923	7450760	2	24/05/2018	T146562
Olpiidae sp.	SRE01	716881	7450100	1	22/05/2018	T146565
Lychas 'bituberculatus complex'	TS04	706249	7445883	1	19/05/2018	T146566
Lychas 'harveyi complex'	TS07	696251	7445929	1	19/05/2018	T146567
Lychas 'multipunctatus complex'	SRE08	706977	7445419	1	23/05/2018	T146568
Lychas 'pilbara 1'	TS04	706249	7445883	1	19/05/2018	T146569
Sepedonophilus 'HD1'	SRE01	716881	7450100	1	22/05/2018	T146570
Gastrocopta sp.	SRE01	716881	7450100	7	22/05/2018	S111506
Gastrocopta sp.	SRE03	704413	7446421	1	25/05/2018	S111511

Species	Site	Coordinates (Zone 50K)		Number of specimens	Collecting date	WAM registration number
		Easting (mE)	Northing (mN)			
Gastrocopta sp.	SRE04	707098	7449693	1	25/05/2018	S111507
Gastrocopta sp.	SRE07	699385	7445954	2	23/05/2018	S111510
Gastrocopta sp.	SRE09	719353	7450631	2	24/05/2018	S111512
Gastrocopta sp.	SRE11	704970	7446447	3	25/05/2018	S111509
Pupoides sp.	SRE01	716881	7450100	3	22/05/2018	S111515
Pupoides sp.	SRE04	707098	7449693	1	25/05/2018	S111513
Pupoides sp.	SRE07	699385	7445954	1	23/05/2018	S111514
Pupoides sp.	SRE11	704970	7446447	1	25/05/2018	S111516
Subulinidae sp.	SRE01	716881	7450100	15	22/05/2018	S111520
Subulinidae sp.	SRE01	716881	7450100	5	22/05/2018	S111518
Subulinidae sp.	SRE02	712291	7450649	1	22/05/2018	S111522
Subulinidae sp.	SRE03	704413	7446421	1	25/05/2018	S111519
Subulinidae sp.	SRE04	707098	7449693	1	25/05/2018	S111517
Subulinidae sp.	SRE10	718923	7450760	1	24/05/2018	S111521
Buddelundia '10ma'	SRE11	704970	7446447	1	25/05/2018	C73873
Buddelundia '10ma'	TS04	706249	7445883	1	19/05/2018	C73876
Buddelundia '10ma'	TS04	706249	7445883	1	19/05/2018	C73872
Buddelundia '10ma'	TS05	705107	7445902	1	19/05/2018	C73871
Buddelundia '10ma'	TS05	705107	7445902	4	19/05/2018	C73874
Buddelundia '10ma'	TS05	705107	7445902	1	19/05/2018	C73875
Karaops banyjima	SRE19	702270	7448404	1	12/03/2019	T149457
Karaops banyjima	SRE21	704827	7450096	1	14/03/2019	T149408
Karaops banyjima	SRE18	716912	7450177	1	11/03/2019	T149484
Karaops 'ARA001'	SRE18	716912	7450177	1	11/03/2019	T149465

Species	Site	Coordinates (Zone 50K)		Number of specimens	Collecting date	WAM registration number
		Easting (mE)	Northing (mN)			
Missulena rutraspina	TS18	705437	7448645	1	10/03/2019	T149449
Missulena rutraspina	TS18	705437	7448645	1	10/03/2019	T149409
Aurecocrypta 'HD1'	SRE17	718175	7450279	1	11/03/2019	T149411
Aurecocrypta 'MYG315'	SRE22	704697	7449733	1	14/03/2019	T149466
Synothele 'MYG309'	TS18	705437	7448645	1	10/03/2019	T149467
Synothele 'MYG311'	TS18	705437	7448645	1	10/03/2019	T149425
Synothele sp.	SRE12	701579	7446476	1	14/03/2019	T149438
Synothele 'xkarara'	TS18	705437	7448645	1	10/03/2019	T149414
Synothele 'xkarara'	TS18	705437	7448645	1	10/03/2019	T149415
Synothele 'xkarara'	TS18	705437	7448645	1	10/03/2019	T149413
Gaius tealei	TS18	705437	7448645	1	10/03/2019	T149486
Gaius tealei	TS18	705437	7448645	1	10/03/2019	T149470
Gaius tealei	TS18	705437	7448645	1	10/03/2019	T149469
Gaius tealei	TS14	697889	7448523	1	9/03/2019	T149417
Gaius tealei	SRE16	702263	7445976	1	10/03/2019	T149418
Gaius tealei	SRE23	706043	7446455	1	16/03/2019	T149416
Aname mellosa	TS16	706428	7448136	1	10/03/2019	T149423
Aname mellosa	Bl01	697807	7448393	1	3/09/2019	T149437
Aname mellosa	TS17	700725	7447419	1	11/03/2019	T149424
Aname mellosa	TS14	697889	7448523	1	9/03/2019	T149464
Aname mellosa	TS17	700725	7447419	1	11/03/2019	T149429
Aname mellosa	TS14	697889	7448523	1	9/03/2019	T149488
Aname mellosa	TS17	700725	7447419	1	11/03/2019	T149443
Aname mellosa	SRE18	716912	7450177	1	11/03/2019	T149420

Species	Site	Coordinates (Zone 50K)		Number of specimens	Collecting date	WAM registration number
		Easting (mE)	Northing (mN)			
Aname mellosa	TS17	700725	7447419	2	11/03/2019	T149421
Aname mellosa	TS16	706428	7448136	1	10/03/2019	T149446
Aname mellosa	TS17	700725	7447419	1	11/03/2019	T149444
Aname mellosa	TS18	705437	7448645	1	10/03/2019	T149435
Aname mellosa	TS17	700725	7447419	1	11/03/2019	T149471
Aname mellosa	TS16	706428	7448136	5	10/03/2019	T149463
Aname mellosa	TS18	705437	7448645	1	10/03/2019	T149494
Aname mellosa	SRE18	716912	7450177	1	11/03/2019	T149432
Aname 'MYG004'	TS17	700725	7447419	1	11/03/2019	T149419
Aname sp.	SRE16	702263	7445976	1	10/03/2019	T149448
Aname sp.	TS15	700594	7448201	1	17/03/2019	T149459
Yilgarnia 'MYG197'	TS14	697889	7448523	1	9/03/2019	T149527
Anatemnus sp.	SRE14	707274	7445766	1	17/03/2019	T149450
Oratemnus sp.	SRE13	707086	7449689	2	9/03/2019	T149472
Oratemnus sp.	SRE15	704230	7446563	8	17/03/2019	T149473
Oratemnus sp.	SRE23	706043	7446455	1	16/03/2019	T149474
Oratemnus sp.	SRE23	706043	7446455	3	16/03/2019	T149475
Sundochernes sp.	SRE23	706043	7446455	1	16/03/2019	T149476
Tyrannochthonius 'HD1'	SRE14	707274	7445766	1	17/03/2019	T149477
Beierolpium '8/4 small'	SRE19	702270	7448404	2	12/03/2019	T149481
Beierolpium 'HD1'	SRE14	707274	7445766	1	17/03/2019	T149478
Beierolpium 'HD2'	TS14	697889	7448523	1	9/03/2019	T149479
Beierolpium '8/4'	SRE13	707086	7449689	1	9/03/2019	T149410
Euryolpium sp.	SRE20	719431	7450376	1	13/03/2019	T149482

Species	Site	Coordinates (Zone 50K)		Number of specimens	Collecting date	WAM registration number
		Easting (mE)	Northing (mN)			
'PSEAAA HD4'	SRE16	702263	7445976	1	10/03/2019	T149480
Olpiidae 'PSE118'	SRE21	704827	7450096	2	14/03/2019	T149483
Isometroides 'pilbara 1'	TS14	697889	7448523	1	9/03/2019	T149406
Isometroides 'pilbara 1'	TS18	705437	7448645	1	10/03/2019	T149487
Isometroides 'pilbara 1'	TS16	706428	7448136	1	10/03/2019	T149468
Isometroides 'pilbara 1'	TS17	700725	7447419	2	11/03/2019	T149453
Isometroides 'pilbara 1'	TS18	705437	7448645	1	10/03/2019	T149485
Isometroides 'pilbara 1'	TS14	697889	7448523	1	9/03/2019	T149452
Isometroides 'pilbara 1'	TS18	705437	7448645	1	10/03/2019	T149441
Lychas 'bituberculatus complex'	Bl01	697807	7448393	1	3/09/2019	T149491
Aname mellosa	TS14	697889	7448523	1	9/03/2019	T149433
Aname mellosa	TS18	705437	7448645	3	10/03/2019	T149426
Aname mellosa	Camp	706880	7449184	1	15/03/2019	T149434
Aname mellosa	TS18	705437	7448645	1	10/03/2019	T149430
Aname mellosa	SRE16	702263	7445976	1	10/03/2019	T149447
Aname mellosa	TS14	697889	7448523	1	9/03/2019	T149454
Aname mellosa	TS17	700725	7447419	1	11/03/2019	T149440
Aname mellosa	TS18	705437	7448645	3	10/03/2019	T149407
Aname mellosa	TS16	706428	7448136	1	10/03/2019	T149445
Aname mellosa	TS16	706428	7448136	1	10/03/2019	T149439
Aname mellosa	TS16	706428	7448136	1	10/03/2019	T149422
Lychas 'bituberculatus complex'	TS14	697889	7448523	1	9/03/2019	T149427
Lychas 'bituberculatus complex'	TS16	706428	7448136	1	10/03/2019	T149490
Lychas 'bituberculatus complex'	TS17	700725	7447419	1	11/03/2019	T149489

Species	Site	Coordinates (Zone 50K)		Number of specimens	Collecting date	WAM registration number
		Easting (mE)	Northing (mN)			
Lychas 'bituberculatus complex'	TS16	706428	7448136	1	10/03/2019	T149460
Lychas 'hairy tail complex'	TS17	700725	7447419	1	11/03/2019	T149493
Lychas 'harveyi complex'	TS18	705437	7448645	1	10/03/2019	T149495
Lychas 'harveyi complex'	TS14	697889	7448523	2	9/03/2019	T149436
Lychas 'multipunctatus complex'	TS14	697889	7448523	1	9/03/2019	T149496
Lychas 'multipunctatus complex'	TS17	700725	7447419	3	11/03/2019	T149455
Lychas 'multipunctatus complex'	Bl01	697807	7448393	3	3/09/2019	T149456
Lychas 'multipunctatus complex'	TS14	697889	7448523	2	9/03/2019	T149497
Lychas 'multipunctatus complex'	TS14	697889	7448523	1	9/03/2019	T149442
Urodacus 'HD1'	SRE13	707086	7449689	1	9/03/2019	T149458
Urodacus 'pilbara 12'	SRE12	701579	7446476	1	14/03/2019	T149431
Sepedonophilus 'HD1'	Op01	701589	7445986	1	15/03/2019	T149502
Sepedonophilus 'HD1'	SRE19	702270	7448404	1	12/03/2019	T149499
Sepedonophilus 'HD1'	SRE17	718175	7450279	1	11/03/2019	T149501
Sepedonophilus 'HD1'	SRE19	702270	7448404	1	12/03/2019	T149498
Sepedonophilus 'HD1'	SRE19	702270	7448404	1	12/03/2019	T149500
Sepedonophilus 'HD1'	SRE17	718175	7450279	1	11/03/2019	T149503
Sepedonophilus 'HD2'	SRE23	706043	7446455	1	16/03/2019	T149504
Sepedonophilus sp.	SRE19	702270	7448404	1	12/03/2019	T149505
Geophilomorpha sp.	SRE16	702263	7445976	1	10/03/2019	T149506
Mecistocephalus 'HD1'	SRE13	707086	7449689	1	9/03/2019	T149507
Mecistocephalus 'HD1'	SRE21	704827	7450096	1	14/03/2019	T149508
Mecistocephalus 'HD1'	SRE23	706043	7446455	1	16/03/2019	T149509
Mecistocephalus 'HD1'	SRE23	706043	7446455	1	16/03/2019	T149510

Species	Site	Coordinates (Zone 50K)		Number of specimens	Collecting date	WAM registration number
		Easting (mE)	Northing (mN)			
Mecistocephalus 'HD2'	SRE23	706043	7446455	1	16/03/2019	T149511
Mecistocephalus 'HD3'	SRE15	704230	7446563	1	17/03/2019	T149512
Mecistocephalus 'HD3'	SRE15	704230	7446563	1	17/03/2019	T149513
Orphnaeus 'HD1'	SRE23	706043	7446455	1	16/03/2019	T149514
Cryptops 'HD1'	SRE15	704230	7446563	1	17/03/2019	T149517
Cryptops 'HD1'	SRE15	704230	7446563	1	17/03/2019	T149515
Cryptops 'HD1'	SRE15	704230	7446563	1	17/03/2019	T149516
Antichiropus sp.	SRE15	704230	7446563	1	17/03/2019	T149461
Antichiropus sp.	SRE23	706043	7446455	2	16/03/2019	T149521
Antichiropus 'wonmunna'	SRE15	704230	7446563	2	17/03/2019	T149519
Antichiropus 'wonmunna'	SRE23	706043	7446455	1	16/03/2019	T149518
Antichiropus 'wonmunna'	SRE23	706043	7446455	1	16/03/2019	T149520
Antichiropus 'wonmunna'	SRE23	706043	7446455	10	16/03/2019	T149412
Austrostrophus 'Clade A'	SRE20	719431	7450376	2	13/03/2019	T149522
Austrostrophus 'Clade E'	TS18	705437	7448645	1	10/03/2019	T149462
Austrostrophus 'Clade E'	TS14	697889	7448523	4	9/03/2019	T149524
Austrostrophus 'Clade E'	SRE22	704697	7449733	1	14/03/2019	T149523
Austrostrophus 'Clade E'	SRE15	704230	7446563	1	17/03/2019	T149451
Austrostrophus sp.	SRE19	702270	7448404	1	12/03/2019	T149526
Austrostrophus sp.	SRE13	707086	7449689	1	9/03/2019	T149529
Austrostrophus sp.	SRE18	716912	7450177	1	11/03/2019	T149492
Austrostrophus sp.	SRE17	718175	7450279	1	11/03/2019	T149525
Austrostrophus sp.	SRE16	702263	7445976	1	10/03/2019	T149428
Austrostrophus sp.	SRE15	704230	7446563	5	17/03/2019	T149528

Species	Site	Coordinates (Zone 50K)		Number of specimens	Collecting date	WAM registration number
		Easting (mE)	Northing (mN)			
Gastrocopta sp.	TS14	697889	7448523	2	9/03/2019	S29639
Gastrocopta sp.	SRE21	704827	7450096	3	14/03/2019	S29643
Gastrocopta sp.	SRE21	704827	7450096	3	14/03/2019	S29642
Gastrocopta sp.	SRE15	704230	7446563	2	17/03/2019	S29640
Gastrocopta sp.	SRE14	707274	7445766	2	17/03/2019	S29641
Pupoides sp.	SRE14	707274	7445766	4	17/03/2019	S29645
Pupoides sp.	SRE21	704827	7450096	1	14/03/2019	S29647
Pupoides sp.	SRE23	706043	7446455	1	16/03/2019	S29646
Pupoides sp.	TS14	697889	7448523	2	9/03/2019	S29644
Eremopeas interioris	SRE17	718175	7450279	4	11/03/2019	S29649
Eremopeas interioris	SRE19	702270	7448404	2	12/03/2019	S29653
Eremopeas interioris	SRE14	707274	7445766	5	17/03/2019	S29652
Eremopeas interioris	TS14	697889	7448523	4	9/03/2019	S29650
Eremopeas interioris	TS14	697889	7448523	1	9/03/2019	S29648
Eremopeas interioris	SRE15	704230	7446563	2	17/03/2019	S29651
Buddelundia '15'	SRE15	704230	7446563	2	17/03/2019	C75033
Buddelundia '15'	SRE19	702270	7448404	1	12/03/2019	C75030
Buddelundia '15'	SRE23	706043	7446455	4	16/03/2019	C75031
Buddelundia '15'	SRE14	707274	7445766	2	17/03/2019	C75032
Buddelundia '15'	SRE23	706043	7446455	1	16/03/2019	C75034
Buddelundia '16'	SRE17	718175	7450279	3	11/03/2019	C75035
Buddelundia '16'	SRE19	702270	7448404	8	12/03/2019	C75036
Buddelundia '77'	SRE19	702270	7448404	4	12/03/2019	C75040
Buddelundia '77'	SRE17	718175	7450279	1	11/03/2019	C75042

Species	Site	Coordinates (Zone 50K)		Number of specimens	Collecting date	WAM registration number
		Easting (mE)	Northing (mN)			
Buddelundia '77'	SRE23	706043	7446455	1	16/03/2019	C75039
Buddelundia '77'	SRE23	706043	7446455	1	16/03/2019	C75041
Buddelundia '77'	SRE15	704230	7446563	2	17/03/2019	C75038
Buddelundia '77'	SRE22	704697	7449733	1	14/03/2019	C75037
Buddelundia sp.	SRE23	706043	7446455	1	16/03/2019	C75043
Buddelundiinae sp.	TS14	697889	7448523	2	9/03/2019	C75044
Buddelundiinae sp.	SRE23	706043	7446455	1	16/03/2019	C75045
Pseudodiploexochus sp.	SRE17	718175	7450279	1	11/03/2019	C75046
Troglarmadillo sp.	SRE13	707086	7449689	1	9/03/2019	C75047
Philosciidae sp.	SRE19	702270	7448404	5	12/03/2019	C75048
Philosciidae sp.	TS14	697889	7448523	1	9/03/2019	C75049

Hope Downs 2 Proposal
Flora and Vegetation Survey
May 2019

Prepared for Rio Tinto



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Flora and Vegetation Survey

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Abbreviations

Abbreviation	Definition
Astron	Astron Environmental Services
BAM Act	*Biosecurity and Agriculture Management Act 2007*
BC Act	*Biodiversity Conservation Act 2016*
BHT	Bedded Hilltop
BoM	Bureau of Meteorology
DBCA	Department of Biodiversity, Conservation and Attractions
DRF	Declared Rare Flora
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ESA	Environmentally Sensitive Area
GDA	Geocentric Datum of Australia
GDE	Groundwater Dependent Ecosystem
GIS	Geographic Information System
GPS	Global Positioning System
ha	Hectare
HD1	Hope Downs 1
HD2	Hope Downs 2
IBRA	Interim Biogeographic Regionalisation for Australia
Km	Kilometre
m	metre
mm	millimetre
MGA	Map Grid of Australia
MNES	Matters of National Environmental Significance
NVIS	National Vegetation Information System
P	Priority
PEC	Priority Ecological Community
PFC	Percentage Foliar Cover
sp.	Species (singular)
spp.	Species (plural)
subsp.	Subspecies
Survey area	Hope Downs 2 Development Envelope, which includes two deposits: Hope Downs 2 and Bedded Hilltop (10,817.7 ha)
T	Threatened
TEC	Threatened Ecological Community
TPFL	Threatened and Priority Flora Database
TP List	Threatened and Priority Flora List
WA Herbarium	Western Australian Herbarium
WoNS	Weeds of National Significance

Executive Summary

Rio Tinto is evaluating the potential development of additional iron ore deposits at Hope Downs 2 (HD2) in the Pilbara region of Western Australia. Astron Environmental Services was commissioned to undertake a Detailed flora and vegetation survey of the HD2 Development Envelope (10,817.7 hectares; herein referred to as the survey area) over three separate phases.

Twenty-three vegetation units were recorded in the survey area. No vegetation units within the survey area represent a threatened ecological community. One vegetation unit (P2) was associated with the Wannamunna land system and held some affinity with the priority 1 priority ecological community '*West Angelas Cracking-Clays*', however is unlikely to represent the community due to differences in species composition, habitat and scale. Vegetation unit P2 accounted for 155.6 hectares (1.4%) of the survey area and consisted of a fine scale mosaic vegetation patterning that comprised tussock grassland patches on cracking clay depressions between patches of scattered *Acacia* shrubs. Interpretation of this vegetation was inhibited by the poor seasonal conditions during the surveys. Although it is unlikely to represent the priority ecological community it may be a locally restricted vegetation community. The Department of Biodiversity, Conservation and Attractions mapped buffer for the priority 1 priority ecological community '*Weeli Wolli Spring Community*' intersects the survey area, although Weeli Wolli Creek does not intersect the survey area. Four vegetation units were considered to have local conservation significance due to their likelihood to act as refugia habitat (H2, D3), having restricted occurrence within the survey area (H2, P2, D3), and/or association with conservation significant flora species (H2, P2, D3, D4). All other vegetation units are considered well represented beyond the survey area and do not support assemblages of species that are unique, located on restricted landforms, or of high conservation significance.

Vegetation condition ranged from Excellent to Completely Degraded. An estimated 81.4% of the survey area was rated in Excellent condition; an estimated 7.7% of the survey area was cleared and rated as Completely Degraded. Weed diversity and abundance was highest in drainage lines and alluvial plains with the hilltops and slopes generally having lower or no weed abundance. Other minor disturbances included grazing by cattle and camels in the drainage lines and associated plains, significant sections of the survey area being burnt during 2015 and 2016, and minor evidence of dust on vegetation, usually in association with exploration tracks through bulldust soils.

There were 411 confirmed vascular flora taxa, from 52 families and 161 genera recorded during the current survey. The most represented families were Fabaceae, Poaceae, Malvaceae, Asteraceae and Myrtaceae.

No threatened flora taxa were recorded. Eleven State-listed priority flora taxa were recorded: *Eremophila* sp. West Angelas (S. van Leeuwen 4068) Priority 1; *Aristida lazaridis* Priority 2, *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) Priority 2; *Eremophila* sp. Hamersley Range (K. Walker KW 136) P3; *Grevillea saxicola* Priority 3; *Rhagodia* sp. Hamersley (M. Trudgen 17794) Priority 3; *Triodia* sp. Mt Ella (M.E. Trudgen 12739) Priority 3; *Acacia bromilowiana* Priority 4; *Eremophila magnifica* subsp. *magnifica* Priority 4; *Lepidium catapycnon* Priority 4; and *Ptilotus mollis* Priority 4.

One taxon (*Tinospora smilacina)* was considered a range extension of greater than 50 kilometres from its currently known distribution.

Seventeen introduced flora species (weeds) were recorded from current and previous surveys, none of which are listed as a Weed of National Significance or as a Declared Pest. **Bidens bipinnata* (bipinnate beggartick) and **Cenchrus ciliaris* (buffel grass) were the most abundant weed species recorded.

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1 Introduction

1.1 Project Background

Rio Tinto is evaluating the potential development of additional iron ore deposits at Hope Downs 2 (HD2) in the Pilbara region of Western Australia, approximately 68 km north-west of Newman. Astron Environmental Services (Astron) was commissioned to undertake a multiple-phase detailed flora and vegetation survey of the 10,817.7 ha HD2 Development Envelope, which includes two deposits: HD2 and Bedded Hilltop (BHT), and herein is referred to as the survey area (Figure 1). This report presents the findings of the detailed surveys completed in November 2017, May 2018 and May 2019.

1.2 Scope and Objectives

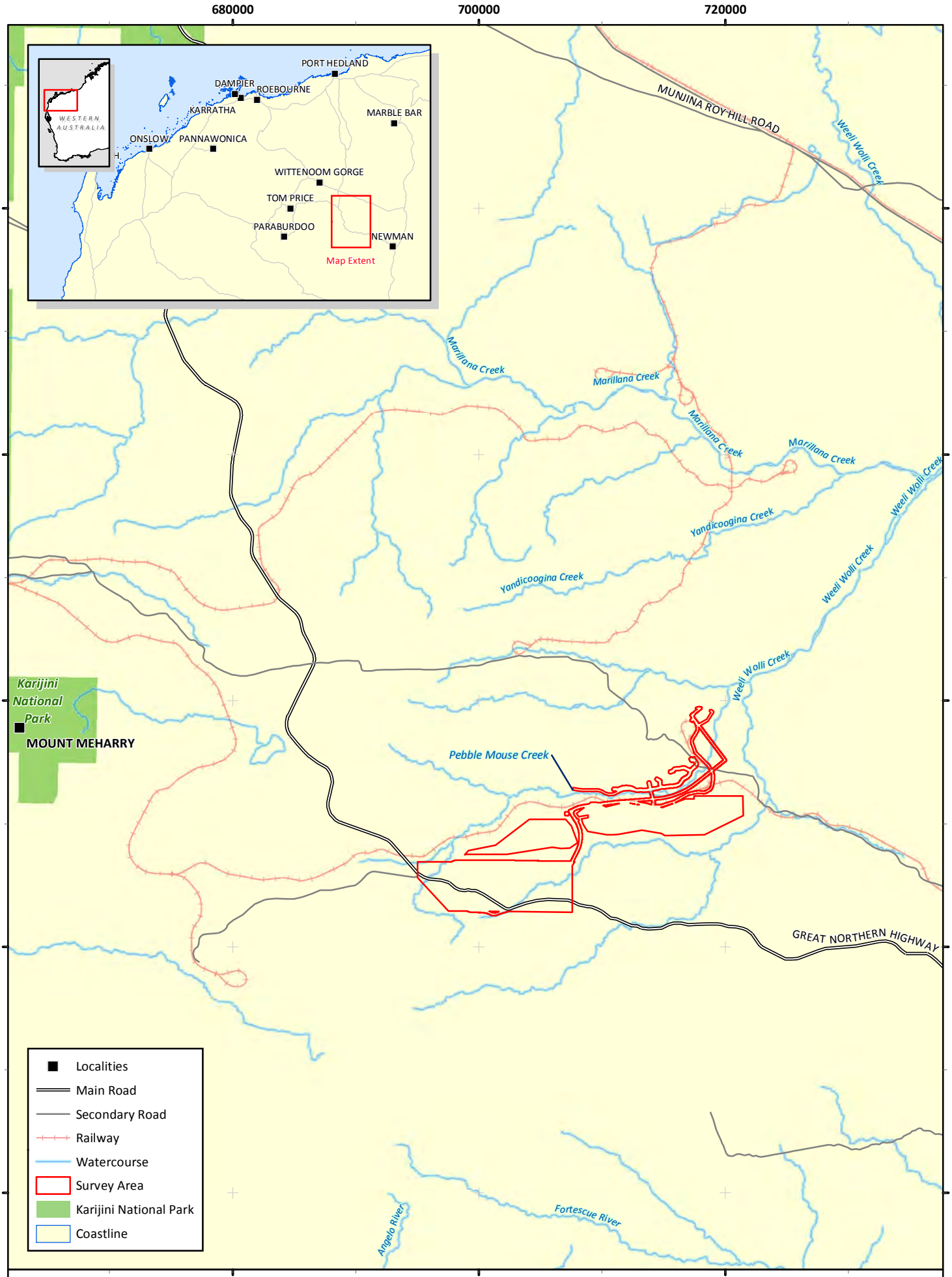
The objective was to undertake a detailed assessment of flora and vegetation values through a desktop assessment and field survey with incorporation of data from previous biological surveys conducted in the vicinity of the survey area. The resultant data has been utilised to produce this report, which is intended to support and inform the environmental assessment process in accordance with the requirements of the Environmental Protection Authority (EPA). The scope of work was to undertake a:

- Desktop assessment, including database searches and literature review of available resources
- Flora and vegetation assessment, including:
    - establish new quadrats to ensure adequate replication within vegetation units and rescore these quadrats
    - ground-truth, verify and refine existing vegetation mapping using quadrats, relevés and mapping notes
    - targeted searches for the presence of threatened (T) and priority (P) flora and vegetation of conservation significance
    - map vegetation condition and disturbance
    - generate a vascular flora species list
    - record introduced flora (weed) species where encountered.

The scope and key limitations of the survey are outlined in Table 1. Section 3.5 of this report provides more detail on the limitations of the survey.

Table 1: Summary of Astron's vegetation and flora assessment.

Level of survey	Survey area size	Survey timing	Relevant regulatory guidance documents	Key survey limitations
Detailed survey	10,817.7 ha	1 to 12 November 2017 (Phase 1) 18 to 30 May 2018 (Phase 2) 20 to 31 May 2019 (Phase 3)	• Technical Guidance – Flora and Vegetation Surveys for Environmental Impact (Environmental Protection Authority 2016b) • Position Statement No. 3 (Environmental Protection Authority 2002) • Guidance Statement No. 51 (Environmental Protection Authority 2004) • Environmental Factor Guideline - Flora and Vegetation (Environmental Protection Authority 2016a)	• Seasonal conditions for ephemeral taxa were below average during all three phases of the field survey. • Fire had affected 5,221.4 ha (48.3%) of the survey area in the previous five years (2015-2019). No fire was recorded in 2018 and 2019. The 2015 fire was the most widespread with 30.2% of the survey area burnt (Darwin Centre for Bushfire Research 2018).



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Hope Downs 2 Proposal – Flora and Vegetation Survey

Figure 1: Survey area location

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Author: B. Eckermann	Date: 05-11-2019
Drawn: C. Dyde	Figure Ref: 14292A-19-BIDR-3RevB_191105_Fig01_Locn

Datum: GDA 1994 - Projection: MGA Zone 50

0 5 10 15 20 Km

N

2 Environmental Context

2.1 Physical Environment

2.1.1 Climate

The climate of the Pilbara region of Western Australia is classified as arid tropical with two distinct seasons: a hot, wet summer (October – April) and a mild, dry winter (May – September) (Bureau of Meteorology 2019).

Based on long-term climatic data from the nearest Bureau of Meteorology weather station at Newman Aero (Station 007176) (approximately 90 km south-east of the survey area) the mean annual rainfall since 1971 is 329.5 mm. The mean maximum daily temperatures since 1996 range between 23.0°C and 39.2°C, and average above 30°C for much of the year (Bureau of Meteorology 2019) (Figure 2).

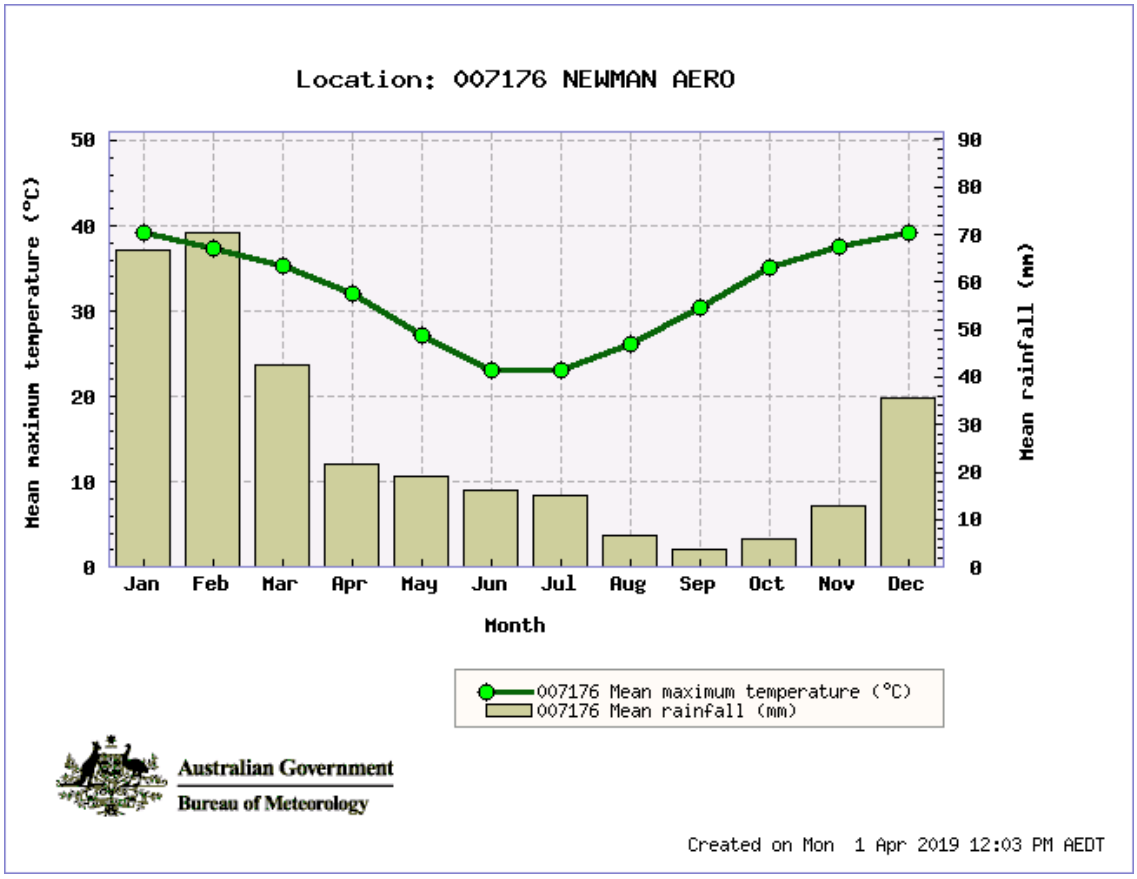


Figure 2: Climate data for Newman Aero Station (Station 007176).

Mean annual rainfall data has been calculated from 1971 – 2019 and mean maximum temperature has been calculated from 1996 – 2019 (Bureau of Meteorology 2019).

2.1.2 Geology and Soils

The surface geology of the survey area is comprised of 10 units (Stewart et al. 2008), with Colluvium 3841 being the most dominant (Table 2). Geological mapping of the survey area and surrounds is presented in Figure A.1 (Appendix A).

Table 2: Geological units of the survey area (Stewart et al. 2008).

Geological name	Label	Area (ha)
Alluvium 38485: Channel and flood plain alluvium; gravel, sand, silt, clay, locally calcreted.	Qa	431.4
Brockman Iron Formation: banded iron-formation, chert, mudstone and siltstone.	Lchk	681.7
calcrete 38497: Pisolitic, nodular or massive calcrete; ferruginous inclusions; calcareous cementing of bedrock and transported materials; locally with intercalated chalcedony; as low mounds, in playa lakes, or as valley calcrete; locally dissected and karstified	Czk	18.1
Colluvium 38491: Colluvium, sheetwash, talus; gravel piedmonts and aprons over and around bedrock; clay-silt-sand with sheet and nodular kankar; alluvial and aeolian sand-silt-gravel in depressions and broad valleys in Canning Basin; local calcrete, reworked laterite.	Qrc	2,587.8
Fortescue Group: Metadolerite, dolerite, gabbro; medium to coarse grained, massive grey-green rock, usually foliated.	Adf	763.6
Jeerinah Formation: Shale, sandstone, siltstone, mudstone, dolomite, local microbanded chert, jaspilite, conglomerate; fine-grained massive rhyolite; mafic tuff with local accretionary lapilli and agglomerate; thin basalt/dolerite and andesitic basalt flows.	Awfj	1,443.9
Marra Mamba Iron Formation: Chert, ferruginous chert, jaspilite, banded iron-formation, minor shale, siltstone, mudstone.	Achm	2,328.3
Mount McRae Shale and Mount Sylvia Formation: Interbedded shale, chert, banded iron-formation.	Ashm	1,212.5
Weeli Wolli Formation: Banded iron-formation (commonly jaspilitic), mudstone, siltstone; common interlayered metadoleritic sills.	Lchw	1,036.1
Wittenoom Formation: Calcitic dolomite, interbedded chert and shale in upper and lower parts, volcaniclastic sandstone.	Alhw	314.3

2.1.3 Surface Water and Hydrology

No Wetlands of International Importance (i.e. Ramsar wetlands) or Nationally Important Wetlands occur within the survey area (Department of the Environment and Energy 2017b, 2017c). The nearest Nationally Important Wetland is Fortescue Marshes, located 40 km north of the survey area, which has been nominated as a proposed Ramsar site. Pebble Mouse Creek passes through a large proportion of the survey area. One of the upper tributaries of Weeli Wolli Creek passes through the survey area (Figure 1).

2.2 Biological Environment

2.2.1 Interim Biogeographic Regionalisation of Australia

The Interim Biogeographic Regionalisation for Australia (IBRA version 7) divides the Australian continent into 89 bioregions and 419 subregions (Department of the Environment and Energy 2017d). The IBRA regions represent a landscape-based approach to classifying the land surface, including attributes of climate, geomorphology, landform, lithology, and characteristic flora and fauna. The survey area occurs in the Pilbara bioregion, of which 8.4% is represented in the national reserve system (Department of the Environment and Energy 2016b).

The biodiversity of the 53 subregions recognised in Western Australia was documented as part of a national audit to provide priorities for conservation action (Department of Conservation and Land Management 2002). The survey area occurs within the Hamersley subregion. This subregion is described in the audit as:

- Hamersley PIL3 – dissected bold plateaux and ranges of flat lying, moderately folded sandstone and quartzite with vegetation described as Mulga low woodland over tussock grasses occurring on fine textured soils in valley floors, with scattered Snappy gum (*Eucalyptus leucophloia*) over *Triodia brizoides* on skeletal soils of the ranges (Kendrick 2001).

2.2.2 Land Systems

Land systems of the Western Australian rangelands have been mapped and described by the Department of Primary Industries and Regional Development (formerly the Department of Agriculture and Food) outlining the distributions and providing comprehensive descriptions of biophysical resources, including soil and vegetation condition. A total of 102 land systems occur in the Pilbara bioregion, covering 181,723 km^2. Nine land systems occur in the survey area (Table 3). The Newman land system is the most widespread land system in the survey area and is characterised by ranges dominated by hard spinifex. The distribution of these land systems within the survey area is shown in Figure A.2 (Appendix A).

Table 3: Distribution of land systems within the survey area.

Land system	Total area within bioregion (ha)	Total area (ha) (proportion of survey area (%))
Boolgeeda - stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands and mulga shrublands.	961,847	1,486.0 (13.7)
Calcrete - Low calcrete platforms and plains supporting shrubby hard spinifex grasslands.	134,834	4.9 (<0.1)
Egerton - Highly dissected plains and slopes with sparse mulga shrublands or shrubby hard spinifex grasslands.	66,849	1.4 (<0.1)
McKay - Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands with acacias and occasional eucalypts.	426,124	326.7 (3.0)
Newman - rugged jaspilite plateaux, ridges and mountains with hard spinifex.	1,994,339	4,647.2 (43.0)
Pindering - Gravelly hardpan plains supporting groved mulga shrublands with hard and soft spinifex.	38,738	410.5 (3.8)
Platform - dissected slopes and raised plains supporting shrubby hard spinifex grasslands.	236,390	2,522.2 (23.3)
Rocklea - basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex and occasionally soft spinifex grasslands with scattered shrubs.	2,880,288	1,314.2 (12.1)
Wannamunna - Hardpan plains and internal drainage tracts supporting mulga shrublands and woodlands and occasionally eucalypt woodlands.	63,004	104.5 (1.0)

2.2.3 Pre-European Vegetation

Beard (1975) completed broad-scale (1:1,000,000) pre-European vegetation mapping at association level. The Beard mapping was later used by the Department of Agriculture and Food (Shepherd, Beeston, and Hopkins 2002) to compile vegetation units that assisted with identifying pre-European and current extents of vegetation throughout Western Australia.

Three pre-European vegetation units, 82, 18 and 29 (Shepherd, Beeston, and Hopkins 2002), are associated with the survey area (Figure A.3, Appendix A). Table 4 summarises the current and pre-European extent of these three vegetation units in the Pilbara bioregion and the survey area.

Vegetation associations 82 and 18 each account for approximately 50% of the survey area, indicating that spinifex hummock grasslands and mulga woodlands are widespread throughout.

Table 4: Extent of pre-European vegetation in the survey area (Government of Western Australia 2018).

Vegetation association	Mapping unit (Beard 1975)	Description	Total area (ha) (proportion of survey area (%))	Pre-European extent (ha)	Current extent in bioregion (ha)	Proportion of pre-European extent remaining (%)	Pre-European extent with formal protection (%)
82	e16Lr t3Hi	Hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*	5,452.2 (50.4)	2,168,702	2,156,558	99.4	13.7
18	a1Li	Low woodland, open low woodland or sparse woodland; mulga (*Acacia aneura*)	5,339.0 (49.4)	580,512	576,389	99.3	29.6
29	a1Lp	Mulga (*Acacia aneura*) and associated species.	26.5 (0.2)	172,083	171,975	99.9	12.8

2.3 State and Commonwealth Conservation Categories and Management

Commonwealth and State regulatory authorities maintain databases of the locations and conservation status of significant flora, fauna and ecological communities in Western Australia.

The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) provides a legal framework to protect and manage Matters of National Environmental Significance (MNES) including listed flora, fauna and ecological communities. These listed flora, fauna and ecological communities are allocated a conservation category, which are outlined in Tables B.1 and B.2 (Appendix B).

Ecological communities may be subject to processes that threaten to destroy or significantly modify it across much of its range. These communities are identified as threatened ecological communities (TECs) and are listed at both Commonwealth level under the EPBC Act and State level under the *Biodiversity Conservation Act 2016* (BC Act) [1](Table B.3, Appendix B). The Department of Biodiversity, Conservation and Attractions (DBCA) maintains a list of priority ecological communities (PECs), which may also be under threat and are assigned one of four priority rankings according to the criteria outlined in Table B.4 (Appendix B).

Under Western Australian legislation, all native flora is protected and it is an offence to 'take' protected flora. The BC Act also provides for native flora to be gazetted as threatened or extinct. Under the BC Act threatened species may be listed as one of three categories: critically endangered, endangered or vulnerable (Table B.5, Appendix B). In addition, due to the diversity of Western Australia's flora, many species are known from only a few collections or locations, but have not been adequately surveyed. Such flora may be threatened, but cannot be considered for declaration as threatened flora until adequate surveys have been undertaken. These flora species are included on a supplementary conservation list managed by DBCA called the *Priority Flora List* (Table B.6, Appendix B).

2.4 Introduced Flora (Weeds)

Significant weed species are identified at both the state and national level. The Australian Weeds Strategy (Australian Weeds Committee 2012a) identifies Weeds of National Significance (WoNS) which have the potential to impact primary industry and/or environmental and social values. The management of weeds in Western Australia is primarily regulated through the *Biosecurity and Agriculture Management Act 2007* (BAM Act), with some provision under the BC Act. Species listed under this act are allocated one of three declared pest categories which define the required level of management (Department of Agriculture and Food Western Australia 2016). Declared pest categories and listed weed species' priority ratings are presented in Table B.7 (Appendix B).

2.5 Land Use and Tenure

The survey area is located within the Shire of East Pilbara. The local area is mainly used for mineral exploration and mining activity. The survey area is not under a current active pastoral lease. Karijini National Park is the nearest conservation reserve, located approximately 35 km to the west of the survey area (Figure 1).

[1] From 1 January 2019, the *Wildlife Conservation Act 1950* has been replaced by the *Biodiversity Conservation Act 2016* (BC Act) and its regulations. Phase 1 and 2 of this survey were completed in 2017-18, prior to the BC Act being enacted.

3 Methods

3.1 Desktop Assessment

3.1.1 Database Searches

Environmentally Sensitive Areas (ESAs) are declared by the Minister for Environment under Section 51B of the *Environmental Protection Act 1986* to prevent incremental degradation of important environmental values such as declared rare (T) flora, TECs or significant wetlands. A search for ESAs in the vicinity of the survey area was conducted using Western Australian government datasets (Department of Water and Environmental Regulation 2017) and the Register of the National Estate dataset (Department of the Environment and Energy 2008).

Database searches were conducted to identify listed conservation significant flora and ecological communities within, or in close proximity to, the survey area. Conservation categories for ecological communities and flora are presented in Appendix B. Database search results are presented in Appendix C. Introduced flora species were compared to the Department of Primary Industries and Regional Development list, to determine if any have been listed as declared pests (Department of Primary Industries and Regional Development 2018), and the WoNS list (Australian Weeds Committee 2012b). Declared pest categories are presented in Table B.7 (Appendix B). DBCA database searches for threatened and priority flora and TECs and PECs in the vicinity of the survey area were received in November 2017, to inform the surveys. Additional DBCA database search results obtained for another project in the immediate vicinity were also considered in 2019, as the broader search area listed some additional species worth considering in survey design and also included up to date results. Details of the 2017 database searches conducted prior to all phases of survey are summarised in Table 5.

Table 5: Database searches undertaken.

Database	Date search results received	Search focus	Search area
NatureMap (Department of Biodiversity, Conservation, and Attractions 2018b)	26/06/2018	Flora of conservation significance	40 km radius from an approximate survey area centre point defined by the coordinates: 23°04'04" S, 119°01'56" E
Threatened and Priority Ecological Communities Database (Department of Biodiversity, Conservation, and Attractions 2017b)	16/11/2017	Listed threatened and priority ecological communities	20 km radius from the survey area boundary
Threatened and Priority Flora Database (TPFL) (Department of Biodiversity, Conservation, and Attractions 2017c)	06/11/2017	Listed threatened and priority flora	40 km radius from the survey area boundary
Threatened and Priority Flora List (TP List) (Department of Biodiversity, Conservation, and Attractions 2017d)			
Western Australian Herbarium Database (Department of Biodiversity, Conservation, and Attractions 2017e)			

Database	Date search results received	Search focus	Search area
Protected Matters Search Tool (Department of the Environment and Energy 2018)	26/06/2018	MNES – flora	40 km radius from an approximate survey area centre point defined by the coordinates: -23.06752, 119.03234 (MGA50, GDA94)
Rio Tinto Database search (custom search) (Rio Tinto Iron Ore 2019)	23/01/2019	Listed threatened and priority flora	40 km radius from the survey area boundary

3.1.2 Literature Review

Flora and vegetation surveys have previously been commissioned by Rio Tinto within the vicinity of the survey area and supplied to Astron for the desktop assessment. The previous survey areas in relation to the current survey area are shown on Figure D.1 (Appendix D).

Previous reports that presented vegetation site data and were used for the broader regional floristic analysis as part of this assessment include:

- Hope Downs Rail Corridor (Juna Downs Section). Vegetation and Flora Survey (Biota Environmental Sciences 2006)
- Flora and Vegetation on the Hope Downs 4 Lease Area (Mattiske Consulting 2008b)
- Flora and Vegetation on the Hope Downs 4 Mine Pipeline Corridor to Ophthalmia Dam (Mattiske Consulting 2009b)
- Flora and Vegetation of the Hope Downs 2 Area (Mattiske Consulting 2010)
- Rio Tinto Greater West Angelas Vegetation and Flora Assessment (Ecologia Environment 2013)
- Baby Hope Downs Flora and Vegetation Survey (Biota Environmental Sciences 2014).

Additional reports that provided contextual information but were not used in the floristic analysis are:

- Flora and vegetation – Southern Transport Corridor – Yandicoogina Junction Project Area (Mattiske Consulting 1995)
- Flora and Vegetation of the Hope Downs 4 Mine Infrastructure Corridor (Mattiske Consulting 2008a)
- Flora and Vegetation of the Hope Downs 1 Area (Mattiske Consulting 2009a).

Data provided in a custom search of the survey area from Rio Tinto (2019) included conservation significant flora and/or weed results from the following sources:

- Hope Downs Proposed Rail SO-06-01466 (Pilbara Iron 2006b)
- Hope Downs Rail Corridor (Juna Downs Section) Vegetation and Flora Survey (Biota Environmental Sciences 2006)
- Flora and Vegetation of the Hope Downs 2 Area (Mattiske Consulting 2010)
- Rare Flora Survey for Dales Gorge Target Drilling (Rio Tinto 2012)
- Flora and Vegetation Survey at Hope Downs 1 (Rio Tinto 2013)

- Baby Hope Downs Flora and Vegetation Survey (Biota Environmental Sciences 2014)
- Hope Downs 2 and Bakers East Flora & Fauna Assessment (Astron Environmental Services 2014)
- Hope Downs 2 AR-13-11444 and Bakers East SO-13-11013 Biological Assessment (Astron Environmental Services 2014)
- Systematic Flora Survey at Hope Downs 1 Bedded Hilltop Drilling AR-15-13090 (Rio Tinto 2015)
- Weed Control Program – Inland Operations – Brockman 2 and Hope Downs 1 (Astron Environmental Services 2015)
- Weed Control Program - Inland Operations, Hope Downs 1 - 2016 Annual Summary Report (Astron Environmental Services 2016)
- Rio Tinto Flora Database - Newman Highway (No Report Observation) (Rio Tinto Iron Ore 2019)
- Weed Control Program – Inland Operations, Hope Downs 1 – 2017 Annual Summary Report (Astron Environmental Services 2018).

3.1.3 Likelihood of Occurrence Assessment

Prior to conducting the field survey, aerial imagery was interpreted to identify potential habitat types. The conservation significant flora taxa identified from the database searches and recorded within previous projects in the vicinity of the survey area were then categorised according to the criteria in Table 6 for potential occurrence within the survey area.

Table 6: Criteria used to assess the likely presence of conservation significant flora in the survey area.

Likelihood of occurrence	Occurrence criteria
Likely	Taxa previously recorded within the survey area or within 10 km of the survey area and suitable habitat appears to be present in the survey area
Potential	Taxa previously recorded within 10 km to 20 km of the survey area and/or suitable habitat appears to be present in the survey area
Unlikely	No suitable habitat appears to be present in the survey area
Recorded	Taxa recorded within the survey area during the current survey
Previously recorded	Taxa recorded from a previous survey within the survey area but not recorded during the current survey

Following all phases of the field survey, the likelihood of occurrence of conservation significant flora taxa not encountered within the survey area was reassessed. Taxa identified during the desktop assessment as having potential to occur were categorised post-field visit based on: the proximity of known populations to the survey area, the presence and level of inspection of suitable habitats within the survey area and the life form, preferred habitat and flowering times for each taxon (Appendix E). The TP list (Department of Biodiversity, Conservation, and Attractions 2019d) is generated according to place names as opposed to locality; as such conservation significant flora may be recorded that occur beyond the 50 km search area. These taxa have been retained in the assessment of likelihood of occurrence (Appendix E).

3.2 Field Survey

3.2.1 Survey Timing and Personnel

Survey timing for each of the three phases, the personnel involved and their collection licence numbers are shown below in Table 7. Each botanist involved with the survey is familiar with undertaking flora and vegetation assessments in the Pilbara region.

Table 7: Personnel involved in survey.

Phase and date	Personnel	Qualifications and experience	Licence numbers
Phase 1 1 to 12 November 2017	Ben Eckermann - Senior Botanist	BSc (Environmental Science) Grad Cert Sc (Land & Water Mgt) 13 years of botanical experience	Flora Permit SL012181; DRF Permit 48-1617
	Lucy Dadour - Botanist	BSc (Conservation Biology) 7 years botanical experience	Flora Permit SLO12123
	Linda Vaughan - Botanist	BSc (Botany & Geography) 14 years of botanical experience	Flora Permit SL011984
	Melissa Hay - Botanist	BSc Hon. (Environmental Biology) 14 years of botanical experience	Flora Permit SL012248
Phase 2 18 to 30 May 2018	Ben Eckermann - Senior Botanist	See above	Flora Permit SL012249; DRF Permit 66-1718
	Lucy Dadour – Botanist	See above	Flora Permit SL012252
	Linda Vaughan – Botanist	See above	Flora Permit SL012241
	David Leach - Botanist	BSc Hon. (Conservation & Park Management) PhD (Plant Biology) 11 years of botanical experience	Flora Permit SL012379
Phase 3 20 to 31 May 2019	Ben Eckermann - Senior Botanist	See above	Flora Permit SL012522; DRF Permit 75-1819
	Dr Kellie McMaster - Senior Botanist	BSc (Zoology) PhD (Zoology) 11 years of botanical experience	Flora Permit SL012520; DRF Permit 56-1819
	Daniel Roocke - Senior Botanist	BSc (Botany & Ecology) 9 years of botanical experience	Flora Permit SL012517
	Lucy Dadour – Botanist	See above	Flora Permit SL012524; DRF Permit 44-1819

3.2.2 Weather

Daily observations for rainfall and temperature were recorded by Rio Tinto at the HD1 Weather Station; however there was a period between 13 and 31 January 2018 where data was not recorded. Data was substituted for this period from the nearby Hope Downs 4 Weather Station which is approximately 48 km south-east of the HD1 Weather Station. Long term rainfall and temperature observations were sourced from the Newman Aero Bureau of Meteorology station (number 007176), approximately 90 km south-east of the survey area and 87 km south-east of the HD1 Weather Station. Local rainfall and temperatures preceding the survey are presented in Figure 3.

Rainfall recorded in the 12 months prior to the Phase 1 survey in November 2017 was 494.8 mm, 174.5 mm more than the long-term mean of 320.3 mm. The majority of this rain fell during an active summer cyclone season, with 340.6 mm being recorded between January and February 2017. In the three months preceding the Phase 1 survey, 2 mm was recorded, the long term mean for the same period was 16.5 mm. The mean maximum temperature of 36.9°C for November 2017 was slightly below the long term maximum temperature of 37.5°C.

Rainfall recorded in the 12 months prior to the Phase 2 survey in May 2018 was 208.8 mm, 111.5 mm less than the long-term mean. In the three months preceding the Phase 2 survey, 75.6 mm was recorded, the long term mean for the same period was 136.1 mm. The mean maximum temperature of 26.6°C for May 2018 was slightly below the long term maximum temperature of 27.1°C.

Rainfall recorded in the 12 months prior to the Phase 3 survey in May 2019 was 110.1 mm, 210.2 mm less than the long-term mean. In the three months preceding the Phase 3 survey, 71.8 mm was recorded, 62.6 mm less than the long-term mean for the same period. The mean maximum temperature of 27.9°C for May 2019 was slightly above the long term maximum temperature of 27.2°C.

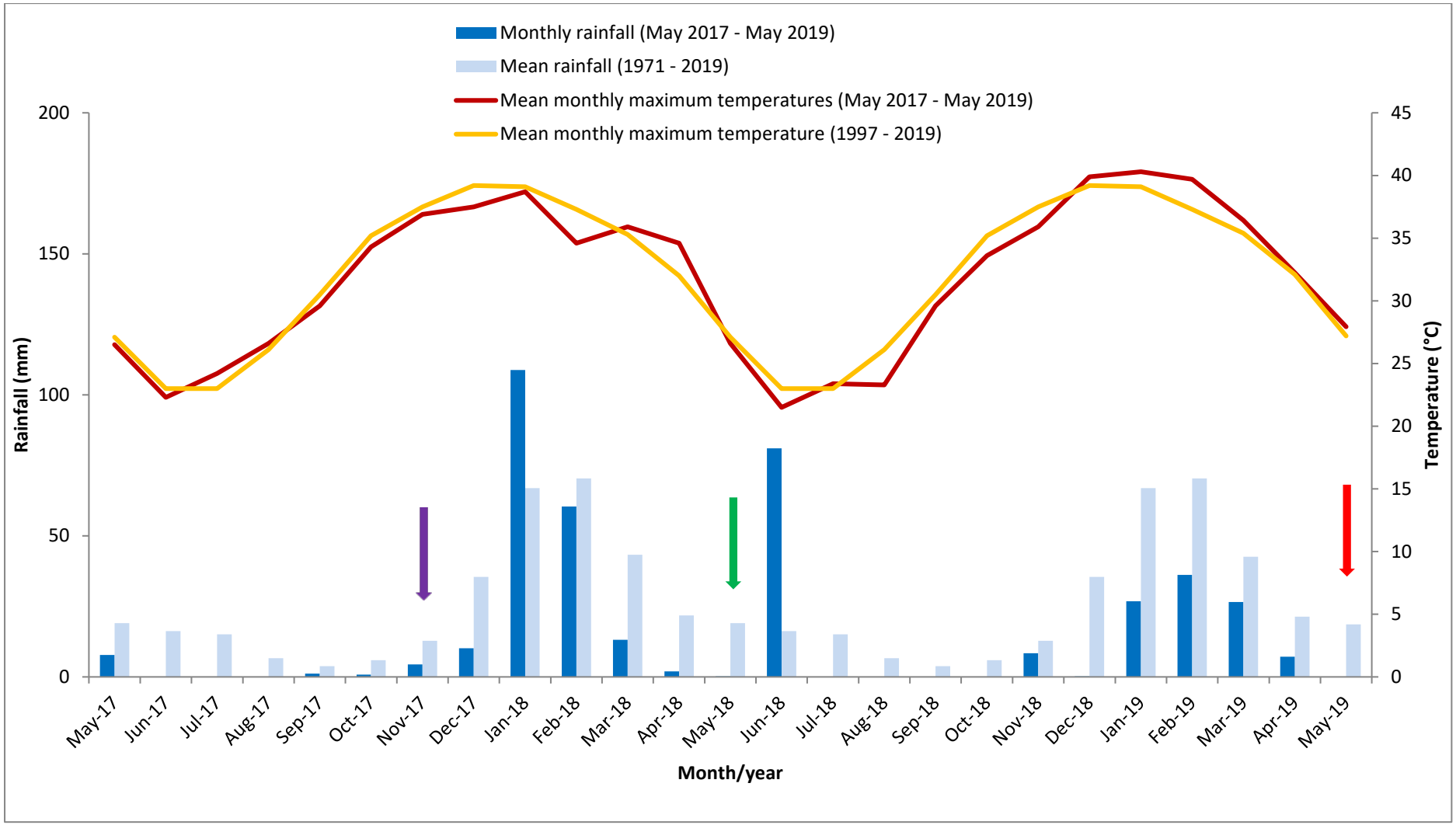


Figure 3: Mean monthly and recorded monthly rainfall (mm) and mean monthly and recorded monthly maximum temperatures (°C).

Daily records supplied by Rio Tinto and long term records supplied by the Bureau of Meteorology from the Newman Aero station (number 007176) (Bureau of Meteorology 2019). The purple arrow displays the timing for the Phase 1 survey, the green arrow displays the timing for the Phase 2 survey and the red arrow displays the timing for the Phase 3 survey.

3.2.3 Vegetation and Flora Assessment

The survey was undertaken over three phases in accordance with the requirements outlined in the provided Scope of Works, dated 18 September 2017 (Phase 1), 7 March 2018 (Phase 2) and 13 December 2018 (Phase 3), as well as the requirements of the EPA and Rio Tinto policy and guidance documents (Environmental Protection Authority 2002, 2004, 2016a, 2016b; Rio Tinto Iron Ore 2019).

Information acquired during the desktop assessment assisted in the design of the field survey prior to Phase 1 in 2017. Pre-survey planning involved the examination of 1:10,000 scale aerial photographic images to identify potentially different landforms, habitat and vegetation units. It also involved a review of the flora and vegetation assessments previously completed in the vicinity of the survey area to provide context and identify data gaps. Proposed quadrat locations were identified prior to the field survey according to the replicates required to support the previous vegetation mapping; these were adjusted on site as appropriate.

None of the existing quadrats from previous surveys were able to be relocated for resampling during Phase 1 and Phase 2. Two quadrats (BHD05 and BHD10) in the Baby Hope area (Biota Environmental Sciences 2014) were able to be located during Phase 3 and were rescored.

Seventy sites were installed during Phase 1, comprising 55 quadrats and 15 relevés. A total of 69 sites established in Phase 1 were rescored during Phase 2, with an additional two relevés sampled. The Phase 3 survey installed 23 quadrats and four relevés and rescored the one remaining site from Phase 1. The total number of quadrats and relevés surveyed was 99 (Table 8).

Quadrats were positioned by measuring a square of 50 m by 50 m, where terrain allowed, with the four corners marked with a fence dropper positioned in the north-west and south-east corners and flagging tape in the alternate corners. Dimensions of the quadrat were adjusted where required, according to terrain, drainage and landform features, to represent an estimated 2,500 m^2.

Relevés were used where the installation of quadrats was limited, such as gorges, drainage lines, steep slopes and in vegetation units affected by recent fires. Data from relevé locations were sampled from an area of approximately 2,500 m^2. Mapping notes were also taken to support the vegetation mapping, these varied in detail but generally included location coordinate, photograph, vegetation description, dominant species, vegetation condition and fire history.

The following information was collected for each quadrat and relevé:

- Location – coordinates measured using a handheld global positioning system (GPS) unit (MGA50, GDA94) at each of the four corners of the site.
- Recorder and date –personnel involved in sampling that site and the survey date.
- Habitat – a broad description of the surrounding landscape based on landform, topography and soil.
- Soil – including colour and texture.
- Rock type and abundance – general description of surface geology and amount of ground covered by rocks.
- Vegetation description – vegetation described according to level V of the NVIS (Department of the Environment and Energy 2017a) and classified according to the Aplin (1979) modification of the vegetation classification system of Specht (1970) (Appendix F).
- Vegetation condition – assessed according to the vegetation condition classification adapted from Trudgen (1988) (Appendix F).

- Species list – percentage foliar cover (PFC) and maximum height were recorded for each vascular plant taxon present within the site. The inventory was comprehensive for relevé locations, with an estimated quadrat dimension searched intensively.
- Disturbances – records of any obvious disturbances such as fire, tracks or grazing.
- Photographs – a photograph was taken at the north-west and south-east corners of each quadrat or from a representative location for relevés.

Table 8: Number of sites surveyed in each phase within the survey area.

Phase of survey	Number of sites	Name of sites
Two phases of survey:	55 quadrats 15 relevés	Quadrats: HD01, HD02, HD03, HD04, HD05, HD06, HD07, HD08, HD09, HD10, HD11, HD12, HD13, HD14, HD15, HD16, HD17, HD18, HD19, HD20, HD21, HD22, HD23, HD24, HD25, HD26, HD27, HD28, HD29, HD30, HD31, HD32, HD33, HD34, HD35, HD37, HD38, HD39, HD40, HD41, HD42, HD43, HD44, HD46, HD47, HD48, HD49, HD50, HD51, HD52, HD53, HD54, HD55, BHD05-AR, BHD10-AR Relevés: HDR01, HDR02, HDR03, HDR04, HDR05, HDR06, HDR07, HDR08, HDR09, HDR10, HDR11, HDR12, HDR13, HDR14, HDR16
One phase of survey	23 quadrats 6 relevés	Quadrats: GH01, GH02, GH03, GH04, GH05, GH06, GH07, GH08, GH09, GH11, GH12, GH13, GH15, GH17, GH19, GH20, GH21, GH22, GH23, GH24, GH25, GH26, GH27 Relevés: HDR18, HDR19, GHR10, GHR16, GHR28, GHR30

Quadrat distribution was designed to have spatial spread over the survey area. There were limitations on the ability to establish quadrats in parts of the survey area affected by recent fire and also within drainage lines, gorges and on slopes where access was limited. Unburnt vegetation was preferentially targeted for installing quadrats to show climax vegetation assemblages, however a number of relevés were established in recently burnt areas where necessary to achieve survey site replication.

Due to its restricted occurrence one vegetation unit (H5) did not have any sites sampled from within the survey area. Vegetation unit H5 was noted in four small areas which had a total area of < 2 ha; as such it was difficult to adequately sample the vegetation without capturing influences from adjacent habitats and vegetation. Vegetation unit H5 was described using data collected from outside of the survey area (quadrats GH18 and GH31) in adjacent similar habitats. The data from these sites is presented to assist in interpretation, but they were not located within the survey area.

Vegetation unit H9 occurred on two small hills in HD2 associated with the Rocklea land system. This area was affected by fire in 2016 and the single quadrat was placed in an area of unburnt vegetation. There was insufficient unburnt vegetation to place further quadrats and as such, H9 had fewer than the recommended three site replication.

Vegetation unit D7 occurred on floodplain terraces surrounding Pebble Mouse Creek, a major drainage line near Baby Hope Downs within the survey area. There were only two locations where the survey area intersected this vegetation unit with enough space to establish quadrats. As such, D7 had fewer than the recommended minimum three sites replication.

Vegetation unit D8 was described following post-survey assessment of quadrat data. The presence of *Eucalyptus xerothermica* as a dominant upper stratum species separated the two sampled sites

from other mulga vegetation units it had been mapped as during the field visit and as such had fewer than the recommended minimum three sites replication.

Vegetation unit P4 occurred on open hardpan plains near major drainage lines within the survey area. There were only two locations where the survey area intersected this vegetation unit with enough space to establish quadrats. As such, P4 had fewer than the recommended minimum three sites replication.

3.2.4 Vegetation Description and Mapping

Existing vegetation mapping conducted by Mattiske Consulting (2009a, 2009b, 2010) in the survey area was ground-truthed and assessed during the initial stages of the Phase 1 survey and found to be a poor representation of the vegetation in situ. Rather than attempting to consolidate the previous work, it was considered the best approach to conduct new vegetation mapping across the survey area during the Phase 1 and Phase 2 surveys.

Vegetation codes using an alpha prefix were applied based on the position in the landscape, e.g. H for hills and slopes, P for plains and D for drainage lines. Vegetation units were described at NVIS Level V – Association level using the data collected from quadrats, relevés and mapping notes and boundaries were refined through foot traverses. Printed colour aerial photographic images at a scale of 1:10,000 were used in the field to assist in navigation and for delineating boundaries between vegetation units.

Fire had affected 5,221.4 ha (48.3%) of the survey area within the previous five years (2015-2019). No fire was recorded in 2018 and 2019. The effects of the 2015 fire were the most widespread with 30.2 % of the survey area burnt (Darwin Centre for Bushfire Research 2018). Fire-responsive regenerator species occurred in these areas and climax vegetation was often difficult to infer. In recently burnt areas, the vegetation mapping was extrapolated from surrounding unburnt areas by comparing flora species presence and relevant landform features (Figure G.1, Appendix G).

3.2.4.1 Vegetation Condition Mapping

Vegetation condition was generally mapped according to vegetation unit boundaries throughout the survey area using a combination of quadrat, relevé and mapping note data, opportunistic weed observations and the mean condition rating for each vegetation unit. Vegetation condition was rated at each survey site using the five point Trudgen (1988) scale and the condition rating was generally applied to the whole vegetation unit polygon in which it was mapped. In landforms where weed and disturbance presence was consistent, e.g. drainage lines, condition was generally applied across the entire landform. A mean condition rating for each vegetation unit was extracted from the data collected at survey sites and this information was then used to apply condition ratings in polygons not already attributed with a rating.

3.2.5 Targeted Flora Survey

Previously recorded conservation significant flora records and associated habitat preference information assisted in identifying vegetation units and habitat within the survey area that had potential to support conservation significant flora. Habitats and vegetation units in the survey area considered to have the greatest potential to support conservation significant flora were preferentially targeted in the field. Traverses were spaced according to the accessibility of habitats, but generally observers were 30 m to 50 m apart. Where conservation significant flora was encountered, a waypoint was recorded to represent one or a number of individuals within a 20 m radius, along with notes about the habitat and reproductive status of the population. During the Phase 2 survey priority was given to conducting searches in areas considered most likely to support

P1 and P2 taxa. In particular, the south facing upper slopes and gorges and the drainage lines were targeted. The Phase 3 survey focused on creeks likely to support *Aristida lazaridis* P2 and an area in the east of BHT within the H2 vegetation unit considered likely to support *Eremophila* sp. West Angelas (S. van Leeuwen 4068) P1.

3.3 Taxonomy and Nomenclature

Plant specimens that were not identified in the field were identified in Perth by Ben Eckermann following Phase 1, by Dr Palitha Jayasekara (Astron Botanist) following Phase 2, and by Lucy Dadour and Dr Palitha Jayasekara following Phase 3. These botanists have worked extensively in the Pilbara and are highly familiar with the flora of the region. The assigned nomenclature is consistent with the current listing of scientific names recognised by the Western Australian Herbarium (WA Herbarium) and was used for the species list and associated species information collected. Where specimens had inadequate descriptive material to allow confident identification, they were assigned a 'sp.' (species) epithet, indicating that identification could not be confirmed beyond genus level. Data from each quadrat, relevé and mapping note were entered into a customised database (Spatial Networks Inc 2000 - 2018). Range extensions and conservation significant taxa were submitted to the Rio Tinto sponsored taxonomist Steven Dillon at the WA Herbarium for confirmation.

3.4 Floristic Analysis

A species accumulation curve was created in order to examine the adequacy of survey effort, while a numerical cluster analysis using species PFC and presence/absence of perennial native taxa was conducted to identify statistically significant floristic groups. The species accumulation curve was completed using R 3.2.1 (R Development Core Team 2015) while the cluster analysis was completed using PRIMER v6 software (Clarke and Gorley 2006). Both analyses were performed by Astron Senior Scientist Dr Aaron Gove.

Cluster analyses were completed to examine the relationship between:

- floristic groups and structural vegetation units within the survey area
- survey area quadrats and relevés and broader local scale quadrats and relevés.

Following normal convention, statistically significant clusters were those distinguished by a P-value <0.05. Square root transformation of the PFC data from the 99 quadrats and relevés was used to examine the relationship of sites within the survey area. An analysis of presence/absence data from the 99 quadrats and relevés within the survey area was also undertaken.

A further analysis of perennial native taxa was conducted using the presence/absence data of 856 sites, made up of the 99 sites from the survey area and 757 sites from previous surveys in the vicinity. This analysis was conducted in order to provide a broader regional comparison (Biota Environmental Sciences 2006; Mattiske Consulting 2008b, 2009b, 2010; Ecologia Environment 2013; Biota Environmental Sciences 2014).

3.5 Limitations

Following completion of the desktop assessment and field surveys, a review of any limitations that may have affected a complete assessment of the data collected was conducted. The limitations listed in Table 9 are based on those suggested as considerations in the EPA Guidance Statements 51 (Environmental Protection Authority 2004) and current Technical Guidance for Flora and Vegetation Surveys (Environmental Protection Authority 2016b).

Table 9: Statement of limitations.

Potential limitation	Statement regarding potential limitation
(i) Sources of information and availability of contextual information Is the region well documented?	Previous biological surveys have been conducted in the broader locality, and broad-scale information is available from Beard (1975) and Payne et al. (1980). There is a recognised lack of plot based databases to compare floristic data within the Pilbara region. The broader regional data used in the contextual analysis of projects from the vicinity of the survey area highlighted the differing standards of biological surveys previously conducted. Nine previous biological reports were considered for providing relevant contexual information for floristic analysis and vegetation mapping for the survey area (Section 3.1.2). Despite there being varying biological focus, intensity of survey and quality of the previous work, contextual information is not considered a limiting factor of this survey.
(ii) Scope The level of survey and detail required to undertake the survey. Was there adequate time to complete the survey to the desired standard?	All parts of the survey area were able to be accessed, although some habitats, such as steep rugged hillslopes, were not able to be thoroughly traversed. There was adequate time to complete the flora and vegetation surveys, vegetation mapping, and targeted searches for threatened and priority flora within the survey area that could be safely accessed, as outlined in the scope of works. The time available to complete the survey is not considered a limiting factor of the assessment.
(iii) Proportion of flora and fauna identified, recorded and/or collected Was the survey sampling, timing and intensity considered adequate? Was the survey conducted at what was considered an appropriate time of the year for plant identification? Were any taxonomic groups considered to be under-represented?	The field surveys were conducted during late spring in November 2017 and late autumn, in May 2018 and May 2019. Sampling intensity was considered adequate, with a minimum of three sampling sites achieved in most vegetation units. Most flora taxonomic groups expected within the survey area were well represented; the total floristic richness was considered comparable to other surveys in the area and the species accumulation curve indicated that between 76% and 90% of the total flora expected in the survey area was sampled. Twenty of the conservation significant flora taxa listed in database search results were assessed as still having the potential to occur in the survey area following all phases of the field survey (Appendix E). Eight of these are annual or short-lived perennial species. The dry seasonal conditions may have contributed to these taxa not being observed within the survey area.
(iv) Completeness Is there further work which may be required i.e. was the relevant area fully surveyed?	The survey area was considered adequately surveyed to the level required to compile a representative list of species, (including the majority of conservation significant and introduced flora taxa) as well as to describe and map vegetation at a level appropriate for possible future management decisions. Five vegetation units (H5, H9, P4, D7, D8) in the survey area did not meet EPA (2016a) requirements for quadrat replication; this was generally due to either a lack of area within accessible parts of the survey area large enough to establish suitable quadrats, or theavoidance of burnt vegetation. One vegetation unit was described post-survey on assessment of the data and had not achieved three replicate quadrats during the survey. The recorded distribution and estimated abundance of the conservation significant taxa within the survey area is not exhaustive and is only a representation of the targeted nature of the surveys. Completeness is therefore considered a minor limitation of this survey but is unlikely to have significantly affected the outcomes of the assessment. .

Potential limitation	Statement regarding potential limitation
(v) Mapping reliability Were the aerial photographs, satellite images and site maps available considered adequate to fully understand the area surveyed? Was the mapping generated considered to have a high degree of reliability?	Colour aerial photography at a scale of 1: 10,000 was used to locate the survey area and to assist in navigation and delineation of vegetation boundaries. The aerial photography was of sufficient resolution and, in general, accurately represented ground conditions. The disturbance mapping layers provided post-survey did not completely align with observations made by the field team, and as such there may be some discrepancies between the reported and current disturbed area; small anomalies in condition mapping are not unusual for a survey area of this size and in this instance is not considered to affect the outcomes or interpretation of survey results.
(vi) Timing When was the survey conducted in terms of season, rainfall, severe weather events etc.? Was the survey conducted at an appropriate time for access, observation of the optimal suite of species and for identification of flowering and fruiting species?	There was below average rainfall for the three months preceding the Phase 1 survey in November 2017, and no significant rainfall since April 2017. Seasonal conditions were considered below average for the Phase 2 survey in May 2018, with below average rainfall for the three months preceding the survey including a drier than average wet season. Seasonal conditions were considered below average for the Phase 3 survey in May 2019, with below average rainfall for both the 12 and three months preceding the survey. As a result, few ephemeral taxa were recorded during the Phase 2 and 3 surveys. There is potential that annual or short-lived perennial conservation significant species may occur but were not present at the time of the survey. Identification of grasses was unreliable across all phases, in particular affecting the interpretation of the grass species assemblage in the P2 vegetation unit. The diversity of species was considered representative, however the spatial distribution of annual and herbaceous species was likely to be reduced and as such timing is considered a limiting factor of this survey.
(vii) Disturbance Had the survey area been impacted by any disturbance which may have limited the survey, i.e. fire, flood, accidental human intervention etc.?	A number of tracks within the survey area had been cleared for exploration drilling. Areas in the vicinity of the central northen part of the survey area were being cleared during the Phase 3 survey. Significant areas within the survey area had been burnt between 2015 and 2016. The upland plateaux and north-facing upper slopes of BHT and the undulating spinifex plains and dolerite habitats of HD2 were the most affected, limiting targeted flora searches, vegetation mapping and quadrat site selection. The vegetation had begun to regenerate in these areas and was dominated by post-fire colonising species, however the structural vegetation units were often difficult to assess. Disturbance is therefore considered a minor limitation of this survey.
(viii) Intensity In retrospect, was the intensity considered to be adequate?	Despite the seasonal conditions and survey timing being sub-optimal, the intensity of the survey was considered adequate to compile a representative species list and map the vegetation of the survey area to association level. The majority of habitat likely to support the P1 and P2 conservation significant flora taxa was surveyed adequately. Habitat supporting large numbers of conservation significant flora on BHT were rugged south-facing upper slopes and gorges which were difficult to access and conduct targeted searches efficiently, however areas with potential for conservation significant flora that could be safely accessed were traversed.

Potential limitation	Statement regarding potential limitation
(ix) Resources Were the appropriate tools and materials available to complete the task effectively?	Resources were adequate to complete the survey and all appropriate tools and materials required to complete the task were available. Only two previous quadrats within the survey area (BHD05 and BHD10 from Biota (2014)) were able to be located for rescoring. No other existing quadrats from Mattiske (2009a, 2009b, 2010) were able to be located within the survey area; as such new sites had to be installed to achieve the desired replication although this did not affect the outcomes of the survey. Resources are therefore not considered to be a limitation of this survey.
(x) Access Were there any factors limiting access to the survey area?	Parts of the survey area cleared for exploration drilling tracks were able to be accessed by vehicle, with areas unable to be reached by vehicle being accessed and traversed by foot. The hot conditions encountered during Phase 1 in particular made this challenging and parts of the survey area were poorly visited due to this restriction. The rugged south-facing slopes of BHT were difficult to safely traverse due to the challenging terrain and therefore could not be thoroughy searched for conservation significant flora in their entirety. Access at Baby Hope Downs was limited due to mining activity and required an escort. There were areas that could not be accessed due to mining infrastructure. Access is therefore considered a minor limiting factor of this survey but is unlikely to have significantly impacted the results of the survey.
(xi) Experience Were personnel undertaking the field survey and plant identification trained and/or experienced in undertaking the required tasks?	The botanists responsible for undertaking the field survey have considerable experience in conducting flora and vegetation surveys in the Pilbara. The identification of specimens collected in the field during Phase 1 was conducted by Ben Eckermann (Senior Botanist), with Phase 2 being conducted by Dr Palitha Jayasekara (Botanist), and Phase 3 by Lucy Dadour and Dr Palitha Jayasekara (Botanists), all of whom have extensive Pilbara botanical experience. Conservation significant flora specimens were confirmed by Steven Dillon at the WA Herbarium. Experience is not considered a limiting factor of this survey.

4 Results

4.1 Desktop Assessment

4.1.1 Environmentally Sensitive Areas

No ESAs intersect the survey area. The nearest ESA is Hamersley Range National Park (1977 boundary), now referred to as Karijini National Park, the nearest boundary of which occurs approximately 35 km west of the survey area (Department of the Environment and Energy 2008).

4.1.2 Vegetation and Flora

No EPBC Act listed MNES TECs or State-listed TECs have been previously recorded within 50 km of the survey area. Eight State-listed PECs have previously been recorded within 50 km of the survey area (Figure C.1, Appendix C, Table 10).

The DBCA mapped buffer for the State-listed priority 1 PEC '*Weeli Wolli Spring Community'* extends over 1,679.4 ha in the eastern and north-eastern part of the survey area (Department of Biodiversity, Conservation, and Attractions 2019b).

The DBCA mapped buffer for the State-listed priority 1 PEC '*West Angelas Cracking-Clays'* occurs approximately 9km south of the survey area. This PEC is composed of open tussock grasslands of *Astrebla pectinata, A. elymoides* and *Aristida latifolia*, in combination with low scattered shrubs of *Sida fibulifera*, on basalt derived cracking-clay loam depressions and flowlines (Department of Biodiversity, Conservation, and Attractions 2019b).

The DBCA mapped buffers for the State-listed priority 1 PEC '*Coolibah – Lignum Flats, sub type 2*' occur approximately 9 km north of the western end of the survey area. The priority 1 '*Coolibah – Lignum Flats, sub type 2*' PEC is composed of woodland or forest of *Eucalyptus victrix* (coolibah) over thicket of *Duma florulenta* (lignum) on red clays in run-on zones. Associated species include *Eriachne benthamii, Themeda triandra, Aristida latifolia, Eulalia aurea* and *Acacia aneura* (Department of Biodiversity, Conservation, and Attractions 2019b).

Table 10: Priority ecological communities previously recorded within 50 km of the survey area.

Ecological community description	Conservation category	Distance from survey area (km)
Weeli Wolli Spring Community	P1	Buffer overlaps survey area
West Angelas Cracking-Clays	P1	9 km south-west
Coolibah - Lignum Flats, sub type 2	P1	10 km north-west
Kumina Land System	P3	21 km east
Brockman Iron Cracking Clay Communities	P1	33 km west
Fortescue Valley Sand Dunes	P3	38 km north-east
Fortescue Marsh	P1	45 km north
Freshwater Claypans of the Fortescue Valley	P1	67 km north

The DBCA TPFL, TP List, WA Herbarium database searches, NatureMap, the Protected Matters Search Tool and a review of the previous projects conducted within the vicinity of the survey area (Section 3.1.2) indicated a total of 82 conservation significant flora taxa have been previously recorded within 80 km of the survey area (Table E.1, Appendix E) (Department of Biodiversity,

Conservation, and Attractions 2019a, 2019d, 2019c, 2019e; Department of the Environment and Energy 2019; Rio Tinto Iron Ore 2019). This includes two threatened, 13 P1, 17 P2, 43 P3 and seven P4 listed taxa. The pre-survey desktop assessment indicated 27 of the listed conservation significant flora species were considered likely to occur (including 14 previously recorded species) and a further 17 were considered to have the potential to occur within the survey area (Table E.1, Appendix E).

4.1.3 Literature Review

Results of the literature review indicate that no TECs and two PECs: '*Weeli Wolli Spring Community*' and '*West Angelas Cracking-Clays*' have been previously recorded from projects within 50 km of the survey area. Twenty-four currently listed conservation significant taxa have been previously recorded from previous projects either inside or within 50 km of the survey area (Table 11) (Biota Environmental Sciences 2006; Ecologia Environment 2013; Mattiske Consulting 1995, 2008b, 2009b, 2009a, 2010; Biota Environmental Sciences 2014).

Table 11: Summary of relevant vegetation and flora surveys in the vicinity of the survey area.

Survey parameter	Mattiske (1995) Flora and vegetation – Southern Transport Corridor – Yandicoogina Junction Project Area	Biota (2006) Hope Downs Rail Corridor (Juna Downs Section) Vegetation and Flora Survey	Mattiske (2008b) Flora and Vegetation on the Hope Downs 4 Lease Area	Mattiske (2008d) Hope Downs 4 Mine Infrastructure Corridor	Mattiske (2009a) Flora and vegetation of the Hope Downs 1 Area	Mattiske (2009b) Flora and Vegetation on the Hope Downs 4 Mine Pipeline Corridor to Ophthalmia Dam	Mattiske (2010) Flora and Vegetation of the Hope Downs 2 Area	Ecologia (2013) Rio Tinto Greater West Angelas Vegetation and Flora Assessment	Biota Environmental Sciences (2014) Baby Hope Downs Flora and Vegetation Survey
Survey area size (ha)	26,500	~100,000	Not presented	Not presented	Not presented	Not presented	Not presented	17,596	1,652
Survey focus	Level 2 – Single phase	Level 2 – Single phase	Vegetation mapping (expanding work presented in Mattiske (2005))	Vegetation mapping (expanding work presented in Mattiske (2005, 2008b, 2009b))	Vegetation mapping (expanding work presented in Mattiske (1995, 2005, 2008c, 2008d, 2009c))	Vegetation mapping (expanding work presented in Mattiske (2005, 2008c, 2008d))	Vegetation mapping (expanding work presented in Mattiske (1995, 2005, 2008c, 2008d, 2009a, 2009c))	Level 2 – Reported as two phase but both field trips in the same season	Level 2 – Two phase
Survey timing	January and March 1994, February 1995	September and October 2005, February 2006	December 2004, January 2005, February 2005, May 2005, September 2007, April 2008 and May 2008	May 2008	June 2009	April 2009	September 2007	July and August 2012	October and November 2014
Seasonal conditions	Not presented	Average to favourable	Average to favourable	Favourable	Not presented	Optimal	Average	Favourable	Favourable
Survey effort (quadrats/relevés)	116 sites	37 quadrats and 1 relevé (also presented 4 sites from Halpern Glick Maunsell (2000))	267 permanent sites: 10 sites – Jan 2005 47 sites – Feb 2005 63 sites – May 2005 17 sites – Sep 2007 105 sites – Apr 2008 25 sites – May 2008	139 permanent sites	32 additional permanent sites (also presented 139 sites from Mattiske (2008d))	83 additional permanent sites (also presented 139 sites from Mattiske (2008d))	118 permanent sites	150 quadrats	29 quadrats 13 relevés
Total vegetation units mapped	32	25	17	25	18	23	16	22	12
Conservation significant ecological communities recorded	0	0	0	1 PEC - *Weeli Wolli Spring Community*	1 PEC - *Weeli Wolli Spring Community*	1 PEC - *Weeli Wolli Spring Community*	0	1 PEC - *West Angelas Cracking Clays*	0
Total taxa recorded	392	382	472	392	217	262	212	441	354
Conservation significant flora species recorded (currently listed - as at August 2018)	2	1	5	5	7	0	1	11	5
Aristida lazaridis P2								✓	
Eremophila pusilliflora P2								✓	
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2									✓
Acacia subtiliformis P3					✓			✓	
Aristida jerichoensis var. *subspinulifera* P3								✓	
Eremophila forrestii subsp. *viridis* P3				✓					
Eremophila magnifica subsp. *velutina* P3					✓				✓

Survey parameter	Mattiske (1995) Flora and vegetation – Southern Transport Corridor – Yandicoogina Junction Project Area	Biota (2006) Hope Downs Rail Corridor (Juna Downs Section) Vegetation and Flora Survey	Mattiske (2008b) Flora and Vegetation on the Hope Downs 4 Lease Area	Mattiske (2008d) Hope Downs 4 Mine Infrastructure Corridor	Mattiske (2009a) Flora and vegetation of the Hope Downs 1 Area	Mattiske (2009b) Flora and Vegetation on the Hope Downs 4 Mine Pipeline Corridor to Ophthalmia Dam	Mattiske (2010) Flora and Vegetation of the Hope Downs 2 Area	Ecologia (2013) Rio Tinto Greater West Angelas Vegetation and Flora Assessment	Biota Environmental Sciences (2014) Baby Hope Downs Flora and Vegetation Survey
Eremophila sp. Hamersley Range (K. Walker KW 136) P3									✓
Goodenia lyrata P3									✓
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727) P3		✓	✓		✓				
Gymnanthera cunninghamii P3			✓						
Indigofera gilesii P3								✓	
Rhagodia sp. Hamersley (M. Trudgen 17794) P3	✓		✓	✓				✓	
Rostellularia adscendens var. *latifolia* P3					✓				
Sida sp. Barlee Range (S. van Leeuwen 1642) P3								✓	
Stylidium weeliwolli P3	✓			✓	✓				
Themeda sp. Hamersley Station (M.E. Trudgen 11431) P3			✓					✓	
Triodia sp. Mt Ella (M.E. Trudgen 12739) P3								✓	
Acacia bromilowiana P4					✓				
Eremophila magnifica subsp. *magnifica* P4					✓				✓
Eremophila youngii subsp. *lepidota* P4			✓	✓					
Goodenia nuda P4								✓	
Lepidium catapycnon P4				✓				✓	
Ptilotus mollis P4							✓		

4.2 Field Survey

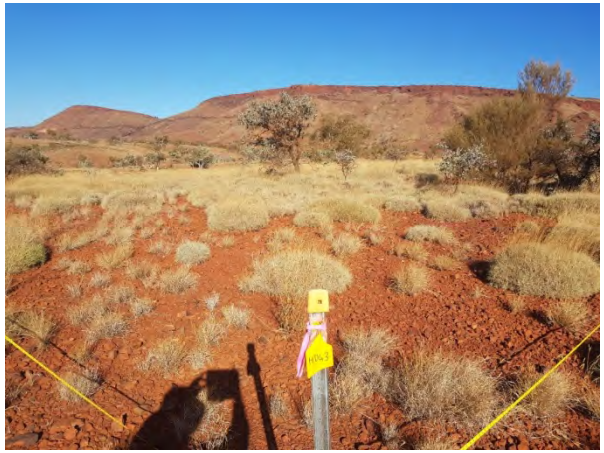
4.2.1 Vegetation

There were 23 vegetation units recorded across the survey area; these were broadly categorised according to three landform types: hills and slopes, plains, and drainage lines. Areas where vegetation had been removed for roads, tracks and mining activities were mapped as 'cleared'. Vegetation mapping, quadrat and relevé locations are presented in Figure H.1 – H.26 (Appendix H), survey site data is provided in Appendix I, and vegetation unit descriptions and representative photos are presented in Table 12.

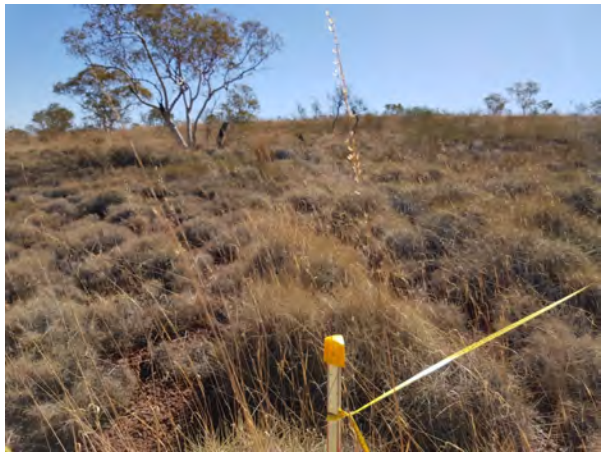
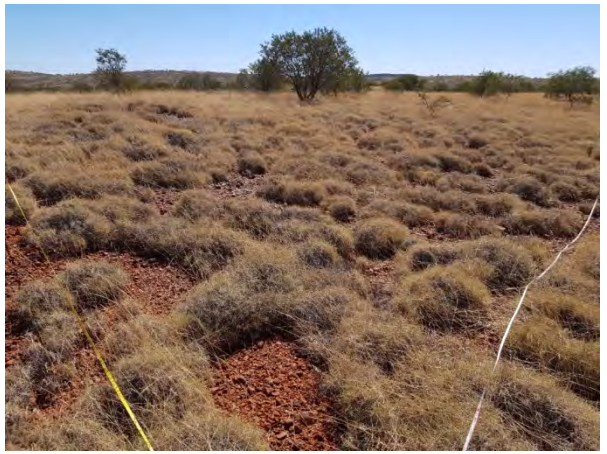
Table 12: Vegetation units described for the survey area.

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
Vegetation of Hills and Slopes				
H1 – *Eucalyptus leucophloia* subsp. *leucophloia*, *Corymbia hamersleyana* sens. lat. scattered low trees to low open woodland over *Petalostylis labicheoides, Senna glutinosa* subsp. *glutinosa* scattered tall shrubs over *Gompholobium oreophilum*, *Acacia hilliana, A. spondylophylla* low open shrubland to low shrubland over *Triodia vanleeuwenii*, *T. wiseana*, *T. pungens* open hummock grassland with *Amphipogon sericeus* scattered tussock grasses **Associated species:** *Acacia pyrifolia*, *Codonocarpus cotinifolius*, *Corchorus lasiocarpus* subsp. *parvus*, *Cymbopogon ambiguus*, *Duperreya commixta*, *Goodenia stobbsiana*, *G. triodiophila*, *Hakea chordophylla*, *Ptilotus calostachyus*, *Scaevola browniana*, *Senna glaucifolia*, *Sida* sp. Excedentifolia (J.L. Egan 1925)	HD04, HD13, HD15	Excellent	H1: 624.3 (5.8)	 **Plate 1: Vegetation unit H1.**

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
H2 – *Eucalyptus repullulans* scattered low mallees over *Acacia catenulata* subsp. *occidentalis*, *A. aptaneura*, (*Grevillea saxicola*) tall shrubland to tall open scrub over *Scaevola acacioides, Dodonaea pachyneura, Eremophila latrobei* subsp. *filiformis* scattered shrubs to open shrubland over *Triodia pungens* scattered hummock grasses to very open hummock grassland with *Eriachne mucronata* scattered tussock grasses to very open tussock grassland **Associated species:** *Acacia mulganeura, A. pruinocarpa*, *Aristida contorta*, **Bidens bipinnata*, *Cheilanthes lasiophylla*, *Duperreya commixta*, *Dysphania rhadinostachya* subsp. *rhadinostachya, Enchylaena tomentosa* var. *tomentosa, Enneapogon lindleyanus*, *Enneapogon polyphyllus, Eremophila platycalyx subsp. pardalota, Eriachne pulchella*, *Eucalyptus leucophloia* subsp. *leucophloia, Paraneurachne muelleri*, *Paspalidium clementii*, *Psydrax suaveolens*, *Ptilotus exaltatus*, *Ptilotus obovatus*, *Santalum lanceolatum*, *Senna glutinosa* subsp. ×*luerssenii*, *Solanum lasiophyllum*, *Triodia vanleeuwenii, T. wiseana*	HD03, HD07, HD52, GH11	Very Good-Excellent	H2: 314.8 (2.9)	 Plate 2: Vegetation unit H2.

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
H3 – *Corymbia deserticola* subsp. *deserticola* scattered low trees over *Acacia inaequilatera*, *Hakea chordophylla* scattered tall shrubs to tall open shrubland over *Senna glutinosa* subsp. *pruinosa* scattered shrubs over *Triodia vanleeuwenii* open hummock grassland with *Amphipogon sericeus* scattered tussock grasses to very open tussock grassland **Associated species:** *Acacia bivenosa*, *Corchorus lasiocarpus* subsp. *parvus*, *Cymbopogon obtectus*, *Dampiera candicans*, *Eucalyptus leucophloia* subsp. *leucophloia*, *Gompholobium oreophilum*, *Goodenia stobbsiana*, *Hibiscus sturtii* var. *campylochlamys*, *Indigofera monophylla*, *Paraneurachne muelleri*, *Polycarpaea holtzei*, *Ptilotus astrolasius*, *Ptilotus calostachyus*, *Ptilotus exaltatus*, *Ptilotus rotundifolius*, *Senna glutinosa* subsp. *glutinosa*, *S. glutinosa* subsp. ×*luerssenii*, *Sida arenicola*, *Solanum lasiophyllum*	HD05, HD43, HDR14, HDR16, GH19	Excellent	H3: 445.2 (4.1)	 Plate 3: Vegetation unit H3.
H4 – *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Senna glutinosa* subsp. *glutinosa*, *S. glutinosa* subsp. *pruinosa* scattered shrubs over *Triodia vanleeuwenii* and/or *T. wiseana* open hummock grassland to hummock grassland **Associated species:** *Acacia bivenosa*, *A. pruinocarpa*, *Amphipogon sericeus*, *Cymbopogon ambiguus*, *Enneapogon caerulescens*, *Eriachne pulchella*, *Gomphrena cunninghamii*, *Goodenia stobbsiana*, *Maireana georgei*, *Paraneurachne muelleri*, *Paspalidium clementii*, *Pterocaulon sphacelatum*, *Ptilotus calostachyus*, *Ptilotus exaltatus*, *Ptilotus obovatus*, *Scaevola acacioides*, *Schizachyrium fragile*, *Senna glutinosa* subsp. ×*luerssenii*, *Senna stricta*, *Sida* sp. Excedentifolia (J.L. Egan 1925), *Sida* sp. Pilbara (A.A. Mitchell PRP 1543), *Tribulus suberosus*	HD48, HDR04, HDR10, HDR11, HDR12, GHR30	Excellent	H4: 703.6 (6.5)	 Plate 4: Vegetation unit H4.

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
H5 – *Eucalyptus socialis* subsp. *eucentrica* scattered low mallees to low open mallee woodland over *Acacia bivenosa* scattered tall shrubs to tall open shrubland over *Senna glutinosa* subsp. × *luerssenii* scattered shrubs over *Ptilotus obovatus* scattered low shrubs over *Triodia wiseana* very open hummock grassland to open hummock grassland **Associated species:** *Acacia pruinocarpa, A. sibirica, Androcalva luteiflora, Eremophila fraseri* subsp. *fraseri, Senna artemisioides* subsp. *helmsii, S. artemisioides* subsp. *oligophylla, Solanum lasiophyllum, Triodia pungens*	GH18, GH31 (outside of survey area)	Very Good-Excellent	H5: 1.9 (<0.1)	 **Plate 5: Vegetation unit H5.**
H6 – *Acacia aptaneura*, *A. catenulata* subsp. *occidentalis* tall open shrubland to tall shrubland over *Eremophila forrestii* subsp. *forrestii*, *Senna stricta* scattered shrubs to open shrubland over *Triodia pungens* and/or *T. vanleeuwenii* and/or *T. wiseana* scattered hummock grasses to very open hummock grassland with *Eriachne mucronata* scattered tussock grasses **Associated species:** *Acacia pruinocarpa*, *Aristida contorta*, *A. inaequiglumis*, *Capparis lasiantha*, *Cymbopogon ambiguus*, *Duperreya commixta*, *Dysphania rhadinostachya* subsp. *rhadinostachya*, *Enneapogon caerulescens*, *E. lindleyanus*, *E. polyphyllus*, *Eremophila latrobei* subsp. *glabra*, *Eriachne pulchella*, *Eucalyptus leucophloia* subsp. *leucophloia*, *Grevillea berryana*, *G. saxicola*, *Maireana georgei*, *Paspalidium clementii*, *Ptilotus obovatus*, *Scaevola acacioides*, *Schizachyrium fragile*	HD23, HD40, HD42, HDR03, HDR06, GHR16	Excellent	H6: 144.8 (1.3)	 **Plate 6: Vegetation unit H6.**

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
H7 – *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees to low open woodland over *Senna glutinosa* subsp. *glutinosa, Acacia maitlandii* scattered shrubs over *Triodia wiseana* and/or *T. vanleeuwenii* and/or *T. pungens* open hummock grassland to hummock grassland **Associated species:** *Acacia aptaneura*, *A. bivenosa*, *A. catenulata* subsp. *occidentalis, A. pruinocarpa, A. tenuissima*, *Amphipogon sericeus*, *Capparis lasiantha*, *Cymbopogon ambiguus*, *Enneapogon polyphyllus*, *Eremophila latrobei* subsp. *glabra*, *Eriachne mucronata*, *Eriachne pulchella*, *Gompholobium oreophilum*, *Goodenia stobbsiana*, *Hakea chordophylla*, *Indigofera monophylla*, *Jasminum didymum* subsp. *lineare*, *Paraneurachne muelleri*, *Ptilotus calostachyus*, *Scaevola acacioides*, *Schizachyrium fragile*, *Senna glutinosa* subsp. ×*luerssenii*, *Sida* sp. Pilbara (A.A. Mitchell PRP 1543), *Solanum lasiophyllum*	HD01, HD14, HD46, HDR05, HDR09, HDR13, BHD05-AR	Good - Excellent	H7: 1,840.6 (17.0)	 Plate 7: Vegetation unit H7.
H8 – *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees to low open woodland over *Acacia pruinocarpa*, *Hakea chordophylla* scattered tall shrubs to tall open shrubland over *Triodia vanleeuwenii*, (*T. pungens*) open hummock grassland to hummock grassland with *Amphipogon sericeus* scattered tussock grasses **Associated species:** *Acacia aptaneura*, *A. bivenosa*, *Cymbopogon ambiguus*, *Duperreya commixta*, *Eriachne mucronata, E. pulchella*, *Eucalyptus gamophylla*, *Goodenia stobbsiana, G. triodiophila*, *Indigofera monophylla*, *Jasminum didymum* subsp. *lineare*, *Pterocaulon sphacelatum*, *Ptilotus calostachyus, Ptilotus rotundifolius*, *Senna artemisioides* subsp. *oligophylla, S. glutinosa* subsp. *glutinosa*, *S. glutinosa* subsp. × *luerssenii, S. glutinosa* subsp. *pruinosa*, *Solanum lasiophyllum*	HD12, HD39, HD41, HD50, HD53, HDR02, BHD10-AR, GH24	Good - Excellent	H8: 1,056.7 (9.8)	 Plate 8: Vegetation unit H8.

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
H9 – *Acacia arida, Grevillea wickhamii* subsp. *hispidula* open shrubland over *Triodia wiseana* open hummock grassland with *Themeda* sp. Mt Barricade (M.E. Trudgen 2471) very open tussock grassland **Associated species:** *Androcalva luteiflora, Corymbia hamersleyana* sens. lat., *Cymbopogon ambiguus*, *Gossypium australe*	HD16	Excellent	H9: 32.4 (0.3)	 Plate 9: Vegetation unit H9.
H10 – *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees with *E. repullulans* and/or *E. socialis* subsp. *eucentrica* and/or *E. pilbarensis* scattered low mallees to low open mallee woodland over *Acacia bivenosa* scattered shrubs over *Triodia wiseana, (T. angusta)* open hummock grassland to hummock grassland **Associated species:** *Acacia synchronicia, Aristida contorta*, *Capparis lasiantha*, *Cymbopogon ambiguus*, *Enneapogon caerulescens*, *Maireana georgei*, *Paraneurachne muelleri*, *Ptilotus exaltatus*, *Ptilotus obovatus*, *Salsola australis*, *Senna artemisioides* subsp. *oligophylla*, *Senna glutinosa* subsp. *glutinosa*, *Senna glutinosa* subsp. ×*luerssenii, Solanum lasiophyllum*, *Sporobolus australasicus*	HD21, HD44, HDR01, HDR07, GH06	Very Good - Excellent	H10: 824.4 (7.6)	 Plate 10: Vegetation unit H10.

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
H11 – *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees with *E. gamophylla* low open mallee woodland over *Acacia ancistrocarpa* scattered tall shrubs to tall open shrubland over *A. hilliana* scattered low shrubs to low open shrubland over *Triodia vanleeuwenii*, (*T. pungens*) open hummock grassland to hummock grassland **Associated species:** *Acacia adoxa* var. *adoxa, A. aptaneura*, *A. bivenosa*, *A. maitlandii*, *A. pachyacra, A. pruinocarpa*, *A. tenuissima, Amphipogon sericeus*, *Anthobolus leptomerioides*, *Aristida holathera* var. *holathera*, *Aristida inaequiglumis*, *Capparis lasiantha*, *Cymbopogon ambiguus*, *Duperreya commixta*, *Enneapogon polyphyllus*, *Gompholobium oreophilum*, *Goodenia stobbsiana*, *Hakea chordophylla*, *Halgania gustafsenii* var. *gustafsenii*, *Indigofera monophylla*, *Jasminum didymum* subsp. *lineare*, *Paraneurachne muelleri*, *Pterocaulon sphacelatum*, *Ptilotus calostachyus*, *Ptilotus rotundifolius*, *Scaevola parvifolia* subsp. *pilbarae*, *Senna glutinosa* subsp. *glutinosa, Solanum lasiophyllum, Themeda triandra, Triodia wiseana*	HD11, HD54, GH12, GH27	Very Good - Excellent	H11: 229.0 (2.1)	 **Plate 11: Vegetation unit H11.**

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
H12 – *Corymbia hamersleyana* sens. lat. scattered low trees over *Acacia inaequilatera*, *Hakea chordophylla*, *A. bivenosa* scattered tall shrubs to tall open shrubland over *Senna artemisioides* subsp. *oligophylla* scattered low shrubs over *Triodia wiseana* open hummock grassland to hummock grassland with *Themeda* sp. Mt Barricade (M.E. Trudgen 2471), *Cymbopogon ambiguus* scattered tussock grasses and *Heliotropium ovalifolium, Corchorus lasiocarpus* subsp. *parvus* scattered herbs **Associated species:** *Acacia arida*, *A. dictyophleba*, *A. pyrifolia*, *Aristida contorta*, *Aristida holathera* var. *holathera*, *Bonamia pilbarensis*, *Cheilanthes lasiophylla*, *Dodonaea coriacea*, *Enneapogon caerulescens*, *Eriachne mucronata*, *Eulalia aurea*, *Euphorbia careyi*, *Goodenia prostrata*, *Hibiscus sturtii* var. *campylochlamys*, *Indigofera monophylla*, *Jasminum didymum* subsp. *lineare*, *Paraneurachne muelleri*, *Polycarpaea corymbosa* var. *corymbosa*, *Pterocaulon sphacelatum*, *Ptilotus astrolasius*, *Ptilotus calostachyus*, *Scaevola amblyanthera* var. *centralis*, *Schizachyrium fragile*, *Senna glutinosa* subsp. *glutinosa*, *Senna glutinosa* subsp. *pruinosa*, *Sida echinocarpa*, *Solanum phlomoides*, *Swainsona maccullochiana*, *Trichodesma zeylanicum* var. *zeylanicum*, *Tricoryne* sp. Hamersley Range (S. van Leeuwen 915)	HD19, HD33, HD47, GH05	Good - Excellent	H12: 656.1 (6.1)	 Plate 12: Vegetation unit H12.

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
Vegetation of Plains				
P1 – *Acacia aptaneura*, *A. catenulata* subsp. *occidentalis*, (*A. pruinocarpa*) tall shrubland to tall open scrub over *Eremophila forrestii* subsp. *forrestii* open shrubland to shrubland over *Triodia pungens*, (*T. vanleeuwenii*) scattered hummock grasses to very open hummock grassland **Associated species:** *Abutilon otocarpum*, *Acacia ayersiana*, *Aristida contorta*, *Aristida obscura*, **Bidens bipinnata*, *Cheilanthes sieberi* subsp. *sieberi*, *Chrysopogon fallax*, *Corchorus lasiocarpus* subsp. *parvus*, *Enneapogon caerulescens*, *E. lindleyanus*, *E. polyphyllus*, *Eremophila latrobei*, *Eriachne pulchella*, *Hibiscus burtonii*, *Iseilema vaginiflorum*, *Maireana tomentosa* subsp. *tomentosa*, *Paspalidium clementii*, *Perotis rara*, *Psydrax suaveolens*, *Ptilotus exaltatus*, *Senna artemisioides* subsp. *helmsii*, *Sida* sp. dark green fruits (S. van Leeuwen 2260), *Sporobolus australasicus*	HD02, HD06, HD10, HD27, HD37, GH15, GH20	Very Good - Excellent	P1: 369.2 (3.4)	 Plate 13: Vegetation unit P1.

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
P2 – *Acacia aptaneura*, *A. pruinocarpa, A. tetragonophylla* scattered tall shrubs to tall open shrubland over *Eremophila forrestii* subsp. *forrestii, A. synchronicia* scattered shrubs over *Ptilotus obovatus, Sida fibulifera* scattered low shrubs over *Aristida latifolia*, *Astrebla elymoides*, *Eragrostis xerophila* open tussock grassland to tussock grassland **Associated species:** *Alternanthera nana, Aristida contorta*, *Chrysopogon fallax, Cleome viscosa*, *Crotalaria medicaginea* var. *neglecta*, *Cynodon convergens*, *Enchylaena tomentosa* var. *tomentosa*, *Enneapogon caerulescens*, *Enneapogon polyphyllus*, *Eragrostis setifolia*, *Eremophila longifolia, Eriachne obtusa, Evolvulus alsinoides* var. *villosicalyx*, *Fimbristylis dichotoma*, *Panicum decompositum*, *Rhagodia eremaea*, *Rhynchosia minima*, *Sclerolaena cornishiana*, *Senna artemisioides* subsp. *×artemisioides*, *Solanum lasiophyllum*, *Sporobolus australasicus*, *Streptoglossa bubakii*, *Themeda triandra*, *Tragus australianus*	HD09, HD29, HD30, GH08	Very Good - Excellent	P2: 155.6 (1.4)	 **Plate 14: Vegetation unit P2.**

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
P3 – *Acacia aptaneura*, *A. catenulata* subsp. *occidentalis*, *A. pruinocarpa* tall open shrubland to tall shrubland over *Eremophila forrestii* subsp. *forrestii* scattered shrubs to open shrubland over *Triodia pungens* open hummock grassland to hummock grassland **Associated species:** *Acacia ayersiana, A. pachyacra*, *Aristida contorta*, *Aristida inaequiglumis*, *Aristida obscura*, *Cheilanthes sieberi* subsp. *sieberi*, *Codonocarpus cotinifolius*, *Corymbia deserticola* subsp. *deserticola*, *Cymbopogon ambiguus*, *Enneapogon polyphyllus*, *Eremophila latrobei*, *Eriachne pulchella*, *Hibiscus burtonii*, *Maireana tomentosa* subsp. *tomentosa*, *M. villosa*, *Petalostylis labicheoides*, *Psydrax suaveolens*, *Ptilotus obovatus, Sida* sp. dark green fruits (S. van Leeuwen 2260), *Solanum lasiophyllum, Triodia vanleeuwenii*	HD20, HD28, HD32, HD55, GH02, GH07	Degraded - Excellent	P3: 1,301.0 (12.0)	 **Plate 15: Vegetation unit P3.**
P4 – *Acacia pruinocarpa, A. aptaneura*, *A. catenulata* subsp. *occidentalis* tall open shrubland to tall shrubland over *Rhagodia eremaea* scattered shrubs **Associated species:** *Acacia macraneura, A. synchronicia, Anthobolus leptomerioides, Aristida contorta, Aristida ingrata, Cheilanthes sieberi* subsp. *sieberi, Duperreya commixta, Enchylaena tomentosa* var. *tomentosa, Enneapogon lindleyanus, Eremophila forrestii* subsp. *forrestii, Eucalyptus xerothermica, Evolvulus alsinoides* var. *villosicalyx, Grevillea berryana, Hibiscus sturtii, Maireana tomentosa* subsp. *tomentosa, Ptilotus obovatus, Salsola australis, Sclerolaena cornishiana, Sida fibulifera, Sida platycalyx, Solanum lasiophyllum*	GH21, GH26	Very Good	P4: 39.2 (0.4)	 **Plate 16: Vegetation unit P4.**

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
Vegetation of Drainage Lines				
D1 – *Corymbia hamersleyana* sens. lat., *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees to low open woodland over *Petalostylis labicheoides*, *Acacia monticola, A. maitlandii* scattered tall shrubs to tall shrubland over *Dodonaea lanceolata* var. *lanceolata, Androcalva luteiflora* scattered shrubs to open shrubland over *Triodia pungens* very open hummock grassland to open hummock grassland with *Themeda triandra*, *Eriachne mucronata* very open tussock grassland to open tussock grassland **Associated species:** *Acacia aptaneura*, *A. bivenosa*, *A. hamersleyensis, A. pruinocarpa*, *A. pyrifolia, Aristida contorta*, *Aristida holathera* var. *holathera*, *Capparis lasiantha*, *Corchorus lasiocarpus* subsp. *parvus*, *Cymbopogon ambiguus*, *Duperreya commixta*, *Enneapogon polyphyllus*, *Eucalyptus gamophylla*, *Gompholobium oreophilum*, *Gossypium robinsonii*, *Jasminum didymum* subsp. *lineare*, *Paraneurachne muelleri*, *Pterocaulon sphacelatum*, *Ptilotus calostachyus*, *Ptilotus exaltatus*, *Ptilotus obovatus*, *Santalum lanceolatum*, *Senna glutinosa* subsp. *glutinosa*, *Seringia elliptica*, *Sida* sp. spiciform panicles (E. Leyland s.n. 14/8/90), *Triodia vanleeuwenii*	HD25, HD34, HD35, HD38, HD51, GHR28	Very Good - Excellent	D1: 784.0 (7.2)	 Plate 17: Vegetation unit D1.

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
D2 – *Acacia aptaneura, A. catenulata* subsp. *occidentalis*, *A. pruinocarpa* tall shrubland to tall open scrub over *Petalostylis labicheoides* scattered shrubs to open shrubland over *Triodia pungens* very open hummock grassland with *Chrysopogon fallax* scattered tussock grasses **Associated species:** *Acacia ayersiana*, *A. citrinoviridis*, *A. tenuissima, Aristida contorta*, **Bidens bipinnata, Capparis lasiantha*, *Cheilanthes sieberi* subsp. *sieberi*, *Duperreya commixta*, *Enchylaena tomentosa* var. *tomentosa*, *Enneapogon polyphyllus*, *Eriachne mucronata, Eriachne pulchella*, *Eucalyptus leucophloia* subsp. *leucophloia*, *Eucalyptus xerothermica*, *Maireana villosa*, *Paraneurachne muelleri, Psydrax latifolia*, *Psydrax suaveolens*, *Ptilotus obovatus*, *Salsola australis*, *Senna artemisioides* subsp. *oligophylla*, *Sida fibulifera*, *Solanum lasiophyllum*, *Sporobolus australasicus, Themeda triandra*	HD08, HD49, HDR19, GH03, GH09	Very Good - Excellent	D2: 190.3 (1.8)	 **Plate 18: Vegetation unit D2.**
D3 – *Corymbia ferriticola*, *Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Petalostylis labicheoides*, *Acacia hamersleyensis, Dodonaea viscosa* subsp. *spatulata* tall open shrubland over *Triodia pungens* very open hummock grassland with *Eriachne mucronata*, *Themeda* sp. Mt Barricade (M.E. Trudgen 2471), *Cymbopogon ambiguus* very open tussock grassland to tussock grassland **Associated species:** *Acacia aptaneura*, *A. catenulata* subsp. *occidentalis*, *A. mulganeura, A. pruinocarpa*, *Bulbostylis barbata*, *Clerodendrum tomentosum* var. *lanceolatum*, *Corymbia hamersleyana* sens. lat., *Dodonaea pachyneura, D. petiolaris*, *Duperreya commixta*, *Eremophila jucunda* subsp. *pulcherrima*, *Ficus brachypoda*, *Grevillea wickhamii* subsp. *hispidula*, *Indigofera fractiflexa* subsp. *fractiflexa*, *Jasminum didymum* subsp. *lineare*, *Psydrax latifolia*, *Ptilotus exaltatus*, *Senna glutinosa* subsp. *glutinosa*, *Sida* sp. Shovelanna Hill (S. van Leeuwen 3842), *Triodia wiseana*	HD24, HD26, HDR08, GHR10	Good - Excellent	D3: 51.8 (0.5)	 **Plate 19: Vegetation unit D3.**

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
D4 – *Eucalyptus victrix*, (*E. camaldulensis* subsp. *obtusa*) low open woodland to open woodland over *Acacia citrinoviridis*, *Petalostylis labicheoides* scattered tall shrubs to tall shrubland over *Androcalva luteiflora*, *Gossypium sturtianum* var. *sturtianum* scattered shrubs to open shrubland over *Triodia longiceps* scattered hummock grasses to very open hummock grassland with *Themeda triandra*, *Eulalia aurea*, (**Cenchrus ciliaris*) very open tussock grassland to tussock grassland and **Bidens bipinnata* scattered herbs **Associated species:** *Acacia bivenosa*, *A. dictyophleba*, *A. maitlandii*, *A. pyrifolia*, *Alternanthera nana*, *Aristida holathera* var. *holathera*, *Aristida lazaridis*, **Cenchrus setiger*, *Cleome viscosa*, *Corchorus lasiocarpus*, *Cymbopogon ambiguus*, *Cyperus vaginatus*, *Dichanthium sericeum* subsp. *humilius*, *Duperreya commixta*, *Enteropogon ramosus*, *Eragrostis tenellula*, *Eremophila longifolia*, *Eriachne mucronata*, *Eucalyptus xerothermica*, **Flaveria trinervia*, *Glycine canescens*, *Gossypium robinsonii*, *Jasminum didymum* subsp. *lineare*, **Malvastrum americanum*, *Paraneurachne muelleri*, *Phyllanthus maderaspatensis*, *Pluchea rubelliflora*, *Pterocaulon sphacelatum*, *Ptilotus obovatus*, *Rhynchosia minima*, *Santalum lanceolatum*, *Scaevola amblyanthera* var. *centralis*, *Tephrosia rosea* var. Fortescue creeks (M.I.H. Brooker 2186), *Triodia pungens*, *Triodia wiseana*	HD17, HD18, HD31, GH04, GH23	Good – Very Good	D4: 60.6 (0.6)	 Plate 20: Vegetation unit D4.

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
D5 – *Eucalyptus xerothermica* scattered low trees to low open woodland over *Petalostylis labicheoides, Acacia maitlandii, A. pyrifolia* tall open shrubland to tall shrubland over *Androcalva luteiflora* scattered shrubs over *Triodia longiceps* very open hummock grassland to open hummock grassland with *Themeda triandra*, *Eulalia aurea* open tussock grassland to tussock grassland and **Bidens bipinnata* scattered herbs **Associated species:** *Abutilon otocarpum*, *Acacia aptaneura*, *A. bivenosa, A. dictyophleba*, *Alternanthera nana*, *Aristida contorta*, *Boerhavia coccinea*, *Chrysocephalum apiculatum* subsp. *pilbarense*, *Chrysopogon fallax*, *Cleome viscosa*, *Crotalaria medicaginea* var. *neglecta*, *Dichanthium sericeum* subsp. *humilius*, *Duperreya commixta*, *Enneapogon lindleyanus, E. polyphyllus*, *Eragrostis cumingii*, *Eragrostis tenellula*, *Euphorbia biconvexa*, *Evolvulus alsinoides* var. *villosicalyx*, **Flaveria trinervia*, *Gossypium sturtianum* var. *sturtianum*, *Indigofera monophylla*, *Jasminum didymum* subsp. *lineare*, **Malvastrum americanum*, *Paraneurachne muelleri*, *Pterocaulon sphacelatum*, *Rhynchosia minima*, *Senna artemisioides* subsp. *×artemisioides*, *Stemodia grossa*	HD22, HDR18, GH01	Good - Excellent	D5: 52.9 (0.5)	 Plate 21: Vegetation unit D5.

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
D7 – *Acacia citrinoviridis, A. aptaneura, A. pruinocarpa* scattered tall shrubs to tall shrubland over *Senna artemisioides* subsp. *oligophylla* scattered low shrubs over *Triodia longiceps* open hummock grassland to hummock grassland **Associated species:** *Acacia pyrifolia*, *Androcalva luteiflora, Cleome viscosa, Duperreya commixta, Eremophila longifolia, Eucalyptus xerothermica, Hibiscus sturtii, Indigofera georgei, *Malvastrum americanum, Ptilotus obovatus, Rhagodia eremaea, Sida fibulifera, Solanum lasiophyllum, Triodia pungens*	GH22, GH25	Very Good - Excellent	D7: 64.2 (0.6)	 **Plate 22: Vegetation unit D7.**
D8 – *Eucalyptus xerothermica* scattered low trees to low open woodland over *Acacia aptaneura, A. catenulata* subsp. *occidentalis* tall open shrubland to tall open scrub over *Triodia pungens* scattered hummock grasses to very open hummock grassland with *Themeda triandra* very open tussock grassland to open tussock grassland **Associated species:** *Acacia pruinocarpa, *Bidens bipinnata, Capparis lasiantha, Chrysopogon fallax, Cleome viscosa, Dipteracanthus australasicus* subsp. *australasicus, Duperreya commixta, Maireana tomentosa* subsp. *tomentosa, *Malvastrum americanum, Ptilotus obovatus*	GH13, GH17	Very Good	D8: 42.6 (0.4)	 **Plate 23: Vegetation unit D8.**

Vegetation unit code and description	Sites(s)	Vegetation condition	Total area (ha) (proportion of survey area (%))	Representative photograph
Cleared	N/A	Completely Degraded	832.7 (7.7)	**N/A**

4.2.1.1 Vegetation Condition

Vegetation in the survey area ranged from 'Excellent' to 'Good' condition, with cleared areas assigned a condition of 'Completely Degraded' (Trudgen 1988) (Table 13; Figure J.1 – J.26, Appendix J). The most prevalent vegetation condition observed was 'Excellent' with 81.4% coverage, with much of the survey area free from introduced flora and grazing evidence. Vegetation of the major drainage lines (vegetation units D4 and D5) were generally in 'Good' to 'Very Good' condition due to the presence of introduced flora, in particular **Cenchrus* species. The presence of **Cenchrus* spp. within the survey area was generally low and restricted to major drainage lines and disturbed areas. **Bidens bipinnata* was the most abundant introduced flora species encountered within the survey area and was generally found in stands of mulga (*Acacia aneura* sens. lat.) and in drainage lines associated with upper slopes.

An extensive network of drill lines, drill pads, tracks and active mining areas existed throughout the survey area. This cleared vegetation accounts for 832.7 ha (7.7%) in the survey area, however the disturbance layer provided for the reporting did not include the majority of the tracks and pads associated with recent exploration drilling at HD2 and clearing at Baby Hope. A number of colonising species were observed regenerating on tracks associated with the exploration drilling, but most tracks remain cleared of vegetation. Other minor disturbances included grazing by cattle and camels in the drainage lines and associated plains, significant sections of the survey area being burnt during 2015 and 2016 (Section 3.2.4), and minor evidence of dust on vegetation, usually in association with exploration tracks through bulldust areas.

Table 13: Vegetation condition recorded for the survey area.

Vegetation condition	Total mapped area within the survey area (ha)	Proportion of the survey area (%)
Excellent	8,805.1	81.4
Very Good	1,147.5	10.6
Good	32.4	0.3
Completely Degraded	832.7	7.7

4.2.1.2 Threatened and Priority Ecological Communities

The buffer of the priority 1 PEC '*Weeli Wolli Spring Community*' intersects the survey area. No vegetation is considered to have affinity with the priority 1 PEC '*Weeli Wolli Spring Community*' within the survey area.

The buffer of the priority 1 PEC '*West Angelas Cracking-Clays*' occurs approximately 9 km to the south-west of the survey area. The P2 vegetation unit which occurred as a fine scale mosaic of shrublands and tussock grasslands on cracking-clays and alluvial plains is considered to share similarities with the PEC, however is unlikely to represent the PEC. The degree to which P2 aligns with the PEC was difficult to determine given the poor seasonal conditions and therefore limited occurence and/or poor condition of annual and short-lived perennial species which characterise the community, however the mosaic and small scale nature of the tussock grasslands is not consistent with mapped occurrences of the PEC. The tussock grasslands component of the P2 mosaic vegetation (which shares most affinity with the PEC) occurred in isolated patches of cracking clay soils in slight depressions. These areas were too small to be mapped individually. The presence of *Aristida latifolia* and *Astrebla elymoides* and a number of other *Aristida* spp. characterised the tussock grasslands of the P2 vegetation, as is typical of the PEC. Similarly, *Sida fibulifera,* which is also typical of the PEC, was present in this vegetation.

During the Phase 1 and Phase 2 surveys the presence of *Astrebla* spp. was unable to be confirmed in sites installed in the P2 vegetation unit. During the Phase 3 survey the presence of *Astrebla elymoides* was confirmed in the newly installed quadrat GH08 and other previously surveyed sites (HD09, HD29, HD30) were reviewed and found to support an unidentifiable *Astrebla* spp. previously misidentified as sterile *Eulalia aurea*. Surrounding these small patches of tussock grasslands (and within the same mapped vegetation habitat) were open shrublands on slightly elevated soils with a stony mantle that were typically characterised by scattered *A. aptaneura, A. pruinocarpa* and/or *A. tetragonophylla*; these areas do not have the same affinity to the PEC. A number of other herbaceous species typical of clay habitats may be expected to occur in the PEC, including: *Senna hamersleyensis, Tephrosia* sp. clay soils (S. van Leeuwen et al. PBS 0273), *Lotus cruentus, Neptunia dimorphantha, Panicum laevinode, Sida spinosa, Hibiscus verdcourtii, Operculina aequisepala, Ipomoea lonchophylla, Desmodium campylocaulon, Desmodium muelleri, Euphorbia inappendiculata, Oldenlandia* sp. Hamersley Station (A.A. Mitchell PRP 1479) and *Swainsona thompsoniana* P3 (H. Ajduk, Rio Tinto, pers.comm). Most of these species were not observed, however the majority are annuals or short-lived perennial species and therefore are unlikely to have been detected during the poor seasonal conditions if they occurred.

The buffer of the '*Coolibah – Lignum Flats*' PEC occurs within 10 km of the survey area. The indicator species *Duma florulenta* (lignum) was not recorded and there are no previous records of this species within the survey area. No vegetation units recorded had affinity with this PEC and as such it is considered unlikely that this PEC occurs within the survey area.

No other vegetation that has affinity to a listed TEC or PEC was observed in the survey area.

4.2.1.3 Ecosystems at Risk

As part of the biodiversity audit of each IBRA bioregion carried out by the then Department of Conservation and Land Management, a number of ecological communities were identified as 'ecosystems at risk' (McKenzie, May, and McKenna 2002). This audit was conducted prior to the formal PEC listing process and many of the ecological communities highlighted were subsequently raised to PEC status. There were a number of ecological communities not raised to PEC status that were identified through this audit, three of which have relevance to the survey area (Kendrick 2001).

- Grove/inter-grove mulga, Eastern Hamersley Range –this community was represented by the vegetation unit P1 within the survey area where the banded mulga is pronounced. Impacts from existing drill lines, cattle grazing and non-aggressive weeds were present in this vegetation unit and there is an ongoing risk of changed surface water flows from clearing for exploration. Despite these impacts the majority of this vegetation unit ranged from 'Excellent' to 'Very Good' condition.
- Valley floor mulga –this community was represented by the vegetation unit P3 within the survey area. Condition ranged from 'Very Good' to 'Excellent' and very little to no disturbance was noted. Scattered non-invasive weeds and low-level grazing were recorded in some areas.
- Lower-slope mulga – this community was represented by the vegetation unit H2 within the survey area. Condition ranged from 'Very Good' to 'Excellent' and very little to no disturbance was noted beyond some scattered non-invasive weeds.

4.2.1.4 Groundwater Dependent Ecosystems

Of the 23 vegetation units within the survey area, one (D4) was considered to be a potential groundwater dependent ecosystem (GDE) due to the presence of *Eucalyptus camaldulensis* subsp.

obtusa and *E. victrix. Eucalyptus camaldulensis* subsp*. obtusa* and *E. victrix* are considered facultative phreatophytes and use groundwater opportunistically during periods of drought or some life stages and therefore have some dependence on groundwater (Lamontagne et al. 2005). Permanent pools of water were not observed within the D4 vegetation unit.

4.2.1.5 Vegetation of Local Significance

The vegetation units associated with conservation significant flora species were assessed against the rating scale prepared and provided by Rio Tinto, to assess local significance (Table F.3, Appendix F). Vegetation units were rated as high, moderate, low or negligible according to the criteria. Vegetation units rated as high or moderate local significance are described below.

The H2 vegetation unit occurred on the south-facing upper debris slopes of BHT and supported conservation significant flora in relatively dense populations, in particular *Eremophila* sp. West Angelas (S. van Leeuwen 4068) P1 and *Eremophila* sp. Hamersley Range (K. Walker KW 136) P3. This vegetation unit was largely unaffected by recent fires and may act as refuge habitat for conservation significant flora taxa. Vegetation unit H2 also has affinity to the Ecosystem at Risk 'lower-slope mulga' referred to in Section 4.2.1.3. As such the H2 vegetation unit has high conservation significance at a local scale (Table F.3, Appendix F).

The D3 vegetation unit occurred on the deeper incised gorges of BHT and supported a number of conservation significant flora taxa including *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2 and *Eremophila* sp. Hamersley Range (K. Walker KW 136) P3. This vegetation unit was largely unaffected by recent fires and may act as refuge habitat for conservation significant flora taxa; as such, the D3 vegetation unit has moderate conservation significance at a local scale (Table F.3, Appendix F).

The P2 vegetation unit occurred on the cracking clays and alluvial plains within HD2 and supported a number of populations of *Aristida lazaridis* P2. This cracking clay habitat appeared to be locally restricted and although not likely to represent a PEC it appears to have a specific habitat requirement and assemblage of species not otherwise observed in the local area; as such it may be restricted. Vegetation unit P2 has moderate conservation significance at a local scale (Table F.3, Appendix F).

The D4 vegetation unit occurred on major drainage lines that supported the potential GDE species *Eucalyptus camaldulensis* subsp*. obtusa* and *E. victrix,* and the P2 taxa *Aristida lazaridis;* it is therefore considered to have high conservation significance at a local scale (Table F.3, Appendix F). To a lesser extent the D5 vegetation unit also supported *E. camaldulensis* subsp*. obtusa, E. victrix* and *A. lazaridis* P2*,* and has moderate to high conservation significance at a local scale (Table F.3, Appendix F).

The remaining vegetation associations recorded in the survey area represent what may be expected on similar landforms in the broader Hamersley subregion and are not considered locally restricted.

4.2.1.6 Floristic Groups – Current Survey

There were 23 significant clusters identified in the dendrogram examining the square root transformation of PFC data of the 99 sites from within the survey area. The number of significant clusters aligned with structural interperation of vegetation diversity and thus the results of the dendrogram were considered when describing vegetation units. Eight of these clusters were represented by a single survey site (Table 14; Figure K.2, Appendix K).

Table 14: Floristic groups identified by one site in the PFC analysis with square root transformation and corresponding structural vegetation unit.

Quadrat /relevé	Quadrat/relevé description	Vegetation unit code
GH13	*Eucalyptus xerothermica* low open woodland over *Acacia aptaneura* tall open shrubland over *Ptilotus obovatus* scattered low shrubs over *Themeda triandra* open tussock grassland	D8
HD16	*Acacia arida, Grevillea wickhamii* subsp. *hispidula, Androcalva luteiflora* open shrubland over *Triodia wiseana* open hummock grassland with *Themeda* sp. Mt Barricade (M.E. Trudgen 2471) very open tussock grassland	H9
HD29	*Acacia aptaneura*, (*A. pruinocarpa*, *Eremophila longifolia*, *A. pteraneura*) tall shrubland over *E. forrestii subsp. forrestii* scattered shrubs over *Ptilotus astrolasicus, E. lanceolata, P. obovatus* low open shrubland over *Chrysopogon fallax, Aristida* sp., (*Aristida latifolia, Eriachne obtusa, E. benthamii, Themeda triandra*) tussock grassland	P2
HD42	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia sibirica*, *A. incurvaneura, A. catenulata* subsp. *occidentalis* tall shrubland over *Senna stricta* open shrubland over *Triodia vanleeuwenii*, (*T. pungens, T. angusta*) open hummock grassland	H6
HD44	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees with *E. repullulans*, (*E. socialis* subsp. *eucentrica*) low open mallee woodland over *Acacia synchronicia* scattered shrubs over *Maireana georgei*, *M. eriosphaera* low open shrubland over *Triodia wiseana*, *T. brizoides* hummock grassland	H10
HDR07	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia inaequilatera, A. synchronicia* open shrubland over *Eremophila jucunda* subsp. *pulcherrima, Senna artemisioides* subsp. *oligophylla* scattered low shrubs over *Triodia wiseana* hummock grassland with *Cymbopogon ambiguus, Eulalia aurea* very open tussock grassland	H10
HDR14	*Acacia inaequilatera*, *Hakea chordophylla* tall open shrubland over *Gompholobium oreophilum, Dampiera candicans* low open shrubland over *Triodia vanleeuwenii* open hummock grassland with *Amphipogon sericeus* scattered tussock grasses	H3
BHD05-AR	*Eucalyptus leucophloia* subsp. *leucophloia*, *Corymbia hamersleyana* sens. lat. low open woodland over *Petalostylis labicheoides*, *Grevillea wickhamii* subsp. *hispidula* tall shrubland over *Mirbelia viminalis* low open shrubland over *Triodia wiseana*, *T. vanleeuwenii* very open hummock grassland	H7

Site GH13 occurred in the drainage vegetation unit D8 to the north-east of HD2. Drainage units may not cluster together when assessed using multivariate analysis; this can be partially attributed to flora species from the surrounding vegetation being present that may not be representative of the drainage vegetation.

Site HD16 occurred in the hills and slopes vegetation unit H9 in HD2 and represented a reasonably species-poor vegetation unit that occurred on low dolerite hills. No other sites showed affinity to this vegetation unit structurally and the landform was considered poorly represented within the survey area. As such the site would be expected to group on its own floristically and is consistent with the structural observations.

Site HD29 occurred in the plains vegetation unit P2 in HD2. Although structurally similar to the other sites in this vegetation unit, HD29 had exposed clay soils that appeared more preferential for grazing. As such a number of species not present at the other sites were recorded, including **Chloris virgata, Aristida obscura, Capparis lasiantha* and *Cuscuta victoriana*.

Site HD42 occurred in the hills and slopes unit H6 in HD2. Occurrences of H6 in this area of HD2 were restricted and surrounded by H7. There was higher cover of *Eucalyptus leucophloia* subsp. *leucophloia* and *Triodia* spp. than were normally recorded in H6, probably influenced by the surrounding H7 vegetation. Site HD42 grouped in a significant cluster adjacent to other H6 sites in the PFC analysis (Figure K.2, Appendix K) and within the same significant cluster as other H6 sites in the presence/absence analysis (Figure K.3, Appendix K).

Site HD44 occurred in the hills and slopes vegetation unit H10 in HD2. This site occurred in an area with minor drainage and denser *Triodia* spp., *Eucalyptus* spp. and a high cover of *Maireana* spp. than was normally associated with H10. These factors may have contributed to its unique cluster.

Site HDR07 also grouped in vegetation unit H10 due to the presence of *E. repullulans* and *E. leucophloia* subsp. *leucophloia.* A number of species more typical of drainage lines, such as *Eriachne benthamii* and *Eulalia aurea*, were recorded in this hills and slopes vegetation unit and are likely to have caused the floristic separation of this site. Specimens of these taxa were not collected from the site and therefore there is potential that they could have been misidentified in the field.

Site HDR14 occurred in the hills and slopes unit H3 on the low undulating hills north of BHT. This site was established in an area affected by fire in 2015 and close to minor drainage line D1 vegetation. The vegetation had not recovered well from fire and had much lower cover of *Triodia vanleeuwenii* than other H3 sites in the nearby area. Site HDR14 grouped in the adjacent significant cluster to other H3 sites in the PFC analysis (Figure K.2, Appendix K) and within the same significant cluster as all other H3 sites in the presence/absence analysis (Figure K.3, Appendix K).

BHD05-AR occurred in the hills and slopes unit H7 at Baby Hope Downs. This quadrat was originally established in Biota (2014),and rescored during the Phase 3 field visit. This area was burnt during 2016 and the resampling recorded a high density of *Petalostylis labicheoides*.

There were 22 significant clusters identified within the presence/absence dendrogram of the 99 sites, eight of which were represented by a single survey site (GH06, GH13, GH23, HD16, HD21, HD29, HD33 and HDR07) (Table 15; Figure K.3, Appendix K). The presence/absence analysis identified a similar number of groups (22 clusters) to the structural interpretation (23 vegetation units). The sites within clusters generally grouped similarly to the structural vegetation units described within the survey area and related to similar landforms.

Table 15: Floristic groups identified by one site in the presence/absence analysis and corresponding structural vegetation unit.

Quadrat /relevé	Quadrat/relevé description	Vegetation unit code
GH06	*Eucalyptus socialis* subsp. *eucentrica, E. repullulans* low open woodland over *Acacia bivenosa* scattered tall shrubs over *Triodia wiseana* open hummock grassland	H10
GH13	*Eucalyptus xerothermica* low open woodland over *Acacia aptaneura* tall open shrubland over *Ptilotus obovatus* scattered low shrubs over *Themeda triandra* open tussock grassland	D8
GH23	*Eucalyptus victrix* scattered low trees over *Acacia citrinoviridis*, (*Atalaya hemiglauca*) tall shrubland over *Corchorus lasiocarpus* subsp. *lasiocarpus* open shrubland over *Triodia longiceps*, *T. pungens* very open hummock grassland	D4
HD16	*Acacia arida*, *Grevillea wickhamii* subsp. *hispidula*, *Androcalva luteiflora* open shrubland over *Triodia wiseana* open hummock grassland with *Themeda* sp. Mt Barricade (M.E. Trudgen 2471) very open tussock grassland	H9
HD21	*Eucalyptus socialis* subsp. *eucentrica*, (*E. pilbarensis*) low open mallee woodland over *Triodia wiseana*, *T. angusta*, (*T. vanleeuwenii*) hummock grassland	H10
HD29	*Acacia aptaneura*, (*A. pruinocarpa*, *Eremophila longifolia*, *A. pteraneura*) tall shrubland over *E. forrestii* subsp. *forrestii* scattered shrubs over *Ptilotus astrolasicus*, *E. lanceolata*, *P. obovatus* low open shrubland over *Chrysopogon fallax*, *Aristida* sp., (*Aristida latifolia*, *Eriachne obtusa*, *E. benthamii*, *Themeda triandra*) tussock grassland	P2
HD33	*Corymbia hamersleyana* scattered low trees over *Acacia inaequilatera* tall open shrubland over *Corchorus lasiocarpus* subsp. *parvus*, *Indigofera monophylla* scattered low shrubs over *Triodia wiseana* hummock grassland with *Heliotropium ovalifolium* scattered herbs	H12
HDR07	*Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia inaequilatera*, *A. synchronicia* open shrubland over *Eremophila jucunda* subsp. *pulcherrima*, *Senna artemisioides* subsp. *oligophylla* scattered low shrubs over *Triodia wiseana* hummock grassland with *Cymbopogon ambiguus*, *Eulalia aurea* very open tussock grassland	H10

Site GH06 occurred in the hills and slopes vegetation unit H10 to the south of HD2. This site was species poor with 12 taxa recorded and the placement of the quadrat intersecting the corner of the neighbouring D1 drainage unit was not optimal. This site did present next to other H10 sites in the PFC dataset presented in Figure K.2 (Appendix K).

Site GH23 occurred in the drainage vegetation unit D4 to the north of BHT. This site lacked some of the taxa present in other D4 sites in the survey area and was defined by taxa typical of drier drainage lines. It is possible that this site represented a new vegetation unit occurring along Pebble Mouse Creek that was not described during the assessment. This site did present next to the cluster that contained all of the other D4 and D5 units in Figure K.3 (Appendix K).

Site HD21 occurred in the hills and slopes of vegetation unit H10 in HD2. The other sites in the H10 vegetation unit (HD44, HDR01, HDR07 and GH06) had an upper stratum typically dominated by *Eucalyptus repullulans, E. leucophloia* subsp. *leucophloia* and/or a presence of *E. socialis* subsp. *eucentrica*. *Eucalyptus pilbarensis* and *E. socialis* subsp. *eucentrica* dominated the upper stratum in site HD21 and no *E. repullulans* or *E. leucophloia* subsp. *leucophloia* were present, showing some floristic diversity in this mallee-dominated vegetation unit.

Site HD33 occurred in the hills and slopes vegetation unit H12 in HD2. HD33 was the only site to record a tree upper stratum (*Corymbia hamersleyana* sens. lat.) and did not have a tussock grass understorey present at the time of the surveys, unlike the other sites from that vegetation unit. A number of species unique to this site, but not unusual for the habitat, were also recorded including *Heliotropium tenuifolium, Scaevola amblyanthera* var. *centralis* and *Eremophila longifolia.*

Sites GH13, HD16, HD29 and HDR07 also occupied significant clusters in the PFC analysis and are interpreted in Table 14 above.

4.2.1.7 Floristic Groups – Broader Regional Context

Data from the 99 quadrats and relevés from the survey area was combined with that from the 757 permanent sites from a selection of projects within the vicinity of the survey area to provide a broader regional dataset for contextual analysis (Biota Environmental Sciences 2006; Mattiske Consulting 2008b, 2009b, 2010; Ecologia Environment 2013; Biota Environmental Sciences 2014). Multivariate floristic analysis using the presence/absence of perennial native taxa identified 118 significant clusters within this broader regional dataset (Figure K.4a - K.4j Appendix K). Sites from the current survey were present in 31 of these significant clusters, with three clusters consisting exclusively of sites from the current survey. There were two sites (GH23 and HD29) that did not group with any other regional sites (Table 16). Neither of these sites grouped with any other quadrat or relevé in either the PFC and/or the presence/absence analysis and are further explained in Section 4.2.1.6.

Table 16: Significant clusters from the broader regional dataset formed exclusively by a single current survey site.

Survey site(s)	Vegetation unit code	Quadrat/relevé description
GH23	D4	*Eucalyptus victrix* scattered low trees over *Acacia citrinoviridis*, (*Atalaya hemiglauca*) tall shrubland over *Corchorus lasiocarpus* subsp. *lasiocarpus* open shrubland over *Triodia longiceps*, *T. pungens* very open hummock grassland
HD29	P2	*Acacia aptaneura*, (*A. pruinocarpa*, *Eremophila longifolia*, *A. pteraneura*) tall shrubland over *E. forrestii* subsp. *forrestii* scattered shrubs over *Ptilotus astrolasicus*, *E. lanceolata*, *P. obovatus* low open shrubland over *Chrysopogon fallax*, *Aristida* sp., (*Aristida latifolia*, *Eriachne obtusa*, *E. benthamii*, *Themeda triandra*) tussock grassland

To understand the regional context and validate concerns about previous data, key results from the floristic analysis for the current and previous surveys are summarised in Table 17. The species lists assembled for each site and used in the broader regional dataset was also used to calculate the average number of taxa occurring per site for each project.

Table 17: Summary of sites for each project included in the broader regional dataset.

Project	No. of sites in dataset	No. of significant clusters occupied[1]	No. of significant clusters exclusively occupied[1]	No. of significant clusters sharing at least one current survey site[1]	Mean number of native taxa per site[2]	No. of sites surveyed per team per day[3]
Biota (2006)	42	17	1	12	31.7 ±2.0	2.5
Mattiske (2008b)	267	46	14	3	17.6 ±0.4	8.1
Mattiske (2009b)	139	39	9	6	17.5 ±0.6	8.2
Mattiske (2010)	118	29	3	3	17.5 ±0.5	16.9
Ecologia (2013)	150	39	13	16	34.1 ±0.9	3.3
Biota (2014)	25	12	2	5	33.8 ±2.6	2.5
Survey area – Phase 1/2	73	25	2	N/A	34.7 ±1.7	2.8
Survey area – Phase 3	30	18	1	N/A	26.1 ±1.5	2.2

[1] – see broader regional context dendrogram presented in Figure K.4a - K.4j (Appendix K).

[2] – taken from the broader regional dataset, includes ephemeral taxa but does not include unconfirmed and hybrid taxa and weeds.

[3] – taken from raw site data provided for each project, team may be single or multiple observers. Figures imply that each survey day was committed entirely to quadrat establishment, so these numbers are likely an overestimate and presented here for comparative purposes.

4.2.2 Flora

The survey area had 411 confirmed vascular flora taxa, from 52 families and 161 genera. There were 48 specimens that could not be identified to species level due to lack of identification material and may represent additional taxa for the survey area. None of these are suspected to represent conservation significant taxa. An additional eight specimens were considered hybrid taxa, seven of which were either *Acacia* or *Senna*, genera known to hybridise regularly, and one a suspected hybrid of *Eucalyptus xerothermica*. None of these are currently considered to represent conservation significant taxa. An additional two taxa (*Acacia aptaneura* sens. lat. and *Corymbia hamersleyana* sens. lat.) are considered to be part of wider complexes (S. van Leeuwen, pers. comm, 1 July 2019), and have not been included in the confirmed taxa count. There were three specimens left unresolved: *Eremophila* aff. *clarkei*, *Goodenia* sp. (of interest) and *Polymeria* aff. *longifolia*. Details of these specimens are presented in Section 4.2.2.4.

Of the unidentified specimens 14 were from the Poaceae family. The dominant confirmed native plant families were Fabaceae and Poaceae. *Acacia* was the most frequently recorded genus (Table 18). Although a number of herbaceous species were recorded, it is likely that diversity of annual and short-lived perennial species would be greater and their occurrence more widespread, following rainfall. A species list for the survey area and a matrix indicating species recorded within each quadrat or relevé is presented in Appendix L.

There was a complex association noted between the spinifex taxa *Triodia wiseana* and *T. angusta* within the survey area. These two taxa are closely related and share morphological similarities that

can make them difficult to separate, particularly when looking at the different variations of *T. wiseana* forms.

The species accumulation curve indicates that between 76% and 90% of the potential total species pool was available at the time of each phase of survey. The species accumulation curve indicates that the total number of species has reached asymptote, and that sampling has been near-exhaustive (Figure K.1, Appendix K).

Table 18: Taxa most frequently recorded in the survey area.

Family	Number of taxa
Fabaceae	74
Poaceae	74
Malvaceae	44
Asteraceae	21
Myrtaceae	18
Genus	**Number of taxa**
Acacia	37
Eremophila	16
Senna	16
Ptilotus	14
Sida	13

4.2.2.1 Conservation Significant Flora

Targeted searches and opportunistic recordings within the survey area identified 11 State-listed priority flora taxa: *Eremophila* sp. West Angelas (S. van Leeuwen 4068) P1, *Aristida lazaridis* P2, *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2, *Eremophila* sp. Hamersley Range (K. Walker KW 136) P3, *Grevillea saxicola* P3, *Rhagodia* sp. Hamersley (M. Trudgen 17794) P3, *Triodia* sp. Mt Ella (M.E. Trudgen 12739) P3, *Acacia bromilowiana* P4, *Eremophila magnifica* subsp. *magnifica* P4, *Lepidium catapycnon* P4 and *Ptilotus mollis* P4. No EPBC Act or State-listed threatened flora was recorded.

Survey effort, as shown by track log traverses within the survey area, is presented in Figure M.1 - M.2 (Appendix M). Photographs and descriptions of conservation significant flora within the survey area are presented in Table N.1 (Appendix N). Conservation significant flora locations are presented in Table 19, Table N.2 (Appendix N) and mapped in Figure N.1 - N.6 (Appendix N). Habitat and abundance details for these taxa are summarised in the below text and Table 19. Three additional State-listed priority flora taxa were previously recorded within the survey area but not encountered during the current survey: A*cacia subtiliformis* P3, *Goodenia lyrata* P3 and *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727) P3.

Eremophila sp. West Angelas (S. van Leeuwen 4068) P1 was recorded from three populations on the south facing slopes of BHT in vegetation unit H2. Records have been taken from the current survey and Rio Tinto (2015). Suitable habitat on the steep hillslopes was searched, however access in some parts was limited and it is possible more individuals may occur within this area, on slopes not able to be safely traversed. As such the population estimates presented in Table 19 are likely to have captured the majority of individuals that occur, but may not be completely comprehensive.

Aristida lazaridis P2 was recorded from drainage lines and associated flood out areas including the surrounding plains and lower hillslopes. Systematic searches were conducted in the majority of habitats likely to support this taxon within the survey area. The population numbers presented in Table 19 are considered a relatively comprehensive assessment of the abundance occurring in the survey area.

Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2 was associated with south facing slopes, gorges and gullies. Thorough searches were conducted for this taxon in accessible habitat where it was encountered. The population estimates presented in Table 19 are considered to be representative of the total abundance in the survey area.

Acacia subtiliformis P3 was previously recorded on the elevated plateau in BHT (Rio Tinto 2012). This area was burnt in 2015 (after the record had been made) and despite the site of the previous record being revisited, this taxon was unable to be relocated within the survey area.

Eremophila sp. Hamersley Range (K. Walker KW 136) P3 was recorded from four populations within the survey area. Two populations were recorded at BHT on south facing slopes in the H2 vegetation unit, and another two populations were recorded in nearby gorges in vegetation unit D3. Thorough searches were conducted for this taxon throughout the H2 vegetation unit, however the steep and rugged nature made accessing all potential habitat impossible. As such, the population details presented in Table 19 are considered to be a good representation of the total occurrence but may not be completely comprehensive.

Goodenia lyrata P3 was previously recorded from a single location within the survey area from the Baby Hope Downs Flora and Vegetation Survey (Biota Environmental Sciences 2014). The previous location was within mulga plains (P3) habitat adjacent to areas being cleared, as such the record was not accessible during the survey and could not be verified. *Goodenia lyrata* P3 was not recorded during the current survey.

Goodenia sp. East Pilbara (A.A. Mitchell PRP 727) P3 was previously recorded from three points in a single area (Biota Environmental Sciences 2006). The population occurs in vegetation unit P2 and was revisited during the survey but unable to be relocated, possibly due to its ephemeral habit. *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727) P3 was not recorded in the current survey.

Grevillea saxicola P3 occurred in the survey area and was predominantly associated with south facing slopes, gorges and occasionally drainage features. Systematic searches were not conducted for this taxon and the population estimates presented in Table 19 are not a comprehensive assessment of the total abundance in the survey area.

Rhagodia sp. Hamersley (M. Trudgen 17794) P3 was recorded from three populations within the survey area and known from a further two populations from previous surveys. *Rhagodia* sp. Hamersley (M. Trudgen 17794) P3 is generally associated with mulga plains and was recorded in similar vegetation in HD2, however it was also recorded on the south facing slopes of BHT. None of the populations were systematically searched and as such the abundance presented in Table 19 is not a comprehensive representation of the total occurrence in the survey area. It may occur elsewhere in suitable habitat not targeted during the current survey.

Triodia sp. Mt Ella (M.E. Trudgen 12739) P3 was recorded in high abundance in association with a large gorge system with east and south-east facing slopes below ironstone escarpment on BHT. Smaller populations of *Triodia* sp. Mt Ella (M.E. Trudgen 12739) P3 were also recorded on south and north facing slopes below the escarpment. Systematic searches were not carried out in the eastern and northern most populations, while the other populations were thoroughly searched. The population numbers presented in Table 19 are not a comprehensive assessment of the total

abundance occurring in the survey area. It may occur elsewhere in suitable habitat not targeted during the current survey.

Acacia bromilowiana P4 was recorded in gorges and gullies. Systematic searches were not conducted for this taxon and as such the abundance presented in Table 19 is not a comprehensive assessment of the total abundance occurring in the survey area. It may occur elsewhere in suitable habitat not targeted during the current survey.

Eremophila magnifica subsp. *magnifica* P4 was previously recorded in close proximity to the survey area in the Baby Hope Downs area (Pilbara Iron 2006a, 2006c; Biota Environmental Sciences 2014; Department of Biodiversity, Conservation, and Attractions 2019e). The current survey recorded three additional locations near to the previous locations, within the survey area. It may occur elsewhere in suitable habitat not targeted during the current survey.

Lepidium catapycnon P4 was recorded from four populations and is generally associated with the steep slopes and rocky outcrops of ironstone hills. None of the known populations were systematically searched and as such the abundance presented in Table 19 is not a comprehensive assessment of the total occurrence in the survey area. It may occur elsewhere in suitable habitat not targeted during the current survey.

Ptilotus mollis P4 was recorded from four populations and was associated with hillslopes below small breakaways. None of the known populations have been systematically searched and as such the abundance presented in Table 19 is not a comprehensive assessment of the total occurrence in the survey area. It may occur elsewhere in suitable habitat not targeted during the current survey.

Table 19: Conservation significant flora recorded in the survey area and regionally.

Species	Survey area		All records	Habitat in survey area	Vegetation unit/s in survey area
	Recorded abundance from current survey	Abundance from all surveys[1]			
Eremophila sp. West Angelas (S. van Leeuwen 4068) P1	532	777	1,040	Very steep hillslopes, base of breakaways. High in the landscape	H1, H2
Aristida lazaridis P2	2,765	2,765	4,316	Plains, drainage lines, associated flood out areas.	D1, D4, H8, P2, P3, Cleared
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2	386	488	1,548	Near summit of hills, high in landscape, gorges. gullies	D1, D3, H1, H2, H7, Cleared
Acacia subtiliformis P3[3]	0	2	93,366	On rocky calcrete plateaux, rocky slopes.	H1
Eremophila sp. Hamersley Range (K. Walker KW 136) P3	1,344	1,872	6,740	High in the landscape, cliff tops, gorge tops, steep rocky slopes.	D3, H1, H10, H2, H6
Goodenia lyrata P3[3]	0	1	127	Plains	P3
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727) P3[3]	0	80	80,290	Calcrete flats and rises	P2
Grevillea saxicola P3	1,669	1,898	2,514	Low rocky hills and associated slopes, footslopes and drainage features.	D1, D3, H1, H10, H2, H4, H6, H7, H8, Cleared
Rhagodia sp. Hamersley (M. Trudgen 17794) P3	77	84	7,446	Mulga plains, south facing slopes of ironstone hills.	D2, D5, D8, H2, P1, P2, P3, Cleared
Triodia sp. Mt Ella (M.E. Trudgen 12739) P3	3,542	4,457	46,851	Amongst rocks and outcrops, east and south-east facing gorge slopes, south facing breakaways.	D3, H1, H2, H7
Acacia bromilowiana P4	132	362	1,956	Rocky hills, breakaways, scree slopes, gorges, creek beds.	D1, D3, H1, H4, Cleared
Eremophila magnifica subsp. *magnifica* P4	3	22	1,690	Rocky hills, breakaways, slopes and gorges	D3, H7
Lepidium catapycnon P4	4,723	11,455	49,070	Hill top, slopes and drainage features.	D1, H1, H2, H3, H4, H7, Cleared

Species	Survey area		All records	Habitat in survey area	Vegetation unit/s in survey area
	Recorded abundance from current survey	Abundance from all surveys[1]			
Ptilotus mollis P4	50	432	946	Stony hills and screes, hillslopes below small breakaways.	D1, H1, H2, H4, H6, Cleared

[1] – Includes all current points that occur within the survey area and previous points occurring in the locality (Table N.2, Appendix N)

[2] – Includes all records compiled from Rio Tinto database, the current survey, all previous surveys in a 50 km radius and records supplied from the DBCA database searches.

[3] – Species not observed in current survey, but previous records exist within the survey area (Table N.2, Appendix N).

4.2.2.2 Post-survey Likelihood of Occurrence of Conservation Significant Flora

Following the survey, and with greater understanding of the landforms, soils and habitats of the survey area, 20 conservation significant flora taxa that have been previously recorded within the vicinity of the survey area are considered to have the potential to occur: *Vittadinia* sp. Coondewanna Flats (S. van Leeuwen 4684) P1, *Eremophila pusilliflora* P2, *Ipomoea racemigera* P2, *Isotropis parviflora* P2, *Oxali*s sp. Pilbara (M.E. Trudgen 12725) P2, *Teucrium pilbaranum* P2, *Amaranthus centralis* P3, *Aristida jerichoensis* var. *subspinulifera* P3*, Eremophila magnifica* subsp. *velutina* P3, , *Gymnanthera cunninghamii* P3, *Indigofera gilesii* P3, *Oldenlandia* sp. Hamersley Station (A.A. Mitchell PRP 1479) P3, *Pilbara trudgenii* P3, *Rostellularia adscendens* var. *latifolia* P3, *Sida* sp. Barlee Range (S. van Leeuwen 1642) P3, *Sida* sp. Hamersley Range (K. Newbey 10692) P3, *Swainsona thompsoniana* P3, *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) P3, *Eremophila youngii* subsp. *lepidota* P4 and *Goodenia nuda* P4 (Appendix E).

Eight of the 20 taxa (*Vittadinia* sp. Coondewanna Flats (S. van Leeuwen 4684) P1, *Ipomoea racemigera* P2, *Isotropis parviflora* P2, *Oxalis* sp. Pilbara (M.E. Trudgen 12725) P2, *Amaranthus centralis* P3, *Oldenlandia* sp. Hamersley Station (A.A. Mitchell PRP 1479) P3, *Swainsona thompsoniana* P3 and *Goodenia nuda* P4) are considered annuals and/or short lived perennials and were not encountered during the survey efforts; this may be due to the below average rainfall for all three site visits. The remaining 12 taxa: *Eremophila pusilliflora* P2, *Teucrium pilbaranum* P2, *Aristida jerichoensis* var. *subspinulifera* P3, *Eremophila magnifica* subsp. *velutina* P3, *Gymnanthera cunninghamii* P3, *Indigofera gilesii* P3, *Pilbara trudgenii* P3, *Rostellularia adscendens* var. *latifolia P3*, *Sida* sp. Barlee Range (S. van Leeuwen 1642) P3, *Sida* sp. Hamersley Range (K. Newbey 10692) P3, *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) P3 and *Eremophila youngii* subsp. *lepidota* P4 are perennial species and still have the potential to occur in the survey area. This is because the entire area was not systematically searched with only certain high-likelihood habitats targeted. Challenging terrain was also a limiting factor for traversing some parts of the survey area.

4.2.2.3 Range Extensions

One taxon recorded within the survey area, *Tinospora smilacina,* was considered a range extension of greater than 50 km from its currently known distribution. This taxon was recorded at one quadrat (HD26) within BHT.

4.2.2.4 Flora of Taxonomic Interest

The previously recorded location of *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727) P3, located in HD2, was revisited during the Phase 3 field visit. The previous population was not relocated, possibly due to the dry seasonal conditions, however a flowering collection was made in nearby cracking clay and identified as *Goodenia* sp. (of interest). This specimen had characteristics similar to *G.* sp. East Pilbara (A.A. Mitchell PRP 727) P3 but this identification was unable to be confirmed due to a lack of seed. A critical identification character needed for confirming *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727) P3 is the width of the wing on the seed (S. Dillon, pers. comm., 1st July 2019). It is possible that this specimen represents a species of conservation significance, as if it is not *G.* sp. East Pilbara (A.A. Mitchell PRP 727) P3 it may potentially be an undescribed taxon.

One specimen was identified as *Eremophila* aff. *clarkei*. *Eremophila clarkei* is a slender, erect shrub found in a variety of habitats throughout the Mid-West and Murchison regions to the south, with only a handful of records occurring in the southern Pilbara in the vicinity of Newman. *Eremophila clarkei* is a morphologically variable taxon and the specimen collected in the survey area was a low shrub with no reproductive material available for confirmation. This specimen was assigned the name *E.* aff. *clarkei* based on sterile leaf characters, leaf folding patterns and resinous nature (R. Davis, pers. comm., 1st July 2019). It is unlikely to represent a taxon of conservation significance.

One specimen was identified as *Polymeria* aff. *longifolia* from the survey area. *Polymeria* taxonomy is not clear at present and the material collected was not in good condition. The specimen appeared to be rhizomatous, which limits it to two taxa, only one of which (*P. longifolia*) has been recorded in Western Australia. The specimen had a corolla which was smaller and leaves which were not as sericeus as for *P. longifolia* (S. Dillon, pers. comm., 1st July 2019). Both of these characters are variable in *Polymeria* and this specimen was assigned the name *P.* aff. *longifolia*. It is unlikely to represent a taxon of conservation significance.

4.2.2.5 Introduced Flora (Weeds)

Weed diversity in the survey area was considered moderate with 17 weed taxa recorded from the current survey and previous surveys. Habitat and abundance details for these taxa are summarised in Table 20.

Bidens bipinnata* (bipinnate beggartick) was the most frequently recorded weed species, and was typically associated with creeks, mulga-dominated vegetation and, to a lesser degree, hillslopes. **Cenchrus* spp. (buffel grass and birdwood grass) were not as abundant as they are in the broader region, likely to be due to the dry seasonal conditions and rocky habitats of the survey area. None of the weed species recorded are listed as WoNS (Australian Weeds Committee 2012b), or as Declared Pest plants in Western Australia under the BAM Act (Department of Primary Industries and Regional Development 2018). Each of the weed species has been previously recorded in the Pilbara region. Eight of the species (Brassica tournefortii, *Cenchrus ciliaris*, **C. setiger*, **Chloris virgata*, **Cynodon dactylon, *Malvastrum americanum, *Setaria verticillata* and **Vachellia farnesiana*) have a high ecological impact and rapid invasiveness, according to the Pilbara prioirtisation process for weed management (Department of Biodiversity, Conservation, and Attractions 2018a) (Table 20).

Photographs and descriptions of weeds within the survey area are presented in Table O.1 (Appendix O). Indicative weed locations are mapped in Figure O.1 and presented in Table O.2 (Appendix O). Locations presented are indicative only and weed distribution was much higher, particularly in the disturbed and cleared areas.

Table 20: Introduced flora species (weeds) and associated habitats recorded within the survey area.

Species	Family	Survey area		Habitat in the survey area	Vegetation unit	Invasiveness rating[3]	
		Recorded abundance from current survey	Abundance from all surveys[1]			Ecological impact	Invasiveness
**Bidens bipinnata* (bipinnate beggartick)	Asteraceae	36,295	37,484	Drainage features, mulga plains, hillslopes	D1, D2, D4, D5, D7, D8, H2, H6, H7, H8, P1, P2, P3, Cleared	Unknown	Rapid
**Brassica tournefortii* (Mediterranean turnip)[2]	Brassicaceae	0	2	Major drainage line	Not recorded in current survey	High	Rapid
**Cenchrus ciliaris* (buffel grass)	Poaceae	11,634	11,651	Disturbed, plains, major and minor drainage, base of low hills	D1, D4, D5, H10, H12, P2, Cleared	High	Rapid
**Cenchrus setiger* (birdwood grass)	Poaceae	1,154	1,156	Major and minor drainage	D4, D5, H10, P2, Cleared	High	Rapid
**Chloris virgata* (feathertop Rhodes grass)	Poaceae	2	4	Plains	D4, P2	High	Rapid
**Conyza bonariensis* (flaxleaf fleabane)	Asteraceae	1	1	Footslopes/drainage feature	D4	No rating	No rating
**Cynodon dactylon* (couch)	Poaceae	5	5	Plains and drainage features including Weeli Wolli Creek	D5	High	Rapid
**Datura leichhardtii* subsp. *leichhardtii* (native thornapple)	Solanaceae	22	22	Plains, drainage features and near infrastructure	D5, P2	Unknown	Unknown
**Flaveria trinervia* (speedy weed)	Asteraceae	112	112	Major and minor drainage	D1, D4, D5, Cleared	No rating	No rating
**Lactuca serriola* (prickly lettuce)	Asteraceae	2	4	Plains	Cleared	No rating	No rating
**Malvastrum americanum* (spiked malvastrum)	Malvaceae	374	578	Major and minor drainage, footslopes	D2, D4, D5, D7, D8, P1, P2, Cleared	High	Rapid

Species	Family	Survey area		Habitat in the survey area	Vegetation unit	Invasiveness rating[3]	
		Recorded abundance from current survey	Abundance from all surveys[1]			Ecological impact	Invasiveness
**Rumex vesicarius* (ruby dock)[2]	Polygonaceae	0	17	Minor drainage line	Cleared	No rating	No rating
**Setaria verticillata* (whorled pigeon grass)	Poaceae	66	67	Major and minor drainage, plains	D1, D4, P2	High	Rapid
**Sigesbeckia orientalis* (Indian weed)	Asteraceae	1	8	Minor drainage	D4	Unknown	Rapid
**Solanum nigrum* (black berry nightshade)[2]	Solanaceae	0	8	Plains/ disturbed	Cleared	Low	Rapid
**Sonchus oleraceus* (common sowthistle)	Asteraceae	61	134	Major drainage	D4, D5, P3, Cleared	Low	Rapid
**Vachellia farnesiana* (mimosa bush)	Fabaceae	289	291	Major and minor drainage, plains, hillslopes	D1, D4, D5, H8, H10, P1, P2, Cleared	High	Rapid

[1] - An assumption of one individual was made where no abundance data was collected.

[2] - Taxa not observed in current survey (Phase 1, 2 or 3), but previously recorded within the survey area (Table O.2, Appendix O) (Astron Environmental Services 2014, 2016, 2018; Biota Environmental Sciences 2006; Mattiske Consulting 2010; Rio Tinto 2015).

[3] – Based on Department of Biodiversity, Conservation and Attractions (2018a).

5 Discussion

5.1 Overview of the Survey Area

The survey area was characterised by a low ironstone ridge that extends in a roughly east to west direction, and associated undulating low hills draining north towards Pebble Mouse Creek and its tributaries. The alluvial plains supported tussock grassland dominated vegetation units with some areas of cracking clays. Vegetation units on the undulating plains were mulga (*Acacia aneura* sens. lat.) dominated, with some areas of banded mulga. Geology differed in the south and east of HD2, with dolerite dominated geology featuring in the uplands and other minor mudstone and calcrete areas occurring in highly eroded low hills and lowlands.

5.2 Vegetation

Previously surveyed quadrats outside of the work conducted by Biota 2014 were not able to be located and re-sampled during the survey and new quadrats were installed to achieve the required spatial coverage for each vegetation unit. Five vegetation units occurring within the survey area (H5, H9, P4, D7, D8) did not achieve the minimum sampling replication effort of three quadrats per vegetation unit. This was generally due to limited areas within the survey area large enough to establish quadrats without influence from surrounding vegetation, restricted access, and the avoidance of burnt vegetation. One vegetation unit was described after completion of the field surveys and had not achieved three replicate quadrats.

Much of the previous vegetation mapping within and adjacent to the survey area poorly represented the vegetation and landforms observed in situ. This limited the ability to ground-truth and consolidate existing vegetation mapping (Mattiske Consulting 2009a, 2009b, 2010). Previous vegetation unit boundaries appeared to have been created post-survey and a number of discrepancies, such as ridge lines being mapped as drainage lines, limited attempts to consolidate it with new work. As such it was considered the best approach to conduct new vegetation mapping across the survey area to ensure consistency. The Biota (2006, 2014) vegetation mapping that intersected parts of the survey area at Baby Hope Downs was found to be a good representation of the vegetation observed in situ and was better able to be utilised in this assessment.

Twenty-three vegetation units were described and mapped within the survey area based on visual structural interpretation and aerial photography analysis. The multivariate floristic analysis of the 99 quadrats and relevés within the survey area found 22 significant clusters when presence of perennial native taxa was analysed, and 23 significant clusters when the PFC of perennial native taxa was analysed. The number of structural vegetation units described appears comprehensive and comparable to the number of significant clusters identified. The significant clusters generally grouped in support of the structural vegetation units described within the survey area; minor exceptions included different drainage units grouping together, hills and slopes sites forming large floristic clusters, and mulga-dominated sites across different landforms grouping together (Appendix K).

There were no Commonwealth or State listed TECs recorded within the survey area. One vegetation unit (P2) was associated with the Wannamunna land system and held some affinity with the priority 1 PEC '*West Angelas Cracking-Clays*'. Due to the below average seasonal conditions prior to all phases of survey, a number of the grass taxa occurring within this vegetation unit were unable to be identified to species level; this limited the ability to compare against the characteristic grass species of the PEC. Likewise, herbaceous species were likely to have been under-represented due to the poor seasonal conditions. Despite the seasonal limitation, it is considered likely that athough P2

shares some affinity with the PEC itis not of a large enough scale and floristically diverse enough to represent the PEC. The occurrence of *Astrebla* spp. within P2 is patchy and does not form the dense tussock grasslands typified by the PEC. Surveying in better seasonal conditions and finer scale vegetation mapping to separate the component vegetation types within the P2 mosaic would refine the current boundaries for the vegetation unit. The main threats to this community are disturbance footprints increasing from mining, future infrastructure development, possible weed invasion and changes in fire regime (Department of Biodiversity, Conservation, and Attractions 2017a).

Three mulga-dominated vegetation units recorded in the survey area may represent Ecosystems at Risk (Kendrick 2001). The 'grove/inter-grove mulga, Eastern Hamersley Range' ecosystem, represented by vegetation unit P1, and the 'valley floor mulga' ecosystem, represented by vegetation unit P3, are both described regionally as threatened by grazing from cattle and feral animals, weed invasion (particularly from ruby dock **Rumex vesicarius*) and changes in the surface hydrology such as water shadowing from linear infrastructure. Both P3 and H2, which represent the 'lower-slope mulga ecosystem', may also be threatened by fires which kill stands of mulga and/or prevent regeneration. Mulga-dominated vegetation was widespread throughout the survey area, and vegetation units P1, P3 and H2, account for 369.2 ha (3.4%), 1,301.0 ha (12.0%) and 314.8 ha (2.9%) of the survey area respectively.

The dominant tree species of vegetation unit D4, *Eucalyptus camaldulensis* subsp*. obtusa* and *E. victrix*, are considered facultative phreatophytes and therefore may have some reliance on groundwater. No permanent pools of water were observed within the areas surveyed in the D4 vegetation unit, and based on reviews of aerial imagery it is considered unlikely that these drainage lines would support pools outside of the wet season.

The survey area lies within the Pre-European vegetation associations 82, 18 and 29 (Beard 1975), all of which have above 99% pre-European extent remaining. This is well above the Australian and New Zealand Environment and Conservation Council 30% retention target (Commonwealth of Australia 2001) and the criteria for 10% level of pre-clearing extent as representing 'endangered' adopted by the EPA (Environmental Protection Authority 2000).

5.3 Flora

The suite of flora species recorded was considered typical of what may be expected in the area (Beard 1975; Kendrick 2001) and aligns with what has been previously recorded in surrounding areas (Biota Environmental Sciences 2006, 2014; Mattiske Consulting 1995, 2005, 2008b, 2008c, 2008d, 2009a, 2009b, 2010; Ecologia Environment 2013). Despite below average rainfall preceding all phases of survey, the floristic diversity was comparable with previous surveys in the region. It is likely however, that many of the annuals, short-lived perennials, grasses and herbaceous species that were noted would have been more widespread throughout suitable habitats in better seasonal conditions. Specimens generally had adequate material to allow confident identification, however a number of specimens collected were unable to be identified to species level.

The survey area was considered to have a relatively high diversity of conservation significant flora. The majority of priority flora points were recorded from the BHT ridge that runs through the centre of the survey area, although calcrete flats and rises, mulga plains and drainage lines also provided habitat for priority flora.

Six vouchered specimens are listed for *Eremophila* sp. West Angelas (S. van Leeuwen 4068) P1 (Western Australian Herbarium 1998-2019). Most of these records occur in the general locality of the survey area, with collections from West Angelas and Mount Robinson. The approximate range of the five specimens listed on NatureMap is 75 km (Department of Biodiversity, Conservation, and

Attractions 2019a). *Eremophila* sp. West Angelas (S. van Leeuwen 4068) P1 has been previously recorded high in the landscape on steep hills, similar to the habitat where the 532 individuals were recorded in the survey area (Table N.2, Appendix N). This accounts for 51.1% of the population known from records within a 40 km radius (Department of Biodiversity, Conservation, and Attractions 2017c, 2017e; Rio Tinto Iron Ore 2019). *Eremophila* sp. West Angelas (S. van Leeuwen 4068) P1 is difficult to distinguish from the common *Eremophila latrobei* subsp. *filiformis* which occurs in similar habitats; as such there is potential that this taxon has been misidentified in previous surveys in the vicinity and given its preference for habitat that is difficult to access it may have a greater distribution than is currently recognised. However, based on the records from this survey the habitat for this taxon appears to be quite specific and not widely distributed. As such there is potential that more populations may occur beyond the survey area but these may be limited in distribution.

Twenty vouchered specimens are listed for *Aristida lazaridis* P2 (Western Australian Herbarium 1998-2019). Vouchered specimens have been recorded from an approximately 130 km linear range, including in the general vicinity of the survey area (particularly near Mount Robinson), and near Mount Meharry in Karijini National Park and Newman. One record occurs approximately 545 km east of the normal range on NatureMap (2019a), however according to location details on the vouchered specimen the location coordinate appears to be incorrect. This species has been previously recorded on plains and floodplains with clay soils. A total of 2,765 individuals were recorded from the survey area (Table N.2, Appendix N). This accounts for 64.1% of the population known from records within a 40 km radius (Department of Biodiversity, Conservation, and Attractions 2017c, 2017e; Rio Tinto Iron Ore 2019). This species may be difficult to identify in poor seasonal conditions and/or following grazing, and therefore may not have been recorded from previous surveys in the vicinity. It is likely that further suitable habitat for *A.lazaridis* P2 occurs beyond the survey area in areas which have not been previously surveyed.

The majority of the 20 vouchered records of *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2 are from the Karijini and Turee Syncline localities, however there are also two records in the vicinity of the survey area, at HD1 and West Angelas (Western Australian Herbarium 1998-2019). Records occur over an approximately 195 km linear range (Department of Biodiversity, Conservation, and Attractions 2019a). Vouchered specimens were generally collected from rocky gullies; the 386 individuals from the survey area were typically recorded on rocky slopes and gorges (Table N.2, Appendix N). This accounts for 24.9% of the population known from records within a 40 km radius (Department of Biodiversity, Conservation, and Attractions 2017c, 2017e; Rio Tinto Iron Ore 2019). Given the considerable range for this taxon, it is likely that further habitat occurs beyond the survey area in areas which have not been previously surveyed.

Twenty-three vouchered specimens are listed for *Acacia subtiliformis* P3 (Western Australian Herbarium 1998-2019), over a range of approximately 130 linear km (Department of Biodiversity, Conservation, and Attractions 2019a). Previous locations of *A. subtiliformis* P3 occur in the general vicinity of the survey area, including Hope Downs, Marillana, Weeli Wolli Springs, Giles Point and Rhodes Ridge. It has been previously associated with calcrete hills, rises and plains, similar habitat to where the two individuals were previously recorded from in the survey area (Table N.2, Appendix N). This accounts for <0.1% of the population known from records within a 40 km radius (Department of Biodiversity, Conservation, and Attractions 2017c, 2017e; Rio Tinto Iron Ore 2019). Although *A. subtiliformis* P3 has quite a specific habitat, it is likely to have further occurrences beyond the survey area in areas which have not been previously surveyed.

There are 17 vouchered specimens of *Eremophila* sp. Hamersley Range (K. Walker KW 136) P3 listed at the WA Herbarium (Western Australian Herbarium 1998-2019), over a range of approximately 215 linear km (Department of Biodiversity, Conservation, and Attractions 2019a). Location details of

these records indicate that the two main areas of occurrence are in the vicinity of Paraburdoo, near Turee Syncline and Channar, and hills close to the survey area, with records near Yandicoogina, West Angelas, Weeli Wolli Creek and Coondewanna. A total of 1,344 individuals were recorded from the survey area (Table N.2, Appendix N). This accounts for 19.9% of the population known from records within a 40 km radius (Department of Biodiversity, Conservation, and Attractions 2017c, 2017e; Rio Tinto Iron Ore 2019). Given the considerable range for this taxon, it is likely that further habitat occurs beyond the survey area in areas which have not been previously surveyed.

There are 17 vouchered specimens of *Goodenia lyrata* P3 listed at the WA Herbarium (Western Australian Herbarium 1998-2019) over an east to west range of approxiantely 940 km and north to south range of approximately 700 km (Department of Biodiversity, Conservation, and Attractions 2019a). This species has a relatively widespread distribution throughout Western Australia, but seems to be restricted to a few locations within the Pilbara region, near Mount Bruce Flats, Coondewanna Flats and West Angelas. The single previous record of *G. lyrata* P3 accounts for 0.8% of the population known from records within a 40 km radius (Department of Biodiversity, Conservation, and Attractions 2017c, 2017e; Rio Tinto Iron Ore 2019). Given the wide distribution of this taxon there is likely to be suitable habitat for *G. lyrata* P3 beyond the survey area in areas which have not been previously surveyed.

There are 37 vouchered specimens of *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727) P3 listed at the WA Herbarium (Western Australian Herbarium 1998-2019), over a range of approximately 350 linear km (Department of Biodiversity, Conservation, and Attractions 2019a). Localities include Paraburdoo, Newman, Balfour Downs Station, Tom Price, Weeli Wolli Spring, Hope Downs, Rhodes Ridge and Noreena Downs Station. The 80 individuals that occur within the survey area account for <0.1% of the population known from records within a 40 km radius (Department of Biodiversity, Conservation, and Attractions 2017c, 2017e; Rio Tinto Iron Ore 2019). Although *G.* sp. East Pilbara (A.A. Mitchell PRP 727) P3 has quite a specific habitat, it is likely to have further occurrences beyond the survey area in areas which have not been previously surveyed.

Grevillea saxicola P3 has 37 vouchered records at the WA Herbarium (Western Australian Herbarium 1998-2019), over a range of approximately 225 linear km (Department of Biodiversity, Conservation, and Attractions 2019a). Distribution ranges from Mount Wall, the Paraburdoo area, Tom Price, Mount Meharry and in the vicinity of the survey area at West Angelas. Voucher records indicate that *G. saxicola* P3 has been previously recorded from a number of habitats, including slopes, gorges and drainage features, similar to the habitats it was associated with in the survey area. Current surveys recorded 1,669 individuals of *G. saxicola* P3 in the survey area (Table N.2, Appendix N). This accounts for 66.4% of the population known from records within a 40 km radius (Department of Biodiversity, Conservation, and Attractions 2017c, 2017e; Rio Tinto Iron Ore 2019). Given the wide distribution of this taxon there is likely to be suitable habitat for *G. saxicola* P3 beyond the survey area in areas which have not been previously surveyed.

Sixty-three vouchered specimens are listed for *Rhagodia* sp. Hamersley (M. Trudgen 17794) P3 (Western Australian Herbarium 1998-2019) over a range of approximately 275 linear km (Department of Biodiversity, Conservation, and Attractions 2019a). This species has a reasonably broad distribution, spanning Roy Hill Station, Shovelanna Hill, north of Tom Price, to the vicinity of the survey area, around Rhodes Ridge, Coondewanna and Weeli Wolli Spring. *Rhagodia* sp. Hamersley (M. Trudgen 17794) P3 is typically associated with alluvial plains with clay soils. According to the WA Herbarium collection database the majority of specimens were collected from plains, although some were also recorded on hillslopes, crests and a cliff (Western Australian Herbarium 1998-2019). Current surveys recorded 77 individuals from mulga plains and hillslopes in the survey area (Table N.2, Appendix N). This accounts for 1.0% of the population known from records within a 40 km radius (Department of Biodiversity, Conservation, and Attractions 2017c, 2017e; Rio Tinto

Iron Ore 2019). There are extensive alluvial plains in the broader area which have not been previously surveyed and are likely to provide suitable habitat for *R.* sp. Hamersley (M. Trudgen 17794) P3.

There were 35 vouchered specimens of *Triodia* sp. Mt Ella (M.E. Trudgen 12739) P3, over a range of approximately 380 linear km (Department of Biodiversity, Conservation, and Attractions 2019a). Occurrences span from Mount Robinson in the west to Shovelanna Hill in the east, and the species therefore has a relatively narrow band of distribution in the Hamersley Ranges, with one disjunct record near Rudall River. It has been previously recorded in similar habitats to those of the 3,542 individuals recorded in the survey area, including gorges, hilltops and slopes (Western Australian Herbarium 1998-2019) (Table N.2, Appendix N). This accounts for 7.6% of the population known from records within a 40 km radius (Department of Biodiversity, Conservation, and Attractions 2017c, 2017e; Rio Tinto Iron Ore 2019). *Triodia* sp. Mt Ella (M.E. Trudgen 12739) P3 can be difficult to distinguish from other resinous *Triodia* species (particularly when sterile) and may have been misidentified previously; its distribution could therefore be wider than currently recognised. The habitat that *T.*sp. Mt Ella (M.E. Trudgen 12739) P3 prefers is relatively widespread in the broader region and there are likely to be further occurrences of this taxon beyond the survey area in areas which have not been previously surveyed.

Twenty-nine vouchered records of *Acacia bromilowiana* P4 are listed, with a range of approximately 430 linear km (Department of Biodiversity, Conservation, and Attractions 2019a). The distribution of these records span from Brockman to Balfour Downs station, and in the vicinity of the survey area near Hope Downs, West Angelas and Mount Robinson (Western Australian Herbarium 1998-2019). The previous records are typically associated with gullies, slopes and hilltops, similar to the gully and gorge habitats it was recorded from in the survey area. The 132 individuals observed in the survey area were all recorded from the breakaways, scree slopes, gorges and drainage lines associated with BHT (Table N.2, Appendix N). This accounts for 6.7% of the population known from records within a 40 km radius. The habitat that *A.bromilowiana* P4 prefers is relatively widespread in the broader region and there are likely to be further occurrences of this taxon beyond the survey area in areas which have not been previously surveyed.

The 46 vouchered records of *Eremophila magnifica* subsp. *magnifica* P4 occur over a range of approximately 315 linear km (Department of Biodiversity, Conservation, and Attractions 2019a) and are localised to the Hamersley Range and surrounding hills, including areas in the vicinity of the survey area. The three individuals recorded in the survey area were located on hills and breakaways in the north-east and account for 0.2% of the population known from records within a 40 km radius (Department of Biodiversity, Conservation, and Attractions 2017c, 2017e; Rio Tinto Iron Ore 2019). Given the wide distribution of *E.magnifica* subsp. *magnifica* P4 there is likely to be suitable habitat beyond the survey area in areas which have not been previously surveyed.

Lepidium catapycnon P4 has 35 vouchered records, over a range of approximately 300 linear km (Department of Biodiversity, Conservation, and Attractions 2019a). Distribution ranges from Tom Price to Newman to Nullagine, with numerous records in the vicinity of the survey area, around Mount Robinson, Rhodes Ridge and Weeli Wolli Creek. Habitat information associated with the vouchers indicates a preference for hillslopes and tops, similar habitats to where *L. catapycnon* P4 was recorded from in the survey area (Western Australian Herbarium 1998-2019). The 4,723 individuals recorded in the survey area were located on hillslopes in BHT (Table N.2, Appendix N). This accounts for 9.6% of the population known from records within a 40 km radius (Department of Biodiversity, Conservation, and Attractions 2017c, 2017e; Rio Tinto Iron Ore 2019). *Lepidium catapycnon* P4 was previously listed as T and as such considerable targeted survey effort for this taxon has been previously undertaken in the broader region.

The WA Herbarium lists 36 vouchered specimens of *Ptilotus mollis* P4, over a range of approximately 650 linear km (Department of Biodiversity, Conservation, and Attractions 2019a). Distribution of *P. mollis* P4 is broad, with records spanning from Panorama Station to Cane River to Turee Creek, and including records in the vicinity of the survey area, near Mount Robinson (Western Australian Herbarium 1998-2019). The majority of vouchered specimens were collected from rocky hillslopes, the same habitat as the 50 individuals recorded in the survey area (Table N.2, Appendix N). This accounts for 5.3% of the population known from records within a 40 km radius (Department of Biodiversity, Conservation, and Attractions 2017c, 2017e; Rio Tinto Iron Ore 2019). Given the wide distribution of *P. mollis* P4 there is likely to be suitable habitat beyond the survey area in areas which have not been previously surveyed.

The amount of time conducting targeted searches for conservation significant flora within the survey area was limited and focused on areas likely to support the largest populations of P1 and P2 taxa. The ridge at BHT where many of the conservation significant flora taxa occur is steep, rugged and difficult to access safely on foot. Hot conditions were experienced during the Phase 1 survey, as such the majority of targeted search effort throughout the survey area was conducted during the Phase 2 survey. Phase 3 searches focused on the eastern end of the rugged south facing hills of BHT as well as searches of the D4 drainage unit for populations of *Aristida lazaridis* P2. Given the limitations of safe access in some areas of BHT, the possible distribution of conservation significant flora populations and the abundance estimates may be under-represented within the survey area.

There remains the possibility of further conservation significant flora taxa occurring within the survey area; 20 taxa have been previously recorded within 50 km, from habitats similar to those within the survey area and are considered to still have the potential to occur. Of these, eight taxa (*Vittadinia* sp. Coondewanna Flats (S. van Leeuwen 4684) P1, *Ipomoea racemigera* P2, *Isotropis parviflora* P2, *Oxalis* sp. Pilbara (M.E. Trudgen 12725) P2, *Amaranthus centralis* P3, *Oldenlandia* sp. Hamersley Station (A.A. Mitchell PRP 1479) P3 *Swainsona thompsoniana* P3 and *Goodenia nuda* P4) are considered annuals and/or short lived perennials. The below average rainfall preceding each of the three phases of survey meant seasonal conditions were not optimal for detecting these species should they occur, as they were likely to have senesced.

Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684) P1, *O.* sp. Hamersley Station (A.A. Mitchell PRP 1479) P3 and *Swainsona thompsoniana* P3 are associated with cracking clay soils such as those that were recorded in vegetation unit P2. *Ipomoea racemigera* P2, *Amaranthus centralis* P3 and *G. nuda* P4 typically occur in ephemeral watercourses and as such are most likely to occur within vegetation units D4 and D5. *Oxalis* sp. Pilbara (M.E. Trudgen 12725) P2 has a habitat preference of gullies and outcropping and is most likely to be associated with vegetation units D3, H1 and H2. *Isotropis parviflora* P2 has been previously recorded from slopes of stony hills and is most likely to be associated with vegetation units H3, H8 and H11, and possibly with H4, H7 and H10.

The other 12 potential priority flora taxa (*Eremophila pusilliflora* P2, *Teucrium pilbaranum* P2, *Aristida jerichoensis* subsp. *subspinulifera* P3, *E. magnifica* subsp. *velutina* P3, *Gymnanthera cunninghamii* P3, *Indigofera gilesii* P3, *Pilbara trudgenii* P3, *Rostellularia adscendens* var. *latifolia* P3, *Sida* sp. Barlee Range (S. van Leeuwen 1642) P3, *S.* sp. Hamersley Range (K. Newbey 10692) P3, *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) P3 and *E. youngii* subsp. *lepidota* P4 are perennial species. These taxa are low shrubs, grasses or herbs that may occur in areas of the survey area difficult to access safely on foot or in small populations that could be overlooked during survey. *Eremophila pusilliflora* P2, *E. youngii* subsp. *lepidota* P4 and *Gymnanthera cunninghamii* P3 are associated with alluvial plains and are most likely to occur within vegetation units D4, D5, D7 and D8 in the survey area. *Aristida jerichoensis* subsp. *subspinulifera* P3 is associated with hardpan plains and is most likely to occur in vegetation units P1, P2, P3 and P4. *Teucrium pilbaranum* P2 and *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) P3 are associated with drainage lines and clay

flats and are most likely to occur within vegetation units D4, D5, D7 and P2. *Eremophila magnifica* subsp. *velutina* P3, *I. gilesii* P3, *P.trudgenii* P3, *R. adscendens* var. *latifolia, S.* sp. Barlee Range (S. van Leeuwen 1642) P3 and *S.* sp. Hamersley Range (K. Newbey 10692) P3 have a habitat preference of gullies, gorges and breakaways associated with the Hamersley Ranges and therefore have greatest potential to occur in vegetation units D3, H1 and H2. This habitat was often challenging to safely traverse along the steep slopes, with some areas of BHT not being able to be thoroughly traversed, therefore there is potential that conservation significant individuals may occur but were not observed during the survey.

Although *Euphorbia clementii* P3 has suitable habitat in the survey ara and meets the distance criteria to be considered potential, it is noted that the majority of records for this species have been previously recorded north of Fortescue Marsh in the Chichester and Roebourne IBRA subregions, so the Rio Tinto record of *E. clementii* P3 15 km from the survey area is considered unusual and the species is therefore considered unlikely to occur.

The range of variation within *Triodia wiseana* and *T. angusta* presented some complex morphological similarity between different forms of the two species within the survey area. These two taxa are closely related and share morphological similarities that can make them difficult to separate, particularly when looking at the different variations of *T. wiseana* forms. There were also a number of unidentified grass taxa recorded within the survey area, due to the below average seasonal conditions encountered prior to all phases of survey. In particular there is expected to be further diversity within the *Aristida* genus than has been recorded.

Weed diversity was considered moderate with 17 introduced flora species recorded. The weed species recorded are not unusual for the Hamersley subregion. Many of the weed species recorded (**Bidens bipinnata, *Cenchrus ciliaris, *C. setiger, *Malvastrum americanum* and **Vachellia farnesiana*) are frequently recorded as dominant species in a variety of habtiats throughout the broader region. Some species, such as **Chloris virgata, *Conyza bonariensis, *Flaveria trinervia, *Lactuca serriola, *Setaria veriticillata, *Sigesbeckia orientalis, *Solanum nigrum* and **Sonchus oleraceus* are less widespread in habitat preference and distribution but are often associated with the clay soils of mulga habitats, as was observed in the survey area. **Brassica tournefortii, *Datura leichhardtii* subsp. *leichhardtii* and **Rumex vesicarius* are typically associated with human disturbances such as vegetation clearing. Weed density was generally low and mainly restricted to areas of previous disturbance and drainage lines. The evidence of grazing pressure was also low and there appears to be minimal impact from cattle and other feral herbivores. The vegetation condition is generally Excellent throughout the majority of the survey area.

5.4 Contextual Analysis

The process of placing vegetation units described within the survey area in a regional context by assessing and analysing site based data from surrounding projects had significant limitations, due to concerns with some previous specimen identifications and vegetation delineations. The data collected during the current survey clustered most closely with that from Biota (2006, 2014) and Ecologia (2013), but had limited affinity with Mattiske (2008d, 2009b, 2010). This is largely suspected to be a result of these previous Mattiske surveys having significantly fewer taxa recorded per site (Table 17).

Vegetation unit D3 occurs in the deeper incised gorges of the central ridge and was only associated with the Newman land system. Vegetation in these landforms was generally long unburnt and may act as refuge habitat for conservation significant flora taxa. Populations of *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2, *Eremophila* sp. Hamersley Range (K. Walker KW 136) P3, *Grevillea saxicola* P3, *Triodia* sp. Mt Ella (M.E. Trudgen 12739) P3, *Acacia bromilowiana* P4 and

Eremophila magnifica subsp. *magnifica* P4 were recorded within D3. The Newman land system is the most prevalent in the survey area, and is also widespread and well-represented in the broader area, accounting for approximately 12% of the Pilbara bioregion. There was 51.8 ha (0.5%) of the survey area mapped as D3.

Vegetation unit D4 is associated with major drainage lines that supported the potential GDE species *Eucalyptus camaldulensis* subsp*. obtusa* and *E. victrix*. *Aristida lazaridis* P2 also occurred within this vegetation. Vegetation unit D4 occurs within five land systems in the survey area, including Boolgeeda, Egerton, Newman, Rocklea and Wannamunna; the majority (40.0 ha, 64% of D4) of which is associated with the Rocklea land system. The Rocklea land system is widespread throughout the broader area, and accounts for 16% of the Pilbara bioregion. Vegetation unit D4 was mapped over 60.6 ha (0.6%) of the survey area.

Vegetation unit H2 had a high incidence of priority flora recorded, with *Eremophila* sp. West Angelas (S. van Leeuwen 4068) P1, *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2, *Eremophila* sp. Hamersley, Range (K. Walker KW 136) P3, *Grevillea saxicola* P3, *Rhagodia* sp. Hamersley (M. Trudgen 17794) P3, *Triodia* sp. Mt Ella (M.E.Trudgen 12739) P3, *Lepidium catapycnon* P4 and *Ptilotus mollis* P4 recorded from the south-facing upper slopes of BHT. The steep and elevated habitat was long unburnt, and as such it may act as refugia. This vegetation also has affinity with 'lower-slope mulga' which is considered an 'ecosystem at risk' (Kendrick 2001). H2 is mapped in three land systems in the survey area: McKay, Newman and Platform; the majority (272.6 ha, 87% of H2) of which is in the Newman land system. Vegetation unit H2 is mapped over 314.8 ha (2.9%) of the survey area.

Vegetation unit P2 may be locally restricted and had a dominance of tussock grasses not seen elsewhere in the survey area or local area. *Aristida lazaridis* P2, *Goodenia* sp. East Pilbara (A.A. Mitchell PRP 727) P3 (previous surveys and *Rhagodia* sp. Hamersley (M. Trudgen 17794) P3 were also recorded within this vegetation. The P2 vegetation occurs in the Boolgeeda, Newman, Platform, Rocklea and Wannamunna land systems, with the majority (95.3 ha, 58% of P2) occurring in the Wannamunna land system which accounts for less than 1% of the Pilbara bioregion. This land system consists of hardpan plains and internal drainage tracts which support mulga shrublands and woodlands, and occasionally eucalypt woodlands (van Vreeswyk et al. 2004). There was 155.6 ha (1.4%) of the survey area mapped as P2.

Other vegetation units within the survey area are typical of those associated with similar landforms and previously described vegetation in the nearby area and are not considered to have conservation significance.

The vegetation condition was generally Excellent within the survey area, with the main impacts being weeds and grazing affecting drainage vegetation units and the clearing of vegetation for mining and drilling activities.

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Appendix A: Geological Units, Land Systems and Pre-European Vegetation of the Survey Area

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700000 710000 720000

7460000

7450000

Survey Area

WA Geology

QUATERNARY

Qa

Qrc

CENOZOIC

Czk

Czl

PALEOPROTEROZOIC

Lchk

Lchw

ARCHEAN

Alhw

Ashm

Adf

Awfj

Achm

Qrc Czk Awfj Achm Qrc Qrc Awfj Ashm Lchw Qrc Czl Qa Lchw Lchw Lchk Ashm Ashm Lchk Ashm Alhw Alhw Qrc Achm Achm Qrc Lchw Lchk Achm Ashm Qa Qrc Achm Achm Awfj Adf Awfj Achm Awfj Czl Awfj Czl

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Rio Tinto

Hope Downs 2 Proposal – Flora and Vegetation Survey

Figure A.1: Geological units of the survey area.

Scale: 1:80,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 1 2 3 4 5 Kilometres

N

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Author: B. Eckermann Drawn: C. Dyde Date: 29-10-2019 Figure Ref: 14292A-19-BIDR-3RevB_191029_FigA1_Geo

700000 710000 720000

7460000

7450000

Survey Area

Land System

- Boolgeeda System
- Calcrete System
- Egerton System
- McKay System
- Newman System
- Oakover System
- Pindering System
- Platform System
- River System
- Rocklea System
- Spearhole System
- Wannamunna System

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Hope Downs 2 Proposal – Flora and Vegetation Survey

Figure A.2: Land systems of the survey area

Scale: 1:80,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 1 2 3 4 5 Kilometres

N

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Author: B. Eckermann | Drawn: C. Dyde | Date: 29-10-2019 | Figure Ref: 14292A-19-BIDR-3RevB_191029_FigA2_LSys

700000 710000 720000

7460000

7450000

Survey Area

Pre-European Vegetation

System Association

HAMERSLEY_18

HAMERSLEY_29

HAMERSLEY_82

HAMMERSLEY_18

HAMMERSLEY_82

HAMMERSLEY_18

HAMMERSLEY_82

HAMMERSLEY_82

HAMMERSLEY_18

HAMMERSLEY_18

HAMMERSLEY_82

HAMMERSLEY_29

HAMMERSLEY_29

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Hope Downs 2 Proposal – Flora and Vegetation Survey

Figure A.3: Pre-European vegetation of the survey area

Scale: 1:80,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 1 2 3 4 5 Kilometres

N

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Author: B. Eckermann Drawn: C. Dyde Date: 29-10-2019 Figure Ref: 14292A-19-BIDR-3RevB_191029_FigA3_PreEuroVeg

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Appendix B: Conservation Categories for Flora and Ecological Communities and Categories for Introduced Flora

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Table B.1: Categories and definitions for threatened flora and fauna species listed under the *Environment Protection and Biodiversity Conservation Act 1999.*

Conservation category	Definition
Extinct	Taxa with no reasonable doubt that the last member of the species has died.
Extinct in the wild	Taxa known to survive only in cultivation, in captivity or as a naturalised population well outside its past range; or it has not been recorded in its known and/or expected habitat, at appropriated seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically endangered (CR)	Taxa facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered (E)	Taxa are not critically endangered; and are facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable (V)	Taxa are not critically endangered or endangered; and are facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

Table B.2: Definitions and criteria for threatened ecological communities under the *Environment Protection and Biodiversity Conservation Act 1999.*

Categories of ecological communities	
Critically endangered	If, at that time, it is facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with the prescribed criteria.
Endangered	If, at that time, it is not critically endangered and is facing a very high risk of extinction in the wild in the near future, as determined in accordance with the prescribed criteria.
Vulnerable	If, at that time, it is not critically endangered or endangered, and is facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with the prescribed criteria.

Table B.3: Categories of threatened ecological communities (Department of Environment and Conservation 2013)

PD: Presumed Totally Destroyed
An ecological community that has been adequately searched for but for which no representative occurrences have been located. The community has been found to be totally destroyed or so extensively modified throughout its range that no occurrence of it is likely to recover its species composition and/or structure in the foreseeable future. An ecological community will be listed as presumed totally destroyed if there are no recent records of the community being extant **and either** of the following applies (A or B): A) Records within the last 50 years have not been confirmed despite thorough searches of known or likely habitats **or** B) All occurrences recorded within the last 50 years have since been destroyed.
CR : Critically Endangered
An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or that was originally of limited distribution and is facing severe modification or destruction throughout its range in the immediate future, or is already severely degraded throughout its range but capable of being substantially restored or rehabilitated. An ecological community will be listed as **Critically Endangered** when it has been adequately surveyed and is found to be facing an extremely high risk of total destruction in the immediate future. This will be determined on the basis of the best available information, by it meeting **any one or more of** the following criteria (A, B or C): A) The estimated geographic range, and/or total area occupied, and/or number of discrete occurrences since European settlement have been reduced by at least 90% **and either or both** of the following apply (i or ii): i) geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is imminent (within approximately 10 years); ii) modification throughout its range is continuing such that in the immediate future (within approximately 10 years) the community is unlikely to be capable of being substantially rehabilitated. B) Current distribution is limited, **and one or more** of the following apply (i, ii or iii): i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the immediate future (within approximately 10 years); ii) there are very few occurrences, each of which is small and/or isolated and extremely vulnerable to known threatening processes; iii) there may be many occurrences but total area is very small and each occurrence is small and/or isolated and extremely vulnerable to known threatening processes. C) The ecological community exists only as highly modified occurrences that may be capable of being rehabilitated if such work begins in the immediate future (within approximately 10 years).

En: Endangered

An ecological community that has been adequately surveyed and found to have been subject to a major contraction in area and/or was originally of limited distribution and is in danger of significant modification throughout its range or severe modification or destruction over most of its range in the near future.

An ecological community will be listed as **Endangered** when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. This will be determined on the basis of the best available information by it meeting **any one or more** of the following criteria (A, B, or C):

A) The geographic range, and/or total area occupied, and/or number of discrete occurrences have been reduced by at least 70% since European settlement **and either or both** of the following apply (i or ii):

i) the estimated geographic range, and/or total area occupied and/or number of discrete occurrences are continuing to decline such that total destruction of the community is likely in the short term future (within approximately 20 years);

ii) modification throughout its range is continuing such that in the short term future (within approximately 20 years) the community is unlikely to be capable of being substantially restored or rehabilitated.

B) Current distribution is limited, **and one or more** of the following apply (i, ii or iii):

i) geographic range and/or number of discrete occurrences, and/or area occupied is highly restricted and the community is currently subject to known threatening processes which are likely to result in total destruction throughout its range in the short term future (within approximately 20 years);

ii) there are few occurrences, each of which is small and/or isolated and all or most occurrences are very vulnerable to known threatening processes;

iii) there may be many occurrences but total area is small and all or most occurrences are small and/or isolated and very vulnerable to known threatening processes.

C) The ecological community exists only as very modified occurrences that may be capable of being substantially restored or rehabilitated if such work begins in the short-term future (within approximately 20 years).

VU: Vulnerable

An ecological community that has been adequately surveyed and is found to be declining and/or has declined in distribution and/or condition and whose ultimate security has not yet been assured and/or a community that is still widespread but is believed likely to move into a category of higher threat in the near future if threatening processes continue or begin operating throughout its range.

An ecological community will be listed as **Vulnerable** when it has been adequately surveyed and is not Critically Endangered or Endangered but is facing a high risk of total destruction or significant modification in the medium to long-term future. This will be determined on the basis of the best available information by it meeting **any one or more of** the following criteria (A, B or C):

A) The ecological community exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.

B) The ecological community may already be modified and would be vulnerable to threatening processes, is restricted in area and/or range and/or is only found at a few locations.

C) The ecological community may be still widespread but is believed likely to move into a category of higher threat in the medium to long term future because of existing or impending threatening processes.

Possible Threatened Ecological Communities that do not meet survey criteria or that are not adequately defined are added to the Priority Ecological Community Lists under Priorities 1, 2 and 3. Ecological communities that are adequately known, and are rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5 (Table B.4).

Table B.4: Definitions and criteria for priority ecological communities (Department of Environment and Conservation 2013)

P1: Priority One – Poorly-known ecological communities
Ecological communities that are known from very few occurrences with a very restricted distribution (generally ≤5 occurrences or a total area of ≤ 100ha). Occurrences are believed to be under threat either due to limited extent, or being on lands under immediate threat (e.g. within agricultural or pastoral lands, urban areas, active mineral leases) or for which current threats exist. May include communities with occurrences on protected lands. Communities may be included if they are comparatively well-known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under immediate threat from known threatening processes across their range.
P2: Priority Two – Poorly-known ecological communities
Communities that are known from few occurrences with a restricted distribution (generally ≤10 occurrences or a total area of ≤200ha). At least some occurrences are not believed to be under immediate threat of destruction or degradation. Communities may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements, and/or are not well defined, and appear to be under threat from known threatening processes.
P3: Priority Three – Poorly-known ecological communities
(i) Communities that are known from several to many occurrences, a significant number or area of which are not under threat of habitat destruction or degradation or: (ii) communities known from a few widespread occurrences, which are either large or within significant remaining areas of habitat in which other occurrences may occur, much of it not under imminent threat, or; (iii) communities made up of large, and/or widespread occurrences, that may or not be represented in the reserve system, but are under threat of modification across much of their range from processes such as grazing by domestic and/or feral stock, and inappropriate fire regimes. Communities may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and/or are not well defined, and known threatening processes exist that could affect them.
P4: Priority Four
Ecological communities that are adequately known, rare but not threatened or meet criteria for Near Threatened, or that have been recently removed from the threatened list. These communities require regular monitoring. (i) Rare. Ecological communities known from few occurrences that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These communities are usually represented on conservation lands. (ii) Near Threatened. Ecological communities that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable. (iii) Ecological communities that have been removed from the list of threatened communities during the past five years.
P5: Priority Five – Conservation dependent ecological communities
Ecological communities that are not threatened but are subject to a specific conservation program, the cessation of which would result in the community becoming threatened within five years.

Table B.5: Conservation codes for threatened Western Australian flora and fauna under the *Biodiversity Conservation Act 2016* (Department of Biodiversity, Conservation, and Attractions 2019).

Conservation category	Conservation category	Definition
Critically endangered (CR)	Schedule 1 of the *Wildlife Conservation*.	Taxa "facing an extremely high risk of extinction in the wild in the immediate future, as determined in accordance with criteria set out in the ministerial guidelines."
Endangered (EN)	Schedule 2 of the *Wildlife Conservation*.	Taxa "facing a very high risk of extinction in the wild in the near future, as determined in accordance with criteria set out in the ministerial guidelines."
Vulnerable (VU)	Schedule 3 of the *Wildlife Conservation*.	Taxa "facing a high risk of extinction in the wild in the medium-term future, as determined in accordance with criteria set out in the ministerial guidelines."
Extinct (EX)	Schedule 4 of the *Wildlife Conservation*.	"there is no reasonable doubt that the last member of the species has died."
Extinct in the wild (EW)	Listing in accordance with Ministerial Guidelines (Section 25 of the BC Act)	Species that "is known only to survive in cultivation, in captivity or as a naturalised population well outside its past range; and has not been recorded in its known habitat or expected habitat, at appropriate seasons, anywhere in its past range, despite surveys over a time frame appropriate to its life cycle and form". Currently there are no threatened flora species listed as EW. If listing of a species as EW occurs, then a schedule will be added to the applicable notice.

Taxa that have not yet been adequately surveyed to be listed under Schedule 1 or 2 are added to the Priority Flora and Priority Fauna Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as Threatened flora or fauna. Taxa that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These taxa require regular monitoring.

Table B.6: Priority species codes for Western Australian flora (Department of Biodiversity, Conservation, and Attractions 2019)

P1: Priority One – Poorly known taxa
Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
P2: Priority Two – Poorly known taxa
Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
P3: Priority Three – Poorly known taxa
Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
P4: Priority Four: Rare, near threatened and other taxa in need of monitoring
(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for vulnerable but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

The management of introduced flora species in Western Australia is now regulated through the *Biosecurity and Agriculture Management Act 2007* (BAM Act). A list of declared pests, including 'pest' plants is provided under the BAM Act, which has been updated to incorporate a number of other Acts that are administered by Department of Agriculture and Food Western Australia (Department of Agriculture and Food Western Australia 2016). Declared pests can fall into two categories: one that relates to the prevention of introducing the species or eradicating it; and the other relates to managing the species and whether it can be kept (i.e. for scientific purposes, education or other purpose).

The threat and risk posed to site-specific biodiversity values, influences to rehabilitation success, primary production, infrastructure assets or human health will differ depending on the unique characteristics of each site and the associated land management practice or operation. Therefore site or project specific weed assessments and priorities should be reviewed for each project.

As per introduced flora species, the BAM Act seeks to establish a modern biosecurity regulatory scheme to prevent serious animal pests from entering the State and becoming established, and to minimise the spread and impact of any that are already present within the State. Declared animal pests fall into three categories as Gazetted under the *Biosecurity and Agriculture Management Regulations 2013*. These categories are outlined in Table B.7.

Table B.7: Declared pests control categories as gazetted under the *Biosecurity and Agriculture Management Regulations 2013*.

Category	Description
C1 (Exclusion)	Pests will be assigned to this category if they are not established in Western Australia and control measures are to be taken, including border checks, in order to prevent them entering and establishing in the State.
C2 (Eradication)	Pests will be assigned to this category if they are present in Western Australia in low enough numbers or in sufficiently limited areas that their eradication is still a possibility.
C3 (Management)	Pests will be assigned to this category if they are established in Western Australia but it is feasible, or desirable, to manage them in order to limit their damage. Control measures can prevent a C3 pest from increasing in population size or density or moving from an area in which it is established into an area which currently is free of that pest.

References

Department of Agriculture and Food Western Australia 2016, *Western Australian Organisms List*, <https://www.agric.wa.gov.au/bam/western-australian-organism-list-waol>.

Department of Biodiversity, Conservation & Attractions 2019, *Conservation Codes for Western Australia flora and fauna* Goverment of Western Australia, Perth WA.

Department of Environment and Conservation 2013, *Definitions, categories and criteria for threatened and priority ecological communities*, Department of Environment and Conservation (Parks and Wildlife), < https://www.dpaw.wa.gov.au/images/plants-animals/threatened-species/definitions_categories_and_criteria_for_threatened_and_priority_ecological_communities.pdf>.

Appendix C: Database Searches and Priority Ecological Communities Previously Recorded in Proximity to the Survey Area

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650000

700000

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River/Creek

Survey Area

Priority Ecological Community

Brockman Iron Cracking Clay Communities - P1

Coolibah - Lignum Flats, sub type 2 - P1

Fortescue Marsh - P1

Freshwater Claypans of the Fortescue Valley - P1

Weeli Wolli Spring Community - P1

West Angelas Cracking-Clays - P1

Kumina Land System - P3

Fortescue Valley Sand Dunes - P3

FORTESCUE RIVER

FORTESCUE MARSH

MARILLANA CREEK

TUREE CREEK

WEELI WOLLI CREEK

PERRIE MOUSE CREEK

TUREE CREEK EAST BRANCH

COONDINER CREEK

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Rio Tinto

Hope Downs 2 Proposal – Flora and Vegetation Survey

Figure C.1: Priority ecological communities recorded in proximity to the survey area

Scale: 1:400,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 5 10 15 20 25 30 Kilometres

N

astron delivering environmental intelligence™

Author: B. Eckermann | Drawn: C. Dyde | Date: 29-10-2019 | Figure Ref: 14292A-19-BIDR-3RevB_191029_FigC1_PriEcComm

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

Your Ref: **92256-17**
Our Ref: **05-01117FL**
Enquiries: Steve Martin
Phone: (08) 9219 9522
Email: flora.data@dbca.wa.gov.au

Astron Environmental Services
129 Royal Street
East Perth WA 6004

Attention: Kellie McMaster

Dear Kellie McMaster,

REQUEST FOR THREATENED AND PRIORITY FLORA INFORMATION

I refer to your request of 25 October 2017 for Threatened (Declared Rare) and Priority Flora information in the Hope Downs area. The search was conducted within the area of the shapefile you submitted with an additional 20km buffer.

A search was undertaken for this area of **(1)** the Department's *Threatened (Declared Rare) and Priority Flora* database (for results, see "TPFL" – coordinates are GDA94), **(2)** the *Western Australian Herbarium Specimen* database for Threatened and Priority flora species opportunistically collected in the area of interest (for results, see "WAHERB"- coordinates are GDA94 – see condition number 4 in the attached 'Conditions in Respect of Supply') and **(3)**, the Department's *Threatened and Priority Flora List* [this list is searched using 'place names'. This list, which may also be used as a species target list, contains species that are declared rare (Conservation Code R or X for those presumed to be extinct), poorly known (Conservation Codes 1, 2 or 3), or require monitoring (Conservation Code 4) – for results, *if any*, see "TP List"]. The results are attached electronically to this email.

Attached also are the conditions under which this information has been supplied. Your attention is specifically drawn to the ninth point, which refers to the requirement to undertake field investigations for the accurate determination of Threatened and Priority flora occurrence at a site. *The information supplied should be regarded as an indication only of the Threatened and Priority flora that may be present and may be used as a target list in any surveys undertaken.*

The information provided does not preclude you from obtaining and complying with, where necessary, land clearing approvals from other agencies.

An invoice for $ 300 (plus GST) to supply this information will be forwarded.

It would be appreciated if any populations of Threatened and Priority flora you encounter in the area could be reported to this Department to ensure their ongoing management.

If you require any further details, or wish to discuss Threatened and Priority flora management, please contact Dr Ken Atkins, Manager, Species and Communities Branch, on (08) 9219 9511.

Yours faithfully

Steve Martin
.....
THREATENED FLORA DATABASE OFFICER
for the Director General

6 November 2017

Species and Communities Branch
17 Dick Perry Avenue, Technology Park, Kensington
Phone: (08) 9219 9511
Postal Address: Locked Bag 104, Bentley Delivery Centre, Western Australia 6983
www.dbca.wa.gov.au

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

THREATENED AND PRIORITY FLORA INFORMATION

Conditions with Respect to the Supply of Information

- The data supplied may not be provided to any other organisations, nor be used for any purpose other than for the project for which it has been originally provided for; without the prior consent of the Executive Director, Department of Biodiversity, Conservation and Attractions.
- Specific locality information for threatened flora is regarded as confidential, and should be treated as such by receiving organisations. Specific locality information for threatened flora may not be used in reports without the written permission of the Executive Director, Department of Biodiversity, Conservation and Attractions. Reports may only show generalised locations at a low resolution or, where necessary, show specific locations without identifying species. Species and Communities Branch is to be contacted for guidance on the presentation of threatened flora information.
- The Department of Biodiversity, Conservation and Attractions respects the privacy of private landowners who may have threatened and priority flora on their property. Threatened and priority flora locations identified in the data as being on private property should be treated in confidence, and contact with property owners must only be made through the Department of Biodiversity, Conservation and Attractions.
- The development of the Perth Herbarium database was not originally intended for electronic mapping (eg. GIS ArcView). The latitude and longitude coordinates for each entry are not verified prior to being data based. It is only in recent times that collections have been submitted with GPS coordinates. Therefore, be aware when using this data in ArcView that some records may not plot to the locality description given with each collection.
- Acknowledgment of the Department Biodiversity, Conservation and Attractions as the source of data is to be made in any published material and cited as Biodiversity, Conservation and Attractions (2017) Threatened and Priority Flora Database Search for [search area] accessed on the [date of search]. Prepared by the Species and Communities Branch for [Requesters name and company] for [purpose of search].
- Copies of all such publications are to be forwarded to the Department of Biodiversity, Conservation and Attractions, Attention; the Manager, Species and Communities Branch.

Disclaimers with Respect to the Supply of Information

- Receiving organisations should note that while every effort has been made to prevent errors and omissions in the data, they may be present. The Department of Biodiversity, Conservation and Attractions accepts no responsibility for this.
- Receiving organisations must also recognise that the database is subject to continual updating and amendment, and such considerations should be taken into account by the user.
- It should be noted that the supplied data does not necessarily represent a comprehensive listing of the threatened flora of the area in question. Its comprehensiveness is dependent on the amount of surveys carried out within a specified area. The receiving organisation should consider engaging a botanist, if required, to undertake a survey of the area under consideration.

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

ABBREVIATIONS USED IN THREATENED AND PRIORITY FLORA DATABASE

VESTING

AAP	Aboriginal Planning Authority
AGR	Chief Executive, Dep. of Agriculture
ALT	Aboriginal Land Trust
APB	Agricultural Protection Board of WA
BGP	Botanical Gardens & Parks Authority
BSA	Boy Scouts Association
CC	Conservation Commission – NPNCA - LFC
CGT	Crown Grant in Trust
COM	Commonwealth of Australia
CRO	Crown Freehold-Govt Ownership
CRW	Crown
DAG	Dep. of Agriculture
DOW	Dep. of Water
DPI	Dep. of Planning
EXD	Exec Direc CALM
FES	Fire and Emergency Services Aust.
HOW	Dep. of Housing/State Housing Commission
ILD	Industrial Lands Develop. Auth
LAC	LandCorp
LGA	Shire/LGA
MAG	Minister for Agriculture
MCB	Metropolitan Cemeteries Board
MED	Ministry of Education
MHE	Minister for Health
MIN	Minister for Mines
MPL	Ministry for Planning
MPR	Minister for Prisons
MRD	Main Roads WA
MTR	Minister for Transport
MWA	Minister for Water Resources
MWO	Minister for Works
NAT	Natural Trust of Australia WA
NON	Not Vested
PLB	Pastoral Lands Board
PRI	Private/Freehold
RAI	Public Transport Authority
REL	Religious Organisation
SPC	State Planning Commission
SYN	Synergy (ex Western Power)
SWA	State of Western Australia
TEL	Telstra
UNK	Unknown
WAT	Water Corporation
WEL	Minister Community Welfare
WRC	Water & Rivers Commission
XPL	Ex-Pastoral Lease

PURPOSES

ABR	Aboriginal Reserve
ACC	Access Track
AER	Aerodrome
AIR	Airport
ARS	Agricultural Research Station
BAP	Baptist Union of WA
CAM	Camping
CAR	Caravan park
CEM	Cemetery
CFA	Conservation of Fauna
CFF	Conservation Of Flora & Fauna
CFL	Conservation of Flora
CHU	Church
CMN	Communications
COM	Common
CON	Conservation Park
CPK	Car Park
CRM	Conservation & Resource Management
DEF	Defence
DRA	Drain
EDE	Educational Endowment
EDU	Educational purposes
UWA	
ENE	Enjoyment of Natural Environ.
EPL	Ex-pastoral Lease (Sect 33(2) CALM Act)
EPS	Explosives
EXC	Excepted from sale
EXL	Exploration Lease
EXP	Experimental Farm
FIR	Firing Range
FOR	State Forest
FP	Foreshore Purposes
GE	General Lease
GHA	Grain Handling
GOL	Golf
GRA	Gravel Pit
GVT	Government Requirements
HAR	Harbour Purposes
HEP	Heritage Purposes
HER	Heritage trail
HOS	Hospital
KEN	Kennels
LGA	LGA/Shire Requirements
LPR	Landscape Protection
MIN	Mining lease
MUN	Municipal Purposes
NPK	National Park
NRE	Nature Reserve
OTH	Other
PAR	Parkland (& Recreation)
PAS	Pastoral lease
PCR	Proposed for Conservation
PFF	Protection of Flora & Fauna
PFL	Protection of Flora
PIC	Picnic ground
PLA	Plantation
PMC	Protection of Meteorite Crater
POS	Public Open Space
PPA	Public parkland
PRS	Prison site
PUR	Purchase Lease
PUT	Public Utility
QUA	Quarry
RAC	Racecourse
RAD	Radio Station
REC	Recreation
REH	Rehabilitation/Re-establish Native Plants
RRE	Railway Reserve
RUB	Rubbish
SAL	Saleyards
SAN	Sand
SCH	School-site
SET	Settlers requirements
SHO	Showgrounds
SNN	Sanitary
SOI	Soil Conservation
STO	Stopping place
STK	Stock Route
TIM	Timber
TOU	Tourism
TOW	Town-site
TRA	Training Ground
TRI	Trig station
UCL	Unallocated Crown Land
UNK	Unknown
VER	Road Verge
VPF	Vermin Proof Fence
WAT	Water
WLS	Wildlife Sanctuary
WOO	Firewood

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

ABBREVIATIONS USED IN THE WESTERN AUSTRALIAN HERBARIUM DATABASE

Geocode Method - The method that was used to record the latitude and longitude.

Auto - Indicates that the coordinate data in the record was created automatically (i.e. by software), usually by creating a coordinate from information provided in the Nearest Named Place or Locality textual description fields.

GAP - Acronym for "Generalised Arbitrary Point" as used in HISPID. GAP indicates that the coordinate data was obtained manually from the Nearest Named Place or Locality textual description fields.

GPS - Acronym for "Global Positioning System". GPS indicates that the coordinate data in the record was obtained from a GPS unit by the collector of the specimen.

MAN - Shorthand for manual. MAN indicates that the coordinate data was created by hand using some method not allowed for by one of the other manual Geocode Method values, in particular, TOPO, GAP, or GPS.

TOPO - Shorthand for topographic map. TOPO indicates that the coordinate data was obtained by plotting textual locality details against a topographic map.

None - Indicates that no coordinate data has been supplied by the collector.

Unknown - Indicates that there is no known method for determining the coordinate data. Should be used if the collector provided no indication of how they sampled the specimen's coordinate data.

PREC (Precision) - precision ratings for coordinates.

Precision 1: Absolutely precise (to nearest 100m or nearest second) and must be GPS determined. For example 35°26'42"S 123°40'26"E

Precision 2: Falling within a diameter of 3km (ca 2 minutes) or if no GPS mentioned in collecting notes. (The location must be able to be pinpointed on a 1:250 000 map, a spot locality. For example 35°26'42"S 123°40'26"E

Precision 3: Falling within a diameter of 10km (ca 7 minutes) or for degrees and minutes, where seconds have not been given. For example 35°26'_"S 123°40'_"E

Precision 4: Falling within a diameter of ca 50km (30 minutes). For example 35°26'_"S 123°40'_"E

Precision 5: Where a location is a prescribed large geographical area within a state or only the state is given. Diameter is greater than 50km. For example 35°_'_"S 123°_'_"E

Precision 6: used when localities are New Holland, Eastern Australia or Not given. Fields will be left blank.

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

CONSERVATION CODES

For Western Australian Flora and Fauna

T Threatened species

Listed as Specially Protected under the *Wildlife Conservation Act 1950,* published under Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora).

- Fauna that is rare or likely to become extinct are declared to be fauna that is in need of special protection
- Flora that are extant and considered likely to become extinct, or rare and therefore in need of special protection, are declared to be rare flora

Species* which have been adequately searched for and are deemed to be, in the wild, either rare, at risk of extinction, or otherwise in need of special protection, and have been gazetted as such.
The assessment of the conservation status of these species is based on their national extent.

X Presumed extinct species

Listed as Specially Protected under the *Wildlife Conservation Act 1950,* published under Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora (which may also be referred to as Declared Rare Flora).

Species which have been adequately searched for and there is no reasonable doubt that the last individual has died, and have been gazetted as such.

IA Migratory birds protected under an international agreement

Listed as Specially Protected under the *Wildlife Conservation Act 1950,* listed under Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice.

Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), relating to the protection of migratory birds.

S Other specially protected fauna

Listed as Specially Protected under the *Wildlife Conservation Act 1950.* Fauna declared to be in need of special protection, otherwise than for the reasons mentioned for Schedules 1, 2 or 3, are published under Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice.

Threatened Fauna and Flora are ranked according to their level of threat using IUCN Red List categories and criteria. *For example:* Carnaby's Cockatoo (*Calyptorynchus latirostris*) is listed as 'Specially Protected' under the *Wildlife Conservation Act 1950,* published under Schedule 1, and referred to as a 'Threatened' species with a ranking of 'Endangered'.

CR Critically Endangered - considered to be facing an extremely high risk of extinction in the wild.

EN Endangered - considered to be facing a very high risk of extinction in the wild.

VU Vulnerable - considered to be facing a high risk of extinction in the wild.

A list of the current rankings can be downloaded from the Parks and Wildlife Threatened Species and Communities webpage at http://dpaw.wa.gov.au/plants-and-animals/threatened-species-and-communities/

Department of **Biodiversity, Conservation and Attractions**

GOVERNMENT OF WESTERN AUSTRALIA

P Priority species

Species that maybe threatened or near threatened but are data deficient, have not yet been adequately surveyed to be listed under the Schedules of the Wildlife Conservation (Specially Protected Fauna) Notice or the Wildlife Conservation (Rare Flora) Notice, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened list for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Conservation dependent species that are subject to a specific conservation program are placed in Priority 5.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

1: Priority One: Poorly-known species

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

2: Priority Two: Poorly-known species

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

3: Priority Three: Poorly-known species

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

4: Priority Four: Rare, Near Threatened and other species in need of monitoring

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.
(b) Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

5: Priority Five: Conservation Dependent species

Species that are not threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

*Species includes all taxa (plural of taxon - a classificatory group of any taxonomic rank, e.g. a family, genus, species or any infraspecific category i.e. subspecies, variety or forma).

Threatened and Priority Ecological Community buffers and boundaries in WA

UNDER NO CIRCUMSTANCES IS THIS DATA TO BE PROVIDED TO ANY THIRD PARTIES, for more details see conditions for the supply of this information.

Citation

Title: Threatened and Priority Ecological Community buffers and boundaries in WA

Custodian: Department of Biodiversity, Conservation and Attractions

Description

Abstract: Ecological communities throughout WA that are "Presumed Totally Destroyed", "Critically Endangered", "Endangered", "Vulnerable", "Priority 1-5", "Lower Risk" and "Not evaluated". Communities are based on various life-forms including plants, invertebrates and micro-organisms.

Geographical Bounding Box

North: -14.788854

South: -35.005719

East: 128.870214

West: 113.765525

Data Currency and Status

Beginning Date: 1/1/94

Ending Date: 30/10/2017

Maintenance/Update: As requested

Access

Stored Data Format: ESRI shapefile

Coordinate System: GCS_GDA_1994

Access Constraints: Digital data is only available with written permission of the custodian.

Data Quality

Positional Accuracy: Point location data within occurrences usually from GPS location, (usually within 100 metres).

Attribute Accuracy: Not documented.

Logical Consistency: Not documented.

Completeness: Information on specific communities was obtained from regional, subregional or specific habitat surveys of floristic communities, invertebrate communities, wetland assemblages and communities of micro-organisms.

Attributes List:

Name	Description
BDY_ID	Associated boundary polygon unique identifier
OCC_UNIQUE	Unique occurrence identifier
COM_ID	Shortened community name identifier
COM_NAME	Community name
STATE_CATE	State listed category of threat
COMM_CATE	Commonwealth listed category of threat
S_ID_COUNT	Number of Site IDs within a buffer
FIRST_S_ID	First site identifier
LAST_S_ID	Last site identifier
BUFFER	Buffer radius from site ID or boundary in metres

General Information:

Buffers

- A buffer is included around each occurrence of a TEC or PEC to help ensure:
  - that nearby developments with potential for impact are taken into account
  - for ecological communities driven by hydrological processes, buffers are applied to ensure essential ecological functions are maintained and/or potential impact of nearby developments is minimised.
  - mapping inaccuracies are accounted for

Contact Information

Contact Organisation: Department of Biodiversity, Conservation and Attractions

Contact Position: TEC Database Ecologist - Species and Communities Branch

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Telephone: (08) 9219 9157

Email: communities.data@dbca.wa.gov.au

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 26/06/2018

Current Names Only Yes
Core Datasets Only Yes
Species Group Vascular Plants
Method 'By Circle'
Centre 119° 01' 56" E,23° 04' 04" S
Buffer 40km

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
1.	4886	*Abutilon amplum*			
2.	4889	*Abutilon cryptopetalum*			
3.	9080	*Abutilon cunninghamii*			
4.	4891	*Abutilon fraseri (Lantern Bush)*			
5.	4895	*Abutilon lepidum*			
6.	4896	*Abutilon leucopetalum (Desert Chinese Lantern)*			
7.	4898	*Abutilon macrum*			
8.	4899	*Abutilon malvifolium (Bastard Marshmallow)*			
9.	4901	*Abutilon otocarpum (Desert Chinese Lantern)*			
10.	43020	*Abutilon oxycarpum subsp. Prostrate (A.A. Mitchell PRP 1266)*			
11.		*Abutilon sp.*			
12.	42920	*Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)*			
13.	14113	*Abutilon sp. Pilbara (W.R. Barker 2025)*			
14.	11215	*Acacia adoxa var. adoxa*			
15.	3205	*Acacia adsurgens*			
16.	44579	*Acacia adsurgens x rhodophloia*			
17.	3209	*Acacia ampliceps*			
18.	3214	*Acacia ancistrocarpa (Fitzroy Wattle)*			
19.	3217	*Acacia aneura (Mulga, Wanari)*			
20.	37260	*Acacia aptaneura*			
21.	3228	*Acacia atkinsiana*			
22.	3232	*Acacia ayersiana*			
23.	3241	*Acacia bivenosa*			
24.	29571	*Acacia bromilowiana*		P4	
25.	19571	*Acacia catenulata*			Y
26.	23524	*Acacia catenulata subsp. occidentalis*			
27.	3260	*Acacia citrinoviridis*			
28.	17013	*Acacia colei var. colei*			
29.	13502	*Acacia coriacea subsp. pendens*			
30.	3272	*Acacia cowleana (Halls Creek Wattle)*			
31.	3300	*Acacia dictyophleba (Sandhill Wattle, Ngarkalya)*			
32.	3316	*Acacia effusa*		P3	
33.	16174	*Acacia elachantha*			
34.	3360	*Acacia hamersleyensis*			
35.	3370	*Acacia hilliana*			
36.	3377	*Acacia inaequilatera (Baderi)*			
37.	36418	*Acacia incurvaneura*			
38.	3399	*Acacia kempeana (Witchetty Bush, Ilykuwara)*			
39.	37240	*Acacia macraneura*			
40.	3434	*Acacia maitlandii (Maitland's Wattle)*			
41.	3435	*Acacia marramamba*			
42.	12952	*Acacia minyura*			
43.	3447	*Acacia monticola (Gawar, Lilwardi)*			
44.	36416	*Acacia mulganeura*			
45.	3475	*Acacia pachyacra*			
46.	15724	*Acacia paraneura*			
47.	3500	*Acacia pruinocarpa (Gidgee)*			
48.	36800	*Acacia pteraneura*			
49.	29016	*Acacia pyrifolia var. morrisonii*			
50.	29015	*Acacia pyrifolia var. pyrifolia*			
51.	3519	*Acacia rhodophloia*			
52.	44584	*Acacia rhodophloia x sibirica*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
53.	13078	*Acacia sclerosperma subsp. sclerosperma*			
54.	3544	*Acacia sibilans*			
55.	8949	*Acacia sibirica (Bastard Mulga)*			
56.	3553	*Acacia spondylophylla*			
57.	23526	*Acacia steedmanii subsp. borealis*			
58.	23529	*Acacia subcontorta*			
59.	23528	*Acacia subtiliformis*		P3	
60.	13070	*Acacia synchronicia*			
61.	3573	*Acacia tenuissima*			
62.	3577	*Acacia tetragonophylla (Kurara, Wakalpuka)*			
63.	23521	*Acacia trudgeniana*			
64.	20319	*Acacia tumida var. pilbarensis*			
65.	3598	*Acacia wanyu*			
66.	172	*Acrachne racemosa*			
67.	17454	*Adriana tomentosa var. hookeri*			
68.	17422	*Adriana tomentosa var. tomentosa*			
69.	2646	*Aerva javanica (Kapok Bush)*	Y		
70.	4739	*Alectryon oleifolius*			
71.	2648	*Alternanthera denticulata (Lesser Joyweed)*			
72.	2651	*Alternanthera nana (Hairy Joyweed)*			
73.	34810	*Amaranthus centralis*		P3	
74.	2660	*Amaranthus cuspidifolius*			
75.	2663	*Amaranthus interruptus (Native Amaranth)*			
76.	20018	*Amaranthus undulatus*			
77.	5277	*Ammannia baccifera*			
78.	19835	*Amphipogon sericeus*			
79.	2372	*Amyema fitzgeraldii (Pincushion Mistletoe)*			
80.	11614	*Amyema gibberula var. gibberula*			
81.	2374	*Amyema hilliana*			
82.	2383	*Amyema preissii (Wireleaf Mistletoe)*			
83.	29080	*Amyema sanguinea var. pulchra*			
84.	11874	*Amyema sanguinea var. sanguinea*			
85.	40910	*Androcalva luteiflora (Yellow-flowered Rulingia)*			
86.	2333	*Anthobolus leptomerioides*			
87.	43104	*Apowollastonia hamersleyensis*			
88.	2961	*Argemone ochroleuca (Mexican Poppy)*	Y		
89.	204	*Aristida burbidgeae*			
90.	207	*Aristida contorta (Bunched Kerosene Grass)*			
91.	12063	*Aristida holathera var. holathera*			
92.	212	*Aristida inaequiglumis (Feathertop Threeawn)*			
93.	213	*Aristida ingrata*			
94.	17918	*Aristida jerichoensis var. subspinulifera*		P3	
95.	215	*Aristida latifolia (Feathertop Wiregrass)*			
96.	216	*Aristida lazaridis*		P2	
97.	217	*Aristida nitidula (Flat-awned Threeawn)*			
98.	218	*Aristida obscura (Brush Threeawn)*			
99.	221	*Aristida pruinosa (Gulf Feathertop Wiregrass)*			
100.		*Aristida sp.*			
101.	227	*Astrebla elymoides (Weeping Mitchell Grass)*			
102.	229	*Astrebla pectinata (Barley Mitchell Grass)*			
103.	6202	*Astrotricha hamptonii (Ironplant)*			
104.	4740	*Atalaya hemiglauca (Whitewood)*			
105.	2476	*Atriplex semilunaris (Annual Saltbush)*			
106.	33030	*Austrobryonia pilbarensis*			
107.	7854	*Bidens bipinnata (Bipinnate Beggartick)*	Y		
108.	46338	*Bidens subalternans var. simulans*	Y		
109.	7866	*Blumea tenella*			
110.	2770	*Boerhavia coccinea (Tar Vine, Wituka)*			
111.	2773	*Boerhavia paludosa*			
112.	2774	*Boerhavia repleta*			
113.	11167	*Bonamia erecta*			
114.	6606	*Bonamia media*			
115.	44782	*Bonamia pilbarensis*			
116.	239	*Bothriochloa bladhii (Forest Bluegrass)*			
117.	240	*Bothriochloa ewartiana (Desert Bluegrass)*			
118.	12716	*Brachychiton acuminatus*			
119.	7878	*Brachyscome iberidifolia*			
120.	7413	*Brunonia australis (Native Cornflower)*			
121.	19070	*Brunonia sp. Long hairs (D.E. Symon 2440)*			
122.	14312	*Bulbine pendula*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
123.	750	*Bulbostylis barbata*			
124.	752	*Bulbostylis turbinata*			
125.	2860	*Calandrinia polyandra (Parakeelya)*			
126.	2864	*Calandrinia ptychosperma*			
127.	2865	*Calandrinia pumila*			
128.	2868	*Calandrinia reticulata*			
129.	31073	*Calandrinia sp. The Pink Hills (F. Obbens FO 19/06)*			
130.	8466	*Callitris columellaris (White Cypress Pine)*			
131.	14090	*Calocephalus beardii*			
132.	7891	*Calocephalus francisii (Fine-leaf Beauty-heads)*			
133.	7893	*Calocephalus knappii*			
134.	7895	*Calocephalus multiflorus (Yellow-top)*			
135.	48223	*Calocephalus pilbarensis*			
136.	7903	*Calotis hispidula (Bindy Eye)*			
137.	7904	*Calotis latiuscula*		P3	
138.	7905	*Calotis multicaulis (Many-stemmed Burr-daisy)*			
139.	7906	*Calotis plumulifera*			
140.	5446	*Calytrix carinata*			
141.	2976	*Capparis lasiantha (Split Jack, Balqarda)*			
142.	2978	*Capparis mitchellii (Wild Orange)*			
143.	2981	*Capparis spinosa*			
144.	2949	*Cassytha capillaris*			
145.	2950	*Cassytha filiformis (Love Vine, Jirawan)*			
146.	258	*Cenchrus ciliaris (Buffel Grass)*	Y		
147.	259	*Cenchrus echinatus (Burrgrass)*	Y		
148.	19762	*Centipeda minima subsp. macrocephala*			
149.	7921	*Centipeda thespidioides (Desert Sneezewood)*			
150.	31	*Cheilanthes austrotenuifolia*			
151.	33	*Cheilanthes contigua*			
152.	37	*Cheilanthes lasiophylla (Woolly Cloak Fern)*			
153.	12815	*Cheilanthes sieberi subsp. pseudovellea*			
154.	12818	*Cheilanthes sieberi subsp. sieberi*			
155.		*Cheilanthes sp.*			
156.	8462	*Cheilanthes tenuifolia (Rock Fern)*			
157.	2485	*Chenopodium auricomum (Queensland Bluebush)*			
158.	269	*Chloris pectinata (Comb Chloris)*			
159.	272	*Chloris virgata (Feathertop Rhodes Grass)*	Y		
160.	47174	*Chrysocephalum apiculatum subsp. pilbarense*			
161.	33516	*Chrysocephalum gilesii*			
162.	12614	*Chrysocephalum pterochaetum*			
163.	273	*Chrysopogon fallax (Golden Beard Grass)*			
164.	7370	*Citrullus lanatus (Pie Melon)*	Y		
165.	2985	*Cleome oxalidea*			
166.	2988	*Cleome viscosa (Tickweed, Tjinduwadhu)*			
167.	13692	*Clerodendrum floribundum var. angustifolium*			
168.	13689	*Clerodendrum tomentosum var. lanceolatum*			
169.	2778	*Codonocarpus cotinifolius (Native Poplar, Kundurangu)*			
170.	1165	*Commelina ensifolia (Wandering Jew, Buargu)*			
171.	6612	*Convolvulus clementii*			
172.	13560	*Corchorus crozophorifolius*			
173.	17405	*Corchorus lasiocarpus*			
174.	18409	*Corchorus lasiocarpus subsp. lasiocarpus*			
175.	18408	*Corchorus lasiocarpus subsp. parvus*			
176.		*Corchorus sp.*			
177.	4865	*Corchorus tridens*			
178.	16783	*Corymbia candida*			
179.	17083	*Corymbia deserticola subsp. deserticola*			
180.	17077	*Corymbia ferriticola*			
181.	17093	*Corymbia hamersleyana*			
182.	17092	*Corymbia opaca*			
183.	3144	*Crassula peduncularis (Purple Stonecrop)*			
184.	3783	*Crotalaria medicaginea*			
185.	20179	*Crotalaria medicaginea var. neglecta*			
186.	3785	*Crotalaria novae-hollandiae (New Holland Rattlepod)*			
187.	11231	*Crotalaria novae-hollandiae subsp. novae-hollandiae*			
188.	16189	*Cryptandra monticola*			
189.	7371	*Cucumis melo (Ulcardo Melon)*			
190.	41722	*Cucumis picrocarpus*			
191.	41721	*Cucumis variabilis*			
192.	17117	*Cullen cinereum*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
193.	17436	*Cullen graveolens*			
194.	17119	*Cullen leucochaites*			
195.	17116	*Cullen martinii*			
196.	17217	*Cullen pallidum*			
197.	17120	*Cullen pogonocarpum*			
198.	3010	*Cuphonotus andraeanus*			
199.	13733	*Cuscuta victoriana*			
200.	279	*Cymbopogon ambiguus (Scentgrass)*			
201.	281	*Cymbopogon obtectus (Silkyheads)*			
202.	6584	*Cynanchum floribundum (Dumara Bush, Tjipa)*			
203.	46558	*Cynodon convergens*			
204.	777	*Cyperus bulbosus (Bush Onion, Tjanmata)*			
205.	12811	*Cyperus cunninghamii subsp. cunninghamii*			
206.	789	*Cyperus difformis (Rice Sedge)*			
207.	12808	*Cyperus hesperius*			
208.	798	*Cyperus iria*			
209.	799	*Cyperus ixiocarpus*			
210.	814	*Cyperus squarrosus*			
211.	818	*Cyperus vaginatus (Stiffleaf Sedge)*			
212.	290	*Dactyloctenium radulans (Button Grass)*			
213.	7424	*Dampiera candicans*			
214.	20378	*Dampiera metallorum*		P3	
215.	47241	*Datura leichhardtii subsp. leichhardtii*	Y		
216.	6218	*Daucus glochidiatus (Australian Carrot)*			
217.	17140	*Daviesia eremaea*			
218.	3856	*Desmodium muelleri*			
219.	13741	*Dichanthium sericeum subsp. humilius*			
220.	13740	*Dichanthium sericeum subsp. polystachyum*			
221.	11964	*Dichanthium sericeum subsp. sericeum*			
222.	7164	*Dicladanthera forrestii*			
223.	6754	*Dicrastylis cordifolia*			
224.	308	*Digitaria ammophila (Silky Umbrella Grass)*			
225.	310	*Digitaria brownii (Cotton Panic Grass)*			
226.	312	*Digitaria coenicola*			
227.	313	*Digitaria ctenantha (Comb Finger Grass)*			
228.	48378	*Diplachne fusca subsp. fusca*			
229.	2395	*Diplatia grandibractea*			
230.	11320	*Dipteracanthus australasicus subsp. australasicus*			
231.	2499	*Dissocarpus paradoxus (Curious Saltbush)*			
232.	4759	*Dodonaea coriacea*			
233.	4767	*Dodonaea lanceolata (Pirrungu)*			
234.	11406	*Dodonaea lanceolata var. lanceolata*			
235.	4772	*Dodonaea pachyneura*			
236.	4773	*Dodonaea petiolaris*			
237.	4782	*Dodonaea viscosa (Sticky Hopbush)*			
238.	11674	*Dodonaea viscosa subsp. mucronata*			
239.	11202	*Dodonaea viscosa subsp. spatulata (Sticky Hop-bush)*			
240.	44508	*Duma florulenta*			
241.	31274	*Duperreya commixta*			
242.	2500	*Dysphania glandulosa*			
243.	11632	*Dysphania glomulifera subsp. eremaea*			
244.	2502	*Dysphania kalpari (Rat's Tail, Kalpari)*			
245.	33479	*Dysphania melanocarpa (Black Crumbweed)*			
246.	33596	*Dysphania melanocarpa forma leucocarpa*			
247.	33597	*Dysphania melanocarpa forma melanocarpa (Black Goosefoot)*			
248.	2506	*Dysphania rhadinostachya*			
249.	11653	*Dysphania rhadinostachya subsp. inflata*			
250.	11890	*Dysphania rhadinostachya subsp. rhadinostachya*			
251.	328	*Echinochloa colona (Awnless Barnyard Grass)*	Y		
252.	7057	*Elacholoma hornii*			
253.	823	*Eleocharis atropurpurea*			
254.	827	*Eleocharis geniculata*			
255.	355	*Elytrophorus spicatus (Spikegrass)*			
256.	2511	*Enchylaena tomentosa (Barrier Saltbush)*			
257.	12064	*Enchylaena tomentosa var. tomentosa (Barrier Saltbush)*			
258.	357	*Enneapogon caerulescens (Limestone Grass)*			
259.	360	*Enneapogon lindleyanus (Wiry Nineawn, Purple-head Nineawn)*			
260.	365	*Enneapogon polyphyllus (Leafy Nineawn)*			
261.	20377	*Enneapogon robustissimus*			
262.	368	*Enteropogon ramosus (Windmill Grass, Curly Windmill Grass)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
263.	375	*Eragrostis cumingii (Cuming's Love Grass)*			
264.	377	*Eragrostis desertorum (Desert Lovegrass)*			
265.	378	*Eragrostis dielsii (Mallee Lovegrass)*			
266.	380	*Eragrostis eriopoda (Woollybutt Grass, Wangurnu)*			
267.	381	*Eragrostis falcata (Sickle Lovegrass)*			
268.	388	*Eragrostis leptocarpa (Drooping Lovegrass)*			
269.	392	*Eragrostis pergracilis*			
270.	393	*Eragrostis setifolia (Neverfail Grass)*			
271.		*Eragrostis sp.*			
272.	20243	*Eragrostis sp. Mt Robinson (S. van Leeuwen 4109)*		P1	Y
273.	398	*Eragrostis tenellula (Delicate Lovegrass)*			
274.	399	*Eragrostis xerophila (Knotty-butt Neverfail)*			
275.	14509	*Eremophila caespitosa*			
276.	15167	*Eremophila canaliculata*			
277.	7189	*Eremophila clarkei (Turpentine Bush)*			
278.	7190	*Eremophila compacta*			
279.	7192	*Eremophila cuneifolia (Pinyuru, T'iranju)*			
280.	7205	*Eremophila exilifolia*			
281.	7208	*Eremophila forrestii (Wilcox Bush)*			
282.	15052	*Eremophila forrestii subsp. forrestii*			
283.	7209	*Eremophila fraseri (Burra)*			
284.	16696	*Eremophila fraseri subsp. fraseri*			
285.	29532	*Eremophila galeata*			
286.	17519	*Eremophila jucunda subsp. pulcherrima*			
287.	7228	*Eremophila lachnocalyx (Woolly-calyxed Eremophila)*			
288.	16940	*Eremophila lanceolata*			
289.	7230	*Eremophila latrobei (Warty Fuchsia Bush, Mintjingka)*			
290.	17597	*Eremophila latrobei subsp. filiformis*			
291.	17576	*Eremophila latrobei subsp. latrobei*			
292.	7234	*Eremophila longifolia (Berrigan, Tulypurpa)*			
293.	14893	*Eremophila magnifica subsp. magnifica*		P4	
294.	14894	*Eremophila magnifica subsp. velutina*		P3	
295.	18570	*Eremophila oppositifolia subsp. angustifolia*			
296.	15164	*Eremophila petrophila subsp. petrophila*			
297.	17283	*Eremophila phyllopoda subsp. obliqua*			
298.	15160	*Eremophila platycalyx subsp. pardalota*			
299.	15058	*Eremophila platycalyx subsp. platycalyx*			
300.		*Eremophila sp.*			
301.	40643	*Eremophila sp. Hamersley Range (K. Walker KW 136)*		P1	
302.	20256	*Eremophila sp. West Angelas (S. van Leeuwen 4068)*		P1	Y
303.	400	*Eriachne aristidea*			
304.	403	*Eriachne benthamii (Swamp Wanderrie)*			
305.	408	*Eriachne flaccida (Claypan Grass)*			
306.	411	*Eriachne helmsii (Buck Wanderrie Grass)*			
307.	13660	*Eriachne lanata*			
308.	413	*Eriachne mucronata (Mountain Wanderrie Grass)*			
309.	415	*Eriachne ovata*			
310.	16485	*Eriachne pulchella subsp. dominii*			
311.	16486	*Eriachne pulchella subsp. pulchella*			
312.		*Eriachne sp.*			
313.	421	*Eriachne tenuiculmis*			
314.	4335	*Erodium cygnorum (Blue Heronsbill)*			
315.	35345	*Eucalyptus camaldulensis subsp. obtusa (Blunt-budded River Red Gum)*			
316.	35343	*Eucalyptus camaldulensis subsp. refulgens*			
317.	5641	*Eucalyptus ewartiana (Ewart's Mallee)*			
318.	5655	*Eucalyptus gamophylla (Twin-leaf Mallee, Warilu)*			
319.	5684	*Eucalyptus kingsmillii (Kingsmill's Mallee)*			
320.	5698	*Eucalyptus leucophloia (Snappy Gum, Migum)*			
321.	18088	*Eucalyptus leucophloia subsp. leucophloia*			
322.	5744	*Eucalyptus pilbarensis*			
323.	18058	*Eucalyptus repullulans*			
324.	5773	*Eucalyptus socialis (Red Mallee, Altarpa)*			
325.	19576	*Eucalyptus socialis subsp. eucentrica*			
326.	18219	*Eucalyptus tephrodes*			
327.	29733	*Eucalyptus trivalva (Victoria Spring Mallee)*			
328.	14548	*Eucalyptus victrix*			
329.	15592	*Eucalyptus xerothermica*			
330.	11011	*Eulalia aurea*			
331.	4617	*Euphorbia australis (Namana)*			
332.	42844	*Euphorbia australis var. hispidula*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
333.	35303	*Euphorbia australis var. subtomentosa*			
334.	4619	*Euphorbia biconvexa*			
335.	4620	*Euphorbia boophthona (Gascoyne Spurge)*			
336.	4622	*Euphorbia clementii*		P2	
337.	4623	*Euphorbia coghlanii (Namana)*			
338.	4626	*Euphorbia drummondii (Caustic Weed, Piwi)*			
339.	42846	*Euphorbia ferdinandi*			
340.	42847	*Euphorbia ferdinandi var. ferdinandi*			
341.		*Euphorbia sp.*			
342.	4646	*Euphorbia stevenii (Caustic Bottletree)*		P3	
343.	12097	*Euphorbia tannensis subsp. eremophila (Desert Spurge)*			
344.	42879	*Euphorbia trigonosperma*			
345.	13281	*Euphorbia vaccaria*			
346.	42877	*Euphorbia vaccaria var. erucoides*			
347.	42876	*Euphorbia vaccaria var. vaccaria*			
348.	6617	*Evolvulus alsinoides (Tropical Speedwell)*			
349.	11200	*Evolvulus alsinoides var. villosicalyx*			
350.	10765	*Exocarpos sparteus (Broom Ballart, Djuk)*			
351.	19648	*Ficus brachypoda*			
352.	1753	*Ficus platypoda (Native Fig, Makartu)*			
353.	842	*Fimbristylis cardiocarpa*			
354.	850	*Fimbristylis depauperata*			
355.	851	*Fimbristylis dichotoma (Eight Day Grass)*			
356.	859	*Fimbristylis littoralis*			
357.	862	*Fimbristylis microcarya*			
358.	882	*Fimbristylis sieberiana*		P3	
359.	12159	*Fimbristylis simulans*			
360.		*Fimbristylis sp.*			
361.	35558	*Flaveria trinervia (Speedy Weed)*	Y		
362.	3903	*Gastrolobium grandiflorum (Wallflower Poison)*			
363.	7060	*Glossostigma diandrum*			
364.	3938	*Glycine canescens (Silky Glycine)*			
365.	7988	*Gnephosis arachnoidea (Cobwebby-headed Gnephosis)*			
366.	20856	*Gompholobium karijini*		P2	
367.	41245	*Gompholobium oreophilum*			
368.	2676	*Gomphrena canescens (Batchelors Buttons)*			
369.	2680	*Gomphrena cunninghamii*			
370.	18367	*Gomphrena kanisii*			
371.	18372	*Gomphrena lanata*			
372.	12517	*Goodenia cusackiana*			
373.	12529	*Goodenia lyrata*		P3	
374.	7526	*Goodenia microptera*			
375.	12552	*Goodenia muelleriana*			
376.	7530	*Goodenia nuda*		P4	
377.	12571	*Goodenia pascua*			
378.	12574	*Goodenia prostrata*			
379.	7545	*Goodenia scaevolina (Ngurubi)*			
380.	29381	*Goodenia sp. East Pilbara (A.A. Mitchell PRP 727) (O'Meara's Goodenia)*		P3	
381.	7550	*Goodenia stellata*			
382.	10982	*Goodenia stobbsiana*			
383.	7556	*Goodenia tenuiloba*			
384.	7558	*Goodenia triodiophila*			
385.	4910	*Gossypium australe (Native Cotton)*			
386.	4918	*Gossypium robinsonii (Wild Cotton)*			
387.	4919	*Gossypium sturtianum (Sturt's Desert Rose)*			
388.	11559	*Gossypium sturtianum var. sturtianum*			
389.	1963	*Grevillea berryana*			
390.	2079	*Grevillea pyramidalis (Caustic Bush, Tjungu)*			
391.	19570	*Grevillea pyramidalis subsp. leucadendron*			
392.	44441	*Grevillea saxicola*		P3	
393.	2096	*Grevillea stenobotrya*			
394.	2121	*Grevillea wickhamii (Wickham's Grevillea)*			
395.	19478	*Grevillea wickhamii subsp. hispidula*			
396.	12832	*Gymnanthera cunninghamii*		P3	
397.	2138	*Hakea chordophylla*			
398.	2177	*Hakea lorea (Witinti)*			
399.	2200	*Hakea rhombales*			
400.	6687	*Halgania cyanea (Rough Halgania)*			
401.	29840	*Halgania cyanea var. Allambi Stn (B.W. Strong 676)*			
402.	6690	*Halgania gustafsenii*			

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403.	30294	*Halgania gustafsenii var. Mid West (G. Perry 370)*			
404.	17493	*Halgania gustafsenii var. gustafsenii*			
405.	30258	*Halgania solanacea var. Mt Doreen (G.M. Chippendale 4206)*			
406.	6174	*Haloragis gossei*			
407.	23465	*Haloragis gossei var. gossei*			
408.	23464	*Haloragis gossei var. inflata*			
409.	20669	*Haloragis maierae*			
410.	6180	*Haloragis trigonocarpa*			
411.	17722	*Hannafordia bissillii subsp. bissillii*			
412.	17325	*Harnieria kempeana subsp. muelleri*			
413.	17301	*Heliotropium chrysocarpum*			
414.	6706	*Heliotropium cunninghamii*			
415.	10992	*Heliotropium glabellum*			
416.	6712	*Heliotropium heteranthum*			
417.	17307	*Heliotropium inexplicitum*			
418.	17309	*Heliotropium pachyphyllum*			
419.	17313	*Heliotropium skeleton*			
420.		*Heliotropium sp.*			
421.	6720	*Heliotropium ventricosum*			
422.	5128	*Hibbertia glaberrima*			
423.	4922	*Hibiscus brachychlaenus*			
424.	4923	*Hibiscus brachysiphonius*			
425.	4924	*Hibiscus burtonii*			
426.	4925	*Hibiscus coatesii*			
427.	4931	*Hibiscus haynaldii*			
428.	4933	*Hibiscus leptocladus*			
429.	43022	*Hibiscus sp. Gardneri (A.L. Payne PRP 1435)*			
430.	40560	*Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)*		P2	
431.	40640	*Hibiscus sp. Mt Robinson (G. Byrne 3537)*			
432.	4942	*Hibiscus sturtii (Sturt's Hibiscus)*			
433.	11651	*Hibiscus sturtii var. campylochlamys*			
434.	11385	*Hibiscus sturtii var. grandiflorus*			
435.	11477	*Hibiscus sturtii var. platychlamys*			
436.	11893	*Hibiscus sturtii var. truncatus*			
437.	43081	*Hibiscus verdcourtii*			
438.	5215	*Hybanthus aurantiacus*			
439.	45473	*Indigofera fractiflexa subsp. fractiflexa*			
440.	3974	*Indigofera georgei (Bovine Indigo)*			
441.	17716	*Indigofera gilesii*		P3	
442.	3978	*Indigofera hirsuta (Hairy Indigo)*			
443.	3980	*Indigofera linifolia*			
444.	3982	*Indigofera monophylla*			
445.	3985	*Indigofera rugosa*			
446.	3987	*Indigofera trita*			
447.	6621	*Ipomoea calobra (Weir Vine)*			
448.	6631	*Ipomoea lonchophylla (Cowvine)*			
449.	6633	*Ipomoea muelleri (Poison Morning Glory, Yumbu)*			
450.	6636	*Ipomoea plebeia (Bellvine)*			
451.	6637	*Ipomoea polymorpha*			
452.	6639	*Ipomoea racemigera*		P2	
453.	12663	*Ischaemum albovillosum*			
454.	458	*Iseilema dolichotrichum*			
455.	459	*Iseilema eremaeum*			
456.	461	*Iseilema fragile*			
457.	464	*Iseilema membranaceum (Small Flinders Grass)*			
458.	465	*Iseilema vaginiflorum (Red Flinders Grass)*			
459.	7397	*Isotoma petraea (Rock Isotome, Tundiwari)*			
460.	3989	*Isotropis atropurpurea (Poison Sage)*			
461.	17790	*Isotropis parviflora*		P2	
462.	48615	*Isotropis sp. Arid zone (G. Byrne 2775)*			
463.	8088	*Ixiochlamys cuneifolia*			
464.	6501	*Jasminum didymum*			
465.	12059	*Jasminum didymum subsp. lineare (Desert Jasmine)*			
466.	7118	*Josephinia eugeniae (Josephinia Burr)*			
467.	14322	*Josephinia sp. Marandoo (M.E. Trudgen 1554)*		P1	
468.	29046	*Lactuca serriola forma serriola*	Y		
469.	5846	*Lamarchea sulcata*			
470.	19726	*Leiocarpa semicalva*			
471.	19236	*Leiocarpa tomentosa*			
472.	3022	*Lepidium catapycnon (Hamersley Lepidium)*		P4	

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473.	3025	*Lepidium echinatum*			
474.	3032	*Lepidium muelleri-ferdinandii*			
475.	3033	*Lepidium oxytrichum*			
476.	3035	*Lepidium pedicellosum*			
477.	3037	*Lepidium phlebopetalum (Veined Peppercress)*			
478.	3038	*Lepidium pholidogynum*			
479.	37480	*Lobelia arnhemiaca*			
480.	7403	*Lobelia heterophylla (Wing-seeded Lobelia)*			
481.	36863	*Lobelia heterophylla subsp. heterophylla*			
482.	36880	*Lobelia heterophylla subsp. pilbarensis*			
483.	4061	*Lotus cruentus (Redflower Lotus)*			
484.	2396	*Lysiana casuarinae*			
485.	2398	*Lysiana murrayi (Mistletoe, Parka-Parka)*			
486.	2538	*Maireana carnosa (Cottony Bluebush)*			
487.	2544	*Maireana georgei (Satiny Bluebush)*			
488.	2551	*Maireana melanocoma (Pussy Bluebush)*			
489.	2556	*Maireana planifolia (Low Bluebush)*			
490.	2566	*Maireana thesioides (Lax Bluebush)*			
491.	2571	*Maireana villosa*			
492.	4962	*Malvastrum americanum (Spiked Malvastrum)*	Y		
493.	12949	*Marsdenia australis*			
494.	74	*Marsilea drummondii (Common Nardoo)*			
495.	75	*Marsilea exarata*			
496.	76	*Marsilea hirsuta (Nardoo)*			
497.		*Marsilea sp.*			
498.	19500	*Maytenus sp. Mt Windell (S. van Leeuwen 846)*			
499.	5875	*Melaleuca argentea (Silver Cadjeput, Bandaran)*			
500.	5908	*Melaleuca eleuterostachya*			
501.	5915	*Melaleuca glomerata*			
502.	5051	*Melhania oblongifolia*			
503.	14985	*Melinis repens*	Y		
504.	3054	*Menkea villosula*			
505.	7082	*Mimulus gracilis*			
506.	8110	*Minuria leptophylla (Minnie Daisy)*			
507.	4105	*Mirbelia viminalis*			
508.	490	*Monachather paradoxus*			
509.	17158	*Myoporum montanum (Native Myrtle)*			
510.	17925	*Myriocephalus oldfieldii*			
511.	3614	*Neptunia dimorphantha (Sensitive Plant)*			
512.	20252	*Newcastelia sp. Hamersley Range (S. van Leeuwen 4264)*			
513.	6971	*Nicotiana benthamiana (Tjuntiwari)*			
514.	6976	*Nicotiana occidentalis (Native Tobacco)*			
515.	11331	*Nicotiana occidentalis subsp. obliqua*			
516.	11856	*Nicotiana occidentalis subsp. occidentalis*			
517.	6977	*Nicotiana rosulata (Rosetted Tobacco)*			
518.	11410	*Nicotiana rosulata subsp. ingulba*			
519.	11734	*Nicotiana rosulata subsp. rosulata*			
520.	6979	*Nicotiana simulans*			
521.	38423	*Notoleptopus decaisnei var. Orbicularis (A.B. Craig 428)*			
522.	7338	*Oldenlandia crouchiana*			
523.	19640	*Oldenlandia sp. Hamersley Station (A.A. Mitchell PRP 1479)*		P3	
524.	12635	*Olearia fluvialis*			
525.	12638	*Olearia mucronata*		P3	
526.	8151	*Olearia stuartii*			
527.	8153	*Olearia xerophila*			
528.	17	*Ophioglossum lusitanicum (Adders Tongue)*			
529.	30374	*Oxalis sp. Pilbara (M.E. Trudgen 12725)*		P2	
530.	7117	*Pandorea pandorana*			
531.	503	*Panicum decompositum (Native Millet, Kaltu-kaltu)*			
532.	504	*Panicum effusum (Hairy Panic Grass)*			
533.	505	*Panicum laevinode*			
534.	43	*Paraceterach reynoldsii*			
535.	515	*Paraneurachne muelleri (Northern Mulga Grass)*			
536.	12670	*Parietaria cardiostegia*			
537.	10975	*Paspalidium basicladum*			
538.	518	*Paspalidium clementii (Clements Paspalidium)*			
539.	519	*Paspalidium constrictum (Knottybutt Grass)*			
540.	521	*Paspalidium gracile (Slender Panic)*			
541.	522	*Paspalidium jubiflorum (Warrego Grass)*			
542.	523	*Paspalidium rarum (Rare Paspalidium)*			

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543.	42160	*Pentalepis trichodesmoides subsp. trichodesmoides*			
544.	12486	*Peplidium aithocheilum*			
545.	7092	*Peplidium muelleri*			
546.	18462	*Peplidium sp. E Evol. Fl. Fauna Arid Aust. (A.S. Weston 12768)*			
547.	34997	*Peripleura arida*			
548.	34998	*Peripleura obovata*			
549.	35001	*Peripleura virgata*			
550.	546	*Perotis rara (Comet Grass)*			
551.	3675	*Petalostylis labicheoides (Slender Petalostylis)*			
552.	9056	*Phyllanthus baccatus*			
553.	17626	*Phyllanthus erwinii*			
554.	4680	*Phyllanthus maderaspatensis*			
555.	4687	*Phyllanthus virgatus*			
556.	20311	*Pilbara trudgenii*		P3	
557.	5245	*Pimelea forrestiana*			
558.	5250	*Pimelea holroydii*			
559.	11185	*Pimelea microcephala subsp. microcephala*			
560.	35276	*Plectranthus scutellarioides*			
561.	8167	*Pluchea dentex*			
562.	17816	*Pluchea ferdinandi-muelleri*			
563.	6491	*Plumbago zeylanica (Native Plumbago)*			
564.	45239	*Podolepis eremaea*			
565.	45242	*Podolepis remota*			
566.	12075	*Polycarpaea corymbosa var. corymbosa*			
567.	2901	*Polycarpaea holtzei*			
568.	2903	*Polycarpaea longiflora*			
569.	41365	*Polygala glaucifolia*			
570.	6653	*Polymeria ambigua (Morning Glory)*			
571.	17513	*Polymeria lanata*			
572.	12964	*Pomax rupestris*			
573.	43981	*Portulaca decipiens*			
574.	2884	*Portulaca oleracea (Purslane, Wakati)*			
575.	2886	*Portulaca pilosa (Djanggara)*	Y		
576.	12707	*Prostanthera albiflora*			
577.	6912	*Prostanthera campbellii*			
578.	8189	*Pseudognaphalium luteoalbum (Jersey Cudweed)*			
579.	18154	*Psydrax latifolia*			
580.	18210	*Psydrax rigidula*			
581.	18155	*Psydrax suaveolens*			
582.	41221	*Pterocaulon serrulatum var. velutinum*			
583.	8192	*Pterocaulon sphacelatum (Apple Bush, Fruit Salad Plant)*			
584.	8193	*Pterocaulon sphaeranthoides*			
585.	2690	*Ptilotus aervoides*			
586.	2696	*Ptilotus astrolasius*			
587.	2698	*Ptilotus auriculifolius*			
588.	2704	*Ptilotus calostachyus (Weeping Mulla Mulla)*			
589.	2706	*Ptilotus carinatus*			
590.	2711	*Ptilotus clementii (Tassel Top)*			
591.	2718	*Ptilotus drummondii (Narrowleaf Mulla Mulla)*			
592.	2725	*Ptilotus fusiformis*			
593.	2727	*Ptilotus gaudichaudii*			
594.	2728	*Ptilotus gomphrenoides*			
595.	2731	*Ptilotus helipteroides (Hairy Mulla Mulla)*			
596.	2734	*Ptilotus incanus*			
597.	2741	*Ptilotus macrocephalus (Featherheads)*			
598.	2744	*Ptilotus mollis*		P4	
599.	2746	*Ptilotus nobilis (Tall Mulla Mulla)*			
600.	41001	*Ptilotus nobilis subsp. nobilis (Yellow Tails)*			
601.	2747	*Ptilotus obovatus (Cotton Bush)*			
602.	2751	*Ptilotus polystachyus (Prince of Wales Feather)*			
603.	2754	*Ptilotus roei*			
604.	2755	*Ptilotus rotundifolius (Royal Mulla Mulla)*			
605.	2757	*Ptilotus schwartzii*			
606.	15855	*Ptilotus schwartzii var. schwartzii*			
607.	2582	*Rhagodia eremaea (Thorny Saltbush)*			
608.	20168	*Rhagodia sp. Hamersley (M. Trudgen 17794)*		P3	
609.	13308	*Rhodanthe charsleyae*			
610.	13301	*Rhodanthe floribunda*			
611.	13246	*Rhodanthe humboldtiana*			
612.	13310	*Rhodanthe margarethae*			

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613.	42011	*Rhodanthe polakii*			
614.	13251	*Rhodanthe propinqua*			
615.	6599	*Rhyncharrhena linearis (Bush Bean, Wintjulanypa)*			
616.	4190	*Rhynchosia australis (Rhynchosia)*			
617.	4191	*Rhynchosia minima (Rhynchosia)*			
618.		*Rhynchosia sp.*			
619.	45148	*Roebuckiella ciliocarpa*			
620.	45178	*Roebuckiella similis*			
621.	11556	*Rostellularia adscendens var. latifolia*		P3	
622.	2443	*Rumex vesicarius (Ruby Dock)*	Y		
623.	8198	*Rutidosis helichrysoides (Grey Wrinklewort)*			
624.	30434	*Salsola australis*			
625.	2356	*Santalum acuminatum (Quandong, Warnga)*			
626.	2357	*Santalum lanceolatum (Northern Sandalwood, Yarnguli)*			
627.	12578	*Scaevola acacioides*			
628.	12723	*Scaevola amblyanthera*			
629.	13179	*Scaevola amblyanthera var. amblyanthera*			
630.	13178	*Scaevola amblyanthera var. centralis*			
631.	12579	*Scaevola browniana*			
632.	13150	*Scaevola browniana subsp. browniana*			
633.	13172	*Scaevola parvifolia subsp. pilbarae*			
634.	7644	*Scaevola spinescens (Currant Bush, Maroon)*			
635.	41660	*Schenkia australis*			
636.	599	*Schizachyrium fragile (Senale Redgrass)*			
637.	13285	*Schoenia ayersii*			
638.	48355	*Schoenoplectiella dissachantha*			
639.	48362	*Schoenoplectiella laevis*			
640.	16257	*Schoenoplectus subulatus*			
641.	2602	*Sclerolaena convexula*			
642.	2603	*Sclerolaena cornishiana (Cartwheel Burr)*			
643.	2604	*Sclerolaena costata*			
644.	2607	*Sclerolaena densiflora*			
645.	2611	*Sclerolaena eriacantha (Tall Bindii)*			
646.	2631	*Sclerolaena tetragona*			
647.	8213	*Senecio magnificus (Showy Groundsel)*			
648.	17645	*Senna artemisioides*			
649.	12279	*Senna artemisioides subsp. helmsii*			
650.	12280	*Senna artemisioides subsp. oligophylla*			
651.	17558	*Senna artemisioides subsp. x artemisioides*			
652.	12283	*Senna artemisioides subsp. x sturtii*			
653.	18448	*Senna cuthbertsonii*			
654.	18443	*Senna ferraria*			
655.	18449	*Senna glaucifolia*			
656.	18346	*Senna glutinosa*			
657.	12305	*Senna glutinosa subsp. chatelainiana*			
658.	12307	*Senna glutinosa subsp. glutinosa*			
659.	12309	*Senna glutinosa subsp. pruinosa*			
660.	12308	*Senna glutinosa subsp. x luerssenii*			
661.	18451	*Senna hamersleyensis*			
662.	12312	*Senna notabilis*			
663.	12315	*Senna pleurocarpa var. angustifolia*			
664.	19347	*Senna sericea*			
665.	18595	*Senna sp. Karijini (M.E. Trudgen 10392)*			
666.	14577	*Senna sp. Meekatharra (E. Bailey 1-26)*			
667.	18445	*Senna stricta*			
668.	12319	*Senna venusta*			
669.	46816	*Seringia elliptica (Showy fire-bush)*			
670.	46821	*Seringia nephrosperma (Free carpel fire-bush)*			
671.	4196	*Sesbania cannabina (Sesbania Pea)*			
672.	606	*Setaria dielsii (Diels' Pigeon Grass)*			
673.	612	*Setaria surgens (Pigeon Grass)*			
674.	613	*Setaria verticillata (Whorled Pigeon Grass)*	Y		
675.	4966	*Sida arenicola*			
676.	4970	*Sida calyxhymenia (Tall Sida)*			
677.	4971	*Sida cardiophylla*			
678.	4972	*Sida clementii*			
679.	4976	*Sida echinocarpa*			
680.	31759	*Sida ectogama*			
681.	4977	*Sida fibulifera (Silver Sida)*			
682.	4986	*Sida platycalyx (Lifesaver Burr)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
683.	4988	*Sida rohlenae*			
684.	18149	*Sida rohlenae subsp. rohlenae*			
685.	31859	*Sida sp. Articulation below (A.A. Mitchell PRP 1605)*			
686.	16616	*Sida sp. Barlee Range (S. van Leeuwen 1642)*		P3	
687.	31854	*Sida sp. Excedentifolia (J.L. Egan 1925)*			
688.	31857	*Sida sp. Golden calyces glabrous (H.N. Foote 32)*			
689.	33697	*Sida sp. Hamersley Range (K. Newbey 10692)*		P1	
690.	33698	*Sida sp. Pilbara (A.A. Mitchell PRP 1543)*			
691.	20253	*Sida sp. Shovelanna Hill (S. van Leeuwen 3842)*			
692.	19712	*Sida sp. dark green fruits (S. van Leeuwen 2260)*			
693.	16617	*Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)*			
694.	18144	*Sida sp. tiny glabrous fruit (A.A. Mitchell PRP1152)*			
695.	16948	*Sida sp. verrucose glands (F.H. Mollemans 2423)*			
696.	4989	*Sida spinosa (Spiny Sida)*			
697.	16923	*Sida trichopoda*			
698.	8223	*Sigesbeckia orientalis (Indian Weed)*	Y		
699.	6995	*Solanum centrale (Desert Raisin, Kampurarpa)*			
700.	6997	*Solanum chippendalei*			
701.	6998	*Solanum cleistogamum*			
702.	42544	*Solanum elatius*			
703.	7008	*Solanum ferocissimum*			
704.	7009	*Solanum gabrielae*			
705.	7014	*Solanum horridum*			
706.	42542	*Solanum kentrocaule*		P3	
707.	7018	*Solanum lasiophyllum (Flannel Bush, Mindjulu)*			
708.	9258	*Solanum morrisonii*			
709.	7022	*Solanum nigrum (Black Berry Nightshade)*	Y		
710.	7026	*Solanum orbiculatum (Wild Tomato)*			
711.	11241	*Solanum orbiculatum subsp. orbiculatum (Round-leaved Solanum)*			
712.	7029	*Solanum phlomoides*			
713.	42546	*Solanum piceum*			
714.	7036	*Solanum sturtianum (Thargomindah Nightshade)*			
715.	8231	*Sonchus oleraceus (Common Sowthistle)*	Y		
716.	13575	*Spermacoce brachystema*			
717.	629	*Sporobolus australasicus (Fairy Grass)*			
718.	4731	*Stackhousia intermedia*			
719.	19555	*Stackhousia muricata subsp. annual (W.R. Barker 2172)*			
720.	18405	*Stackhousia sp. swollen gynophore (W.R. Barker 2041)*			
721.	12488	*Stemodia glabella*			
722.	7098	*Stemodia grossa (Marsh Stemodia, Mindjaara)*			
723.	7102	*Stemodia viscosa (Pagurda)*			
724.	16199	*Stenanthemum petraeum*			
725.	3074	*Stenopetalum anfractum*			
726.	3075	*Stenopetalum decipiens*			
727.	3078	*Stenopetalum nutans*			
728.	3082	*Stenopetalum velutinum (Velvet Thread Petal)*			
729.	8234	*Streptoglossa adscendens*			
730.	8235	*Streptoglossa bubakii*			
731.	8237	*Streptoglossa decurrens*			
732.	8238	*Streptoglossa liatroides*			
733.	12492	*Striga squamigera*			
734.	18123	*Stylidium weeliwolli*		P3	
735.	3182	*Stylobasium spathulatum (Pebble Bush)*			
736.	12353	*Stylosanthes hamata (Verano Stylo)*	Y		
737.	4220	*Swainsona canescens (Grey Swainsona)*			
738.	13596	*Swainsona complanata*			
739.	4223	*Swainsona decurrens*			
740.	13595	*Swainsona elegantoides*			
741.	12356	*Swainsona formosa*			
742.	4231	*Swainsona kingii*			
743.	4233	*Swainsona leeana*			
744.	4234	*Swainsona maccullochiana (Ashburton Pea)*			
745.	4238	*Swainsona oroboides (Variable Swainsona)*			
746.	13585	*Swainsona tenuis*			
747.	42142	*Swainsona thompsoniana*		P3	
748.	25902	*Symphyotrichum squamatum (Bushy Starwort)*	Y		
749.	7363	*Synaptantha tillaeacea*			
750.	48206	*Synostemon rhytidospermus*			
751.	4252	*Templetonia egena (Round Templetonia)*			
752.	41986	*Tephrosia oxalidea*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
753.	41825	*Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)*			
754.	17768	*Tephrosia sp. Bungaroo Creek (M.E. Trudgen 11601)*			
755.	41811	*Tephrosia sp. Fortescue (A.A. Mitchell 606)*			
756.	42442	*Tephrosia sp. NW Eremaean (S. van Leeuwen et al. PBS 0356)*			
757.	42225	*Tephrosia sp. Newman (A.A. Mitchell PRP 29)*			
758.	40060	*Tephrosia sp. clay soils (S. van Leeuwen et al. PBS 0273)*			
759.	4287	*Tephrosia virens*			
760.	25768	*Tetratheca fordiana*		P1	
761.	48313	*Teucrium disjunctum*			
762.	19366	*Teucrium pilbaranum*		P2	
763.	48603	*Teucrium teucriiflorum*			
764.	17820	*Themeda sp. Hamersley Station (M.E. Trudgen 11431)*		P3	
765.	17819	*Themeda sp. Mt Barricade (M.E. Trudgen 2471)*			
766.	673	*Themeda triandra*			
767.	674	*Thyridolepis mitchelliana (Mulga Grass)*			
768.	1329	*Thysanotus exiliflorus*			
769.	6278	*Trachymene oleracea*			
770.	19043	*Trachymene oleracea subsp. oleracea*			
771.	19053	*Trachymene pilbarensis*			
772.	678	*Tragus australianus (Small Burrgrass)*			
773.	44241	*Trianthema glossostigmum*			
774.	44305	*Trianthema pilosum*			
775.	4374	*Tribulus astrocarpus*			
776.	4376	*Tribulus forrestii*			
777.	4377	*Tribulus hirsutus*			
778.	4379	*Tribulus macrocarpus*			
779.	18072	*Tribulus suberosus*			
780.	6727	*Trichodesma zeylanicum (Camel Bush, Kumbalin)*			
781.	29483	*Tricoryne sp. Hamersley Range (S. van Leeuwen 915)*			
782.	8252	*Tridax procumbens (Tridax, Tridax Daisy)*	Y		
783.	48201	*Trigastrotheca molluginea*			
784.	4316	*Trigonella suavissima (Sweet Fenugreek)*			
785.	17886	*Triodia biflora*			
786.	681	*Triodia brizoides*			
787.	690	*Triodia longiceps (Giant Grey Spinifex)*			
788.	17877	*Triodia melvillei*			
789.	696	*Triodia pungens (Soft Spinifex)*			
790.	17873	*Triodia schinzii*			
791.		*Triodia sp.*			
792.	41101	*Triodia sp. Karijini (S. van Leeuwen 4111)*		P1	
793.	19534	*Triodia sp. Mt Ella (M.E. Trudgen 12739)*		P3	
794.	48463	*Triodia vanleeuwenii*			
795.	704	*Triodia wiseana (Limestone Spinifex)*			
796.	48319	*Tripogonella loliiformis*			
797.	706	*Triraphis mollis (Needle Grass)*			
798.	4879	*Triumfetta leptacantha*			
799.	14942	*Triumfetta maconochieana*			
800.	29268	*Urochloa occidentalis*			
801.	717	*Urochloa piligera*			
802.	718	*Urochloa pubigera*			
803.	30716	*Vachellia farnesiana (Mimosa Bush)*	Y		
804.	7654	*Velleia connata (Cup Velleia)*			
805.	4323	*Vigna lanceolata (Maloga Vigna, Wega)*			
806.	11576	*Vigna lanceolata var. lanceolata*			
807.		*Vigna sp.*			
808.	31391	*Vigna sp. Hamersley Clay (A.A. Mitchell PRP 113)*			
809.	11788	*Vittadinia dissecta var. hirta*			
810.	8265	*Vittadinia eremaea*			
811.	33026	*Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684)*		P1	
812.	20153	*Vittadinia sp. Earaheedy (D.J. Edinger 3106)*			
813.	7386	*Wahlenbergia gracilenta (Annual Bluebell)*			
814.	7393	*Wahlenbergia tumidifructa*			
815.	5106	*Waltheria indica*			
816.	48251	*Xerochrysum boreale*		P3	
817.	48250	*Xerochrysum interiore*			
818.	44861	*Xerochrysum macranthum*			
819.	732	*Yakirra australiensis*			
820.	18140	*Zygophyllum eichleri*			
821.	4392	*Zygophyllum iodocarpum*			
822.	4396	*Zygophyllum tesquorum*			

Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area

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.

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.

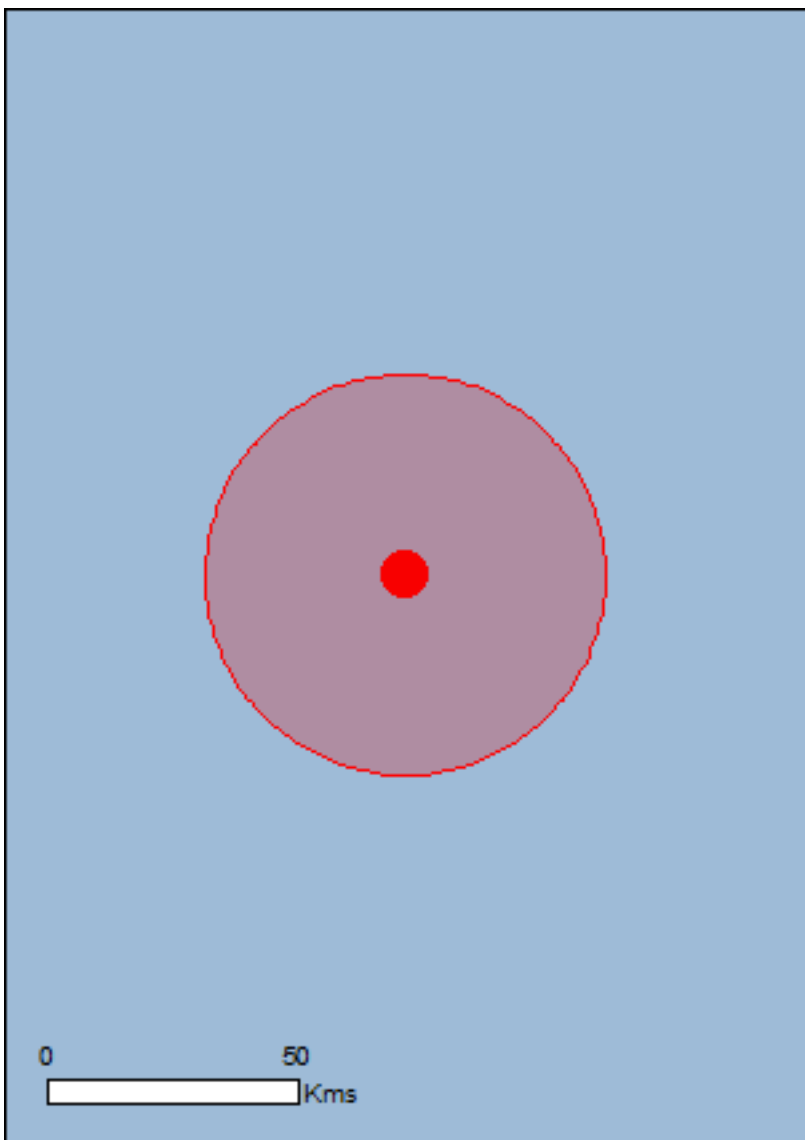
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

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

Report created: 26/06/18 15:57:07

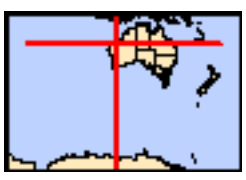
Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements



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

Coordinates
Buffer: 40.0Km



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:	8
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:	13
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	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:	None
Regional Forest Agreements:	None
Invasive Species:	9
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 likely to 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 known to occur within area
Macroderma gigas		
Ghost Bat [174]	Vulnerable	Breeding known to occur within area
Macrotis lagotis		
Greater Bilby [282]	Vulnerable	Species or species habitat may occur within area
Rhinonicteris aurantia (Pilbara form)		
Pilbara Leaf-nosed Bat [82790]	Vulnerable	Species or species habitat known to 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

Name	Threatened	Type of Presence
		habitat may occur within area
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
Hirundo rustica Barn Swallow [662]		Species or species

Name	Threatened	Type of Presence
		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

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
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
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur

Name	Status	Type of Presence 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

-23.06752 119.03234

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 D: Previous Survey Area Locations

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680000 700000 720000 740000 760000

7460000 7440000 7420000

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Mattiske (1995)

Mattiske (2009a)

Biota (2014)

Biota (2006)

Mattiske (2008a)

Mattiske (2009b)

Mattiske (2010)

Ecologia (2013)

Mattiske (2008b)

- Survey Area
- Biota (2006) Hope Downs Rail Corridor (Juna Downs Section) Vegetation and Flora Survey
- Mattiske (2008b) Flora and Vegetation of the Hope Downs 4 Lease Area
- Mattiske (2009b) Flora and Vegetation of the Hope Downs 4 Mine Pipeline Corridor to Ophthalmia Dam
- Mattiske (2010) Flora and Vegetation of the Hope Downs 2 Area
- Ecologia (2013) Rio Tinto Greater West Angelas Vegetation and Flora Assessment
- Biota (2014) Baby Hope Downs Flora and Vegetation Survey
- Mattiske (1995) Flora and Vegetation – Southern Transport Corridor
- Mattiske (2008a) Flora and Vegetation of the Hope Downs 4 Mine Infrastructure Corridor
- Mattiske (2009a) Flora and Vegetation Of The Hope Downs 1 Area

Rio Tinto

Hope Downs 2 Proposal – Flora and Vegetation Survey

Figure D.1. Previous flora surveys conducted in the vicinity of the survey area

Coordinate System: GDA 1994 MGA Zone 50

0 5 10 15 20 Kilometres

N

astron delivering environmental intelligence™

Author: B. Eckermann Drawn: C. Dyde Date: 30-10-2019 Figure Ref: 14292A-19-BIDR-3RevB_191030_FigD1_PrevSurveys

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Appendix E: Threatened and Priority Flora Species Likelihood of Occurrence within the Survey Area

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Table E.1: Likelihood of occurrence of conservation significant flora recorded within 50 km of the survey area (NatureMap (Department of Biodiversity, Conservation, and Attractions 2019a), PMST (Department of the Environment and Energy 2019), TPFL (Department of Biodiversity, Conservation, and Attractions 2019b), TP List (Department of Biodiversity, Conservation, and Attractions 2019c), WA Herbarium (Department of Biodiversity, Conservation, and Attractions 2019d) and the Rio Database custom search (Rio Tinto Iron Ore 2019)). The TP List database is searched using place names, as a result, many of the records obtained from this database may occur beyond 50 km of the survey area.

Species	Habit and flowering information[1]	Life form[1]	Habitat[1]	Distance from survey area (km)	Likelihood of occurrence	
					Pre-survey	Post-survey
Threatened						
Pityrodia augustensis	Bushy shrub to 1 m. Flowers purple-red, August to September.	Perennial	Amongst rocks on slopes, or in drainage lines, gullies. Sandstone substrate or yellow brown sandy loam over granite. Within open *Acacia* shrublands or scrub.	>200	Unlikely	Unlikely
Thryptomene wittweri	Spreading, rounded, conifer- like, aromatic shrub, 0.5-1.5 (-2.1) m high. Leaves with conspicuous oil glands. White-cream flowers in April or July or August.	Perennial	Skeletal red stony soils. Breakaways, stony creek beds. Only known from high mountain peaks, in stony creek beds and water channels.	33	Unlikely	Unlikely
Priority 1						
Calotis squamigera	Procumbent, branches, hairy annual herbs to 0.25 m high. Yellow flowers in July.	Annual	Pebbly/stony red brown loam in a poorly defined flow line.	38	Unlikely	Unlikely
Cochlospermum macnamarae	Spreading, multi-stemmed shrubs to 2 m high and 3 m wide with digitately lobed leaves and large yellow flowers.	Perennial	Granite outcrops, hills with exposed granite faces and domes. Plants grow as isolated shrubs over very open *Triodia* spp. hummock grassland.	~100	Unlikely	Unlikely
Dicrastylis mitchellii	Shrubs to 0.3 m with a very dense, white indumentum of short and long dendritic hairs. White or cream flowers, with dots or stripes in throat of corolla.	Perennial	Sand or clay soils. Around dunes.	63	Unlikely	Unlikely

Species	Habit and flowering information[1]	Life form[1]	Habitat[1]	Distance from survey area (km)	Likelihood of occurrence	
					Pre-survey	Post-survey
Euphorbia inappendiculata var. *queenslandica*	Spreading, much-branched, procumbent herb to 0.3m long. Leaves opposite, petiolate, obovate, very small sinuate-denticulate and glabrous.	Annual	Cracking clay (gilgai) flats and depressions, quartzite. Can be found in hummock grasslands of *Triodia* spp.	20	Potential	Unlikely - no suitable habitat
Eragrostis sp. Mt Robinson (S. van Leeuwen 4109)	Tussock-forming grass with woolly base to 0.3 m high. Flowers September.	Perennial	Red-brown skeletal soils, ironstone, Brockman Iron Formation. Steep slopes, summits on Mt Robinson. Found within *Eucalyptus* mallee shrubs and *Acacia* spp. over hummock grasses.	46	Unlikely	Unlikely
Eremophila sp. West Angelas (S. van Leeuwen 4068)	Erect-branched spindly whip shrub with narrow leaves to 3 m high. Flower purple with corolla medial lobe of lower lip completely closes the throat.	Perennial	Rocky hills or ridges and mulga bands in clay soil between rocky ridges. Very steep hillslope of brown silty loam. Breakaways, skeletal red gritty soil over massive banded iron.	0	Likely	Recorded
Eremophila spongiocarpa	Intricately spreading, compact, succulent-leaved shrub, to 1 m high, non-resinous. Fruit with a spongy skeletal network. Flowers white, May or September.	Perennial	Sub-saline red clay loams in the Fortescue Marsh	48	Unlikely	Unlikely
Goodenia pedicellata	Single-stemmed perennial herb, (with dense cottony and strigose hairs), to 0.25 m high. Flowers yellow, June	Perennial	Rocky clayey soils, rocky slopes and crests of low hills.	38	Unlikely	Unlikely
Hibiscus sp. Mt Brockman (E. Thoma ET 1354)	Shrub to 3 m high. Flowers purple, February to August.	Perennial	Hill summit, gorge, sheltered or rocky drainage lines below associated cliff-lines or rocky ridges. Red - brown sand, skeletal soils.	10	Potential	Unlikely - suitable habitat searched

Species	Habit and flowering information[1]	Life form[1]	Habitat[1]	Distance from survey area (km)	Likelihood of occurrence	
					Pre-survey	Post-survey
Rhodanthe ascendens	Ascending herb, daisy with narrow cauline leaves to 0.1 m high. Flowers yellow, August.	Annual	Flat terrain, low in landscape, stony gibber with red cracking clay soils or sandy soils.	34	Unlikely	Unlikely
Synostemon hamersleyensis	Glabrous, monoecious or dioecious subshrub from a perennial woody rootstock with stems much-branched to 1 m tall. Flowers in spring (observations are limited to August, October and November)	Perennial	Breakaway formations and rock outcrops either side of incised gully systems and upper slopes on wide undulating ridges adjacent to large deeply incised gullies. Occurs most commonly at altitudes of 500 m to 700 m above sea level. (Telford and Naaykens, 2015)	32	Unlikely	Unlikely
Triodia sp. Karijini (S. van Leeuwen 4111)	Hummock grass to 1 m high. Non-resinous to weakly resinous, soft-type foliage.	Perennial	On or near outcropping ironstone, on summits or steep hillslopes of mountains.	39	Unlikely	Unlikely
Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684)	Erect herb.	Annual	Flat plain, cracking clay, low in landscape, red sandy clay loam with some stone.	9	Likely	Potential – habitat present, poor seasonal conditions
Priority 2						
Adiantum capillus-veneris	A soft, cascading fern with fronds arising from a creeping rhizome 3 mm to 8 mm thick.	Perennial	Moist, sheltered sites in gorges and on cliff walls.	~170	Unlikely	Unlikely
Aristida lazaridis	Densely clumped grass with clumps to 1.4 m high. Leaf-blade surface scaberulous. Flowers April.	Perennial	Sand, loam, clayey soils. Plains, ironstone hills in *Triodia* spp. hummock grassland with sparse overstorey of *Eucalyptus leucophloia*. Mulga Shrublands.	<1	Likely	Recorded

Species	Habit and flowering information[1]	Life form[1]	Habitat[1]	Distance from survey area (km)	Likelihood of occurrence	
					Pre-survey	Post-survey
Arthropodium sp. Ironstone (J. Bull & J. Waters ONS PJ 36.01)	Herb to 1 m high	Short-lived perennial	Slope. Outcropping of banded iron formation, red-brown loam soil.	43	Unlikely	Unlikely
Cladium procerum	Densely tufted grass-like or herb (sedge) to 2 m high. Nodding Inflorescences. Flowers November.	Perennial	Perennial streams and pond edges and along streams in deep gorges of the Hamersley Range.	11	Potential	Unlikely – no suitable habitat
Eremophila pusilliflora	Low spreading shrub. Flowers purple, July to April.	Perennial	Seasonally inundated alluvial plains between Turee Creek, Pingandy Creek and drainage systems leading into the Ashburton River, growing in red-brown sandy loam soils in open low shrubland with *Acacia aneura*, *Ptilotus nobilis*, *Goodenia* spp. and *Triodia* spp. (Buirchell and Brown 2016).	19	Potential	Potential – habitat present, poor seasonal conditions
Euphorbia australis var. *glabra*	Prostrate herb, stems much-branched, prostrate sometimes ascending c. 50 mm to 30 mm long, usually green or reddish.	Annual or short-lived perennial	Sump, low in landscape. Saline flats on alluvial cracking clay loamy soil, gritty with ironstone fragments. Associated with low forest of *Eucalyptus victrix* over low scrub of *Muehlenbeckia florulenta*.	36	Unlikely	Unlikely
Gompholobium karijini	Shrub to 0.7 m high.	Perennial	Low undulating hills, skeletal soils on the edges of deep ravines or plateaux on banded ironstone.	~90	Unlikely	Unlikely
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)	Spindly upright shrub to 3 m high. Flowers May to July.	Perennial	Near summit of hill, high in landscape, skeletal red-brown stony soil over massive ironstone of the Brockman Iron Formation. Sheltered or rocky drainage lines below associated cliff lines or rocky ridges.	0	Likely	Recorded

Species	Habit and flowering information[1]	Life form[1]	Habitat[1]	Distance from survey area (km)	Likelihood of occurrence	
					Pre-survey	Post-survey
Indigofera ixocarpa	Shrub, to 1 m high. Flowers pink, May.	Perennial	Skeletal red soils over massive ironstone. Gorge, gully, hilltop. Creekline.	~90	Unlikely	Unlikely
Ipomoea racemigera	Creeping herb or climber. Flowers white, flowers throughout the year, mainly March-August	Annual	Flats with brown silty loam soil, major drainage. Creekline. Basalt uplands.	26	Potential	Potential - habitat present, poor seasonal conditions
Isotropis parviflora	Compact sub-shrub, 0.1 m high. Flowers white/pink, pea-like, March.	Short-lived perennial	Valley slope of ironstone plateau. Associated with Mallee on slopes or with hard spinifex on ironstone.	10	Potential	Potential – habitat present, poor seasonal conditions
Kohautia australiensis	Erect sparsely or much-branched annual, herb, 0.1 m to 0.5 m high. Flowers blue.	Annual	Low rise or hill. Calcrete	38	Unlikely	Unlikely
Oxalis sp. Pilbara (M.E. Trudgen 12725)	Small, trailing or tufted, three leaved herb. Leaves purplish below. Flowers yellow, May to September.	Annual or short-lived perennial	Shaded areas around rock outcropping, gullies and gully walls.	14	Potential	Potential – habitat present, poor seasonal conditions
Pentalepis trichodesmoides subsp. *hispida*	Multi-stemmed shrub to 0.8 m high. Flowers July to October.	Perennial	Summit of ridge, cobbled slopes, outcrops, high in landscape, steep terrain, skeletal brown gritty soil, banks of creeks and edges of basalt screes.	59	Unlikely	Unlikely
Tetratheca fordiana	Dwarf twiggy leafless shrub with large obvious hairs on the stem, grows to 0.4 m high. Flowers, pink, June to July, September.	Perennial	Shale pocket amongst ironstone. Cliff faces, crests, ridges and outcrops in upper rocky ironstone ridgelines, skeletal soils.	22	Unlikely	Unlikely
Rhodanthe frenchii	Upright herb, to 0.35 m high. Flowers yellow, August to October.	Annual	Stony hills, rocky river banks & outcrops.	21	Unlikely	Unlikely

Species	Habit and flowering information[1]	Life form[1]	Habitat[1]	Distance from survey area (km)	Likelihood of occurrence	
					Pre-survey	Post-survey
Teucrium pilbaranum	Upright shrub, 0.2 m high. Flowers white, May or September.	Perennial	Clay. Crab hole plain in a river floodplain, margin of calcrete table.	14	Potential	Potential - habitat present, poor seasonal conditions
Priority 3						
Acacia daweana	Low-spreading, often more or less flat-topped shrubs to 1.5 m tall and 2 m to 5 m across. Flowers yellow, July to September.	Perennial	Rocky red skeletal loam with *Triodia* spp. on lower scree slopes and bajada outwash fans of rocky banded ironstone ranges and ridges (often along diffuse but well incised drainage lines).	33	Unlikely	Unlikely
Acacia effusa	Low, dense, spreading (0.6 m to 3 m across), domed or flat-topped somewhat viscid shrub, to 1.2 m high, bark 'minniritchi'. Flowers yellow, May to August.	Perennial	Rocky red loam with surface strew of rocks with *Triodia* spp. On lower scree slopes of low rocky ranges (often along diffuse drainage lines) or on the bajada alluvial plain at the base of large banded ironstone mountains and ranges such as Mt Bruce.	17	Potential	Unlikely – suitable habitat searched
Acacia subtiliformis	Spindly, slender, erect shrub, to 3.5 m high, new growth slightly viscid, resinous, aromatic. Flowers yellow, June.	Perennial	Low, undulating country on calcareous rises adjacent to drainage lines.	0	Likely	Previously recorded
Amaranthus centralis	Herb, decumbent or erect to 0.6 m high. Stems angular, sometimes reddish. Flowers throughout the year	Annual	Red sand in ephemeral watercourses, sandy to clayey loam on river banks and edges of permanent pools in *Eucalyptus* lined channels or *Acacia* shrubland. It also occurs in areas of permanent water such as bore overflows, gardens and cultivation.	20	Potential	Potential – some habitat present, poor seasonal conditions
Ampelopteris prolifera	Rhizomatous herb (fern), to 4 m high.	Perennial	Near water or in wet ground, along shaded perennial stream banks.	~70	Unlikely	Unlikely

Species	Habit and flowering information[1]	Life form[1]	Habitat[1]	Distance from survey area (km)	Likelihood of occurrence	
					Pre-survey	Post-survey
Aristida jerichoensis var. *subspinulifera*	A compactly tufted grass-like or herb with lemma groove muricate. It grows 0.30 m to 0.80 m in height, leaf blade wire-like.	Perennial	Hardpan plains with deep soil with open *Acacia* woodlands over *Triodia* and other grasses.	4	Likely	Potential - habitat present, not all suitable habitat searched, poor seasonal conditions.
Atriplex flabelliformis	Monoecious, erect, rounded herb, (with grey-green leaves) to 0.35 m high.	Perennial	Clay loam, loam. Saline flats or marshes, saline soils that are seasonally inundated.	52	Unlikely	Unlikely
Dampiera anonyma	Multi-stemmed diffuse to straggling herb, 0.3 - 0.5 (1) m high. Whitish, dendritic hairs on most parts, becoming glabrescent. Flowers and fruit recorded from June - September.	Perennial	Hummock grasslands on hills slopes and summits above 1,000 m, in skeletal, red-brown soil over massive banded ironstone of the Brockman Iron Formation. Also meta-basalt, shale and jaspilite.	~100	Unlikely	Unlikely
Dampiera metallorum	Rounded, multistemmed shrub to 0.5 m high with dense, appressed, whiteish, dendritic hairs on most parts but becoming glabrescent with age. Flowers blue, April, June or October.	Perennial	Hill summits or upper slopes (above 1,000 m) in skeletal, red-brown gravelly soil over massive banded ironstone of the Brockman Iron Formation.	3	Likely	Unlikely - suitable habitat searched
Dysphania congestiflora	Erect herb to 0.1 m. Flowers June to August following favourable late summer rainfall events that inundate the Fortescue Marsh	Short-lived annual	Flats on the margin and towards the centre of seasonally inundated flood plains and lake beds, on saline, deep, light-medium to heavy clay soils (Dillion and Markey 2016).	60	Unlikely	Unlikely
Eremophila forrestii subsp. *viridis*	Much-branched shrub, to 1 m high with leaves deep green and very sparsely pubescent. Flowers pink-cream, August.	Perennial	Red sand dunes, gully of mesa, shallow, gravelly sandy clay loam soils.	>600	Unlikely	Unlikely

Species	Habit and flowering information[1]	Life form[1]	Habitat[1]	Distance from survey area (km)	Likelihood of occurrence	
					Pre-survey	Post-survey
Eremophila magnifica subsp. *velutina*	Aromatic shrub to 1.3 m high. Velutinous. Flowers blue-purple, June to September.	Perennial	Skeletal soils on the slopes and summits of ironstone hills in the Hamersley Range area.	<1	Likely	Potential – habitat present, not all suitable habitat searched
Eremophila rigida	Erect, very rigid shrubs to 1.2 m high with rigid to leathery ovate leaves. Flower cream, June - September.	Perennial	Red sand alluvium, hardpan plains, stony clay depressions with Acacia and *Eremophila* spp.	46	Unlikely	Unlikely
Eremophila sp. Hamersley Range (K. Walker KW 136)	Erect shrub. Flowers white-cream-yellow-pink-purple, August to September.	Perennial	High in the landscape, cliff tops, gorge tops, steep rocky slopes, gullies and rock faces associated with large hills and cliffs. Skeletal red-brown soils.	0	Likely	Recorded
Eucalyptus rowleyi	Lignotuberous mallee 3 m to 5 m high, bark smooth throughout, not powdery. Flowers November to June.	Perennial	Occurs on red sandy loams on plains and very minor and broad flood-out plains often in small pure stands or in open mallee vegetation with other eucalypt species including *E. gamophylla - E. odontocarpa intergrades* and *E. victrix* usually over a *Triodia* spp. hummock grassland.	~60	Unlikely	Unlikely
Euphorbia clementii	A hard, decumbent, pale stemmed herb to 0.1 m high.	Annual or short-lived perennial	Gravelly hillsides, stony grounds. Clay plains, rocky ironstone slopes, drainage lines on red brown sand.	15	Potential	Unlikely – normal distribution is north of Fortescue Marsh, identification of nearest record is questionable.

Species	Habit and flowering information[1]	Life form[1]	Habitat[1]	Distance from survey area (km)	Likelihood of occurrence	
					Pre-survey	Post-survey
Euphorbia stevenii	Glabrous, upright, succulent perennial (? Biennial) herbaceous subshrub to 0.5 m high. Likely to flower throughout the year, in response to rainfall.	Perennial (? Biennial)	Sandy, or clay-loam soils, floodplains	22	Potential	Unlikely - suitable habitat searched
Fimbristylis sieberiana	Shortly rhizomatous, tufted, grass-like or herb (sedge), 0.25 m to 0.6 m high. Flowers brown, May to June.	Perennial	Mud, skeletal soil pockets. Pool edges, sandstone cliffs.	9	Potential	Unlikely – habitat not found to occur in survey area
Geijera salicifolia	Tree, 1.5 m to 6 m high with large leathery, aromatic (Citrus smell) ovate leaves. Flowers white, September.	Perennial	Skeletal soils, stony soils, massive rock scree, gorges.	26	Unlikely	Unlikely
Glycine falcata	Mat-forming herb. Flowers May to July.	Perennial	Drainage depressions in crabhole plains on river floodplains. Black clayey sand. Along drainage depressions in crabhole plains on river floodplains.	54	Unlikely	Unlikely
Goodenia lyrata	Prostrate herb, with lyrate leaves. Flowers yellow, August.	Short-lived perennial	Red sandy loam. Near claypan. Plains. In sand and clay on poorly drained flats often occurring with various *Calandrinia* spp. and *Eucalyptus victrix.* Mulga.	0	Likely	Previously recorded
Goodenia purpurascens	Erect herb, 0.1 m to 0.3 m high. Flowers blue-purple/white/yellow, January to December.	Annual or short-lived perennial	Clay, mud. Swamps & seasonally wet depressions.	>300	Unlikely	Unlikely

Species	Habit and flowering information[1]	Life form[1]	Habitat[1]	Distance from survey area (km)	Likelihood of occurrence	
					Pre-survey	Post-survey
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)	Small rosetted herb (with spathulata leaves), to 0.2 m high. Flowers yellow, March to September.	Annual or short-lived perennial	Red-brown clay soil, calcrete pebbles. Low undulating plain, swampy plains, stony plains, hill slopes.	0	Likely	Previously recorded
Grevillea saxicola	Erect shrub to 2.5 m high. Flowers February, April, November.	Perennial	Low rocky hill, red-brown sandy loam with ironstone pebble cover, steep scree slopes often associated with banded iron formation. Mulga woodlands.	0	Likely	Recorded
Gymnanthera cunninghamii	An erect shrub that grows between 1 m and 2 m in height. Flowers cream-yellow-green, January to December.	Perennial	Red / brown / white sand in and adjacent to drainage lines, riverine brown loam-clay, ironstone scree slopes adjacent to drainage lines, floodplains with sandy soil, foot of low limestone ridge adjacent to mudflats, beach sand.	8	Likely	Potential - habitat present, not all suitable habitat searched
Indigofera gilesii	Shrub, to 1.5 m high. Flowers purple-pink, June to October.	Perennial	Pebbly loam. Amongst boulders and outcrops, hills.	4	Likely	Potential – habitat present, not all suitable habitat searched
Iotasperma sessilifolium	Erect herb. Flowers pink.	Annual	Cracking clay, black loam. Edges of waterholes, plains.	54	Unlikely	Unlikely
Nicotiana umbratica	Erect, viscid herb, 0.3 m to 0.7 m high. Flowers white, April to June.	Annual or short-lived perennial	Shallow soils. Under rocky outcrops and overhangs where it is protected from much of the heat of the sun.	~100	Unlikely	Unlikely

Species	Habit and flowering information[1]	Life form[1]	Habitat[1]	Distance from survey area (km)	Likelihood of occurrence	
					Pre-survey	Post-survey
Oldenlandia sp. Hamersley Station (A.A. Mitchell PRP 1479)	Spreading herb, 0.05 m to 0.1 m high. Flowers blue, March.	Annual	Cracking clay, basalt. Gently undulating plain with large surface rocks, flat crabholed plain.	15	Potential	Potential - habitat present, poor seasonal conditions
Olearia mucronata	Densely branched, unpleasantly aromatic shrub, 0.6 m to 1 m high. Flowers white and yellow, August to December or January.	Perennial	Schistose hills, along drainage channels.	21	Unlikely	Unlikely
Pilbara trudgenii	Gnarled, aromatic shrub, to 1 m high. Flowers September.	Perennial	Skeletal, red stony soil over ironstone. Hill summits, steep slopes, screes, cliff faces.	5	Likely	Potential – habitat present, not all suitable habitat searched
Ptilotus subspinescens	Compact shrub, to 0.8 m high. Flowers February, July, September.	Perennial	Gentle rocky slopes, screes and the bases of screes, particularly on calcareous substrates.	~130	Unlikely	Unlikely
Rhagodia sp. Hamersley (M. Trudgen 17794)	Shrub, 2.5 m high. Leaves small lanceolate, not aromatic. Flowers yellow. Fruit small red drupelets.	Perennial	Mulga plains. Alluvial plains. Red brown clay to loamy clay. Occasionally on slopes.	0	Likely	Recorded
Rostellularia adscendens var. *latifolia*	Herb or shrub, 0.1 m to 0.3 m high. Flowers blue-purple-violet, April to May.	Perennial	Ironstone soils. Near creeks or watercourses, along shaded rocky ridges, often in dry gullies and gorges.	2	Potential	Potential – habitat present, not all suitable habitat searched, poor seasonal conditions
Sida sp. Barlee Range (S. van Leeuwen 1642)	Spreading shrub to 0.5m high. Flowers yellow, August.	Perennial	Skeletal red soils pockets. Scree slopes and rock piles in full sun to afternoon shade or in small chines and gullies.	3	Likely	Potential – habitat present, not all suitable habitat searched

Species	Habit and flowering information[1]	Life form[1]	Habitat[1]	Distance from survey area (km)	Likelihood of occurrence	
					Pre-survey	Post-survey
Sida sp. Hamersley Range (K. Newbey 10692)	Semi-prostrate to upright shrub to 2 m high. Flowers September to October.	Perennial	Gorges, base of cliffs, rocky breakaways. Sometimes found in flat areas between hills in shrubby grasslands.	24	Potential	Potential - habitat present, not all suitable habitat searched
Solanum kentrocaule	Shrub 0.5 m to 1.5 m high. Flowers mauve or purple.	Perennial	Hamersley ranges between 700 m to 1,250 m altitude. Hillsides and mountaintops, or occasionally creek beds, in skeletal red-brown soil over ironstone or on basalt scree.	3	Likely	Unlikely - suitable habitat searched
Stackhousia clementii	Dense broom-like aphyllous shrub or herb, to 0.45 m high. Flowers green/yellow/brown.	Perennial	Sand to cracking clay, gibber plains and gilgai, often associated with limestone flats and ridges. Skeletal soils, sandstone hills.	36	Unlikely	Unlikely
Stylidium weeliwolli	Herb, 0.1 m to 0.25 m high. Flowers pink- red, August to September.	Annual	Gritty sand soil, sandy clay. Often in wet root masses of *Melaleuca leucadendra* at the edge of permanent pools or in gorges.	1	Likely	Unlikely – no suitable habitat
Swainsona thompsoniana	Prostrate herb to 0.1 m. Flowers mauve-cream-yellow, August to September.	Annual	Open flood plains on heavy clay soils. From gibber plains, crabhole plains and gilgai, usually at some elevation and in association with tussock grasses.	22	Potential	Potential - habitat present, poor seasonal conditions
Themeda sp. Hamersley Station (M.E. Trudgen 11431)	Tussocky grass, 0.9 m to 1.8 m high. Flowers late in the season after rains.	Perennial	Drainage lines, clay flats, crabhole flats and dark, self-mulching clays.	1	Likely	Potential - habitat present, poor seasonal conditions
Triodia sp. Mt Ella (M.E. Trudgen 12739)	Grass-like or herb, 0.4 m high.	Perennial	Light orange-brown, pebbly loam. Amongst rocks and outcrops, gully slopes.	0	Likely	Recorded

Species	Habit and flowering information[1]	Life form[1]	Habitat[1]	Distance from survey area (km)	Likelihood of occurrence	
					Pre-survey	Post-survey
Xerochrysum boreale	Erect shrub, 1.5 m high. Flowers yellow.	Perennial	Mulga on stony surfaced red-brown, clay-loam.	25	Unlikely	Unlikely
Priority 4						
Acacia bromilowiana	Tree or shrub, to 12 m high. Flowers yellow/pink, July to August.	Perennial	Red skeletal stony loam, orange-brown pebbly, gravel loam, laterite, banded ironstone, basalt. Rocky hills, breakaways, scree slopes, gorges, creek beds.	0	Likely	Recorded
Eremophila magnifica subsp. *magnifica*	Shrub, 0.5 m to 1.5 m high. Flowers blue, August to November.	Perennial	Skeletal soils on the slopes and summits of ironstone hills in the Hamersley Range area.	0	Likely	Recorded
Eremophila youngii subsp. *lepidota*	Dense, spreading shrub, (0.2-) 1-3 m high. Flowers purple-red-pink, January, March, June or August to September.	Perennial	Mulga woodlands/shrublands often associated with Chenopodiaceous shrubs. Drainage lines subject to periodic flooding, floodplains or on the margins of clay depressions, on red-brown soils or occasionally on stony flats.	1	Likely	Potential – habitat present, not all suitable habitat searched
Goodenia nuda	Erect to ascending herb, to 0.5 m high. Flowers yellow, April to August.	Annual or short-lived perennial	Alluvial soils over ironstone, floodplains, valleys, watercourses, floodplains and in orange-brown alluvial sand over ironstone.	9	Likely	Potential – habitat present, poor seasonal conditions
Lepidium catapycnon	Open, woody herb or shrub, 0.2 m to 0.3 m high, stems zigzag. Flowers white, October.	Perennial	Occurs on hillsides in skeletal soils, shale, ironstone.	0	Likely	Recorded
Ptilotus mollis	Compact shrub, to 0.5 m high, soft grey foliage. Flowers white/pink, May or September.	Perennial	Stony hills, steep rocky sites and screes. Usually in full sun on massive ironstone formations.	0	Likely	Recorded

Species	Habit and flowering information[1]	Life form[1]	Habitat[1]	Distance from survey area (km)	Likelihood of occurrence	
					Pre-survey	Post-survey
Rhynchosia bungarensis	Compact, prostrate shrub, to 0.5 m high. Flowers yellow.	Perennial	Rock piles, gorges, river beds and alluvial soils in shrubland or gallery woodland.	22	Unlikely	Unlikely

[1] – Florabase (Western Australian Herbarium 1998-2019).

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Appendix F: Vegetation Classification and Condition Scales

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Table F.1: Vegetation Classification System Specht (1970) as modified by Aplin (1979).

Stratum	70-100% cover	30-70% cover	10-30% cover	2-10% cover	<2% cover
Trees > 30 m	Tall closed forest	Tall open Forest	Tall woodland	Tall open woodland	Scattered tall trees
Trees 10-30 m	Closed forest	Open forest	Woodland	Open woodland	Scattered trees
Trees < 10 m	Low closed forest	Low open forest	Low woodland	Low open woodland	Scattered low trees
Shrubs > 2 m	Tall closed scrub	Tall open scrub	Tall shrubland	Tall open shrubland	Scattered tall shrubs
Shrubs 1-2 m	Closed heath	Open heath	Shrubland	Open shrubland	Scattered shrubs
Shrubs < 1 m	Low closed heath	Low open heath	Low shrubland	Low open shrubland	Scattered low shrubs
Hummock grasses	Closed hummock grassland	Hummock grassland	Open hummock grassland	Very open hummock grassland	Scattered hummock grasses
Grasses, sedges, herbs	Closed tussock grassland/ sedgeland/ herbland	Tussock grassland/ sedgeland/ herbland	Open tussock grassland/ sedgeland/ herbland	Very open tussock grassland/ sedgeland/ herbland	Scattered tussock grasses/ sedges/ herbs

Table F.2: Vegetation condition scale as adapted from Trudgen (1988).

Vegetation condition	Condition 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 activity since European settlement, including some obvious impact on the vegetation structure such as that caused by low levels of grazing or slightly aggressive weeds.
Poor	Still retains basic vegetation structure or ability to regenerate it after very obvious impacts of human activities since European settlement, such as grazing, partial clearing, frequent fires or aggressive weeds.
Degraded	Severely impacted by grazing, very frequent fires, clearing or a combination of these activities. Scope for some regeneration but not to a state approaching good condition without intensive management. Usually with 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.

Table F.3: Rating scale for local significance of vegetation, developed by Rio Tinto.

Local significance	Description
High	Supports threatened flora; supports priority 1 flora; associated with listed TECs or PECs; or associated with major drainage systems supporting riparian vegetation.
Moderate	Supports priority 2 flora, or high densities of priority 3 flora and associated habitat; associated with local drainage systems supporting riparian vegetation; or has limited local representation.
Low	Supports scattered records of priority 3 flora, or locally common priority 4 flora; associated with minor local drainage systems supporting riparian vegetation.
Negligible	Supports priority 4 flora that are regionally common; or associated with vegetation common across the Pilbara region.

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Appendix G: Fire Mapping

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690000 700000 710000 720000

7460000

7450000

7440000

Survey Area

Fire Detected (Year) ***Darwin Centre for Bushfire Research, Charles Darwin University***

2017

2016

2015

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Figure G.1: Historical fire mapping

Scale: 1:100,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 1 2 3 4 5 Kilometres

N

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Author: B. Eckermann | Drawn: C. Dyde | Date: 07-11-2019 | Figure Ref: 14292A-19-BIDR-3RevB_191107_Fire_FigG1

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Appendix H: Vegetation Unit Mapping and Site Locations

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695000 700000 705000 710000 715000 720000

7460000 7455000 7450000 7445000

Map Extent
Survey Area

Sampling Site
Quadrat
Relevé
Vegetation Mapping Note

Vegetation Unit

D1	D5	H3	H8	P1
D2	D7	H4	H9	P2
D3	D8	H5	H10	P3
D4	H1	H6	H11	P4
	H2	H7	H12	Cleared

H.1 H.2 H.3 H.4 H.5 H.6 H.7 H.8 H.9 H.10 H.11 H.12 H.13 H.14 H.15 H.16 H.17 H.18 H.19 H.20 H.21 H.22 H.23 H.24 H.25 H.26

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Figure H: Vegetation unit mapping and site locations - Overview

Scale: 1:80,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 1 2 3 4 5 Kilometres

N

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Author: B. Eckermann | Drawn: C. Dyde | Date: 23-09-2019 | Figure Ref: 14292A-19-BIDR-3RevB_191107_VegType_FigH_Overview

694000 695000 696000 697000

7447000

7446000

7445000

H.20 H.21 H.17 H.22 H.10 H.15 H.18 H.23 H.25 H.6 H.11 H.16 H.19 H.24 H.26 H.3 H.7 H.12 H.1 H.4 H.8 H.13 H.2 H.5 H.9 H.14

GHMNBE004 HD29 HD31 HD51 MNLV13 MNLV12

P3 D8 D1 P2 H8 D4

Source: Esri, Maxar, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

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Figure H.1: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

N

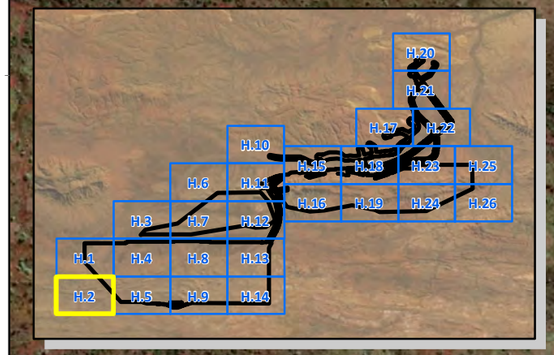
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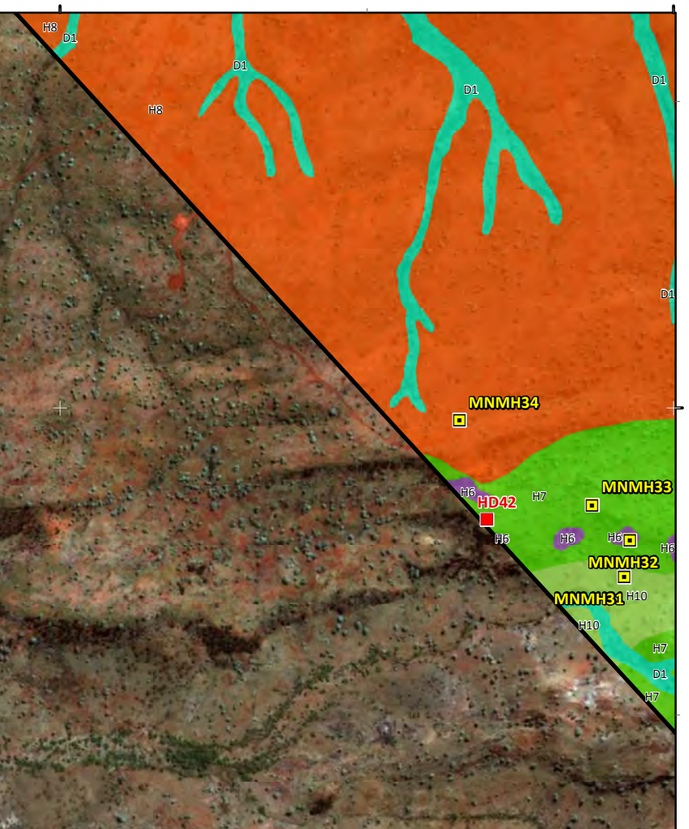
Author: B. Eckermann Drawn: C. Dyde Date: 07-11-2019 Figure Ref: 14292A-19-BIDR-3RevB_191107_VegType_FigH

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7444000

7443000





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Figure H.2: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

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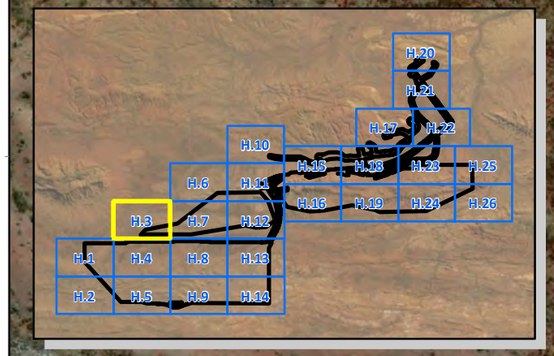
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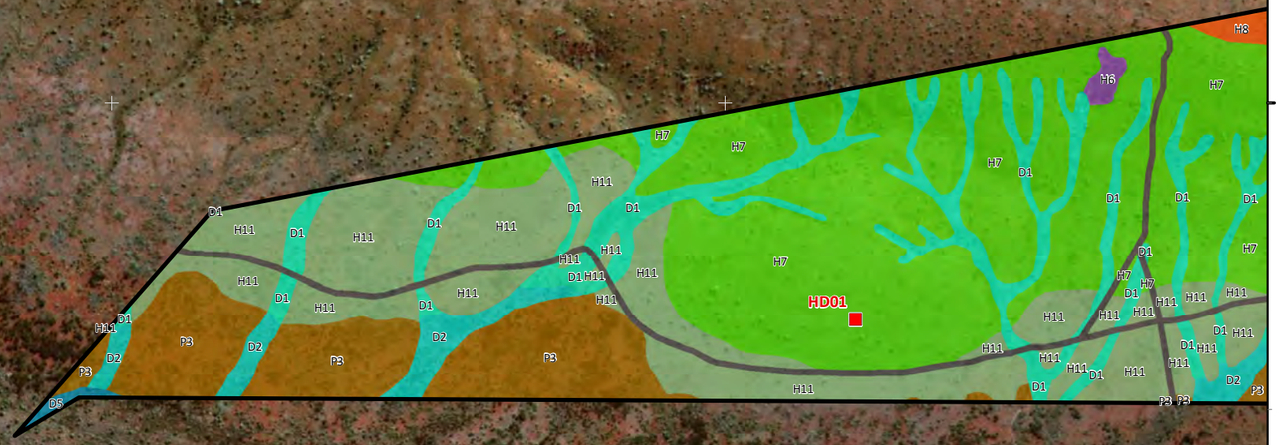
Author: B. Eckermann | Drawn: C. Dyde | Date: 07-11-2019 | Figure Ref: 14292A-19-BIDR-3RevB_191107_VegType_FigH

697000 698000 699000 700000

7449000

7448000





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Figure H.3: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

N

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Figure H.4: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

N

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697000 698000 699000 700000

7444000

7443000

MNMH37 MNMH35 MNMH36 HD44 HD21 MNMH18 MNMH19 HDR18 HDR13

H.20 H.21 H.17 H.22 H.10 H.15 H.18 H.23 H.25 H.6 H.11 H.16 H.19 H.24 H.26 H.3 H.7 H.12 H.1 H.4 H.8 H.13 H.2 H.5 H.9 H.14

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Figure H.5: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

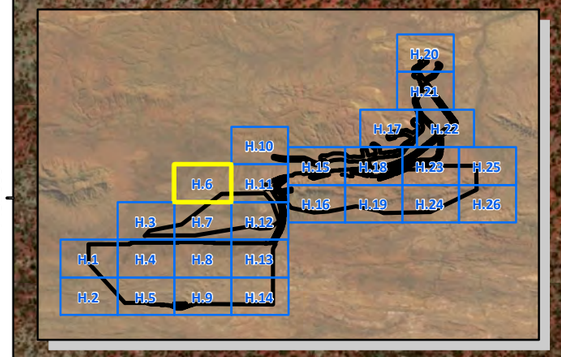
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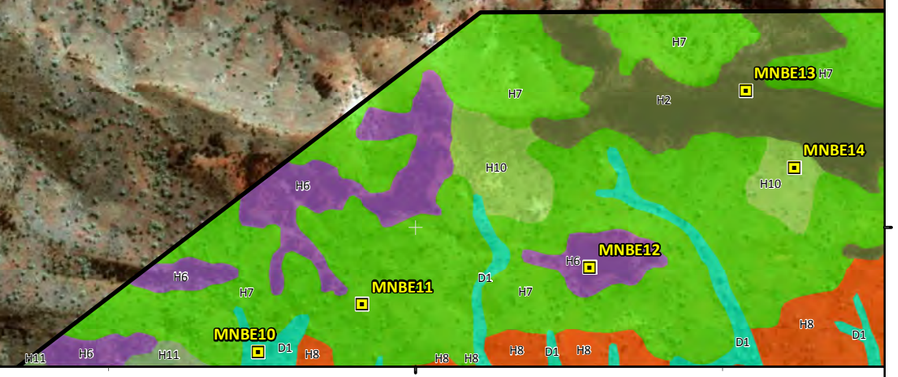
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Author: B. Eckermann Drawn: C. Dyde Date: 07-11-2019 Figure Ref: 14292A-19-BIDR-3RevB_191107_VegType_FigH

701000
702000
703000
704000
7452000
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7450000





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Figure H.6: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

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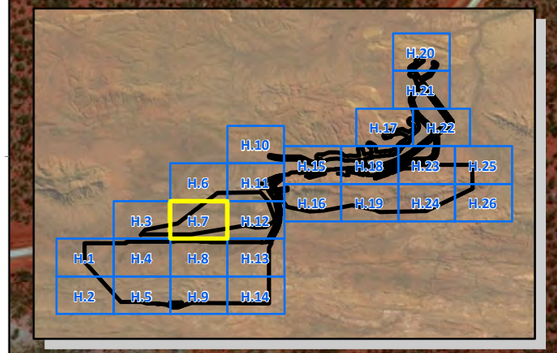
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Author: B. Eckermann | Drawn: C. Dyde | Date: 07-11-2019 | Figure Ref: 14292A-19-BIDR-3RevB_191107_VegType_FigH

701000 702000 703000 704000

7449000

7448000



HD49

GHR10

GHMNBE005

GHMNBE008

GHMNBE007

GHR28

GH27

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Figure H.7: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

N

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701000 702000 703000 704000

7447000

7446000

7445000

GH09 HD28 HDR19 HD08 HD22 MNMH28 HD16 MNBE02 HDR03

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Figure H.8: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

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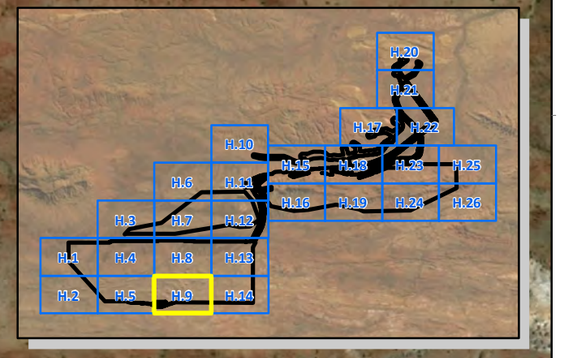
Author: B. Eckermann | Drawn: C. Dyde | Date: 07-11-2019 | Figure Ref: 14292A-19-BIDR-3RevB_191107_VegType_FigH

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7444000

7443000

HD23 HDR09 MNLV06 MNLV07 GH06 GH05 GH04 GHMNBE003



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Figure H.9: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

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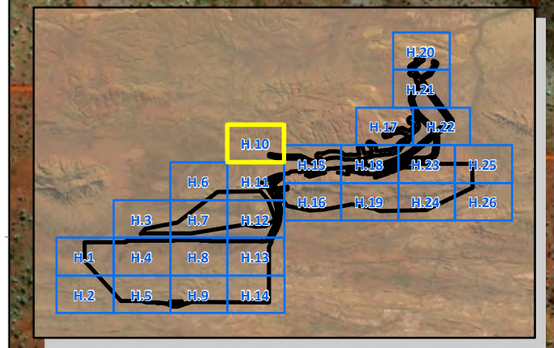
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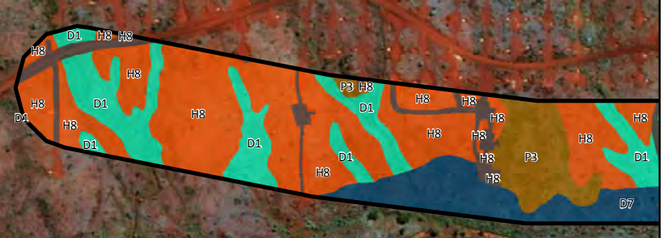
Author: B. Eckermann | Drawn: C. Dyde | Date: 07-11-2019 | Figure Ref: 14292A-19-BIDR-3RevB_191107_VegType_FigH

705000 706000 707000 708000

7454000

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Figure H.10: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

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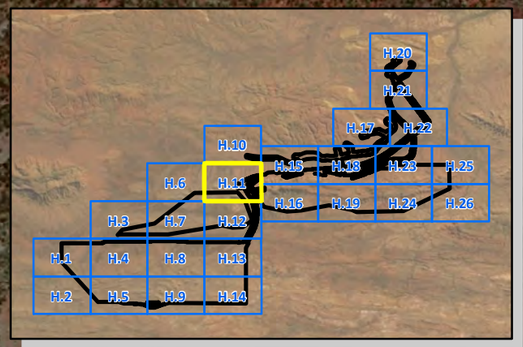
Author: B. Eckermann | Drawn: C. Dyde | Date: 07-11-2019 | Figure Ref: 14292A-19-BIDR-3RevB_191107_VegType_FigH

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7452000

7451000

7450000



HDR16

MNBE03

GHR30

GH11

HD53

HD48

HD52

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Figure H.11: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

N

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705000 706000 707000 708000

7449000

7448000

MNBE15 MNBE09 HD55 HD54 HD02 GH03 GH02 GH12 GHMNKM05 GH13 GH15

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Figure H.12: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

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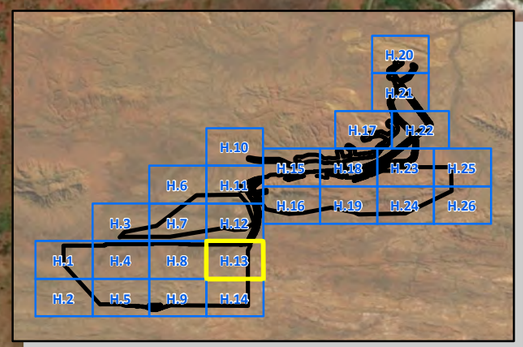
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Author: B. Eckermann | Drawn: C. Dyde | Date: 07-11-2019 | Figure Ref: 14292A-19-BIDR-3RevB_191107_VegType_FigH

705000 706000 707000 708000

7447000 7446000 7445000

GH07 GH08 HD12 HD10 HD09 HD11 HD14 HD30 HD18 HDR07 HDR05 MNLV01 MNMH01 MNMH27 MNLV02 MNMH07 MNMH02 MNMH06 MNMH03 MNMH05 MNMH04



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Figure H.13: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

N

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705000 706000 707000 708000

7444000

7443000

MNLV05 MNLV04 MNMH16 MNMH17 HD33 MNMH15 MNMH10 HD19 MNMH09 MNMH14 HD17 MNMH11 MNMH12 HD47 MNMH13

H.20 H.21 H.17 H.22 H.10 H.15 H.18 H.23 H.25 H.6 H.11 H.16 H.19 H.24 H.26 H.3 H.7 H.12 H.1 H.4 H.8 H.13 H.2 H.5 H.9 H.14

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Figure H.14: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

N

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Author: B. Eckermann Drawn: C. Dyde Date: 07-11-2019 Figure Ref: 14292A-19-BIDR-3RevB_191107_VegType_FigH

709000 710000 711000 712000

7453000 7452000 7451000

H.1 H.2 H.3 H.4 H.5 H.6 H.7 H.8 H.9 H.10 H.11 H.12 H.13 H.14 H.15 H.16 H.17 H.18 H.19 H.20 H.21 H.22 H.23 H.24 H.25 H.26

GHR16

HDR10

HD26

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Hope Downs 2 Proposal – Flora and Vegetation Survey

Figure H.15: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

N

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Author: B. Eckermann | Drawn: C. Dyde | Date: 07-11-2019 | Figure Ref: 14292A-19-BIDR-3RevB_191107_VegType_FigH

709000 710000 711000 712000

7450000

7449000

MNBE07 HD03 HD24 HD46 MNMH23 MNMH22 MNMH24 MNMH21 HD40 HD39 MNMH25 MNLV09 MNMH26 MNLV08 HD41 MNMH20 HD35 HDR02

H.1 H.2 H.3 H.4 H.5 H.6 H.7 H.8 H.9 H.10 H.11 H.12 H.13 H.14 H.15 H.16 H.17 H.18 H.19 H.20 H.21 H.22 H.23 H.24 H.25 H.26

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Hope Downs 2 Proposal – Flora and Vegetation Survey

Figure H.16: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

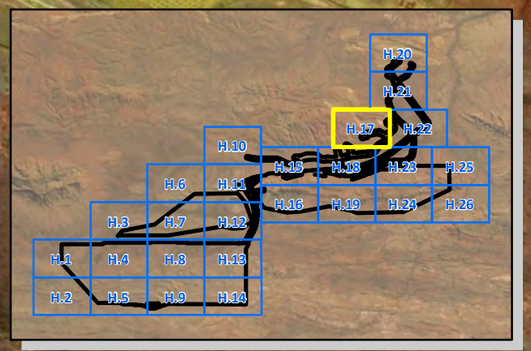
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Author: B. Eckermann Drawn: C. Dyde Date: 07-11-2019 Figure Ref: 14292A-19-BIDR-3RevB_191107_VegType_FigH

714000 715000 716000 717000

7456000 7455000 7454000



BHD05-AR

GHMNKM13

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Hope Downs 2 Proposal – Flora and Vegetation Survey

Figure H.17: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

N

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713000 714000 715000 716000

7453000 7452000 7451000

H.20 H.21 H.17 H.22 H.10 H.15 H.18 H.23 H.25 H.6 H.11 H.16 H.19 H.24 H.26 H.3 H.7 H.12 H.1 H.4 H.8 H.13 H.2 H.5 H.9 H.14

GH24 GH17 HD06

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Figure H.18: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

N

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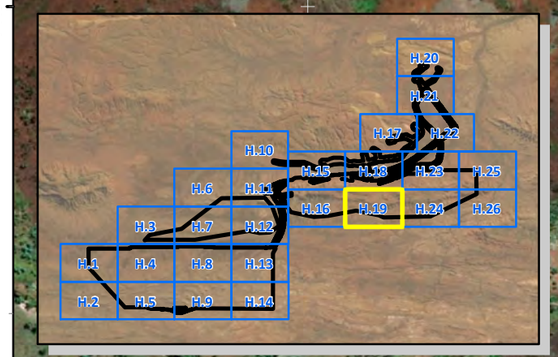
Author: B. Eckermann | Drawn: C. Dyde | Date: 07-11-2019 | Figure Ref: 14292A-19-BIDR-3RevB_191107_VegType_FigH

713000 714000 715000 716000

7450000

7449000

MNBE03 HD04 HD07 HD05 MNMH08 HDR11 MNLV03 HDR01



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Hope Downs 2 Proposal – Flora and Vegetation Survey

Figure H.19: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

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Figure H.20: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

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Author: B. Eckermann | Drawn: C. Dyde | Date: 07-11-2019 | Figure Ref: 14292A-19-BIDR-3RevB_191107_VegType_FigH

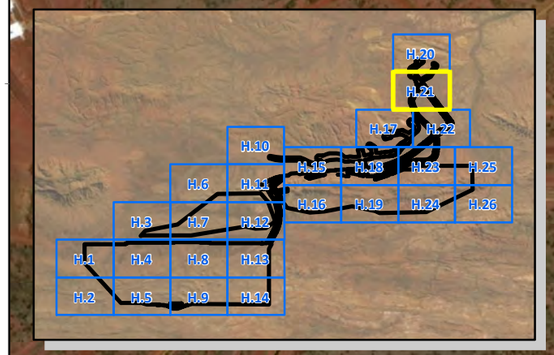
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718000

719000

7458000

7457000



P3 P3 H5 P3 H5 H5 P3 P3 D8 D8 P4 D7 P3 D7 D8 P3 D8 P3 D8 D7 P3 D8 P3 P3 P4 GH21 GH22 D7 GH23 D4 D7 P3 P4 P3 GHMNKM07 P4

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Figure H.21: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

N

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Author: B. Eckermann | Drawn: C. Dyde | Date: 07-11-2019 | Figure Ref: 14292A-19-BIDR-3RevB_191107_VegType_FigH

718000 719000 720000 721000

7456000 7455000 7454000

GHMNKM08 GHMNKM09 GHMNKM10 GHMNKM11 GHMNKM12

GH26 GH25 GH20

GHMNDR02 GHMNBE010 GHMNDR01

H.1 H.2 H.3 H.4 H.5 H.6 H.7 H.8 H.9 H.10 H.11 H.12 H.13 H.14 H.15 H.16 H.17 H.18 H.19 H.20 H.21 H.22 H.23 H.24 H.25 H.26

P1 P3 P4 D1 D2 D4 D7 D8 H5 H11

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Figure H.22: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

N

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Author: B. Eckermann Drawn: C. Dyde Date: 07-11-2019 Figure Ref: 14292A-19-BIDR-3RevB_191107_VegType_FigH

717000 718000 719000 720000

7453000 7452000 7451000

GH19 HD43 HD37 MNBE05

H.1 H.2 H.3 H.4 H.5 H.6 H.7 H.8 H.9 H.10 H.11 H.12 H.13 H.14 H.15 H.16 H.17 H.18 H.19 H.20 H.21 H.22 H.23 H.24 H.25 H.26

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Figure H.23: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

N

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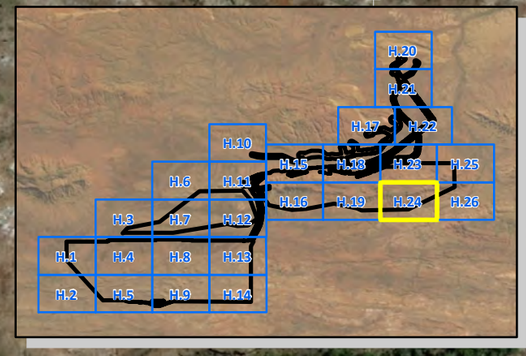
Author: B. Eckermann | Drawn: C. Dyde | Date: 07-11-2019 | Figure Ref: 14292A-19-BIDR-3RevB_191107_VegType_FigH

717000 718000 719000 720000

7450000

7449000

HDR08 HD15 HD13 HDR04



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Figure H.24: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

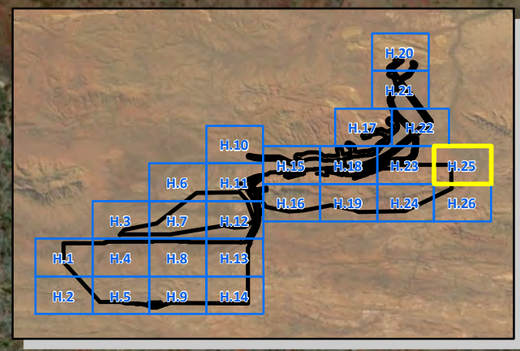
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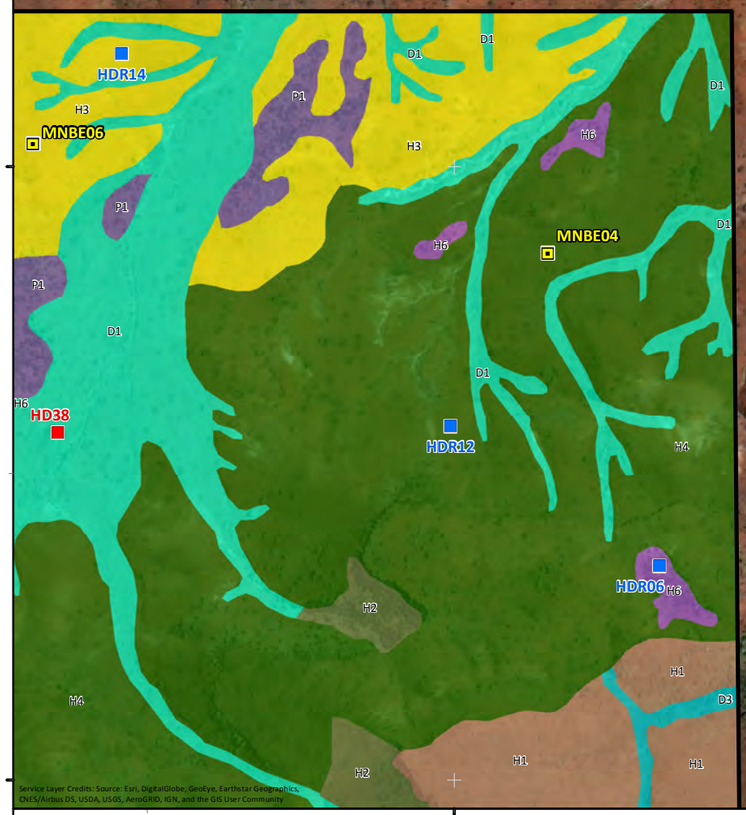
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721000 722000 723000 724000

7453000 7452000 7451000





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Figure H.25: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

N

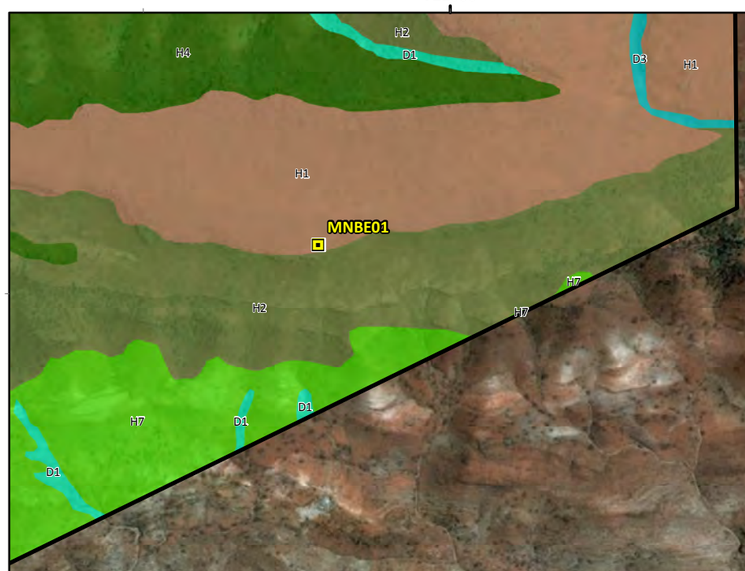
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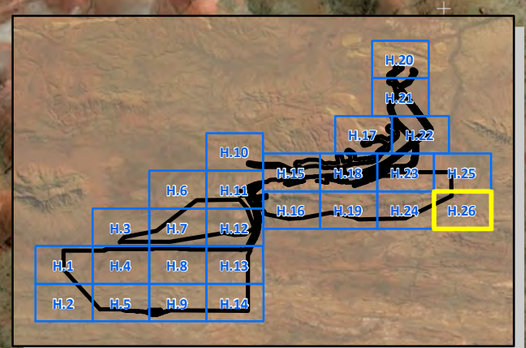
Author: B. Eckermann | Drawn: C. Dyde | Date: 07-11-2019 | Figure Ref: 14292A-19-BIDR-3RevB_191107_VegType_FigH

721000 722000 723000 724000

7450000

7449000





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Figure H.26: Vegetation unit mapping and site locations

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

N

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Author: B. Eckermann | Drawn: C. Dyde | Date: 07-11-2019 | Figure Ref: 14292A-19-BIDR-3RevB_191107_VegType_FigH

Vegetation of Drainage Lines

D1 *Corymbia hamersleyana* sens. lat., *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees to low open woodland over *Petalostylis labicheoides*, *Acacia monticola, A. maitlandii* scattered tall shrubs to tall shrubland over *Dodonaea lanceolata* var. *lanceolata, Androcalva luteiflora* scattered shrubs to open shrubland over *Triodia pungens* very open hummock grassland to open hummock grassland with *Themeda triandra*, *Eriachne mucronata* very open tussock grassland to open tussock grassland

D2 *Acacia aptaneura, A. catenulata* subsp. *occidentalis*, *A. pruinocarpa* tall shrubland to tall open scrub over *Petalostylis labicheoides* scattered shrubs to open shrubland over *Triodia pungens* very open hummock grassland with *Chrysopogon fallax* scattered tussock grasses

D3 *Corymbia ferriticola*, *Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Petalostylis labicheoides*, *Acacia hamersleyensis, Dodonaea viscosa* subsp. *spatulata* tall open shrubland over *Triodia pungens* very open hummock grassland with *Eriachne mucronata*, *Themeda* sp. Mt Barricade (M.E. Trudgen 2471), *Cymbopogon ambiguus* very open tussock grassland to tussock grassland

D5 *Eucalyptus xerothermica* scattered low trees to low open woodland over *Petalostylis labicheoides, Acacia maitlandii*, *A. pyrifolia* tall open shrubland to tall shrubland over *Androcalva luteiflora* scattered shrubs over *Triodia longiceps* very open hummock grassland to open hummock grassland with *Themeda triandra*, *Eulalia aurea* open tussock grassland to tussock grassland and **Bidens bipinnata* scattered herbs

D4 *Eucalyptus victrix*, (*E. camaldulensis* subsp. *obtusa*) low open woodland to open woodland over *Acacia citrinoviridis*, *Petalostylis labicheoides* scattered tall shrubs to tall shrubland over *Androcalva luteiflora*, *Gossypium sturtianum* var. *sturtianum* scattered shrubs to open shrubland over *Triodia longiceps* scattered hummock grasses to very open hummock grassland with *Themeda triandra*, *Eulalia aurea*, (**Cenchrus ciliaris*) very open tussock grassland to tussock grassland and **Bidens bipinnata* scattered herbs

D7 *Acacia citrinoviridis, A. aptaneura, A. pruinocarpa* scattered tall shrubs to tall shrubland over *Senna artemisioides* subsp. *oligophylla* scattered low shrubs over *Triodia longiceps* open hummock grassland to hummock grassland

D8 *Eucalyptus xerothermica* scattered low trees to low open woodland over *Acacia aptaneura, A. catenulata* subsp. *occidentalis* tall open shrubland to tall open scrub over *Triodia pungens* scattered hummock grasses to very open hummock grassland with *Themeda triandra* very open tussock grassland to open tussock grassland

Vegetation of Plains

P1 *Acacia aptaneura*, *A. catenulata* subsp. *occidentalis*, (*A. pruinocarpa*) tall shrubland to tall open scrub over *Eremophila forrestii* subsp. *forrestii* open shrubland to shrubland over *Triodia pungens*, (*T. vanleeuwenii*) scattered hummock grasses to very open hummock grassland

P2 *Acacia aptaneura*, *A. pruinocarpa, A. tetragonophylla* scattered tall shrubs to tall open shrubland over *Eremophila forrestii* subsp. *forrestii, A. synchronicia* scattered shrubs over *Ptilotus obovatus, Sida fibulifera* scattered low shrubs over *Aristida latifolia*, *Astrebla elymoides*, *Eragrostis xerophila* open tussock grassland to tussock grassland

P3 *Acacia aptaneura*, *A. catenulata* subsp. *occidentalis*, *A. pruinocarpa* tall open shrubland to tall shrubland over *Eremophila forrestii* subsp. *forrestii* scattered shrubs to open shrubland over *Triodia pungens* open hummock grassland to hummock grassland

P4 *Acacia pruinocarpa, A. aptaneura*, *A. catenulata* subsp. *occidentalis* tall open shrubland to tall shrubland over *Rhagodia eremaea* scattered shrubs

Vegetation of Hills and Slopes

H1 *Eucalyptus leucophloia* subsp. *leucophloia*, *Corymbia hamersleyana* sens. lat. scattered low trees to low open woodland over *Petalostylis labicheoides, Senna glutinosa* subsp. *glutinosa* scattered tall shrubs over *Gompholobium oreophilum*, *Acacia hilliana, A. spondylophylla* low open shrubland to low shrubland over *Triodia vanleeuwenii*, *T. wiseana*, *T. pungens* open hummock grassland with *Amphipogon sericeus* scattered tussock grasses

H2 *Eucalyptus repullulans* scattered low mallees over *Acacia catenulata* subsp. *occidentalis*, *A. aptaneura*, (*Grevillea saxicola*) tall shrubland to tall open scrub over *Scaevola acacioides, Dodonaea pachyneura, Eremophila latrobei* subsp. *filiformis* scattered shrubs to open shrubland over *Triodia pungens* scattered hummock grasses to very open hummock grassland with *Eriachne mucronata* scattered tussock grasses to very open tussock grassland

H3 *Corymbia deserticola* subsp. *deserticola* scattered low trees over *Acacia inaequilatera*, *Hakea chordophylla* scattered tall shrubs to tall open shrubland over *Senna glutinosa* subsp. *pruinosa* scattered shrubs over *Triodia vanleeuwenii* open hummock grassland with *Amphipogon sericeus* scattered tussock grasses to very open tussock grassland

H4 *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Senna glutinosa* subsp. *glutinosa*, *S. glutinosa* subsp. *pruinosa* scattered shrubs over *Triodia vanleeuwenii* and/or *T. wiseana* open hummock grassland to hummock grassland

H5 *Eucalyptus socialis* subsp. *eucentrica* scattered low mallees to low open mallee woodland over *Acacia bivenosa* scattered tall shrubs to tall open shrubland over *Senna glutinosa* subsp. × *luerssenii* scattered shrubs over *Ptilotus obovatus* scattered low shrubs over *Triodia wiseana* very open hummock grassland to open hummock grassland

H6 *Acacia aptaneura*, *A. catenulata* subsp. *occidentalis* tall open shrubland to tall shrubland over *Eremophila forrestii* subsp. *forrestii*, *Senna stricta* scattered shrubs to open shrubland over *Triodia pungens* and/or *T. vanleeuwenii* and/or *T. wiseana* scattered hummock grasses to very open hummock grassland with *Eriachne mucronata* scattered tussock grasses

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Legend: Vegetation Unit Mapping

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Vegetation of Hills and Slopes (cont'd)

H7 *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees to low open woodland over *Senna glutinosa* subsp. *glutinosa, Acacia maitlandii* scattered shrubs over *Triodia wiseana* and/or *T. vanleeuwenii* and/or *T. pungens* open hummock grassland to hummock grassland

H8 *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees to low open woodland over *Acacia pruinocarpa*, *Hakea chordophylla* scattered tall shrubs to tall open shrubland over *Triodia vanleeuwenii*, (*T. pungens*) open hummock grassland to hummock grassland with *Amphipogon sericeus* scattered tussock grasses

H9 *Acacia arida, Grevillea wickhamii* subsp. *hispidula* open shrubland over *Triodia wiseana* open hummock grassland with *Themeda* sp. Mt Barricade (M.E. Trudgen 2471) very open tussock grassland

Cleared

H10 *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees with *E. repullulans* and/or *E. socialis* subsp. *eucentrica* and/or *E. pilbarensis* scattered low mallees to low open mallee woodland over *Acacia bivenosa* scattered shrubs over *Triodia wiseana, (T. angusta)* open hummock grassland to hummock grassland

H11 *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees with *E. gamophylla* low open mallee woodland over *Acacia ancistrocarpa* scattered tall shrubs to tall open shrubland over *A. hilliana* scattered low shrubs to low open shrubland over *Triodia vanleeuwenii*, (*T. pungens*) open hummock grassland to hummock grassland

H12 *Corymbia hamersleyana* sens. lat. scattered low trees over *Acacia inaequilatera*, *Hakea chordophylla*, *A. bivenosa* scattered tall shrubs to tall open shrubland over *Senna artemisioides* subsp. *oligophylla* scattered low shrubs over *Triodia wiseana* open hummock grassland to hummock grassland with *Themeda* sp. Mt Barricade (M.E. Trudgen 2471), *Cymbopogon ambiguus* scattered tussock grasses and *Heliotropium ovalifolium, Corchorus lasiocarpus* subsp. *parvus* scattered herbs

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Legend: Vegetation Unit Mapping

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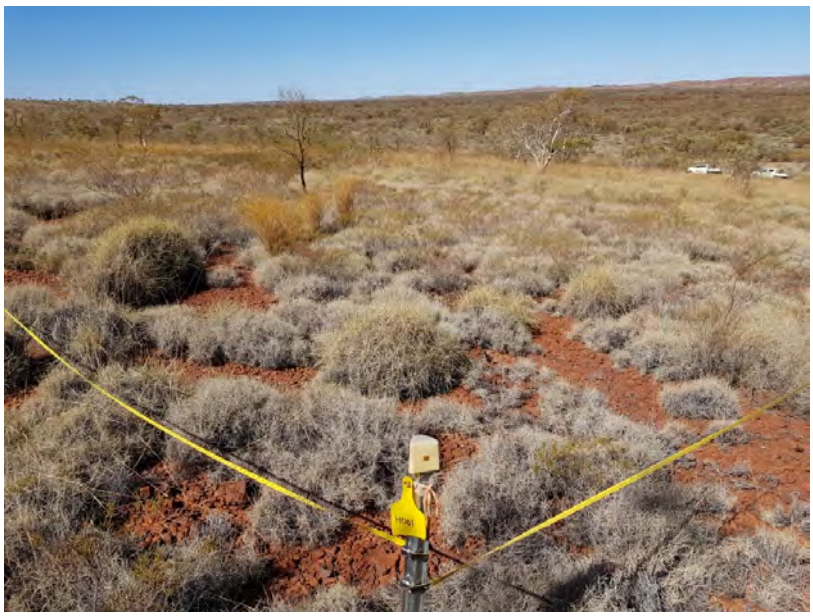
Author: B. Eckermann | Drawn: C. Dyde | Date: 7/11/2019 | Figure Ref: 14292-19-BIDR-3RevB_191107_FigH1_VegType_Legend

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Appendix I: Vegetation Sample Site Data

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Site: HD01
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 2/11/2017 **Phase 3 Date:** 21/05/2019 **Described by:** LV
MGA Zone: 50 **Easting:** 700213 **Northing:** 7447647
Habitat: Hillslope
Soil: Dark reddish brown clay loam
Rock type: Ironstone
Vegetation code: H7
Vegetation: *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia maitlandii* scattered shrubs over *Acacia hilliana* scattered low shrubs over *Triodia vanleeuwenii* and *Triodia wiseana* hummock grassland
Vegetation Condition: Excellent
Fire Age: >10 years



Species List:

Name	Cover (%)	Height (m)
Acacia adoxa var. *adoxa*	0.1	0.4
Acacia adsurgens	0.1	1.1
Acacia hilliana	1	0.6
Acacia maitlandii	1	1.3
Acacia pachyacra	0.1	0.4
Acacia pruinocarpa	0.1	2.2
Acacia pyrifolia	0.1	2.1
Eriachne mucronata	0.1	0.2
Eucalyptus leucophloia subsp. *leucophloia*	1	6
Gompholobium oreophilum	0.1	0.8
Hakea chordophylla	0.1	2.5
Halgania gustafsenii var. *gustafsenii*	0.1	0.3
Jasminum didymum subsp. *lineare*	0.1	0.8
Mirbelia viminalis	0.1	0.1
Ptilotus rotundifolius	0.1	0.7

Name	Cover (%)	Height (m)
Scaevola browniana subsp. *browniana*	0.1	0.3
Senna ferraria	0.1	2
Senna glutinosa subsp. *glutinosa*	0.1	1.7
Solanum lasiophyllum	0.1	0.5
Themeda triandra	0.1	0.4
Triodia vanleeuwenii	35	0.2
Triodia wiseana	15	0.5

Site: HD02
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 2/11/2017 **Phase 2 Date:** 24/05/2018 **Described by:** LV
MGA Zone: 50 **Easting:** 706655 **Northing:** 7448969
Habitat: Plain
Soil: Red brown clay loam
Rock type: Ironstone
Vegetation code: P1
Vegetation: *Acacia aptanuera*, (*A. catenulata* subsp. *occidentalis*) tall shrubland over *Eremophila forrestii* subsp. *forrestii* shrubland over *Maireana tomentosa* subsp. *tomentosa* scattered low shrubs over *Triodia pungens* very open hummock grassland with **Bidens bipinnata* scattered herbs
Vegetation Condition: Very Good
Fire Age: 5-10 years



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	22	6.0
Acacia catenulata subsp. *occidentalis*	2	5.0
Aristida contorta	0.1	0.25
Aristida inaequiglumis	0.1	0.4
Aristida obscura	0.1	0.4
**Bidens bipinnata*	0.5	0.2
Boerhavia coccinea	0.1	0.1
Bulbostylis barbata	0.1	0.1
Cheilanthes sieberi subsp. *sieberi*	0.1	0.1
Chrysopogon fallax	0.1	0.4
Cynodon convergens	0.1	0.1
Duperreya commixta	0.1	twiner
Dysphania plantaginella	0.1	0.1
Enneapogon caerulescens	0.1	0.15
Enneapogon lindleyanus	0.1	0.25

Name	Cover (%)	Height (m)
Enneapogon polyphyllus	0.1	0.35
Eragrostis cumingii	0.1	0.1
Eremophila forrestii subsp. *forrestii*	15	1.7
Eremophila latrobei	0.1	0.5
Eriachne pulchella	0.1	0.1
Euphorbia sp.	0.1	0.02
Evolvulus alsinoides var. *villosicalyx*	0.1	0.3
Hibiscus burtonii	0.1	0.4
Hibiscus leptocladus	0.1	0.4
Iseilema vaginiflorum	0.1	0.2
Maireana tomentosa subsp. *tomentosa*	0.5	0.2
Panicum decompositum	0.1	0.35
Paspalidium clementii	0.1	0.2
Perotis rara	0.1	0.2
Polycarpaea corymbosa var. *corymbosa*	0.1	0.2
Polycarpaea holtzei	0.1	0.1
Polycarpaea longiflora	0.1	0.15
Psydrax suaveolens	0.1	0.3
Pterocaulon sphacelatum	0.1	0.25
Ptilotus astrolasius	0.1	0.5
Ptilotus exaltatus	0.1	0.2
Ptilotus obovatus	0.1	0.25
Sida sp.	0.1	0.2
Sida sp. dark green fruits (S. van Leeuwen 2260)	0.1	0.4
Sporobolus australasicus	0.1	0.1
Triodia pungens	4	0.4
Wahlenbergia tumidifructa	0.1	0.2

* denotes weed species

Site: HD03
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 3/11/2017 **Phase 2 Date:** 25/05/2018 **Described by:** LV
MGA Zone: 50 **Easting:** 710941 **Northing:** 7450542
Habitat: Hillslope
Soil: Reddish brown sandy loam
Rock type: Ironstone
Vegetation code: H3
Vegetation: *Eucalyptus repullulans* scattered low mallees over *Acacia aptaneura*, *A. catenulata* subsp. *occidentalis*, (*A. ayersiana*, *Grevillea saxicola*, *A. mulganeura*) tall open scrub over *Eremophila latrobei* subsp. *filiformis* scattered shrubs over *Ptilotus obovatus* scattered low shrubs over *Triodia pungens* scattered hummock grasses with *Eriachne mucronata* very open tussock grassland
Vegetation Condition: Very Good
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	25	5.0
Acacia ayersiana	6	5.3
Acacia catenulata subsp. *occidentalis*	10	5.0
Acacia mulganeura	1	5.4
Acacia pruinocarpa	0.1	5.0
Aristida contorta	0.1	0.1
Aristida sp.	0.1	0.15
**Bidens bipinnata*	0.1	0.15
Cheilanthes lasiophylla	0.1	0.2
Cymbopogon ambiguus	0.1	0.4
Dodonaea lanceolata var. *lanceolata*	0.1	1.3
Duperreya commixta	0.1	twiner
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.1
Enneapogon lindleyanus	0.1	0.5
Enneapogon polyphyllus	0.1	0.1

Name	Cover (%)	Height (m)
Eremophila latrobei subsp. *filiformis*	0.5	1.8
Eremophila sp. Hamersley Range (K. Walker KW 136) P3	1	2.3
Eriachne mucronata	3	0.3
Eriachne pulchella	0.1	0.1
Eucalyptus repullulans	1	3.0
Euphorbia sp.	0.1	0.08
Grevillea saxicola P3	3	5.5
Nicotiana sp.	0.1	0.1
Paraneurachne muelleri	0.1	0.1
Paspalidium clementii	0.1	0.2
Psydrax suaveolens	0.1	0.4
Ptilotus exaltatus	0.1	0.3
Ptilotus obovatus	0.5	0.4
Rhagodia eremaea	0.1	0.2
Scaevola acacioides	1	2.4
Schizachyrium fragile	0.1	0.5
Solanum lasiophyllum	0.1	0.3
Triodia pungens	1	0.4
Triodia vanleeuwenii	0.1	0.4
Triodia wiseana	0.1	0.5

* denotes weed species

Site: HD04
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 3/11/2017 **Phase 2 Date:** 22/05/2018 **Described by:** DL
MGA Zone: 50 **Easting:** 713294 **Northing:** 7450657
Habitat: Hillslope
Soil: Dark reddish brown sandy loam
Rock type: Ironstone
Vegetation code: H1
Vegetation: *Corymbia hamersleyana* sens. lat., *Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Acacia hamersleyensis*, *Senna glutinosa* subsp. *glutinosa*, *A. catenulata* subsp. *occidentalis* tall open shrubland over *Triodia wiseana*, *T. pungens*, *T. vanleeuwenii* hummock grassland
Vegetation Condition: Excellent
Fire Age: >10 years



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	0.1	2.2
Acacia catenulata subsp. *occidentalis*	0.5	3.5
Acacia hamersleyensis	1	3.2
Acacia pruinocarpa	0.1	2.5
Acacia pyrifolia	0.1	3.2
Amyema miquelii	0.1	mistletoe
Bulbostylis barbata	0.1	0.05
Clerodendrum floribundum var. *angustifolium*	0.1	1.5
Corchorus lasiocarpus subsp. *parvus*	0.1	0.5
Corymbia hamersleyana sens. lat.	4	4.5
Cymbopogon ambiguus	0.1	0.1
Duperreya commixta	0.1	twiner
Eriachne lanata	0.1	0.4
Eucalyptus leucophloia subsp. *leucophloia*	2.5	4.5
Goodenia stobbsiana	0.1	0.3

Name	Cover (%)	Height (m)
Hakea chordophylla	0.1	3.0
Mirbelia viminalis	0.1	0.6
Petalostylis labicheoides	0.1	2.5
Polycarpaea corymbosa var. *corymbosa*	0.1	0.05
Polycarpaea holtzei	0.1	0.02
Ptilotus calostachyus	0.1	0.5
Scaevola browniana	0.1	0.3
Senna glaucifolia	0.1	2.2
Senna glutinosa subsp. *glutinosa*	1	2.2
Sida echinocarpa	0.1	0.5
Sida sp. Excedentifolia (J.L. Egan 1925)	0.1	0.2
Sida sp. Shovelanna Hill (S. van Leeuwen 3842)	0.1	0.5
Triodia pungens	10	0.5
Triodia vanleeuwenii	10	0.4
Triodia wiseana	20	0.6

Site: HD05
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 4/11/2017 **Phase 2 Date:** 22/05/2018 **Described by:** LD
MGA Zone: 50 **Easting:** 714854 **Northing:** 7450939
Habitat: Footslope
Soil: Reddish brown sandy loam
Rock type: Ironstone
Vegetation code: H3
Vegetation: *Corymbia deserticola* subsp. *deserticola* scattered low trees over *Acacia inaequilatera* scattered tall shrubs over *Triodia vanleeuwenii* open hummock grassland with *Amphipogon sericeus* very open tussock grassland
Vegetation Condition: Excellent
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Acacia adsurgens	0.1	2.5
Acacia aptaneura	0.1	2.0
Acacia inaequilatera	0.5	3.0
Amphipogon sericeus	3	0.2
Bonamia pilbarensis	0.1	0.1
Bulbostylis barbata	0.1	0.1
Codonocarpus cotinifolius	0.1	0.5
Corchorus lasiocarpus subsp. *parvus*	0.1	0.4
Corymbia deserticola subsp. *deserticola*	0.5	5.0
Cymbopogon ambiguus	0.1	0.6
Dampiera candicans	0.1	0.2
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.1
Eriachne pulchella subsp. *pulchella*	0.1	0.1
Fimbristylis simulans	0.1	0.1
Gompholobium oreophilum	0.1	0.3

Name	Cover (%)	Height (m)
Goodenia stobbsiana	0.1	0.2
Hakea chordophylla	0.1	2.0
Hibiscus sturtii var. *campylochlamys*	0.1	0.1
Indigofera monophylla	0.1	0.2
Jasminum didymum subsp. *lineare*	0.1	twiner
Maireana tomentosa subsp. *tomentosa*	0.1	0.2
Polycarpaea corymbosa var. *corymbosa*	0.1	0.1
Polycarpaea holtzei	0.1	0.05
Ptilotus calostachyus	0.1	0.6
Ptilotus exaltatus	0.1	0.3
Scaevola parvifolia subsp. *pilbarae*	0.1	0.2
Schizachyrium fragile	0.1	0.2
Senna artemisioides subsp. *oligophylla*	0.1	0.6
Senna glutinosa subsp. x *luerssenii*	0.1	1.7
Solanum lasiophyllum	0.1	0.7
Sporobolus australasicus	0.1	0.1
Triodia pungens	0.1	0.4
Triodia vanleeuwenii	27	0.3

Site: HD06
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 4/11/2017 **Phase 2 Date:** 23/05/2018 **Described by:** LD
MGA Zone: 50 **Easting:** 715969 **Northing:** 7451699
Habitat: Plain
Soil: Reddish brown sandy loam
Rock type: Ironstone
Vegetation code: P1
Vegetation: *Acacia catenulata* subsp. *occidentalis*, *A. aptaneura*, (*A. pruinocarpa*) tall shrubland over *Eremophila forrestii* subsp. *forrestii* open shrubland over *Triodia vanleeuwenii*, (*T. pungens*) open hummock grassland with *Amphipogon sericeus* very open tussock grassland
Vegetation Condition: Very Good
Fire Age: >10 years



Species List:

Name	Cover (%)	Height (m)
Abutilon lepidum	0.1	0.4
Abutilon ?lepidum	0.1	0.3
Abutilon macrum	0.1	0.4
Abutilon otocarpum	0.1	0.5
Acacia aptaneura	4	5.0
Acacia ayersiana	0.1	4.5
Acacia bivenosa	0.1	0.4
Acacia catenulata subsp. *occidentalis*	10	5.0
Acacia maitlandii	0.1	0.6
Acacia monticola	0.1	1.5
Acacia pruinocarpa	1	5.0
Acacia tenuissima	0.1	0.6
Amphipogon sericeus	5	0.2
Androcalva luteiflora	0.1	1.6
Aristida contorta	0.1	0.2

Name	Cover (%)	Height (m)
Aristida inaequiglumis	0.1	0.6
**Bidens bipinnata*	0.1	0.2
Cheilanthes sieberi subsp. *sieberi*	0.1	0.1
Cleome viscosa	0.1	0.3
Codonocarpus cotinifolius	0.1	0.4
Corchorus lasiocarpus subsp. *parvus*	0.1	0.7
Cucumis variabilis	0.1	twiner
Digitaria brownii	0.1	0.4
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.2
Enchylaena tomentosa var. *tomentosa*	0.1	0.3
Enneapogon lindleyanus	0.1	0.4
Enneapogon polyphyllus	0.1	0.3
Eremophila forrestii subsp. *forrestii*	3	1.8
Eriachne pulchella	0.1	0.1
Euphorbia australis var. *subtomentosa*	0.1	0.1
Euphorbia sp.	0.1	0.05
Evolvulus alsinoides var. *villosicalyx*	0.1	0.2
Gomphrena cunninghamii	0.1	0.1
Goodenia stobbsiana	0.1	0.2
Gossypium robinsonii	0.1	2.0
Hibiscus burtonii	0.1	0.3
Hibiscus coatesii	0.1	1.5
Hibiscus sturtii var. *campylochlamys*	0.1	0.4
Indigofera monophylla	0.1	0.4
Iseilema vaginiflorum	0.1	0.1
Paraneurachne muelleri	0.1	0.3
Paspalidium clementii	0.1	0.1
Perotis rara	0.1	0.1
Polycarpaea corymbosa var. *corymbosa*	0.1	0.1
Polycarpaea holtzei	0.1	0.1
Pterocaulon sphacelatum	0.1	0.5
Ptilotus astrolasius	0.1	0.3
Ptilotus calostachyus	0.1	0.6
Ptilotus exaltatus	0.1	0.5
Ptilotus fusiformis	0.1	0.3
Ptilotus helipteroides	0.1	0.2
Rhagodia eremaea	0.1	0.5
Schizachyrium fragile	0.1	0.1
Senna artemisioides subsp. *helmsii*	0.1	0.5
Senna glutinosa subsp. x *luerssenii*	0.1	2.1
Senna notabilis	0.1	0.2

Name	Cover (%)	Height (m)
Sida fibulifera	0.1	0.1
Sida sp. dark green fruits (S. van Leeuwen 2260)	0.1	0.6
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	0.1	0.3
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	0.1	2.1
Solanum lasiophyllum	0.1	0.3
Solanum phlomoides	0.1	0.3
Sporobolus australasicus	0.1	0.1
Streptoglossa decurrens	0.1	0.4
Teucrium teucriiflorum	0.1	1.3
Tribulus suberosus	0.1	0.5
Trichodesma zeylanicum var. *zeylanicum*	0.1	0.6
Triodia pungens	5	0.4
Triodia vanleeuwenii	10	0.3
Waltheria indica	0.1	0.3

* denotes weed species
? denotes unconfirmed ID

Site: HD07
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 4/11/2017 **Phase 2 Date:** 22/05/2018 **Described by:** LD
MGA Zone: 50 **Easting:** 713558 **Northing:** 7450156
Habitat: Hillslope
Soil: Reddish brown sandy loam
Rock type: Ironstone
Vegetation code: H2
Vegetation: *Eucalyptus repullulans* scattered low mallees over *Acacia catenulata* subsp. *occidentalis*, *A. aptaneura*, (*A. incurvaneura*, *A. mulganeura*, *Grevillea saxicola*) tall open scrub over *Senna stricta*, (*Eremophila latrobei* subsp. *filiformis*, *S. artemisioides* subsp. *helmsii*) open shrubland over *Triodia pungens* very open hummock grassland
Vegetation Condition: Excellent
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	10	5.0
Acacia catenulata subsp. *occidentalis*	20	4.5
Acacia hamersleyensis	0.1	5.0
Acacia incurvaneura	2	5.0
Acacia mulganeura	1	5.0
Aristida contorta	0.1	0.1
Asteraceae sp.	0.1	0.2
Cheilanthes lasiophylla	0.1	0.2
Dodonaea pachyneura	0.1	2.0
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.1
Enchylaena tomentosa var. *tomentosa*	0.1	0.3
Enneapogon polyphyllus	0.1	0.4
Eremophila latrobei subsp. *filiformis*	0.5	1.8
Eremophila platycalyx subsp. *pardalota*	0.1	3.0
Eriachne mucronata	0.1	0.3

Name	Cover (%)	Height (m)
Eriachne pulchella	0.1	0.1
Eucalyptus repullulans	1	2.5
Grevillea saxicola P3	1	5.0
Lobelia heterophylla subsp. *pilbarensis*	0.1	0.1
Nicotiana sp.	0.1	0.1
Paspalidium clementii	0.1	0.1
Psydrax suaveolens	0.1	0.7
Ptilotus exaltatus	0.1	0.4
Ptilotus obovatus	0.1	0.3
Santalum lanceolatum	0.1	2.4
Scaevola acacioides	0.5	2.5
Senna artemisioides subsp. *helmsii*	0.5	1.8
Senna glaucifolia	0.1	2.1
Senna glutinosa subsp. x *luerssenii*	0.1	1.3
Senna stricta	2	1.2
Solanum lasiophyllum	0.1	0.4
Triodia pungens	5	0.4
Triodia vanleeuwenii	0.1	0.2

Site: HD08
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 5/11/2017 **Phase 2 Date:** 21/05/2018 **Described by:** DL
MGA Zone: 50 **Easting:** 703384 **Northing:** 7446220
Habitat: Minor creek
Soil: Reddish brown sandy loam
Rock type: Ironstone
Vegetation code: D2
Vegetation: *Corymbia hamersleyana* sens. lat. scattered low trees over *Acacia catenulata* subsp. *occidentalis*, (*A. pruinocarpa, A. aptaneura*, *Petalostylis labicheoides*, *A. citrinoviridis*) tall shrubland over *Triodia pungens* very open hummock grassland with *Eriachne mucronata*, (*Themeda triandra*) very open tussock grassland
Vegetation Condition: Very Good
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	4	4.2
Acacia ayersiana	0.1	2.8
Acacia catenulata subsp. *occidentalis*	15	5.5
Acacia citrinoviridis	2	5.0
Acacia pruinocarpa	4	5.2
Aristida contorta	0.1	0.3
Capparis lasiantha	0.1	2.5
Corymbia hamersleyana sens. lat.	1	5.0
Cymbopogon ambiguus	0.1	0.5
Dodonaea petiolaris	2	3.0
Duperreya commixta	0.1	twiner
Eremophila platycalyx subsp. *pardalota*	0.1	1.1
Eriachne mucronata	5	0.3
Eucalyptus gamophylla	0.1	1.7
Eucalyptus leucophloia subsp. *leucophloia*	0.1	5.0

Name	Cover (%)	Height (m)
Jasminum didymum subsp. *lineare*	0.1	twiner
Petalostylis labicheoides	4	2.5
Psydrax latifolia	0.1	0.5
Senna artemisioides subsp. *oligophylla*	0.1	0.7
Sida sp.	0.1	0.1
Themeda triandra	0.5	0.4
Triodia pungens	3	0.4

Site: HD09
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 5/11/2017 **Phase 2 Date:** 19/05/2018 **Described by:** BE
MGA Zone: 50 **Easting:** 706457 **Northing:** 7446593
Habitat: Floodplain
Soil: Dark reddish brown sandy clay
Rock type: Ironstone
Vegetation code: P2
Vegetation: *Acacia pruinocarpa*, (*A. aptaneura*) tall open shrubland over *Eremophila forrestii* subsp. *forrestii* open shrubland over *Aristida latifolia*, (*Astrebla* sp.) tussock grassland
Vegetation Condition: Very Good
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Abutilon otocarpum	0.1	0.1
Acacia aptaneura	1	2.2
Acacia pachyacra	0.1	0.9
Acacia pruinocarpa	5	4
Acacia sp.	0.1	2.4
Acacia synchronicia	0.1	3.8
Acacia tetragonophylla	0.1	2.2
Alternanthera nana	0.1	0.1
Anthobolus leptomerioides	0.1	1
Aristida contorta	0.1	0.3
Aristida latifolia	35	0.7
Asteraceae sp.	0.1	0.2
Astrebla sp.	5	0.6
Bidens bipinnata	0.1	0.2
Boerhavia coccinea	0.1	0.2
Bulbostylis barbata	0.1	0.1

Name	Cover (%)	Height (m)
Chrysopogon fallax	0.1	0.4
Cleome viscosa	0.1	0.3
Crotalaria medicaginea var. *neglecta*	0.1	0.2
Cymbopogon ambiguus	0.1	0.7
Cynodon convergens	0.1	0.1
Dactyloctenium ?radulans	0.1	0.1
Dichanthium sericeum subsp. *humilius*	0.1	0.3
Enchylaena tomentosa var. *tomentosa*	0.1	0.9
Enneapogon caerulescens	0.1	0.1
Enneapogon polyphyllus	0.1	0.2
Eragrostis setifolia	0.1	0.4
Eragrostis tenellula	0.1	0.2
Eragrostis xerophila	0.1	0.4
Eremophila forrestii subsp. *forrestii*	2	1.7
Eremophila longifolia	0.1	0.7
Eriachne ?benthamii	0.1	0.3
Eriachne obtusa	0.1	0.4
Euphorbia sp.	0.1	0.1
Evolvulus alsinoides var. *villosicalyx*	0.1	0.2
Fimbristylis dichotoma	0.1	0.1
Indigofera linifolia	0.1	0.1
Iseilema eremaeum	0.1	0.1
Maireana villosa	0.1	0.2
Malvastrum americanum	0.1	0.3
Panicum decompositum	0.1	0.3
Paraneurachne muelleri	0.1	0.5
Pterocaulon sphacelatum	0.1	0.2
Ptilotus aervoides	0.1	0.1
Ptilotus exaltatus	0.1	0.4
Ptilotus helipteroides	0.1	0.1
Ptilotus obovatus	0.1	0.6
Rhagodia eremaea	0.1	1
Rhagodia sp. Hamersley (M. Trudgen 17794)	0.1	1.6
Rhynchosia minima	0.1	twiner
Salsola australis	0.1	0.4
Sclerolaena cornishiana	0.1	0.3
Senna artemisioides subsp. *oligophylla*	0.1	1.3
Senna artemisioides subsp. x *artemisioides*	0.1	0.3
Sida fibulifera	0.1	0.2
Solanum lasiophyllum	0.1	0.3
Sporobolus australasicus	0.1	0.1

Name	Cover (%)	Height (m)
Streptoglossa bubakii	0.1	0.4
Tragus australianus	0.1	0.1
Triodia wiseana	0.1	0.4

? denotes unconfirmed ID

Site: HD10
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 5/11/2017 **Phase 2 Date:** 19/05/2018 **Described by:** DL
MGA Zone: 50 **Easting:** 705856 **Northing:** 7446600
Habitat: Plain
Soil: Dark reddish brown sandy loam
Rock type: Ironstone
Vegetation code: P1
Vegetation: *Acacia aptaneura*, (*A. catenulata* subsp. *occidentalis*, *A. ayersiana, A. aptaneura* x, *A. incurvaneura*) tall shrubland over *Eremophila forrestii* subsp. *forrestii* open shrubland over *Triodia pungens* very open hummock grassland
Vegetation Condition: Very Good
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Abutilon otocarpum	0.1	0.3
Acacia aptaneura	15	4.3
Acacia aptaneura x	1	4.0
Acacia ayersiana	2	3.8
Acacia catenulata subsp. *occidentalis*	6	4.3
Acacia incurvaneura	0.5	4.0
Acacia tetragonophylla	0.1	2.3
Aristida contorta	0.1	0.1
Aristida obscura	0.1	0.1
**Bidens bipinnata*	0.1	0.2
Cheilanthes sieberi subsp. *sieberi*	0.1	0.1
Chrysopogon fallax	0.1	1.1
Corymbia deserticola subsp. *deserticola*	0.1	4.0
Dichanthium sp.	0.1	0.2
Enchylaena tomentosa var. *tomentosa*	0.1	0.3

Name	Cover (%)	Height (m)
Enneapogon caerulescens	0.1	0.1
Enneapogon polyphyllus	0.1	0.1
Eremophila forrestii subsp. *forrestii*	4	1.0
Eremophila latrobei subsp. *filiformis*	0.1	1.7
Eriachne pulchella	0.1	0.1
Evolvulus alsinoides var. *decumbens*	0.1	0.2
Glycine canescens	0.1	twiner
Hibiscus burtonii	0.1	0.6
Iseilema vaginiflorum	0.1	0.2
Maireana tomentosa subsp. *tomentosa*	0.1	0.2
Paspalidium clementii	0.1	0.1
Perotis rara	0.1	0.1
Psydrax suaveolens	0.1	1.5
Sida ?ectogama	0.1	0.5
Sida fibulifera	0.1	0.1
Sida sp.	0.1	0.5
Sida sp. dark green fruits (S. van Leeuwen 2260)	0.1	0.4
Sporobolus australasicus	0.1	0.2
Triodia pungens	7	0.5
Triodia vanleeuwenii	0.1	0.2

* denotes weed species
? denotes unconfirmed ID

Site: HD11
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 5/11/2017 **Phase 2 Date:** 19/05/2018 **Described by:** LV
MGA Zone: 50 **Easting:** 706727 **Northing:** 7446383
Habitat: Footslope
Soil: Dark reddish brown sandy clay loam
Rock type: Ironstone
Vegetation code: H11
Vegetation: *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees with *E. gamophylla* low open mallee woodland over *Acacia ancistrocarpa* scattered tall shrubs over *Senna ferraria* scattered shrubs over *A. hilliana* low open shrubland over *Triodia vanleeuwenii*, (*T. pungens*) hummock grassland
Vegetation Condition: Excellent
Fire Age: No fire evident



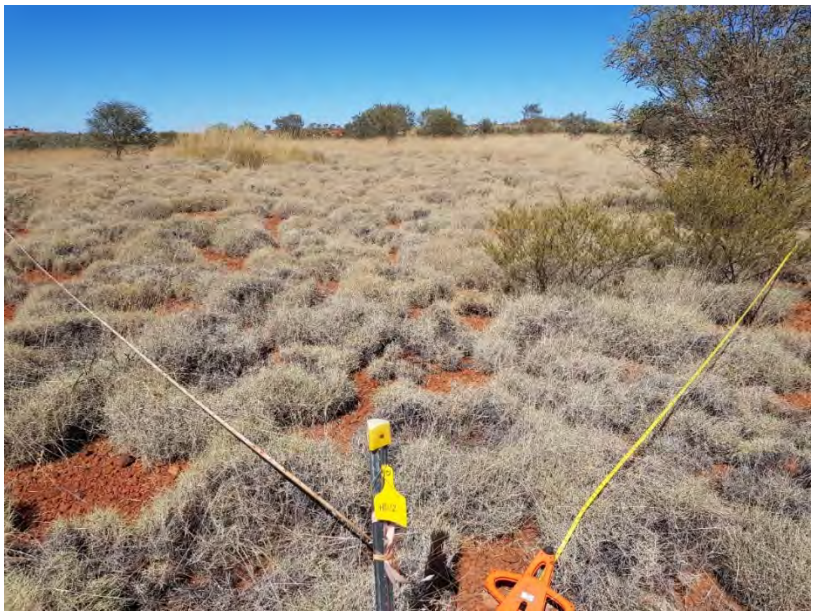
Species List:

Name	Cover (%)	Height (m)
Acacia ancistrocarpa	1	2.9
Acacia aptaneura	0.1	3.0
Acacia hilliana	4	0.5
Acacia maitlandii	0.1	1.8
Acacia pachyacra	0.1	0.5
Acacia pruinocarpa	0.1	2.1
Acacia tenuissima	0.1	1.7
Amphipogon sericeus	0.1	0.8
Anthobolus leptomerioides	0.1	1.8
Aristida contorta	0.1	0.3
Aristida holathera var. *holathera*	0.1	0.4
Aristida inaequiglumis	0.1	0.6
Capparis lasiantha	0.1	0.1
Corchorus lasiocarpus subsp. *parvus*	0.1	0.4
Cymbopogon ambiguus	0.1	0.5

Name	Cover (%)	Height (m)
Cymbopogon obtectus	0.1	0.4
Digitaria ammophila	0.1	0.2
Digitaria brownii	0.1	0.4
Duperreya commixta	0.1	twiner
Enneapogon caerulescens	0.1	0.2
Enneapogon polyphyllus	0.1	0.3
Eremophila forrestii subsp. *forrestii*	0.1	0.7
Eremophila longifolia	0.1	2.5
Eriachne ?benthamii	0.1	0.1
Eriachne mucronata	0.1	0.2
Eriachne pulchella subsp. *pulchella*	0.1	0.1
Eucalyptus gamophylla	4	5.0
Eucalyptus leucophloia subsp. *leucophloia*	1	5.5
Gompholobium oreophilum	0.1	0.4
Goodenia stobbsiana	0.1	0.3
Hakea chordophylla	0.1	3.3
Indigofera monophylla	0.1	0.3
Jasminum didymum subsp. *lineare*	0.1	twiner
Paraneurachne muelleri	0.1	0.3
Pterocaulon sphacelatum	0.1	0.2
Ptilotus astrolasius	0.1	0.3
Ptilotus calostachyus	0.1	0.1
Ptilotus exaltatus	0.1	0.2
Ptilotus rotundifolius	0.1	1.1
Scaevola parvifolia subsp. *pilbarae*	0.1	0.2
Schizachyrium fragile	0.1	0.2
Senna artemisioides subsp. *oligophylla*	0.1	0.7
Senna ferraria	1	1.5
Senna glutinosa subsp. *glutinosa*	0.1	1.5
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	0.1	0.4
Solanum lasiophyllum	0.1	1.0
Trichodesma zeylanicum var. *zeylanicum*	0.1	0.05
Triodia pungens	12	0.5
Triodia vanleeuwenii	45	0.5
Triodia wiseana	0.1	0.4

? denotes unconfirmed ID

Site: HD12
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 5/11/2017 **Phase 2 Date:** 19/05/2018 **Described by:** DL
MGA Zone: 50 **Easting:** 705230 **Northing:** 7446638
Habitat: Hillcrest
Soil: Dark reddish brown sandy loam
Rock type: Ironstone
Vegetation code: H8
Vegetation: *Acacia pruinocarpa* tall open shrubland over *Triodia vanleeuwenii*, (*T. pungens*) hummock grassland
Vegetation Condition: Excellent
Fire Age: >10 years



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	0.1	1.3
Acacia ayersiana	0.1	1.1
Acacia pruinocarpa	5	2.7
Goodenia sp.	0.1	0.2
Jasminum didymum subsp. *lineare*	0.1	twiner
Psydrax latifolia	0.1	0.8
Ptilotus calostachyus	0.1	0.4
Solanum horridum	0.1	0.2
Solanum lasiophyllum	0.1	0.3
Triodia pungens	1	0.5
Triodia vanleeuwenii	45	0.3

Site: HD13
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 6/11/2017 **Phase 2 Date:** 24/05/2018 **Described by:** DL
MGA Zone: 50 **Easting:** 718945 **Northing:** 7450427
Habitat: Hillcrest
Soil: Red brown sandy clay loam
Rock type: Ironstone
Vegetation code: H1
Vegetation: *Corymbia hamersleyana* sens. lat., *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees with *E. gamophylla* low open mallee woodland over *Hakea chordophylla*, *Petalostylis labicheoides* scattered tall shrubs over *Acacia spondylophylla*, *Gompholobium oreophilum*, *A. hilliana* low shrubland over *Triodia vanleeuwenii*, (*T. pungens, T. wiseana*) open hummock grassland
Vegetation Condition: Excellent
Fire Age: 5-10 years



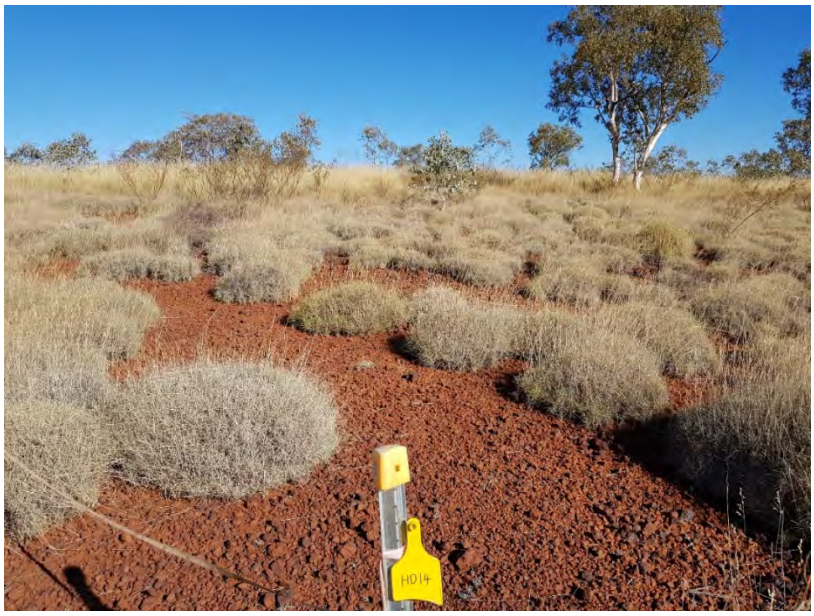
Species List:

Name	Cover (%)	Height (m)
Acacia hilliana	4	0.5
Acacia pyrifolia	0.1	0.6
Acacia spondylophylla	5	0.5
Amphipogon sericeus	0.1	0.3
Aristida inaequiglumis	0.1	0.9
Codonocarpus cotinifolius	0.1	0.5
Corchorus lasiocarpus subsp. *parvus*	0.1	0.3
Corymbia hamersleyana sens. lat.	0.5	5.0
Cymbopogon ambiguus	0.1	0.4
Duperreya commixta	0.1	twiner
Eriachne pulchella subsp. *dominii*	0.1	0.05
Eucalyptus gamophylla	4	3.5
Eucalyptus leucophloia subsp. *leucophloia*	0.5	4.0
Gompholobium oreophilum	5	0.4
Goodenia triodiophila	0.1	0.4

Name	Cover (%)	Height (m)
Grevillea wickhamii subsp. *hispidula*	0.1	0.7
Hakea chordophylla	1	3.0
Hibiscus ?coatesii	0.1	0.35
Petalostylis labicheoides	0.5	2.4
Ptilotus calostachyus	0.1	0.7
Santalum lanceolatum	0.1	0.6
Scaevola browniana	0.1	0.4
Senna glutinosa subsp. *glutinosa*	0.1	0.9
Triodia pungens	1	0.7
Triodia vanleeuwenii	17	0.5
Triodia wiseana	1	0.5

? denotes unconfirmed ID

Site: HD14
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 7/11/2017 **Phase 2 Date:** 19/05/2018 **Described by:** LD
MGA Zone: 50 **Easting:** 704939 **Northing:** 7445738
Habitat: Hillcrest
Soil: Dark reddish brown sandy loam
Rock type: Ironstone
Vegetation code: H7
Vegetation: *Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Acacia maitlandii* scattered tall shrubs over *Triodia pungens*, *T. vanleeuwenii* hummock grassland
Vegetation Condition: Excellent
Fire Age: No fire evident

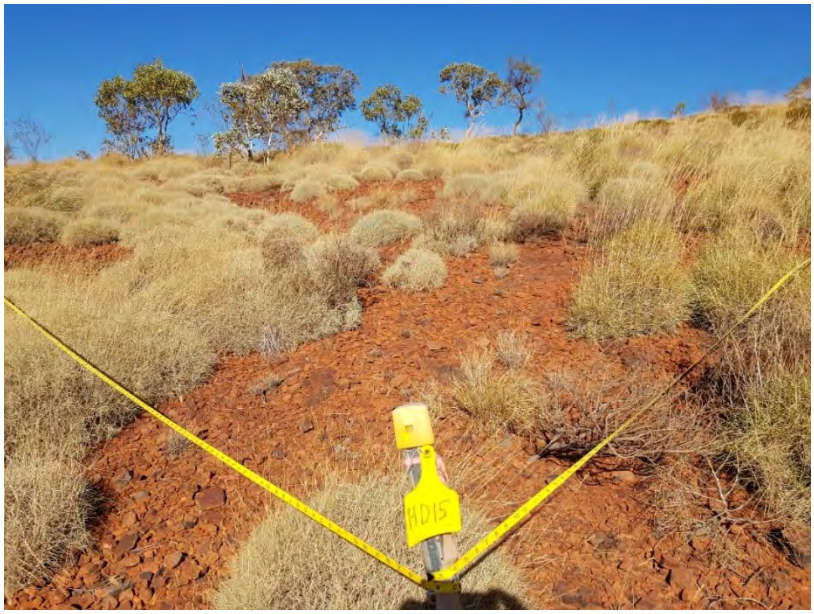


Species List:

Name	Cover (%)	Height (m)
Abutilon lepidum	0.1	0.3
Acacia adoxa var. *adoxa*	0.1	0.4
Acacia maitlandii	1	3.0
Acacia pachyacra	0.1	2.1
Acacia pruinocarpa	0.1	2.5
Acacia pteraneura x *aptaneura*	0.1	0.5
Aristida contorta	0.1	0.2
Aristida holathera var. *holathera*	0.1	0.3
Bonamia pilbarensis	0.1	0.1
Bulbostylis barbata	0.1	0.1
Capparis lasiantha	0.1	0.4
Corymbia deserticola subsp. *deserticola*	0.1	0.6
Cymbopogon ambiguus	0.1	0.4
Enneapogon caerulescens	0.1	0.1
Enneapogon polyphyllus	0.1	0.1
Eremophila fraseri subsp. *fraseri*	0.1	0.3

Name	Cover (%)	Height (m)
Eremophila latrobei subsp. *glabra*	0.1	1.1
Eriachne mucronata	0.1	0.2
Eriachne pulchella	0.1	0.1
Eucalyptus leucophloia subsp. *leucophloia*	8	7.5
Euphorbia australis var. *subtomentosa*	0.1	0.1
Goodenia stobbsiana	0.1	0.3
Goodenia tenuiloba	0.1	0.2
Indigofera monophylla	0.1	0.2
Lepidium pedicellosum	0.1	0.3
Maireana triptera	0.1	0.2
Paraneurachne muelleri	0.1	0.2
Paspalidium clementii	0.1	0.1
Polycarpaea corymbosa var. *corymbosa*	0.1	0.1
Ptilotus astrolasius	0.1	0.3
Ptilotus exaltatus	0.1	0.2
Ptilotus obovatus	0.1	0.4
Salsola australis	0.1	0.1
Schizachyrium fragile	0.1	0.1
Senna glutinosa subsp. *glutinosa*	0.1	1.6
Senna glutinosa subsp. *pruinosa*	0.1	1.6
Senna glutinosa subsp. x *luerssenii*	0.1	2.1
Sida sp. Excedentifolia (J.L. Egan 1925)	0.1	0.2
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	0.1	0.2
Solanum lasiophyllum	0.1	0.3
Sporobolus australasicus	0.1	0.1
Themeda triandra	0.1	0.5
Triodia pungens	25	0.5
Triodia vanleeuwenii	15	0.3

Site: HD15
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 6/11/2017 **Phase 2 Date:** 23/05/2018 **Described by:** DL
MGA Zone: 50 **Easting:** 717618 **Northing:** 7450313
Habitat: Hillcrest
Soil: Red brown sandy clay loam
Rock type: Ironstone
Vegetation code: H1
Vegetation: *Eucalyptus leucophloia* subsp. *leucophloia*, *Corymbia hamersleyana* sens. lat. low open woodland over *Gompholobium oreophilum*, *Acacia hilliana* low open shrubland over *Triodia vanleeuwenii*, (*T. wiseana*, *T. pungens*) open hummock grassland
Vegetation Condition: Excellent
Fire Age: 5-10 years



Species List:

Name	Cover (%)	Height (m)
Acacia hilliana	2	0.4
Acacia spondylophylla	0.1	0.4
Amphipogon sericeus	0.1	0.3
Aristida holathera var. *holathera*	0.1	0.3
Cheilanthes sieberi subsp. *sieberi*	0.1	0.2
Codonocarpus cotinifolius	0.1	1.8
Corymbia hamersleyana sens. lat.	1	4.0
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.15
Eremophila jucunda subsp. *pulcherrima*	0.1	0.8
Eriachne aristidea	0.1	0.25
Eriachne mucronata	0.1	0.3
Eucalyptus leucophloia subsp. *leucophloia*	3	5.0
Fimbristylis sp.	0.1	0.2
Gompholobium oreophilum	2	0.6
Goodenia stobbsiana	0.1	0.35

Name	Cover (%)	Height (m)
Goodenia triodiophila	0.1	0.3
Hakea chordophylla	0.1	3.5
Iseilema sp.	0.1	0.1
Jasminum didymum subsp. *lineare*	0.1	twiner
Paraneurachne muelleri	0.1	0.2
Petalostylis labicheoides	0.1	2.2
Ptilotus calostachyus	0.1	0.7
Ptilotus fusiformis	0.1	0.35
Scaevola browniana	0.1	0.3
Schizachyrium fragile	0.1	0.1
Senna glaucifolia	0.1	1.5
Senna glutinosa subsp. *glutinosa*	0.1	2.5
Sida arenicola	0.1	0.3
Sida sp. Excedentifolia (J.L. Egan 1925)	0.1	0.2
Solanum lasiophyllum	0.1	0.4
Triodia pungens	0.5	0.4
Triodia vanleeuwenii	15	0.4
Triodia wiseana	5	0.4

Site: HD16
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 7/11/2017 **Phase 2 Date:** 20/05/2018 **Described by:** LD
MGA Zone: 50 **Easting:** 703984 **Northing:** 7445042
Habitat: Hillcrest
Soil: Dark reddish brown sandy loam
Rock type: Dolerite
Vegetation code: H9
Vegetation: *Acacia arida*, *Grevillea wickhamii* subsp. *hispidula*, *Androcalva luteiflora* open shrubland over *Triodia wiseana* open hummock grassland with *Themeda* sp. Mt Barricade (M.E. Trudgen 2471) very open tussock grassland
Vegetation Condition: Excellent
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Acacia arida	3	1.4
Acacia arida x	0.1	1.1
Acacia inaequilatera	0.1	0.7
Androcalva luteiflora	1	1.8
Aristida holathera var. *holathera*	0.1	0.3
Cheilanthes lasiophylla	0.1	0.1
Corymbia hamersleyana sens. lat.	0.1	3.2
Cymbopogon ambiguus	0.1	0.6
Eremophila fraseri subsp. *fraseri*	0.1	0.4
Eriachne mucronata	0.1	0.5
Gossypium australe	0.1	0.2
Grevillea wickhamii subsp. *hispidula*	1.5	1.9
Senna glutinosa subsp. *glutinosa*	0.1	1.1
Themeda sp. Mt Barricade (M.E. Trudgen 2471)	7	0.5
Triodia wiseana	25	0.5

Site: HD17
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 7/11/2017 **Phase 2 Date:** 20/05/2018 **Described by:** LV
MGA Zone: 50 **Easting:** 706292 **Northing:** 7443062
Habitat: Drainage depression
Soil: Brown sand
Rock type: Dolerite
Vegetation code: D4
Vegetation: *Eucalyptus victrix* low open woodland over *Melaleuca glomerata*, *Acacia citrinoviridis* tall open shrubland over *Gossypium sturtianum* var. *sturtianum, Androcalva luteiflora*, *Acacia bivenosa* open shrubland over *Themeda triandra*, (**Cenchrus setiger*, *Eulalia aurea, *C. ciliaris*) open tussock grassland with **Bidens bipinnata* scattered herbs
Vegetation Condition: Good
Fire Age: 5-10 years



Species List:

Name	Cover (%)	Height (m)
Acacia bivenosa	1	1.5
Acacia citrinoviridis	2	8.0
Acacia maitlandii	0.1	1.3
Acacia pyrifolia	0.1	1.6
Androcalva luteiflora	1.5	1.7
**Bidens bipinnata*	1	0.2
Bothriochloa ewartiana	0.1	1.0
Cassytha sp.	0.1	twiner
**Cenchrus ciliaris*	1	0.5
**Cenchrus setiger*	4	0.7
Cleome viscosa	0.1	0.2
Clerodendrum floribundum var. *angustifolium*	0.1	0.35
Corchorus lasiocarpus subsp. *parvus*	0.1	0.35
Cucumis variabilis	0.1	twiner
Cymbopogon ambiguus	0.1	0.3

Name	Cover (%)	Height (m)
Cyperus vaginatus	0.1	0.6
Eremophila canaliculata	0.1	0.15
Eremophila longifolia	0.1	1.5
Eucalyptus camaldulensis subsp. *obtusa*	0.1	2.0
Eucalyptus victrix	2.0	10
Eulalia aurea	1.5	0.9
Euphorbia biconvexa	0.1	0.2
**Flaveria trinervia*	0.1	0.4
Glycine canescens	0.1	twiner
Gossypium australe	0.1	0.4
Gossypium robinsonii	0.1	2.3
Gossypium sturtianum var. *sturtianum*	1.5	1.8
Jasminum didymum subsp. *lineare*	0.1	twiner
Marsdenia sp.	0.1	twiner
Melaleuca glomerata	3.0	4.0
Peripleura arida	0.1	0.25
Petalostylis labicheoides	0.1	1.9
Phyllanthus maderaspatensis	0.1	0.2
Pluchea dentex	0.1	0.3
Pluchea rubelliflora	0.1	0.3
Pluchea sp.	0.1	0.5
Pterocaulon sphacelatum	0.1	0.2
Rhynchosia minima	0.1	twiner
Scaevola amblyanthera var. *centralis*	0.1	0.15
Scaevola browniana	0.1	0.1
**Sigesbeckia orientalis*	0.1	0.4
Solanum lasiophyllum	0.1	0.3
Stemodia grossa	0.1	0.3
Themeda triandra	12	0.7
Trichodesma zeylanicum var. *zeylanicum*	0.1	1.2
Tricoryne sp. Hamersley Range (S. van Leeuwen 915)	0.1	0.3
Triodia longiceps	0.1	0.5

* denotes weed species

Site: HD18
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 7/11/2017 **Phase 2 Date:** 19/05/2018 **Described by:** LV
MGA Zone: 50 **Easting:** 707275 **Northing:** 7445867
Habitat: Major creek
Soil: Reddish brown sandy loam
Rock type: Ironstone
Vegetation code: D4
Vegetation: *Eucalyptus camaldulensis* subsp. *obtusa*, (*E. victrix*) open woodland with *E. xerothermica* low open woodland over *Petalostylis labicheoides*, (*Melaleuca bracteata*) tall open shrubland over *Androcalva luteiflora* scattered shrubs over over *Gossypium sturtianum* var. *sturtianum* scattered low shrubs over *Triodia longiceps* very open hummock grassland with *Themeda triandra*, *Eulalia aurea*, **Cenchrus ciliaris*, (*Enteropogon ramosus*, *Dichanthium sericeum* subsp. *humilius*) open tussock grassland
Vegetation Condition: Good
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Abutilon amplum	0.1	1.7
Abutilon otocarpum	0.1	0.2
Acacia bivenosa	0.1	2.0
Acacia citrinoviridis	0.1	0.5
Acacia dictyophleba	0.1	0.5
Acacia maitlandii	0.1	0.3
Androcalva luteiflora	1.0	1.8
Aristida contorta	0.1	0.25
Aristida holathera var. *holathera*	0.5	0.4
Aristida lazaridis P2	0.1	0.3
**Bidens bipinnata*	0.1	0.1
Bonamia pilbarensis	0.1	0.1
Bothriochloa ewartiana	0.1	0.7
**Cenchrus ciliaris*	3.0	0.6

Name	Cover (%)	Height (m)
**Cenchrus setiger*	0.1	0.4
Chrysopogon fallax	0.1	1.0
Convolvulus clementii	0.1	twiner
**Conyza bonariensis*	0.1	0.2
Corchorus lasiocarpus subsp. *parvus*	0.1	0.4
Crotalaria medicaginea var. *neglecta*	0.1	0.3
Cucumis variabilis	0.1	twiner
Cymbopogon ambiguus	0.1	0.4
Cyperus vaginatus	0.1	0.4
Dichanthium sericeum subsp. *humilius*	1	0.6
Duperreya commixta	0.1	twiner
Enneapogon lindleyanus	0.1	0.4
Enteropogon ramosus	2	0.6
Eragrostis eriopoda	0.1	0.3
Eragrostis tenellula	0.1	0.1
Eremophila longifolia	0.1	0.4
Eriachne mucronata	0.1	0.2
Eucalyptus camaldulensis subsp. *obtusa*	8	12
Eucalyptus leucophloia subsp. *leucophloia*	0.1	2.1
Eucalyptus victrix	1.5	15
Eucalyptus xerothermica	2	6.5
Eulalia aurea	6	0.6
Euphorbia boophthona	0.1	0.3
Evolvulus alsinoides var. *villosicalyx*	0.1	0.3
**Flaveria trinervia*	0.1	0.2
Glycine canescens	0.1	twiner
Goodenia lamprosperma	0.1	0.2
Gossypium robinsonii	0.1	2.0
Gossypium sturtianum var. *sturtianum*	1.0	0.8
Hakea lorea subsp. *lorea*	0.1	1.7
Hibiscus sturtii var. *campylochlamys*	0.1	0.3
Indigofera monophylla	0.1	0.3
Jasminum didymum subsp. *lineare*	0.1	twiner
**Malvastrum americanum*	0.1	0.3
Melaleuca bracteata	2.0	3.7
Melhania oblongifolia	0.1	0.2
Paraneurachne muelleri	0.1	0.4
Paspalidium rarum	0.1	0.2
Petalostylis labicheoides	7.0	2.2
Pluchea rubelliflora	0.1	0.2
Polycarpaea corymbosa var. *corymbosthaa*	0.1	0.2

Name	Cover (%)	Height (m)
Polygala isingii	0.1	0.1
Pterocaulon sphacelatum	0.1	0.2
Ptilotus astrolasius	0.1	0.35
Ptilotus exaltatus	0.1	0.45
Ptilotus obovatus	0.1	0.2
Rhynchosia minima	0.1	twiner
Salsola australis	0.1	0.2
Santalum lanceolatum	0.1	1.7
Scaevola amblyanthera var. *centralis*	0.1	0.1
Senna artemisioides subsp. *x artemisioides*	0.1	0.5
Senna pleurocarpa var. *angustifolia*	0.1	0.6
Setaria dielsii	0.1	0.3
Sida echinocarpa	0.1	0.4
Sida fibulifera	0.1	0.15
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	0.1	0.3
Solanum phlomoides	0.1	0.2
Sporobolus australasicus	0.1	0.1
Themeda triandra	8.0	0.6
Trichodesma zeylanicum var. *zeylanicum*	0.1	1.5
Tricoryne sp. Hamersley Range (S. van Leeuwen 915)	0.1	0.4
Triodia longiceps	3.0	0.4
Triodia wiseana	0.1	0.5
**Vachellia farnesiana*	0.1	1.8
Wahlenbergia tumidifructa	0.1	0.3

* denotes weed species

Site: HD19
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 7/11/2017 **Phase 2 Date:** 20/05/2018 **Described by:** BE
MGA Zone: 50 **Easting:** 705911 **Northing:** 7443247
Habitat: Hillslope
Soil: Dark reddish brown sandy clay loam
Rock type: Dolerite
Vegetation code: H12
Vegetation: *Hakea chordophylla*, *Acacia pyrifolia* scattered shrubs over *Triodia wiseana* hummock grassland with *Themeda* sp. Mt Barricade (M.E. Trudgen 2471) scattered tussock grasses and *Tricoryne* sp. Hamersley Range (S. van Leeuwen 915) scattered herbs
Vegetation Condition: Excellent
Fire Age: No fire evident
Notes: Parts of the east and north have been burnt in the last two years

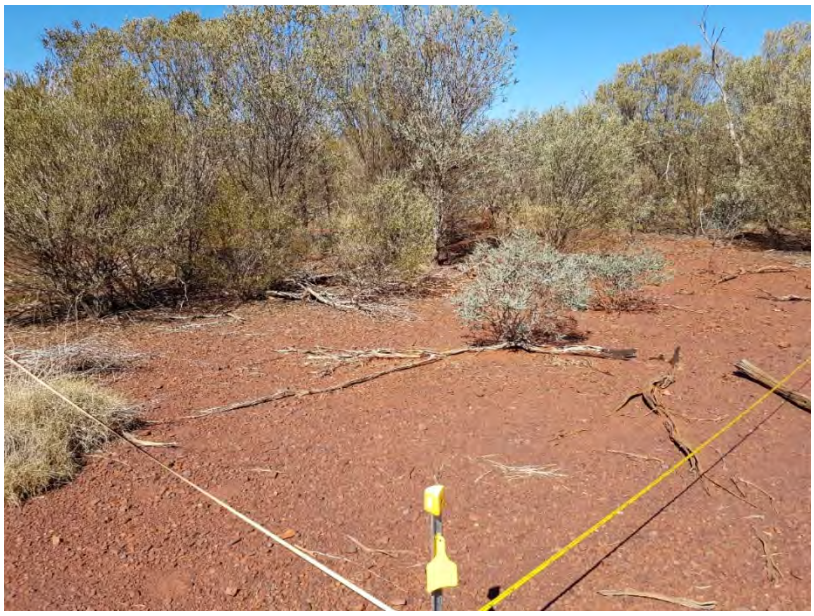


Species List:

Name	Cover (%)	Height (m)
Acacia arida	0.1	0.8
Acacia bivenosa	0.1	1.1
Acacia dictyophleba	0.1	0.8
Acacia kempeana	0.1	0.8
Acacia pyrifolia	0.5	1.7
Acacia sibirica	0.1	0.5
Aristida contorta	0.1	0.1
Aristida holathera var. *holathera*	0.1	0.3
Cheilanthes lasiophylla	0.1	0.1
Cymbopogon ambiguus	0.1	0.8
Dodonaea coriacea	0.1	0.5
Eriachne mucronata	0.1	0.2
Euphorbia careyi	0.1	0.1
Goodenia cusackiana	0.1	0.2
Goodenia prostrata	0.1	0.1

Name	Cover (%)	Height (m)
Hakea chordophylla	0.5	1.8
Heliotropium ovalifolium	0.1	0.2
Mirbelia viminalis	0.1	0.8
Poaceae sp.	0.1	0.1
Polygala isingii	0.1	0.1
Senna artemisioides subsp. *oligophylla*	0.1	0.5
Senna glutinosa subsp. *pruinosa*	0.1	1.3
Swainsona maccullochiana	0.1	0.2
Themeda sp. Mt Barricade (M.E. Trudgen 2471)	0.5	0.8
Trachymene oleracea subsp. *oleracea*	0.1	0.5
Trichodesma zeylanicum var. *zeylanicum*	0.1	0.7
Tricoryne sp. Hamersley Range (S. van Leeuwen 915)	0.5	0.5
Triodia wiseana	40	0.7

Site: HD20
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 8/11/2017 **Phase 2 Date:** 21/05/2018 **Described by:** DL
MGA Zone: 50 **Easting:** 699216 **Northing:** 7446699
Habitat: Plain
Soil: Dark reddish brown sandy loam
Rock type: Ironstone
Vegetation code: P3
Vegetation: *Acacia aptaneura*, (*A. pruinocarpa*, *A. catenulata* subsp. *occidentalis*) tall shrubland over *Triodia pungens* open hummock grassland
Vegetation Condition: Excellent
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	20	4.5
Acacia ayersiana x	0.1	3.0
Acacia catenulata subsp. *occidentalis*	2.0	4.5
Acacia pachyacra	0.1	3.5
Acacia pruinocarpa	5.0	4.0
Aristida contorta	0.1	0.2
Aristida inaequiglumis	0.1	0.4
Chrysopogon fallax	0.1	0.3
Digitaria brownii	0.1	0.2
Duperreya commixta	0.1	twiner
Enneapogon polyphyllus	0.1	0.2
Eragrostis cumingii	0.1	0.3
Eremophila fraseri subsp. *fraseri*	0.1	1.0
Eriachne pulchella	0.1	0.1
Hibiscus burtonii	0.1	0.5
Iseilema vaginiflorum	0.1	0.2

Name	Cover (%)	Height (m)
Maireana tomentosa subsp. *tomentosa*	0.1	0.3
Maireana villosa	0.1	0.2
Paspalidium jubiflorum	0.1	0.1
Psydrax suaveolens	0.1	1.6
Ptilotus astrolasius	0.1	0.3
Ptilotus exaltatus	0.1	0.1
Ptilotus obovatus	0.1	0.6
Rhagodia sp. Hamersley (M. Trudgen 17794) P3	0.1	0.4
Senna artemisioides subsp. *helmsii*	0.1	1.5
Sida ?sp. dark green fruits (S. van Leeuwen 2260)	0.1	0.2
Triodia pungens	12	0.5

? denotes unconfirmed ID

Site: HD21
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 7/11/2017 **Phase 2 Date:** 21/05/2018 **Described by:** LD
MGA Zone: 50 **Easting:** 699950 **Northing:** 7444300
Habitat: Footslope
Soil: Dark reddish brown sandy clay loam
Rock type: Ironstone
Vegetation code: H10
Vegetation: *Eucalyptus socialis* subsp. *eucentrica*, (*E. pilbarensis*) low open mallee woodland over *Triodia wiseana*, *T. angusta*, (*T. vanleeuwenii*) hummock grassland
Vegetation Condition: Excellent
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Abutilon lepidum	0.1	0.4
Acacia bivenosa	0.1	2.0
Acacia synchronicia	0.1	0.4
Aristida contorta	0.1	0.2
Aristida holathera var. *holathera*	0.1	0.3
Aristida inaequiglumis	0.1	0.7
Capparis lasiantha	0.1	0.8
Codonocarpus cotinifolius	0.1	1.2
Cucumis variabilis	0.1	twiner
Cymbopogon obtectus	0.1	0.3
Duperreya commixta	0.1	twiner
Enneapogon polyphyllus	0.1	0.1
Eriachne pulchella	0.1	0.1
Eucalyptus pilbarensis	1.0	4.0
Eucalyptus socialis subsp. *eucentrica*	4.0	4.0
Goodenia muelleriana	0.1	0.2

Name	Cover (%)	Height (m)
Hakea chordophylla	0.1	4.0
Jasminum didymum subsp. *lineare*	0.1	twiner
Maireana georgei	0.1	0.2
Paraneurachne muelleri	0.1	0.3
Ptilotus astrolasius	0.1	0.3
Ptilotus exaltatus	0.1	0.2
Salsola australis	0.1	0.1
Senna glutinosa subsp. *glutinosa*	0.1	0.6
Senna glutinosa subsp. *pruinosa*	0.1	0.4
Senna glutinosa subsp. x *luerssenii*	0.1	1.1
Senna sp. Meekatharra (E. Bailey 1-26)	0.1	0.2
Sida sp. Excedentifolia (J.L. Egan 1925)	0.1	0.5
Solanum lasiophyllum	0.1	0.3
Templetonia egena	0.1	0.6
Triodia angusta	10	0.5
Triodia vanleeuwenii	1.0	0.2
Triodia wiseana	25	0.7

Site: HD22
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 8/11/2017 **Phase 2 Date:** 21/05/2018 **Described by:** DL
MGA Zone: 50 **Easting:** 701608 **Northing:** 7445751
Habitat: Major creek
Soil: Dark reddish brown sandy clay loam
Rock type: Ironstone
Vegetation code: D5
Vegetation: *Eucalyptus xerothermica* low open woodland over *Acacia maitlandii*, *Petalostylis labicheoides*, *A. pyrifolia*, (*A. dictyophleba*, *Santalum lanceolatum*) tall shrubland over *Androcalva luteiflora* scattered shrubs over *Triodia longiceps* open hummock grassland with *Eulalia aurea*, *Themeda triandra* open tussock grassland and **Bidens bipinnata* scattered herbs
Vegetation Condition: Good
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Abutilon otocarpum	0.1	0.3
Acacia aptaneura	0.1	4.2
Acacia bivenosa	0.1	0.6
Acacia dictyophleba	1.0	3.0
Acacia maitlandii	4.0	3.0
Acacia pyrifolia	3.0	2.2
Acacia sibirica	0.1	3.5
Alternanthera nana	0.1	0.1
Androcalva luteiflora	1.0	1.2
Aristida contorta	0.1	0.2
Aristida holathera var. *holathera*	0.1	0.2
Aristida ingrata	0.1	1.1
**Bidens bipinnata*	1.0	0.4
Boerhavia coccinea	0.1	0.2
**Cenchrus ciliaris*	0.1	0.4

Name	Cover (%)	Height (m)
Cheilanthes sieberi subsp. *sieberi*	0.1	0.1
Chrysocephalum apiculatum subsp. *pilbarense*	0.1	0.3
Chrysopogon fallax	0.1	0.4
Cleome viscosa	0.1	0.1
Crotalaria medicaginea var. *neglecta*	0.1	0.2
Cucumis variabilis	0.1	twiner
Cymbopogon ambiguus	0.1	0.4
Cynodon convergens	0.1	0.3
Dichanthium sericeum subsp. *humilius*	0.1	0.6
Digitaria brownii	0.1	0.5
Duperreya commixta	0.1	twiner
Dysphania kalpari	0.1	0.1
Enneapogon lindleyanus	0.1	0.3
Enneapogon polyphyllus	0.1	0.1
Eragrostis cumingii	0.1	0.2
Eragrostis tenellula	0.1	0.2
Eriachne mucronata	0.1	0.2
Eriachne pulchella	0.1	0.1
Eucalyptus leucophloia subsp. *leucophloia*	0.1	1.7
Eucalyptus xerothermica	3.0	8.0
Eulalia aurea	6.0	0.3
Euphorbia australis var. *subtomentosa*	0.1	0.2
Euphorbia biconvexa	0.1	0.1
Euphorbia trigonosperma	0.1	0.1
Evolvulus alsinoides var. *villosicalyx*	0.1	0.1
**Flaveria trinervia*	0.1	0.3
Glycine canescens	0.1	twiner
Gossypium sturtianum var. *sturtianum*	0.1	0.3
Hakea chordophylla	0.1	0.7
Haloragis gossei	0.1	0.2
Indigofera georgei	0.1	0.4
Indigofera monophylla	0.1	0.3
Iseilema vaginiflorum	0.1	0.2
Jasminum didymum subsp. *lineare*	0.1	twiner
**Malvastrum americanum*	0.1	0.3
Melhania oblongifolia	0.1	0.3
Panicum effusum	0.1	0.4
Paraneurachne muelleri	0.1	0.2
Peripleura arida	0.1	0.3
Perotis rara	0.1	0.2
Petalostylis labicheoides	4.0	2.1

Name	Cover (%)	Height (m)
Phyllanthus erwinii	0.1	0.1
Pluchea dentex	0.1	0.1
Polycarpaea corymbosa var. *corymbosa*	0.1	0.1
Pterocaulon sphacelatum	0.1	0.3
Ptilotus exaltatus	0.1	0.4
Ptilotus helipteroides	0.1	0.2
Ptilotus obovatus	0.1	0.4
Rhynchosia minima	0.1	twiner
Santalum lanceolatum	1.0	2.1
Scaevola amblyanthera var. *centralis*	0.1	0.1
Scaevola parvifolia subsp. *pilbarae*	0.5	0.2
Schizachyrium fragile	0.1	0.1
Senna artemisioides subsp. *oligophylla*	0.1	0.8
Senna artemisioides subsp. *x artemisioides*	0.1	0.4
Sida fibulifera	0.1	0.2
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	0.1	1.2
Solanum lasiophyllum	0.1	1.5
**Sonchus oleraceus*	0.1	0.2
Sporobolus australasicus	0.1	0.4
Stemodia grossa	0.1	0.2
Themeda triandra	5.0	0.5
Triodia longiceps	12	0.7
Triodia pungens	0.1	0.4
Wahlenbergia tumidifructa	0.1	0.4

* denotes weed species

Site: HD23
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 7/11/2017 **Phase 2 Date:** 21/05/2018 **Described by:** DL
MGA Zone: 50 **Easting:** 701062 **Northing:** 7443836
Habitat: Hillslope
Soil: Brown sandy clay loam
Rock type: Ironstone
Vegetation code: H6
Vegetation: *Acacia aptaneura*, (*A. catenulata* subsp. *occidentalis*) tall open scrub over *Eremophila forrestii* subsp. *forrestii*, (*Senna stricta*) shrubland over *Maireana melanocoma* scattered low shrubs over *Triodia wiseana* scattered hummock grasses
Vegetation Condition: Excellent
Fire Age: 5-10 years



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	35	4.5
Acacia catenulata subsp. *occidentalis*	2.0	2.7
Acacia tetragonophylla	0.1	1.7
Aristida contorta	0.1	0.2
Aristida sp.	0.1	1.2
Duperreya commixta	0.1	twiner
Enneapogon caerulescens	0.1	0.25
Enneapogon lindleyanus	0.1	0.3
Eragrostis tenellula	0.1	0.2
Eremophila forrestii subsp. *forrestii*	20	1.2
Eremophila platycalyx subsp. *pardalota*	0.1	0.6
Eriachne mucronata	0.1	0.4
Eriachne pulchella	0.1	0.2
Eucalyptus leucophloia subsp. *leucophloia*	0.1	4.0
Euphorbia biconvexa/coghlanii/trigonosperma	0.1	0.1

Name	Cover (%)	Height (m)
Grevillea berryana	0.1	4.0
Maireana melanocoma	0.5	0.4
Psydrax suaveolens	0.1	0.4
Ptilotus obovatus	0.1	0.4
Scaevola acacioides	0.1	1.8
Senna glutinosa subsp. x *luerssenii*	0.1	1.8
Senna stricta	1.0	1.4
Triodia pungens	0.1	0.7
Triodia wiseana	1.0	0.4

Site: HD24
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 9/11/2017 **Phase 2 Date:** 22/05/2018 **Described by:** LD
MGA Zone: 50 **Easting:** 712488 **Northing:** 7450677
Habitat: Gully
Soil: Dark reddish brown sandy loam
Rock type: Ironstone
Vegetation code: D3
Vegetation: *Corymbia ferriticola*, (*Corymbia* sp.) low open woodland over *Petalostylis labicheoides*, *Dodonaea petiolaris*, *Acacia catenulata* subsp. occidentalis tall open shrubland over *Triodia pungens* very open hummock grassland with *Themeda* sp. Mt Barricade (M.E. Trudgen 2471), (*Cymbopogon ambiguus*) very open tussock grassland
Vegetation Condition: Excellent
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Abutilon sp.	0.1	0.1
Acacia aptaneura	0.1	3.0
Acacia catenulata subsp. *occidentalis*	1.0	5.0
Acacia hamersleyensis	0.1	4.0
Acacia pruinocarpa	0.1	4.0
Aristida burbidgeae	0.1	0.5
Capparis spinosa subsp. *nummularia*	0.1	0.3
Cheilanthes sieberi subsp. *sieberi*	0.1	0.1
Clerodendrum tomentosum var. *lanceolatum*	0.1	0.6
Corymbia ferriticola	8.0	7.5
Corymbia sp.	0.5	8.0
Cucumis variabilis	0.1	twiner
Cymbopogon ambiguus	1.0	0.4
Cyperus cunninghamii subsp. *cunninghamii*	0.1	0.2
Dodonaea petiolaris	2.0	2.5

Name	Cover (%)	Height (m)
Duperreya commixta	0.1	twiner
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.1
Eremophila jucunda subsp. *pulcherrima*	0.1	1.6
Eriachne mucronata	0.1	0.2
Euphorbia biconvexa/coghlanii/trigonosperma	0.1	0.2
Euphorbia coghlanii	0.1	0.4
Ficus brachypoda	0.1	1.6
Gomphrena cunninghamii	0.1	0.1
Goodenia sp.	0.1	0.1
Goodenia stobbsiana	0.1	0.3
Grevillea wickhamii subsp. *hispidula*	0.1	1.2
Hibiscus coatesii	0.1	1.2
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2	0.1	1.9
Indigofera fractiflexa subsp. *fractiflexa*	0.1	0.2
Jasminum didymum subsp. *lineare*	0.1	twiner
Maireana tomentosa subsp. *tomentosa*	0.1	0.4
Newcastelia sp. Hamersley Range (S. van Leeuwen 4264)	0.1	0.2
Paspalidium clementii	0.1	0.2
Petalostylis labicheoides	2.0	3.0
Psydrax latifolia	0.1	3.2
Psydrax suaveolens	0.1	0.3
Pterocaulon sphacelatum	0.1	0.4
Ptilotus exaltatus	0.1	0.2
Ptilotus obovatus	0.1	0.3
Rhodanthe margarethae	0.1	0.3
Senna glutinosa subsp. *glutinosa*	0.1	2.1
Senna notabilis	0.1	0.3
Senna stricta	0.1	1.7
Sida sp. Shovelanna Hill (S. van Leeuwen 3842)	0.1	0.4
Solanum horridum	0.1	0.1
Stemodia grossa	0.1	0.2
Streptoglossa sp.	0.1	0.3
Themeda sp. Mt Barricade (M.E. Trudgen 2471)	8.0	0.4
Trichodesma zeylanicum var. *zeylanicum*	0.1	0.6
Triodia pungens	2.0	0.1

Site: HD25
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 8/11/2017 **Phase 2 Date:** 20/05/2018 **Described by:** LV
MGA Zone: 50 **Easting:** 697803 **Northing:** 7445532
Habitat: Drainage depression
Soil: Dark reddish brown sandy clay
Rock type: Ironstone
Vegetation code: D1
Vegetation: *Corymbia hamersleyana* sens. lat. low open woodland over *Petalostylis labicheoides*, (*Androcalva luteiflora*, *Acacia monticola*, *Dodonaea lanceolata* var. *lanceolata*) tall open scrub over *Santalum lanceolatum* scattered shrubs with *Duperreya commixta* scattered vines over *Triodia pungens* very open hummock grassland with *Themeda triandra*, (*Eriachne mucronata*) open tussock grassland
Vegetation Condition: Excellent
Fire Age: 2-5 years



Species List:

Name	Cover (%)	Height (m)
Abutilon otocarpum	0.1	0.1
Acacia ancistrocarpa	0.1	2.5
Acacia aptaneura	0.1	1.5
Acacia maitlandii	0.1	3.0
Acacia monticola	6.0	3.0
Acacia pruinocarpa	0.1	3.0
Acacia sibirica	0.1	3.0
Androcalva luteiflora	8.0	3.0
Anthobolus leptomerioides	0.1	1.5
Aristida contorta	0.1	0.3
Aristida holathera var. *holathera*	0.1	0.3
Aristida inaequiglumis	0.1	0.6
Capparis lasiantha	0.1	0.8
Corchorus lasiocarpus subsp. *parvus*	0.1	0.3
Corymbia hamersleyana sens. lat.	6.0	5.0

Name	Cover (%)	Height (m)
Cymbopogon ambiguus	0.1	0.8
Cymbopogon obtectus	0.1	0.8
Dodonaea lanceolata var. *lanceolata*	1.0	2.5
Duperreya commixta	0.5	twiner
Enneapogon polyphyllus	0.1	0.4
Enneapogon robustissimus	0.1	0.6
Eremophila longifolia	0.1	1.2
Eriachne benthamii	0.1	0.4
Eriachne mucronata	0.5	0.3
Eriachne pulchella subsp. *pulchella*	0.1	0.1
Eucalyptus gamophylla	0.1	4.5
Eucalyptus leucophloia subsp. *leucophloia*	0.1	2.0
Euphorbia sp.	0.1	0.1
Gompholobium oreophilum	0.1	0.6
Gossypium robinsonii	0.1	1.5
Gossypium sturtianum var. *sturtianum*	0.1	0.6
Hakea chordophylla	0.1	4.5
Hybanthus aurantiacus	0.1	0.3
Jasminum didymum subsp. *lineare*	0.1	twiner
Panicum effusum	0.1	0.2
Paraneurachne muelleri	0.1	0.3
Peripleura virgata	0.1	0.3
Petalostylis labicheoides	15	3.5
Pterocaulon serrulatum var. *velutinum*	0.1	0.2
Pterocaulon sphacelatum	0.1	0.3
Ptilotus calostachyus	0.1	0.6
Ptilotus exaltatus	0.1	0.3
Ptilotus obovatus	0.1	0.3
Santalum lanceolatum	0.5	1.7
Scaevola parvifolia subsp. *pilbarae*	0.1	0.3
Schizachyrium fragile	0.1	0.1
Senna artemisioides subsp. *oligophylla x helmsii*	0.1	0.2
Senna glutinosa subsp. *glutinosa*	0.1	1.6
Senna glutinosa subsp. *pruinosa*	0.1	0.8
Seringia elliptica	0.1	0.4
Sida cardiophylla	0.1	0.3
Sida sp.	0.1	0.5
Solanum cleistogamum	0.1	0.2
Solanum horridum	0.1	0.1
Solanum lasiophyllum	0.1	0.2
Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)	0.1	0.2

Name	Cover (%)	Height (m)
Themeda triandra	15	0.7
Trianthema glossostigmum	0.1	0.1
Triodia pungens	9.0	0.7
Triodia vanleeuwenii	0.1	0.3

Site: HD26
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 9/11/2017 **Phase 2 Date:** 23/05/2018 **Described by:** LD
MGA Zone: 50 **Easting:** 711093 **Northing:** 7451039
Habitat: Gully
Soil: Dark reddish brown sandy loam
Rock type: Ironstone
Vegetation code: D3
Vegetation: *Corymbia ferriticola*, *Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Acacia catenulata* subsp. *occidentalis*, *Petalostylis labicheoides*, *A. pruinocarpa*, *Eremophila* sp. Hamersley Range (K. Walker KW 136) tall open shrubland over *Dodonaea petiolaris* scattered shrubs over *Ptilotus incanus* scattered low shrubs over *Triodia pungens* very open hummock grassland with *Eriachne mucronata*, *Cymbopogon ambiguus*, *Aristida* sp. very open tussock grassland
Vegetation Condition: Excellent
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Abutilon lepidum	0.1	0.5
Acacia aptaneura	0.1	8.0
Acacia bromilowiana P4	0.1	3.5
Acacia catenulata subsp. *occidentalis*	3	5.0
Acacia mulganeura	0.1	3.5
Acacia pruinocarpa	2	5.0
Acacia pyrifolia	0.1	0.7
Aristida sp.	0.5	0.1
Astrotricha hamptonii	0.1	3.0
Bulbostylis barbata	0.1	0.1
Capparis lasiantha	0.1	0.5
Cleome viscosa	0.1	0.3
Clerodendrum tomentosum var. *lanceolatum*	0.1	0.5
Corymbia ferriticola	2	5.0

Name	Cover (%)	Height (m)
Corymbia hamersleyana sens. lat.	0.1	2.0
Cucumis variabilis	0.1	twiner
Cymbopogon ambiguus	1	0.4
Cynanchum floribundum	0.1	twiner
Dodonaea petiolaris	0.5	1.8
Dodonaea viscosa subsp. *spatulata*	0.1	1.5
Duperreya commixta	0.1	twiner
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.1
Enchylaena tomentosa var. *tomentosa*	0.1	0.3
Enneapogon caerulescens	0.1	0.1
Enneapogon lindleyanus	0.1	0.4
Enneapogon polyphyllus	0.1	0.1
Eremophila jucunda subsp. *pulcherrima*	0.1	0.9
Eremophila sp. Hamersley Range (K. Walker KW 136) P3	1	3.5
Eriachne mucronata	2	0.3
Eucalyptus leucophloia subsp. *leucophloia*	2	4.0
Euphorbia biconvexa	0.1	0.3
Euphorbia biconvexa/coghlanii/trigonosperma	0.1	0.2
Ficus brachypoda	0.1	0.5
Gomphrena cunninghamii	0.1	0.1
Hibiscus coatesii	0.1	1.2
Indigofera fractiflexa subsp. *fractiflexa*	0.1	0.4
Paspalidium clementii	0.1	0.2
Peripleura virgata	0.1	0.2
Petalostylis labicheoides	3	3.0
Psydrax latifolia	0.1	1.0
Pterocaulon sphacelatum	0.1	0.4
Ptilotus calostachyus	0.1	0.5
Ptilotus exaltatus	0.1	0.3
Ptilotus incanus	1	0.3
Ptilotus obovatus	0.1	0.3
Rhagodia eremaea	0.1	0.4
Salsola australis	0.1	0.2
Senna glutinosa subsp. *glutinosa*	0.1	1.2
Senna stricta	0.1	1.7
Senna venusta	0.1	1.2
Sida sp.	0.1	0.1
Sida sp. Shovelanna Hill (S. van Leeuwen 3842)	0.1	0.3
Solanum ferocissimum	0.1	0.2
Solanum gabrielae	0.1	0.4
Solanum horridum	0.1	0.2

Name	Cover (%)	Height (m)
Sporobolus australasicus	0.1	0.1
Streptoglossa sp.	0.1	0.2
Tinospora smilacina	0.1	twiner
Trichodesma zeylanicum var. *zeylanicum*	0.1	1.2
Triodia pungens	3	0.4

Site: HD27
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 8/11/2017 **Phase 2 Date:** 21/05/2018 **Described by:** LV
MGA Zone: 50 **Easting:** 697731 **Northing:** 7446197
Habitat: Plain
Soil: Red brown sandy clay loam
Rock type: Ironstone
Vegetation code: P1
Vegetation: *Acacia catenulata* subsp. *occidentalis*, (*Eremophila fraseri* subsp. *fraseri*, *A. pruinocarpa*) tall shrubland over *Corchorus lasiocarpus* subsp. *parvus* open shrubland over *Triodia pungens* very open hummock grassland
Vegetation Condition: Excellent
Fire Age: >10 years



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	0.1	2.8
Acacia catenulata subsp. *occidentalis*	25	8.0
Acacia pruinocarpa	1	6.5
Anthobolus leptomerioides	0.1	1.6
Cheilanthes sieberi subsp. *sieberi*	0.1	0.2
Corchorus lasiocarpus subsp. *parvus*	2	1.2
Enneapogon lindleyanus	0.1	0.25
Eragrostis eriopoda	0.1	0.35
Eragrostis xerophila	0.1	0.25
Eremophila fraseri subsp. *fraseri*	5	2.5
Eriachne pulchella subsp. *pulchella*	0.1	0.08
Maireana tomentosa subsp. *tomentosa*	0.1	0.25
Paspalidium clementii	0.1	0.2
Perotis rara	0.1	0.1
Ptilotus rotundifolius	0.1	0.6

Name	Cover (%)	Height (m)
Ptilotus schwartzii var. *schwartzii*	0.1	0.3
Senna artemisioides subsp. *helmsii*	0.1	1.7
Sida ?ectogama	0.1	1.5
Sporobolus australasicus	0.1	0.1
Triodia pungens	9	0.4

? denotes unconfirmed ID

Site: HD28
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 10/11/2017 **Phase 2 Date:** 19/05/2018 **Described by:** DL
MGA Zone: 50 **Easting:** 704640 **Northing:** 7446462
Habitat: Plain
Soil: Red brown sandy clay loam
Rock type: Ironstone
Vegetation code: P3
Vegetation: *Acacia aptaneura*, *A. catenulata* subsp. *occidentalis*, (*A. pruinocarpa*, *A. ayersiana*) tall shrubland over *Triodia pungens*, *T. vanleeuwenii* open hummock grassland
Vegetation Condition: Excellent
Fire Age: >10 years



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	15	6.0
Acacia ayersiana	0.5	3.0
Acacia catenulata subsp. *occidentalis*	10	4.0
Acacia pruinocarpa	2	3.0
Acacia tetragonophylla	0.1	2.5
Aristida contorta	0.1	0.15
Aristida obscura	0.1	0.2
Cheilanthes sieberi subsp. *sieberi*	0.1	0.1
Codonocarpus cotinifolius	0.1	1.5
Eremophila latrobei subsp. *filiformis*	0.1	2.0
Eriachne obtusa	0.1	0.3
Eriachne pulchella	0.1	0.1
Petalostylis labicheoides	0.1	1.5
Polycarpaea corymbosa var. *corymbosa*	0.1	0.05
Psydrax latifolia	0.1	0.6
Senna ferraria	0.1	1.6

Name	Cover (%)	Height (m)
Triodia pungens	8	0.4
Triodia vanleeuwenii	6	0.4

Site: HD29
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 8/11/2017 **Phase 2 Date:** 21/05/2018 **Described by:** LV
MGA Zone: 50 **Easting:** 695980 **Northing:** 7446338
Habitat: Clay plain
Soil: Red brown clay loam
Rock type: Ironstone
Vegetation code: P2
Vegetation: *Acacia aptaneura,* (*A. pruinocarpa, Eremophila longifolia, A. pteraneura*) tall shrubland over *E. forrestii* subsp. *forrestii scattered* shrubs over *Ptilotus astrolasicus, E. lanceolata, P. obovatus* low open shrubland over *Chrysopogon fallax, Aristida* sp., *(Aristida latifolia, Eriachne benthamii, Themeda triandra)* tussock grassland
Vegetation Condition: Excellent
Fire Age: 5-10 years



Species List:

Name	Cover (%)	Height (m)
Abutilon cryptopetalum	0.1	0.09
Abutilon otocarpum	0.1	0.2
Acacia aptaneura	18	7
Acacia pruinocarpa	1	2.6
Acacia pteraneura	0.5	2.1
Alternanthera nana	0.1	0.15
Amaranthus sp.	0.1	0.2
Aristida contorta	0.1	0.2
Aristida latifolia	2	0.4
Aristida obscura	0.1	0.4
Aristida sp.	20	0.4
Astrebla sp.	0.1	0.45
Bidens bipinnata	0.1	0.2
Capparis lasiantha	0.1	2.5
Cheilanthes sieberi subsp. *sieberi*	0.1	0.2

Name	Cover (%)	Height (m)
Chloris virgata	0.1	0.3
Chrysocephalum gilesii	0.1	0.2
Chrysopogon fallax	20	0.4
Cleome viscosa	0.1	0.15
Cuscuta victoriana	0.1	twiner
Dactyloctenium radulans	0.1	0.2
Enneapogon lindleyanus	0.1	0.2
Enneapogon polyphyllus	0.1	0.3
Eragrostis xerophila	0.1	0.3
Eremophila forrestii subsp. *forrestii*	0.5	1.4
Eremophila lanceolata	1.5	0.35
Eremophila longifolia	0.5	2.3
Eriachne benthamii	0.5	0.4
Eriachne obtusa	0.5	0.35
Evolvulus alsinoides var. *villosicalyx*	0.1	0.25
Fimbristylis dichotoma	0.1	0.15
Hakea chordophylla	0.1	1.4
Iseilema vaginiflorum	0.1	0.15
Maireana tomentosa subsp. *tomentosa*	0.1	0.15
Panicum decompositum	0.1	0.2
Perotis rara	0.1	0.06
Pterocaulon sphacelatum	0.1	1.1
Ptilotus aervoides	0.1	0.02
Ptilotus astrolasius	2	0.6
Ptilotus helipteroides	0.1	0.2
Ptilotus obovatus	0.5	0.35
Ptilotus sp.	0.1	0.2
Rhagodia eremaea	0.1	1.3
Rhynchosia minima	0.1	twiner
Salsola australis	0.1	0.35
Sida echinocarpa	0.1	0.02
Sida fibulifera	0.1	0.15
Sida platycalyx	0.1	0.2
Solanum cleistogamum	0.1	0.2
Solanum lasiophyllum	0.1	0.5
Sporobolus australasicus	0.1	0.15
Themeda triandra	0.5	0.4
Tragus australianus	0.1	0.1

* denotes weed species

Site: HD30
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 10/11/2017 **Phase 2 Date:** 20/05/2018 **Described by:** DL
MGA Zone: 50 **Easting:** 705973 **Northing:** 7445811
Habitat: Floodplain
Soil: Dark reddish brown sandy clay loam
Rock type: Ironstone
Vegetation code: P2
Vegetation: *Acacia tetragonophylla, A. synchronicia* open shrubland over *Aristida latifolia, Astrebla* sp., *Eragrostis xerophila,* (*Eriachne obtusa*) tussock grassland
Vegetation Condition: Very Good
Fire Age: >10 years



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	0.1	1
Acacia synchronicia	1	1.6
Acacia tetragonophylla	1	1.8
Alternanthera nana	0.1	0.2
Aristida contorta	0.1	0.3
Aristida latifolia	30	0.7
Aristida sp.	10	0.4
Asteraceae sp.	0.1	0.2
Astrebla sp.	10	0.4
Centipeda minima subsp. *macrocephala*	0.1	0.1
Cleome viscosa	0.1	0.3
Crotalaria medicaginea var. *neglecta*	0.1	0.3
Cynodon convergens	0.1	0.2
Dichanthium sericeum subsp. *humilius*	0.1	0.1
Dipteracanthus australasicus subsp. *australasicus*	0.1	0.4
Enchylaena tomentosa var. *tomentosa*	0.1	0.3

Name	Cover (%)	Height (m)
Enneapogon caerulescens	0.1	0.2
Enneapogon polyphyllus	0.1	0.2
Eragrostis setifolia	10	0.3
Eragrostis tenellula	0.1	0.2
Eragrostis xerophila	10	0.3
Eremophila forrestii subsp. *forrestii*	0.1	0.7
Eremophila jucunda subsp. *pulcherrima*	0.1	0.7
Eremophila longifolia	0.1	0.7
Eriachne obtusa	1	0.4
Eriachne pulchella subsp. *dominii*	0.1	0.1
Euphorbia sp.	0.1	0.1
Evolvulus alsinoides var. *villosicalyx*	0.1	0.2
Fimbristylis dichotoma	0.1	0.1
Hibiscus leptocladus	0.1	0.3
Indigofera linifolia	0.1	0.2
Iseilema vaginiflorum	0.1	0.2
Malvastrum americanum	0.1	0.2
Panicum decompositum	0.1	0.6
Panicum effusum	0.1	0.3
Ptilotus exaltatus	0.1	0.4
Ptilotus obovatus	0.1	0.4
Rhagodia eremaea	0.1	0.8
Rhynchosia minima	0.1	twiner
Schenkia australis	0.1	0.2
Sclerolaena cornishiana	0.1	0.3
Sclerolaena densiflora	0.1	0.1
Senna artemisioides subsp. x *artemisioides*	0.1	1.5
Senna glutinosa subsp. x *luerssenii*	0.1	0.6
Setaria verticillata	0.1	0.3
Sida fibulifera	0.1	0.2
Solanum cleistogamum	0.1	0.2
Solanum lasiophyllum	0.1	0.3
Sporobolus australasicus	0.1	0.1
Streptoglossa bubakii	0.1	0.4
Themeda triandra	0.1	1
Tragus australianus	0.1	0.05
Triodia longiceps	0.1	1.2
Vittadinia eremaea	0.1	0.3

? denotes unconfirmed ID

Site: HD31
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 8/11/2017 **Phase 2 Date:** 21/05/2018 **Described by:** BE
MGA Zone: 50 **Easting:** 696425 **Northing:** 7445990
Habitat: Major creek
Soil: Dark reddish brown sandy clay
Rock type: Ironstone
Vegetation code: D4
Vegetation: *Eucalyptus victrix* open woodland over *E. xerothermica* low open woodland over *Petalostylis labicheoides*, *Acacia dictyophleba*, (*A. pyrifolia*, *Androcalva luteiflora*) tall shrubland over *Senna artemisioides* subsp. ×*artemisioides* scattered shrubs over *Triodia longiceps* very open hummock grassland with *Themeda triandra*, *Eulalia aurea*, *Enteropogon ramosus*, (**Chloris virgata*, *Aristida lazaridis*) tussock grassland and **Bidens bipinnata*, (*Chrysocephalum apiculatum* subsp. *pilbarense*) very open herbland
Vegetation Condition: Poor
Fire Age: 5-10 years



Species List:

Name	Cover (%)	Height (m)
Acacia dictyophleba	8	4.0
Acacia maitlandii	0.1	1.8
Acacia pyrifolia	4	3.0
Acacia sibirica	0.1	0.9
Acrachne racemosa	0.1	0.7
Alternanthera denticulata	0.1	0.2
Alternanthera nana	0.1	0.05
Androcalva luteiflora	0.5	2.5
Aristida contorta	0.1	0.1
Aristida holathera var. *holathera*	0.1	0.2
Aristida inaequiglumis	0.1	1.0
Aristida lazaridis P2	0.5	0.7
**Bidens bipinnata*	3	0.4
Boerhavia ?coccinea	0.1	0.2

Name	Cover (%)	Height (m)
Centipeda minima subsp. *macrocephala*	0.1	0.1
**Chloris virgata*	0.5	1.2
Chrysocephalum apiculatum subsp. *pilbarense*	0.5	0.3
Chrysopogon fallax	0.1	0.9
Cleome viscosa	0.1	0.3
Crotalaria medicaginea var. *neglecta*	0.1	0.2
Cucumis melo	0.1	twiner
Cymbopogon ambiguus	0.1	1.2
Cyperus difformis	0.1	0.2
Cyperus vaginatus	0.1	0.7
Dichanthium sericeum subsp. *humilius*	0.1	0.5
Duperreya commixta	0.1	twiner
Enneapogon polyphyllus	0.1	0.2
Enneapogon robustissimus	0.5	0.7
Enteropogon ramosus	10	0.8
Eragrostis cumingii	0.1	0.1
Eragrostis tenellula	0.1	0.3
Eremophila longifolia	0.1	2.5
Eriachne benthamii	0.1	0.4
Eriachne mucronata	0.1	0.4
Eriachne pulchella subsp. *pulchella*	0.1	0.1
Eucalyptus victrix	7	12
Eucalyptus xerothermica	4	9.0
Eulalia aurea	15	0.7
Euphorbia coghlanii	0.1	0.3
Euphorbia sp.	0.1	0.1
Glycine canescens	0.1	twiner
Gossypium robinsonii	0.1	1.2
Gossypium sturtianum var. *sturtianum*	0.1	0.3
Heliotropium tenuifolium	0.1	0.3
Hibiscus coatesii	0.1	0.4
Iseilema membranaceum	0.1	0.1
Isotropis sp. Arid zone (G. Byrne 2775)	0.1	0.6
Jasminum didymum subsp. *lineare*	0.1	twiner
**Malvastrum americanum*	0.1	0.4
Panicum decompositum	0.1	1.2
Paraneurachne muelleri	0.1	0.3
Petalostylis labicheoides	15	3.2
Phyllanthus maderaspatensis	0.1	0.2
Pterocaulon sphacelatum	0.1	0.5
Ptilotus obovatus	0.1	0.5

Name	Cover (%)	Height (m)
Salsola australis	0.1	0.3
Santalum lanceolatum	0.1	2.2
Senna artemisioides subsp. *x artemisioides*	0.5	1.5
Setaria dielsii	0.1	0.6
**Setaria verticillata*	0.1	0.4
Sida fibulifera	0.1	0.2
Solanum cleistogamum	0.1	0.15
Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)	0.1	0.3
Themeda triandra	30	0.8
Triodia longiceps	8	0.8
Triodia pungens	0.1	0.5
Triodia wiseana	0.1	0.6
Triraphis mollis	0.1	0.1
**Vachellia farnesiana*	0.1	2.5

* denotes weed species
? denotes unconfirmed ID

Site: HD32
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 10/11/2017 **Phase 2 Date:** 21/05/2018 **Described by:** BE
MGA Zone: 50 **Easting:** 698038 **Northing:** 7445534
Habitat: Plain
Soil: Red brown sandy clay loam
Rock type: Ironstone
Vegetation code: P3
Vegetation: *Corymbia deserticola* subsp. *deserticola* scattered low trees over *Acacia catenulata* subsp. *occidentalis*, (*A. pruinocarpa*) tall shrubland over *A. ayersiana*, *Eremophila forrestii* subsp. *forrestii* open shrubland over *Triodia pungens* open hummock grassland with *Aristida inaequiglumis*, *Eragrostis eriopoda* scattered tussock grasses
Vegetation Condition: Excellent
Fire Age: 5-10 years



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	0.1	2.2
Acacia ayersiana	2	1.7
Acacia catenulata subsp. *occidentalis*	11	5
Acacia incurvaneura	0.1	0.6
Acacia pruinocarpa	3	3.5
Aristida contorta	0.1	0.2
Aristida holathera var. *holathera*	0.1	0.25
Aristida inaequiglumis	0.5	0.8
Aristida latifolia	0.1	0.35
Aristida obscura	0.1	0.2
Aristida sp.	0.1	0.2
Codonocarpus cotinifolius	0.1	0.9
Corymbia deserticola subsp. *deserticola*	1	4
Cymbopogon ambiguus	0.1	0.4
Enneapogon polyphyllus	0.1	0.35

Name	Cover (%)	Height (m)
Eragrostis eriopoda	0.5	0.35
Eremophila forrestii subsp. *forrestii*	1	1.3
Eriachne mucronata	0.1	0.4
Eucalyptus gamophylla	0.1	3.7
Hibiscus burtonii	0.1	0.4
Indigofera monophylla	0.1	0.4
Maireana tomentosa subsp. *tomentosa*	0.1	0.2
Panicum effusum	0.1	0.3
Paraneurachne muelleri	0.1	0.4
Psydrax suaveolens	0.1	1.6
Ptilotus calostachyus	0.1	0.8
Ptilotus obovatus	0.1	1.1
Salsola australis	0.1	0.3
Schizachyrium fragile	0.1	0.25
Senna glaucifolia	0.1	1.2
Sida sp. Golden calyces glabrous (H.N. Foote 32)	0.1	0.3
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	0.1	0.3
Solanum lasiophyllum	0.1	0.5
Triodia pungens	20	1.2

Site: HD33
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 8/11/2017 **Phase 2 Date:** 20/05/2018 **Described by:** LV
MGA Zone: 50 **Easting:** 706525 **Northing:** 7443697
Habitat: Footslope
Soil: Dark reddish grey sandy clay loam
Rock type: Dolerite
Vegetation code: H12
Vegetation: *Corymbia hamersleyana* sens. lat. scattered low trees over *Acacia inaequilatera* tall open shrubland over *Corchorus lasiocarpus* subsp. *parvus*, *Indigofera monophylla* scattered low shrubs over *Triodia wiseana* hummock grassland with *Heliotropium ovalifolium* scattered herbs
Vegetation Condition: Very Good
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Acacia adsurgens	0.1	1.5
Acacia bivenosa	0.1	2.2
Acacia dictyophleba	0.1	1.5
Acacia hamersleyensis	0.1	2.5
Acacia inaequilatera	3	2.6
Acacia pachyacra	0.1	1.7
Aristida contorta	0.1	0.3
Aristida holathera var. *holathera*	0.1	0.25
Boerhavia coccinea	0.1	0.1
Bonamia pilbarensis	0.1	0.1
Corchorus lasiocarpus subsp. *parvus*	0.5	0.5
Corymbia hamersleyana sens. lat.	0.5	4.5
Cymbopogon ambiguus	0.1	0.5
Enneapogon caerulescens	0.1	0.15
Eremophila longifolia	0.1	0.5

Name	Cover (%)	Height (m)
Eulalia aurea	0.1	0.5
Euphorbia australis var. *subtomentosa*	0.1	0.06
Goodenia sp.	0.1	0.1
Gossypium australe	0.1	0.5
Hakea chordophylla	0.1	2.5
Heliotropium ovalifolium	0.5	0.2
Heliotropium tenuifolium	0.1	0.1
Hibiscus sturtii var. *campylochlamys*	0.1	0.2
Indigofera monophylla	0.5	0.4
Jasminum didymum subsp. *lineare*	0.1	twiner
Paraneurachne muelleri	0.1	0.3
Paspalidium clementii	0.1	0.2
Polycarpaea corymbosa var. *corymbosa*	0.1	0.1
Polymeria ambigua	0.1	0.1
Ptilotus astrolasius	0.1	0.35
Ptilotus obovatus	0.1	0.4
Scaevola amblyanthera var. *centralis*	0.1	0.2
Schizachyrium fragile	0.1	0.1
Senna artemisioides subsp. *filifolia*	0.1	0.4
Senna artemisioides subsp. *oligophylla*	0.1	0.5
Senna pleurocarpa var. *angustifolia*	0.1	0.4
Sida echinocarpa	0.1	0.2
Swainsona maccullochiana	0.1	0.3
Triodia wiseana	60	0.4

Site: HD34
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 10/11/2017 **Phase 2 Date:** 21/05/2018 **Described by:** LD
MGA Zone: 50 **Easting:** 699399 **Northing:** 7445532
Habitat: Drainage depression
Soil: Dark reddish brown sandy clay loam
Rock type: Ironstone
Vegetation code: D1
Vegetation: *Corymbia hamersleyana* sens. lat. low open woodland with *Eucalyptus repullulans*, *E. gamophylla* low open mallee woodland over *Petalostylis labicheoides*, (*Acacia monticola*, *Dodonaea petiolaris*) tall shrubland over *Androcalva luteiflora* scattered shrubs over *Triodia pungens* very open hummock grassland with *Themeda triandra*, (*Aristida holathera* var. *holathera*) open tussock grassland
Vegetation Condition: Very Good
Fire Age: >10 years



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	0.1	3.0
Acacia bivenosa	0.1	1.6
Acacia hamersleyensis	0.1	3.5
Acacia maitlandii	0.1	2.1
Acacia monticola	2	3.0
Acacia pruinocarpa	0.1	2.0
Acacia steedmanii subsp. *borealis*	0.1	2.1
Acacia tumida var. *pilbarensis*	0.1	2.1
Androcalva luteiflora	1	1.6
Aristida contorta	0.1	0.1
Aristida holathera var. *holathera*	1	0.3
Capparis lasiantha	0.1	0.8
Corchorus lasiocarpus subsp. *parvus*	0.1	0.6
Corymbia hamersleyana sens. lat.	6	4.5
Dodonaea petiolaris	1	2.1

Name	Cover (%)	Height (m)
Eriachne mucronata	0.1	0.3
Eucalyptus gamophylla	1	4.2
Eucalyptus repullulans	3	3.5
Gompholobium oreophilum	0.1	0.4
Gossypium robinsonii	0.1	2.2
Indigofera monophylla	0.1	0.2
Jasminum didymum subsp. *lineare*	0.1	twiner
Peripleura obovata	0.1	0.2
Petalostylis labicheoides	13	2.2
Ptilotus calostachyus	0.1	0.5
Santalum lanceolatum	0.1	1.6
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	0.1	0.7
Themeda triandra	20	0.5
Triodia pungens	8	0.4
Triodia vanleeuwenii	0.1	0.2

Site: HD35
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 9/11/2017 **Phase 2 Date:** 22/05/2018 **Described by:** BE
MGA Zone: 50 **Easting:** 711138 **Northing:** 7449553
Habitat: Minor creek
Soil: Red brown sandy clay loam
Rock type: Ironstone
Vegetation code: D1
Vegetation: *Corymbia hamersleyana* sens. lat.low open woodland with *Eucalyptus gamophylla* low open mallee woodland over *Dodonea lanceolata* var. *lanceolata*, *Petalostylis labicheoides*, (*Acacia maitlandii*) tall open scrub over *Triodia pungens* open hummock grassland with *Eriachne mucronata*, (*Themeda triandra*) very open tussock grassland
Vegetation Condition: Excellent
Fire Age: >10 years



Species List:

Name	Cover (%)	Height (m)
Acacia bivenosa	0.1	3.0
Acacia catenulata subsp. *occidentalis*	0.1	3.2
Acacia hilliana	0.1	0.5
Acacia maitlandii	2	3.0
Acacia pyrifolia	0.1	1.5
Acacia tenuissima	0.1	4.0
Amphipogon sericeus	0.1	0.3
Androcalva luteiflora	0.1	2.3
Aristida contorta	0.1	0.2
Aristida holathera var. *holathera*	0.1	0.3
Capparis lasiantha	0.1	1.1
Clerodendrum floribundum var. *angustifolium*	0.1	0.4
Corchorus lasiocarpus subsp. *parvus*	0.1	0.3
Corymbia hamersleyana sens. lat.	4	9.0
Cymbopogon ambiguus	0.1	0.9

Name	Cover (%)	Height (m)
Dodonaea lanceolata var. *lanceolata*	35	2.5
Duperreya commixta	0.1	twiner
Enneapogon lindleyanus	0.1	0.5
Eriachne mucronata	3	0.4
Eucalyptus gamophylla	8	6.0
Eucalyptus leucophloia subsp. *leucophloia*	0.1	2.4
Eucalyptus socialis subsp. *eucentrica*	0.1	4.0
Eulalia aurea	0.1	0.5
Gompholobium oreophilum	0.1	0.4
Gossypium sturtianum var. *sturtianum*	0.1	1.2
Hakea chordophylla	0.1	3.8
Hibiscus coatesii	0.1	0.45
Jasminum didymum subsp. *lineare*	0.1	twiner
Marsdenia australis	0.1	twiner
Paraneurachne muelleri	0.1	0.3
Petalostylis labicheoides	15	2.5
Pterocaulon sphacelatum	0.1	0.2
Ptilotus obovatus	0.1	0.5
Santalum lanceolatum	0.1	2.8
Scaevola parvifolia subsp. *pilbarae*	0.1	0.25
Senna artemisioides subsp. *oligophylla*	0.1	1.2
Senna ferraria	0.1	2.0
Senna glutinosa subsp. *glutinosa*	0.1	1.0
Seringia elliptica	0.1	0.6
Themeda triandra	0.5	0.8
Triodia pungens	15	0.6
Triodia vanleeuwenii	0.1	0.3

Site: HD37
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 9/11/2017 **Phase 2 Date:** 23/05/2018 **Described by:** LV
MGA Zone: 50 **Easting:** 716614 **Northing:** 7451366
Habitat: Plain
Soil: Red brown sandy clay loam
Rock type: Ironstone
Vegetation code: P1
Vegetation: *Acacia aptaneura*, (*A. catenulata* subsp. *occidentalis*, *Grevillea berryana*) tall shrubland over *Eremophila forrestii* subsp. *forrestii*, (*A. pteraneura*, *Senna stricta*) shrubland over *Triodia vanleeuwenii* open hummock grassland
Vegetation Condition: Excellent
Fire Age: 5-10 years



Species List:

Name	Cover (%)	Height (m)
Abutilon otocarpum	0.1	0.1
Acacia aptaneura	15	4.0
Acacia bivenosa	0.1	2.0
Acacia catenulata subsp. *occidentalis*	5	5.0
Acacia maitlandii	0.1	0.2
Acacia pruinocarpa	0.1	4.0
Acacia pteraneura	0.5	1.5
Acacia synchronicia	0.1	2.5
Amphipogon sericeus	0.1	0.3
Aristida contorta	0.1	0.3
Corchorus lasiocarpus subsp. *parvus*	0.1	0.45
Cymbopogon ambiguus	0.1	0.45
Enneapogon caerulescens	0.1	0.2
Enneapogon polyphyllus	0.1	0.2
Eremophila forrestii subsp. *forrestii*	11	1.7

Name	Cover (%)	Height (m)
Eremophila platycalyx subsp. *pardalota*	0.1	1.6
Eriachne pulchella subsp. *pulchella*	0.1	0.35
Eucalyptus leucophloia subsp. *leucophloia*	0.1	1.9
Goodenia stobbsiana	0.1	0.3
Gossypium robinsonii	0.1	1.8
Grevillea berryana	1	4.0
Hakea chordophylla	0.1	0.6
Hibiscus burtonii	0.1	0.3
Hibiscus coatesii	0.1	0.4
Hybanthus aurantiacus	0.1	0.4
Paspalidium clementii	0.1	0.15
Ptilotus calostachyus	0.1	0.35
Ptilotus exaltatus	0.1	0.2
Scaevola spinescens	0.1	1.1
Schizachyrium fragile	0.1	0.1
Senna artemisioides subsp. *helmsii*	0.1	1.0
Senna glutinosa subsp. x *luerssenii*	0.1	1.6
Senna notabilis	0.1	0.25
Senna sp. Meekatharra (E. Bailey 1-26) ×	0.1	0.1
Senna stricta	0.5	1.4
Seringia elliptica	0.1	0.3
Sida arenicola	0.1	1.6
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	0.1	0.4
Solanum cleistogamum	0.1	0.2
Solanum phlomoides	0.1	0.4
Sporobolus australasicus	0.1	0.1
Triodia pungens	0.1	0.35
Triodia vanleeuwenii	20	0.4
Triodia wiseana	0.1	0.35

Site: HD38
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 10/11/2017 **Phase 2 Date:** 23/05/2018 **Described by:** DL
MGA Zone: 50 **Easting:** 720355 **Northing:** 7451567
Habitat: Minor creek
Soil: Dark reddish brown silty loam
Rock type: Ironstone
Vegetation code: D1
Vegetation: *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Gossypium robinsonii* scattered tall shrubs over *Dodonaea viscosa* subsp. *spatulata*, *Stylobasium spathulatum* open shrubland over *Tephrosia rosea* var. Fortescue creeks (M.I.H. Brooker 2186), *Corchorus lasiocarpus* subsp. *parvus* low open shrubland over *Triodia pungens* very open hummock grassland with *Themeda* sp. Mt Barricade (M.E. Trudgen 2471), (*Eriachne mucronata*, *Enneapogon lindleyanus*) open tussock grassland
Vegetation Condition: Very Good
Fire Age: 2-5 years



Species List:

Name	Cover (%)	Height (m)
Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)	0.1	1.2
Acacia aptaneura	0.1	4.0
Acacia bivenosa	0.1	0.6
Acacia coriacea subsp. *pendens*	0.1	5.0
Acacia pruinocarpa	0.1	2.2
Acacia pyrifolia	0.1	1.0
Acacia sibirica	0.1	1.5
Acacia spondylophylla	0.1	0.3
**Bidens bipinnata*	0.1	0.4
Boerhavia coccinea	0.1	0.2
Capparis lasiantha	0.1	3.0
Cleome viscosa	0.1	0.4
Corchorus crozophorifolius	0.1	0.5
Corchorus lasiocarpus subsp. *parvus*	1.5	0.4

Name	Cover (%)	Height (m)
Crotalaria medicaginea var. *neglecta*	0.1	0.3
Cucumis variabilis	0.1	twiner
Cymbopogon ambiguus	0.1	0.4
Dampiera candicans	0.1	0.4
Dichanthium sericeum subsp. *humilius*	0.1	0.6
Dodonaea viscosa subsp. *spatulata*	2	1.9
Duperreya commixta	0.1	twiner
Dysphania plantaginella	0.1	0.1
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.2
Enchylaena tomentosa var. *tomentosa*	0.1	1.3
Enneapogon lindleyanus	0.5	0.5
Enneapogon polyphyllus	0.1	0.4
Enneapogon sp.	0.1	0.6
Eragrostis cumingii	0.1	0.2
Eragrostis tenellula	0.1	0.3
Eremophila latrobei subsp. *glabra*	0.1	0.6
Eriachne mucronata	6	0.4
Eucalyptus gamophylla	0.1	0.25
Eucalyptus leucophloia subsp. *leucophloia*	1.5	8.0
Euphorbia biconvexa/coghlanii/trigonosperma	0.1	0.3
Euphorbia boophthona	0.1	0.3
Euphorbia sp.	0.1	0.1
Evolvulus alsinoides var. *villosicalyx*	0.1	0.1
**Flaveria trinervia*	0.1	0.2
Gomphrena cunninghamii	0.1	0.3
Goodenia muelleriana	0.1	0.1
Goodenia sp.	0.1	0.4
Goodenia stobbsiana	0.1	0.3
Goodenia tenuiloba	0.1	0.3
Gossypium robinsonii	1	2.5
Grevillea saxicola P3	0.1	5.0
Grevillea wickhamii subsp. *hispidula*	0.1	2.3
Hibiscus sturtii var. *campylochlamys*	0.1	0.3
Hibiscus sturtii var. *platychlamys*	0.1	0.3
Hybanthus aurantiacus	0.1	0.4
Indigofera monophylla	0.1	0.2
Jasminum didymum subsp. *lineare*	0.1	twiner
Lepidium catapycnon P4	0.1	0.2
Paraneurachne muelleri	0.1	0.4
Paspalidium clementii	0.1	0.3
Petalostylis labicheoides	0.1	3.0

Name	Cover (%)	Height (m)
Polycarpaea longiflora	0.1	0.3
Pterocaulon sphacelatum	0.1	0.2
Ptilotus calostachyus	0.1	0.4
Ptilotus clementii	0.1	0.3
Ptilotus exaltatus	0.1	0.5
Ptilotus obovatus	0.1	0.3
Rhagodia eremaea	0.1	1.6
Salsola australis	0.1	0.2
Santalum lanceolatum	0.1	0.8
Senna artemisioides subsp. *oligophylla*	0.1	0.8
Senna glutinosa subsp. *glutinosa*	0.1	1.5
Senna glutinosa subsp. x *luerssenii*	0.1	0.6
Senna notabilis	0.1	0.6
Senna sp. Meekatharra (E. Bailey 1-26)	0.1	0.4
**Setaria verticillata*	0.1	0.4
Sida fibulifera	0.1	0.2
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	0.1	0.3
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	0.1	2.5
Solanum lasiophyllum	0.1	0.3
Solanum phlomoides	0.1	0.3
Sporobolus australasicus	0.1	0.1
Stemodia grossa	0.1	0.3
Streptoglossa sp.	0.1	0.1
Stylobasium spathulatum	2	1.9
Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)	2	0.7
Themeda sp. Mt Barricade (M.E. Trudgen 2471)	12	0.5
Trachymene oleracea subsp. *oleracea*	0.1	0.2
Trichodesma zeylanicum var. *zeylanicum*	0.1	0.3
Triodia pungens	4	0.4
Triodia wiseana	0.1	0.3

* denotes weed species

Site: HD39
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 9/11/2017 **Phase 2 Date:** 22/05/2018 **Described by:** LV
MGA Zone: 50 **Easting:** 709274 **Northing:** 7449696
Habitat: Footslope
Soil: Dark reddish brown sandy clay loam
Rock type: Ironstone
Vegetation code: H8
Vegetation: *Eucalyptus leucophloia* subsp. *leucophloia*, *Corymbia hamersleyana* sens. lat. scattered low trees over *Hakea chordophylla*, *Acacia aptaneura* scattered tall shrubs over *Triodia vanleeuwenii* hummock grassland with *Amphipogon sericeus* very open tussock grassland
Vegetation Condition: Excellent
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Acacia adoxa var. *adoxa*	0.1	0.3
Acacia aptaneura	0.5	2.6
Acacia maitlandii	0.1	0.4
Acacia pruinocarpa	0.1	1.7
Acacia pteraneura	0.1	0.4
Amphipogon sericeus	2	0.3
Bulbostylis barbata	0.1	0.1
Corymbia hamersleyana	0.5	3.5
Cymbopogon ambiguus	0.1	0.5
Dodonaea coriacea	0.1	1.2
Duperreya commixta	0.1	twiner
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.1
Eremophila latrobei subsp. *latrobei*	0.1	1.3
Eriachne pulchella subsp. *dominii*	0.1	0.1
Eucalyptus leucophloia subsp. *leucophloia*	0.5	4.2

Name	Cover (%)	Height (m)
Fimbristylis simulans	0.1	0.1
Goodenia stobbsiana	0.1	0.35
Goodenia triodiophila	0.1	0.35
Hakea chordophylla	0.5	3.0
Hibiscus sturtii var. *campylochlamys*	0.1	0.35
Hybanthus aurantiacus	0.1	0.2
Indigofera monophylla	0.1	0.3
Paraneurachne muelleri	0.1	0.2
Polycarpaea corymbosa var. *corymbosa*	0.1	0.1
Polycarpaea holtzei	0.1	0.1
Pterocaulon sphacelatum	0.1	0.35
Ptilotus calostachyus	0.1	1.2
Ptilotus rotundifolius	0.1	1.4
Schizachyrium fragile	0.1	0.1
Senna ferraria	0.1	3.7
Senna glutinosa subsp. *glutinosa*	0.1	1.7
Sida arenicola	0.1	0.4
Stackhousia muricata subsp. annual (W.R. Barker 2172)	0.1	0.3
Triodia vanleeuwenii	40	0.5

Site: HD40
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 10/11/2017 **Phase 2 Date:** 22/05/2018 **Described by:** LV
MGA Zone: 50 **Easting:** 709045 **Northing:** 7449688
Habitat: Hillslope
Soil: Dark reddish brown sandy loam
Rock type: Ironstone
Vegetation code: H6
Vegetation: *Acacia catenulata* subsp. *occidentalis*, (*A. aptaneura*, *Grevillea saxicola*, *A. pruinocarpa*) tall shrubland over *Eremophila forrestii* subsp. *forrestii* shrubland over *Triodia vanleeuwenii*, *T. pungens* very open hummock grassland
Vegetation Condition: Excellent
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	5	4.5
Acacia aptaneura x	0.1	1.8
Acacia catenulata subsp. *occidentalis*	18	5.0
Acacia pruinocarpa	2	4.0
Aristida contorta	0.1	0.35
Aristida inaequiglumis	0.1	0.35
**Bidens bipinnata*	0.1	0.1
Bulbostylis barbata	0.1	0.1
Capparis lasiantha	0.1	0.3
Cheilanthes lasiophylla	0.1	0.1
Cheilanthes sieberi subsp. *sieberi*	0.1	0.1
Chrysopogon fallax	0.1	0.3
Cucumis variabilis	0.1	twiner
Cymbopogon ambiguus	0.1	0.4
Duperreya commixta	0.1	twiner

Name	Cover (%)	Height (m)
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.2
Enneapogon caerulescens	0.1	0.1
Enneapogon polyphyllus	0.1	0.2
Enneapogon sp.	0.1	0.6
Eragrostis eriopoda	0.1	0.2
Eremophila forrestii subsp. *forrestii*	11	1.9
Eremophila latrobei subsp. *glabra*	0.1	0.5
Eriachne mucronata	0.1	0.35
Eriachne obtusa	0.1	0.35
Eriachne pulchella	0.1	0.1
Eucalyptus leucophloia subsp. *leucophloia*	0.1	5.5
Goodenia stobbsiana	0.1	0.25
Grevillea berryana	0.1	1.8
Grevillea saxicola P3	3	4.0
Hibiscus burtonii	0.1	0.25
Iseilema vaginiflorum	0.1	0.1
Paspalidium clementii	0.1	0.15
Polycarpaea holtzei	0.1	0.05
Psydrax latifolia	0.1	2.0
Psydrax suaveolens	0.1	2.0
Pterocaulon sphacelatum	0.1	0.2
Schizachyrium fragile	0.1	0.1
Senna artemisioides subsp. *oligophylla*	0.1	1.2
Senna glaucifolia	0.1	1.5
Sida sp. Excedentifolia (J.L. Egan 1925)	0.1	0.25
Solanum lasiophyllum	0.1	0.3
Triodia pungens	3	0.3
Triodia vanleeuwenii	5	0.3

* denotes weed species

Site: HD41
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 9/11/2017 **Phase 2 Date:** 22/05/2018 **Described by:** BE
MGA Zone: 50 **Easting:** 710463 **Northing:** 7449277
Habitat: Footslope
Soil: Dark reddish brown sandy clay loam
Rock type: Ironstone
Vegetation code: H8
Vegetation: *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Triodia vanleeuwenii* hummock grassland with *Amphipogon sericeus* very open tussock grassland
Vegetation Condition: Excellent
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Acacia bivenosa	0.1	0.9
Acacia incurvaneura	0.1	0.5
Amphipogon sericeus	3	0.3
Codonocarpus cotinifolius	0.1	2.8
Corymbia hamersleyana sens. lat.	0.1	1.0
Cymbopogon ambiguus	0.1	0.8
Eriachne pulchella subsp. *dominii*	0.1	0.1
Eucalyptus leucophloia subsp. *leucophloia*	1.5	4.5
Eulalia aurea	0.1	0.5
Goodenia stobbsiana	0.1	0.3
Goodenia triodiophila	0.1	0.1
Hakea chordophylla	0.1	3.8
Paraneurachne muelleri	0.1	0.4
Ptilotus calostachyus	0.1	0.7
Senna artemisioides subsp. *oligophylla*	0.1	0.5
Senna glutinosa subsp. *glutinosa*	0.1	2.3

Name	Cover (%)	Height (m)
Senna glutinosa subsp. *pruinosa*	0.1	1.8
Senna glutinosa subsp. x *luerssenii*	0.1	2.0
Seringia elliptica	0.1	0.2
Seringia nephrosperma	0.1	0.6
Sida arenicola	0.1	0.3
Solanum lasiophyllum	0.1	0.4
Tephrosia oxalidea	0.1	0.1
Triodia vanleeuwenii	35	0.5

Site: HD42
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 11/11/2017 **Phase 2 Date:** 25/05/2018 **Described by:** DL
MGA Zone: 50 **Easting:** 696679 **Northing:** 7443808
Habitat: Hillslope
Soil: Dark reddish brown sandy clay loam
Rock type: Ironstone
Vegetation code: H6
Vegetation: *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia sibirica*, *A. incurvaneura*, *A. catenulata* subsp. *occidentalis* tall shrubland over *Senna stricta* open shrubland over *Triodia vanleeuwenii*, (*T. pungens*, *T. angusta*) open hummock grassland
Vegetation Condition: Excellent
Fire Age: No fire evident

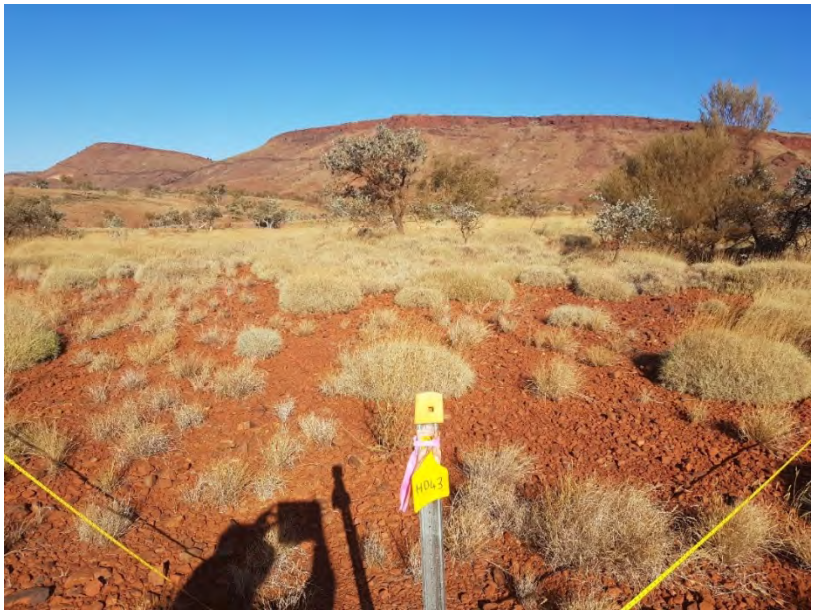


Species List:

Name	Cover (%)	Height (m)
Acacia adsurgens	0.1	0.7
Acacia aptaneura	0.1	2.4
Acacia catenulata subsp. *occidentalis*	2	5.5
Acacia incurvaneura	4	3.0
Acacia macraneura	0.1	3.0
Acacia pruinocarpa	0.1	1.8
Acacia sibirica	4	5.0
Acacia sp.	0.1	0.5
Acacia tetragonophylla	0.1	1.5
Aristida contorta	0.1	0.2
Aristida holathera var. *holathera*	0.1	0.2
Aristida inaequiglumis	0.1	0.7
Cheilanthes lasiophylla	0.1	0.1
Cheilanthes sieberi subsp. *sieberi*	0.1	0.1
Cucumis variabilis	0.1	twiner

Name	Cover (%)	Height (m)
Cymbopogon ambiguus	0.1	0.4
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.1
Enneapogon lindleyanus	0.1	0.2
Enneapogon polyphyllus	0.1	0.2
Eremophila latrobei subsp. *latrobei*	0.1	1.8
Eriachne mucronata	0.1	0.4
Eriachne pulchella subsp. *dominii*	0.1	0.1
Eriachne pulchella subsp. *pulchella*	0.1	0.1
Eucalyptus leucophloia subsp. *leucophloia*	0.5	4.0
Jasminum didymum subsp. *lineare*	0.1	twiner
Lepidium pedicellosum	0.1	0.4
Maireana georgei	0.1	0.6
Paraneurachne muelleri	0.1	0.3
Paspalidium clementii	0.1	0.2
Ptilotus exaltatus	0.1	0.2
Ptilotus obovatus	0.1	0.4
Salsola australis	0.1	0.2
Scaevola acacioides	0.1	0.7
Senna glutinosa subsp. *glutinosa*	0.1	1.1
Senna stricta	2	1.5
Seringia sp.	0.1	0.9
Solanum cleistogamum	0.1	0.2
Solanum lasiophyllum	0.1	0.4
Sporobolus australasicus	0.1	0.1
Templetonia egena	0.1	0.6
Triodia angusta	3	0.4
Triodia pungens	5	0.9
Triodia vanleeuwenii	20	0.5

Site: HD43
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 9/11/2017 **Phase 2 Date:** 23/05/2018 **Described by:** LD
MGA Zone: 50 **Easting:** 717459 **Northing:** 7452031
Habitat: Footslope
Soil: Dark reddish brown sandy clay loam
Rock type: Ironstone
Vegetation code: H3
Vegetation: *Corymbia deserticola* subsp. *deserticola* scattered low trees over *Acacia inaequilatera* tall open shrubland over *Triodia vanleeuwenii* open hummock grassland with *Amphipogon sericeus* very open tussock grassland
Vegetation Condition: Excellent
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Acacia ancistrocarpa	0.1	1.2
Acacia inaequilatera	4	2.5
Acacia incurvaneura	0.1	3.0
Acacia marramamba	0.1	2.1
Amphipogon sericeus	5	0.4
Aristida inaequiglumis	0.1	0.6
Codonocarpus cotinifolius	0.1	1.6
Corchorus lasiocarpus subsp. *parvus*	0.1	0.4
Corymbia deserticola subsp. *deserticola*	1	4.0
Cymbopogon obtectus	0.1	0.6
Duperreya commixta	0.1	twiner
Enneapogon polyphyllus	0.1	0.2
Eremophila longifolia	0.1	1.2
Fimbristylis simulans	0.1	0.1
Goodenia stobbsiana	0.1	0.3

Name	Cover (%)	Height (m)
Goodenia triodiophila	0.1	0.2
Hibiscus sturtii var. *campylochlamys*	0.1	0.3
Indigofera monophylla	0.1	0.4
Paraneurachne muelleri	0.1	0.3
Paspalidium clementii	0.1	0.1
Polycarpaea corymbosa var. *corymbosa*	0.1	0.1
Polycarpaea holtzei	0.1	0.1
Ptilotus astrolasius	0.1	0.4
Ptilotus calostachyus	0.1	0.7
Ptilotus exaltatus	0.1	0.1
Ptilotus rotundifolius	0.1	0.8
Schizachyrium fragile	0.1	0.1
Senna glaucifolia	0.1	1.5
Senna glutinosa subsp. *glutinosa*	0.1	1.8
Senna glutinosa subsp. *pruinosa*	0.1	1.8
Senna glutinosa subsp. x *luerssenii*	0.1	2.2
Sida arenicola	0.1	0.5
Solanum lasiophyllum	0.1	0.4
Tephrosia oxalidea	0.1	0.2
Triodia vanleeuwenii	25	0.6

Site: HD44
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 11/11/2017 **Phase 2 Date:** 27/05/2018 **Described by:** BE
MGA Zone: 50 **Easting:** 697914 **Northing:** 7443587
Habitat: Footslope
Soil: Light reddish brown sandy clay loam
Rock type: Ironstone, Quartz
Vegetation code: H10
Vegetation: *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees with *E. repullulans*, (*E. socialis* subsp. *eucentrica*) low open mallee woodland over *Acacia synchronicia* scattered shrubs over *Maireana georgei*, *M. eriosphaera* low open shrubland over *Triodia wiseana*, *T. brizoides* hummock grassland
Vegetation Condition: Excellent
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	0.1	1.0
Acacia bivenosa	0.1	1.5
Acacia pachyacra	0.1	1.6
Acacia pruinocarpa	0.1	1.0
Acacia sibirica	0.1	0.6
Acacia synchronicia	1	1.8
Aristida contorta	0.1	0.2
Capparis lasiantha	0.1	1.0
Cymbopogon ambiguus	0.1	0.8
Cynodon prostratus	0.1	0.02
Enneapogon caerulescens	0.1	0.1
Eremophila latrobei subsp. *latrobei*	0.1	1.0
Eremophila platycalyx subsp. *pardalota*	0.1	1.0
Eucalyptus leucophloia subsp. *leucophloia*	1.5	7.0
Eucalyptus repullulans	5	3.5

Name	Cover (%)	Height (m)
Eucalyptus socialis subsp. *eucentrica*	0.5	4.0
Euphorbia sp.	0.1	0.1
Lepidium pedicellosum	0.1	0.3
Maireana carnosa	0.1	0.2
Maireana eriosphaera	1	0.2
Maireana georgei	2	0.3
Maireana melanocoma	0.1	0.2
Maireana triptera	0.1	0.3
Ptilotus exaltatus	0.1	0.2
Ptilotus obovatus	0.1	0.6
Salsola australis	0.1	0.1
Sclerolaena cuneata	0.1	0.2
Sclerolaena densiflora	0.1	0.2
Sclerolaena ?gardneri	0.1	0.1
Senna glutinosa subsp. *glutinosa*	0.1	1.0
Senna glutinosa subsp. x *luerssenii*	0.1	1.0
Senna stricta	0.1	1.2
Sida fibulifera	0.1	0.2
Solanum horridum	0.1	0.1
Solanum lasiophyllum	0.1	0.3
Sporobolus australasicus	0.1	0.1
Triodia brizoides	15	0.7
Triodia wiseana	20	0.8

? denotes unconfirmed ID

Site: HD46
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 11/11/2017 **Phase 2 Date:** 22/05/2018 **Described by:** LV
MGA Zone: 50 **Easting:** 708917 **Northing:** 7450014
Habitat: Hillslope
Soil: Dark reddish brown sandy loam
Rock type: Ironstone
Vegetation code: H7
Vegetation: *Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Acacia pruinocarpa*, *A. catenulata* subsp. *occidentalis* tall open shrubland over *A. tenuissima*, *Senna glutinosa* subsp. *glutinosa*, *Codonocarpus cotinifolius*, *Scaevola acacioides* open shrubland over *Triodia pungens*, (*T. vanleeuwenii*) hummock grassland
Vegetation Condition: Excellent
Fire Age: >10 years



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	0.1	2.2
Acacia bivenosa	0.1	1.7
Acacia catenulata subsp. *occidentalis*	1	5.0
Acacia dictyophleba	0.1	1.8
Acacia maitlandii	0.1	1.3
Acacia pruinocarpa	2	2.5
Acacia pyrifolia	0.1	4.2
Acacia tenuissima	0.5	1.8
Amphipogon sericeus	0.1	0.3
Capparis lasiantha	0.1	0.5
Codonocarpus cotinifolius	0.5	1.5
Cymbopogon ambiguus	0.1	0.7
Cymbopogon obtectus	0.1	0.6
Dodonaea coriacea	0.1	0.5
Duperreya commixta	0.1	twiner

Name	Cover (%)	Height (m)
Eremophila latrobei subsp. *glabra*	0.1	1.3
Eremophila latrobei subsp. *latrobei*	0.1	1.3
Eriachne lanata	0.1	0.4
Eriachne mucronata	0.1	0.3
Eriachne pulchella	0.1	0.15
Eriachne pulchella subsp. *pulchella*	0.1	0.1
Eucalyptus gamophylla	0.1	4.2
Eucalyptus leucophloia subsp. *leucophloia*	5	4.6
Gompholobium oreophilum	0.1	0.5
Goodenia stobbsiana	0.1	0.2
Goodenia triodiophila	0.1	0.3
Hakea chordophylla	0.1	0.4
Jasminum didymum subsp. *lineare*	0.1	twiner
Paraneurachne muelleri	0.1	0.3
Ptilotus calostachyus	0.1	1.1
Scaevola acacioides	0.5	1.2
Schizachyrium fragile	0.1	0.1
Senna glaucifolia	0.1	1.6
Senna glutinosa subsp. *glutinosa*	0.5	1.8
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	0.1	0.3
Solanum lasiophyllum	0.1	0.8
Triodia pungens	45	0.7
Triodia vanleeuwenii	6	0.5

Site: HD47
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 11/11/2017 **Phase 2 Date:** 27/05/2018 **Described by:** DL
MGA Zone: 50 **Easting:** 707179 **Northing:** 7443005
Habitat: Hillslope
Soil: Dark reddish brown sandy clay loam
Rock type: Dolerite
Vegetation code: H12
Vegetation: *Acacia inaequilatera*, *Hakea chordophylla* tall open shrubland over *Senna artemisioides* subsp. *oligophylla* scattered low shrubs over *Triodia wiseana* hummock grassland with *Cymbopogon ambiguus*, *Themeda* sp. Mt Barricade (M.E. Trudgen 2471) scattered tussock grasses
Vegetation Condition: Excellent
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Acacia arida	0.1	1.7
Acacia inaequilatera	3	2.6
Acacia pyrifolia	0.1	2.3
Aristida contorta	0.1	0.2
Aristida holathera var. *holathera*	0.1	0.2
Bonamia pilbarensis	0.1	0.2
Cassytha capillaris	0.1	twiner
Cheilanthes lasiophylla	0.1	0.1
Corchorus lasiocarpus subsp. *parvus*	0.1	0.3
Cymbopogon ambiguus	1	0.6
Dodonaea coriacea	0.1	0.1
Enneapogon caerulescens	0.1	0.2
Eriachne mucronata	0.1	0.3
Goodenia muelleriana	0.1	0.3
Goodenia prostrata	0.1	0.2

Name	Cover (%)	Height (m)
Goodenia stobbsiana	0.1	0.2
Goodenia triodiophila	0.1	0.3
Hakea chordophylla	1.5	3.0
Heliotropium ovalifolium	0.1	0.2
Indigofera monophylla	0.1	0.2
Jasminum didymum subsp. *lineare*	0.1	twiner
Oldenlandia crouchiana	0.1	0.1
Paraneurachne muelleri	0.1	0.2
Polycarpaea corymbosa var. *corymbosa*	0.1	0.1
Polycarpaea holtzei	0.1	0.1
Pterocaulon sphacelatum	0.1	0.3
Ptilotus astrolasius	0.1	0.3
Ptilotus calostachyus	0.1	0.3
Schizachyrium fragile	0.1	0.1
Senna artemisioides subsp. *oligophylla*	0.5	1.0
Senna glutinosa subsp. *glutinosa*	0.1	1.7
Sida echinocarpa	0.1	0.5
Solanum phlomoides	0.1	0.5
Stackhousia muricata subsp. annual (W.R. Barker 2172)	0.1	0.2
Swainsona maccullochiana	0.1	0.3
Themeda sp. Mt Barricade (M.E. Trudgen 2471)	0.5	0.7
Trichodesma zeylanicum var. *zeylanicum*	0.1	0.5
Tricoryne sp. Hamersley Range (S. van Leeuwen 915)	0.1	0.5
Triodia wiseana	30	0.7

Site: HD48
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 12/11/2017 **Phase 2 Date:** 24/05/2018 **Described by:** LV
MGA Zone: 50 **Easting:** 707007 **Northing:** 7450110
Habitat: Hillslope
Soil: Dark reddish brown sandy clay loam
Rock type: Ironstone
Vegetation code: H4
Vegetation: *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia pruinocarpa*, *A. aptaneura*, *Senna glutinosa* subsp. *glutinosa* open shrubland over *Triodia vanleeuwenii* hummock grassland with *Eriachne pulchella* subsp. *pulchella* scattered tussock grasses
Vegetation Condition: Excellent
Fire Age: 5-10 years



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	1	1.8
Acacia pruinocarpa	1	1.9
Cymbopogon obtectus	0.1	0.3
Enneapogon caerulescens	0.1	0.2
Eremophila latrobei subsp. *latrobei*	0.1	1.0
Eriachne pulchella subsp. *pulchella*	1	0.06
Eucalyptus leucophloia subsp. *leucophloia*	1.5	5.6
Iseilema membranaceum	0.1	0.1
Maireana georgei	0.1	0.35
Paspalidium clementii	0.1	0.1
Pterocaulon sphacelatum	0.1	0.3
Ptilotus incanus	0.1	0.6
Ptilotus obovatus	0.1	0.5
Ptilotus rotundifolius	0.1	0.6
Scaevola acacioides	0.1	0.5

Name	Cover (%)	Height (m)
Senna glutinosa subsp. *glutinosa*	0.5	1.7
Senna glutinosa subsp. *pruinosa*	0.1	2.1
Senna glutinosa subsp. x *luerssenii*	0.1	0.8
Senna stricta	0.1	0.5
Sida arenicola	0.1	0.4
Sida sp.	0.1	0.4
Sida sp. Shovelanna Hill (S. van Leeuwen 3842)	0.1	0.4
Sporobolus australasicus	0.1	0.06
Tribulus suberosus	0.1	0.6
Trichodesma zeylanicum var. *zeylanicum*	0.1	0.2
Triodia vanleeuwenii	65	0.35

Site: HD49
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 12/11/2017 **Phase 2 Date:** 24/05/2018 **Described by:** LV
MGA Zone: 50 **Easting:** 702774 **Northing:** 7449267
Habitat: Minor creek
Soil: Dark reddish brown sandy clay loam
Rock type: Ironstone
Vegetation code: D2
Vegetation: *Acacia catenulata* subsp. *occidentalis*, (*A. aptaneura*, *Petalostylis labicheoides*, *A. pruinocarpa*) tall shrubland over *Triodia pungens* very open hummock grassland with *Chrysopogon fallax* scattered tussock grasses
Vegetation Condition: Very Good
Fire Age: 5-10 years



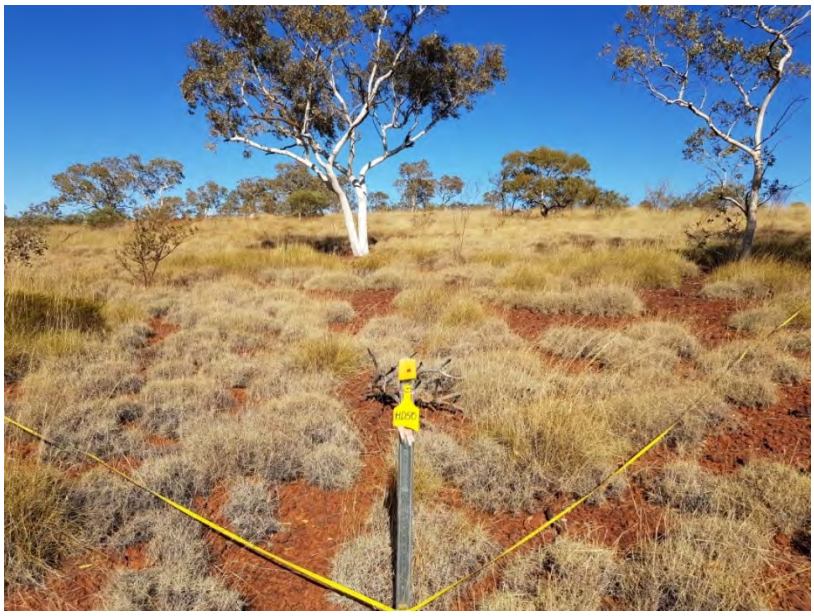
Species List:

Name	Cover (%)	Height (m)
Abutilon sp.	0.1	0.3
Acacia aptaneura	5	5.0
Acacia aptaneura x	0.1	3.0
Acacia catenulata subsp. *occidentalis*	12	6.0
Acacia dictyophleba	0.1	0.5
Acacia maitlandii	0.1	3.5
Acacia pruinocarpa	0.5	4.0
Acacia tenuissima	0.1	1.4
Amyema fitzgeraldii	0.1	mistletoe
Aristida contorta	0.1	0.25
Aristida obscura	0.1	0.3
Aristida sp.	0.1	0.35
Asteraceae sp.	0.1	0.1
**Bidens bipinnata*	0.1	0.3
Capparis lasiantha	0.1	0.6

Name	Cover (%)	Height (m)
Chrysopogon fallax	1	0.8
Cleome viscosa	0.1	0.3
Duperreya commixta	0.1	twiner
Enchylaena tomentosa var. *tomentosa*	0.1	0.6
Enneapogon caerulescens	0.1	0.3
Enneapogon polyphyllus	0.1	0.25
Eremophila forrestii subsp. *forrestii*	0.1	1.6
Eriachne mucronata	0.1	0.4
Eriachne obtusa	0.1	0.35
Eriachne pulchella	0.1	0.2
Eucalyptus leucophloia subsp. *leucophloia*	0.1	3.5
Eucalyptus xerothermica	0.1	5.6
Eulalia aurea	0.1	0.4
Euphorbia biconvexa/coghlanii/trigonosperma	0.1	0.2
Evolvulus alsinoides var. *villosicalyx*	0.1	0.15
Iseilema vaginiflorum	0.1	0.15
Panicum effusum	0.1	0.4
Paraneurachne muelleri	0.1	0.1
Paspalidium clementii	0.1	0.3
Petalostylis labicheoides	3	3.5
Polycarpaea corymbosa var. *corymbosa*	0.1	0.2
Psydrax latifolia	0.1	2.9
Pterocaulon sphacelatum	0.1	0.4
Ptilotus astrolasius	0.1	0.5
Ptilotus obovatus	0.1	0.6
Rhagodia eremaea	0.1	1.6
Salsola australis	0.1	0.3
Senna artemisioides subsp. *oligophylla*	0.1	0.6
Senna artemisioides subsp. x *artemisioides*	0.1	1.6
Senna stricta	0.1	1.0
Seringia sp.	0.1	2.3
Sida sp. dark green fruits (S. van Leeuwen 2260)	0.1	0.3
Solanum lasiophyllum	0.1	0.5
Sporobolus australasicus	0.1	0.1
Themeda triandra	0.1	0.8
Triodia pungens	8	0.6
Triodia vanleeuwenii	0.1	0.4

* denotes weed species

Site: HD50
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 11/11/2017 **Phase 2 Date:** 21/05/2018 **Described by:** LV
MGA Zone: 50 **Easting:** 697330 **Northing:** 7444649
Habitat: Hillslope
Soil: Red brown sandy clay loam
Rock type: Ironstone
Vegetation code: H8
Vegetation: *Eucalyptus leucophloia* subsp. *leucophloia* low woodland over *Acacia pruinocarpa* scattered tall shubs over *A. rhodophloia* scattered shrubs over *Triodia vanleeuwenii*, *T. pungens* hummock grassland
Vegetation Condition: Excellent
Fire Age: >10 years



Species List:

Name	Cover (%)	Height (m)
Acacia dictyophleba	0.1	2.2
Acacia hilliana	0.1	0.5
Acacia pruinocarpa	1	2.1
Acacia pyrifolia	0.1	1.5
Acacia rhodophloia	0.5	1.8
Aristida holathera var. *holathera*	0.1	0.3
Corchorus lasiocarpus subsp. *parvus*	0.1	0.5
Cymbopogon ambiguus	0.1	0.5
Eriachne pulchella	0.1	0.1
Eucalyptus leucophloia subsp. *leucophloia*	11	7.0
Goodenia stobbsiana	0.1	0.3
Grevillea wickhamii subsp. *hispidula*	0.1	1.8
Hakea chordophylla	0.1	3.0
Jasminum didymum subsp. *lineare*	0.1	twiner
Pterocaulon sphacelatum	0.1	0.3
Ptilotus obovatus	0.1	0.3

Name	Cover (%)	Height (m)
Ptilotus rotundifolius	0.1	0.5
Scaevola browniana	0.1	0.35
Senna glutinosa subsp. *glutinosa*	0.1	1.6
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	0.1	1.0
Solanum cleistogamum	0.1	0.3
Triodia pungens	12	0.5
Triodia vanleeuwenii	20	0.3

Site: HD51
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 11/11/2017 **Phase 2 Date:** 21/05/2018 **Described by:** BE
MGA Zone: 50 **Easting:** 695931 **Northing:** 7445220
Habitat: Minor creek
Soil: Dark reddish brown sandy loam
Rock type: Ironstone
Vegetation code: D1
Vegetation: *Corymbia hamersleyana* sens. lat.scattered low trees over *Petalostylis labicheiodes*, (*Acacia monticola*, *A. maitlandii*) tall shrubland over *Dodonaea lanceolata* var. *lanceolata*, *Androcalva luteiflora* scattered shrubs over *Triodia pungens* very open hummock grassland with *Eriachne mucronata*, *Themeda triandra* open tussock grassland
Vegetation Condition: Excellent
Fire Age: 5-10 years



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	0.1	2.8
Acacia bivenosa	0.1	1.5
Acacia hamersleyensis	0.1	2.7
Acacia maitlandii	1	2.5
Acacia monticola	6	4.2
Acacia pruinocarpa	0.1	1.9
Androcalva luteiflora	0.5	1.7
Aristida contorta	0.1	0.3
Aristida inaequiglumis	0.1	0.35
Capparis umbonata	0.1	2.3
Corchorus lasiocarpus subsp. *parvus*	0.1	0.3
Corymbia hamersleyana sens. lat.	0.5	8.0
Cymbopogon ambiguus	0.1	0.8
Dodonaea lanceolata var. *lanceolata*	0.5	1.9
Duperreya commixta	0.1	twiner

Name	Cover (%)	Height (m)
Dysphania plantaginella	0.1	0.1
Enneapogon robustissimus	0.1	0.4
Eriachne mucronata	7	0.4
Eucalyptus leucophloia subsp. *leucophloia*	0.1	3.0
Evolvulus alsinoides var. *villosicalyx*	0.1	0.1
Gossypium robinsonii	0.1	1.6
Grevillea wickhamii subsp. *hispidula*	0.1	3.2
Jasminum didymum subsp. *lineare*	0.1	twiner
Marsdenia australis	0.1	twiner
Petalostylis labicheoides	13	3.0
Pterocaulon sphacelatum	0.1	0.3
Santalum lanceolatum	0.1	2.5
Schizachyrium fragile	0.1	0.1
Senna ferraria	0.1	1.2
Senna glutinosa subsp. *glutinosa*	0.1	1.8
Seringia elliptica	0.1	0.5
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	0.1	1.5
Themeda triandra	5	1.1
Triodia pungens	4	0.6

Site: HD52
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 11/11/2017 **Phase 2 Date:** 24/05/2018 **Described by:** LD
MGA Zone: 50 **Easting:** 707034 **Northing:** 7449992
Habitat: Hillslope
Soil: Dark reddish brown sandy clay loam
Rock type: Ironstone
Vegetation code: H2
Vegetation: *Eucalyptus repullulans* scattered low mallees over *Acacia catenulata* subsp. *occidentalis*, (*A. aptaneura*, *Grevillea saxicola*, *Scaevola acacioides*, *A. pruinocarpa*) tall open scrub over *Triodia pungens*, *T. vanleeuwenii* very open hummock grassland
Vegetation Condition: Excellent
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	10	5.0
Acacia catenulata subsp. *occidentalis*	40	5.0
Acacia pruinocarpa	1	5.0
Aristida obscura	0.1	0.3
Cheilanthes lasiophylla	0.1	0.1
Dodonaea pachyneura	0.1	1.8
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.1
Enneapogon lindleyanus	0.1	0.3
Enneapogon polyphyllus	0.1	0.1
Eremophila latrobei subsp. *latrobei*	0.1	1.5
Eriachne mucronata	0.1	0.4
Eriachne pulchella subsp. *pulchella*	0.1	0.1
Eucalyptus leucophloia subsp. *leucophloia*	0.1	4.0
Eucalyptus repullulans	1	3.9
Grevillea saxicola P3	2	5.0

Name	Cover (%)	Height (m)
Hakea lorea subsp. *lorea*	0.1	2.0
Iseilema membranaceum	0.1	0.1
Paspalidium clementii	0.1	0.2
Perotis rara	0.1	0.1
Psydrax suaveolens	0.1	1.2
Ptilotus astrolasius	0.1	0.4
Ptilotus exaltatus	0.1	0.2
Scaevola acacioides	2	2.8
Senna glutinosa subsp. *glutinosa*	0.1	1.6
Solanum lasiophyllum	0.1	0.1
Triodia pungens	2	0.5
Triodia vanleeuwenii	0.5	0.5
Wahlenbergia sp.	0.1	0.2

Site: HD53
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 12/11/2017 **Phase 2 Date:** 24/05/2018 **Described by:** LD
MGA Zone: 50 **Easting:** 706347 **Northing:** 7450159
Habitat: Plain
Soil: Red brown sandy clay loam
Rock type: Ironstone, Dolerite
Vegetation code: H8
Vegetation: *Eucalyptus leucophloia* subsp. *leucophloia* low open woodland with *E. gamophylla* scattered low mallees over *Hakea chordophylla* scattered tall shrubs over *Acacia pruinocarpa* scattered shrubs over *Triodia vanleeuwenii*, (*T. pungens*) hummock grassland
Vegetation Condition: Excellent
Fire Age: >10 years



Species List:

Name	Cover (%)	Height (m)
Acacia adoxa var. *adoxa*	0.1	0.4
Acacia bivenosa	0.1	1.6
Acacia pruinocarpa	0.5	1.6
Acacia tenuissima	0.1	1.5
Acacia tumida var. *pilbarensis*	0.1	0.3
Cymbopogon ambiguus	0.1	0.5
Duperreya commixta	0.1	twiner
Eremophila latrobei subsp. *latrobei*	0.1	1.6
Eriachne lanata	0.1	0.3
Eucalyptus gamophylla	1	5.5
Eucalyptus leucophloia subsp. *leucophloia*	5	6.0
Goodenia triodiophila	0.1	0.2
Hakea chordophylla	1	3.0
Indigofera monophylla	0.1	0.4
Jasminum didymum subsp. *lineare*	0.1	twiner

Name	Cover (%)	Height (m)
Pterocaulon sphacelatum	0.1	0.2
Ptilotus calostachyus	0.1	0.6
Scaevola browniana	0.1	0.3
Senna artemisioides subsp. *helmsii*	0.1	0.7
Senna ferraria	0.1	1.6
Senna glutinosa subsp. *glutinosa*	0.1	1.3
Senna glutinosa subsp. *pruinosa*	0.1	0.8
Senna glutinosa subsp. x *luerssenii*	0.1	1.3
Triodia pungens	10	0.4
Triodia vanleeuwenii	40	0.35
Triodia wiseana	0.1	0.35

Site: HD54
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 12/11/2017 **Phase 2 Date:** 24/05/2018 **Described by:** LD
MGA Zone: 50 **Easting:** 706428 **Northing:** 7449405
Habitat: Plain
Soil: Red brown sandy clay loam
Rock type: Ironstone
Vegetation code: H11
Vegetation: *Eucalyptus gamophylla* low mallee woodland over *Acacia ancistrocarpa*, *A. tenuissima* tall open shrubland over *A. bivenosa* scattered shrubs over *Triodia vanleeuwenii* hummock grassland
Vegetation Condition: Excellent
Fire Age: >10 years



Species List:

Name	Cover (%)	Height (m)
Acacia ancistrocarpa	2	2.5
Acacia aptaneura	0.1	1.0
Acacia bivenosa	1	1.7
Acacia pruinocarpa	0.1	1.5
Acacia tenuissima	0.5	2.2
Amphipogon sericeus	0.1	0.35
Aristida holathera var. *holathera*	0.1	0.35
Aristida obscura	0.1	0.2
Cymbopogon ambiguus	0.1	0.4
Duperreya commixta	0.1	twiner
Eucalyptus gamophylla	15	5.0
Hakea chordophylla	0.1	2.2
Indigofera monophylla	0.1	0.3
Paraneurachne muelleri	0.1	0.3
Pterocaulon sphacelatum	0.1	0.2
Ptilotus calostachyus	0.1	0.5

Name	Cover (%)	Height (m)
Ptilotus rotundifolius	0.1	0.5
Scaevola parvifolia subsp. *pilbarae*	0.1	0.3
Themeda triandra	0.1	0.45
Triodia pungens	0.1	0.4
Triodia vanleeuwenii	50	0.4

Site: HD55
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 1 Date: 11/11/2017 **Phase 2 Date:** 24/05/2018 **Described by:** LD
MGA Zone: 50 **Easting:** 705103 **Northing:** 7449190
Habitat: Plain
Soil: Dark reddish brown sandy clay loam
Rock type: Ironstone
Vegetation code: P3
Vegetation: *Acacia aptaneura*, (*A. pruinocarpa*, *A. catenulata* subsp. *occidentalis*) tall shrubland over *Triodia pungens* hummock grassland
Vegetation Condition: Excellent
Fire Age: 5-10 years



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	11	4.0
Acacia ayersiana	0.1	3.0
Acacia bivenosa	0.1	1.6
Acacia catenulata subsp. *occidentalis*	2	4.5
Acacia dictyophleba	0.1	15
Acacia maitlandii	0.1	0.9
Acacia pachyacra	0.1	2.0
Acacia pruinocarpa	4	3.5
Acacia sibirica	0.1	3.2
Cymbopogon ambiguus	0.1	0.4
Eremophila latrobei subsp. *latrobei*	0.1	1.5
Eremophila longifolia	0.1	1.6
Eriachne pulchella subsp. *pulchella*	0.1	0.1
Eucalyptus leucophloia subsp. *leucophloia*	0.1	4.0
Eucalyptus socialis subsp. ?*eucentrica*	0.1	3.5
Petalostylis labicheoides	0.1	3.0

Name	Cover (%)	Height (m)
Psydrax suaveolens	0.1	1.2
Seringia elliptica	0.1	0.4
Sida sp.	0.1	0.2
Triodia pungens	65	0.7

? denotes unconfirmed ID

Site: HDR01
Location: HD2 Detailed Survey Area **Type:** Relevé
Phase 1 Date: 4/11/2017 **Phase 2 Date:** 29/05/2018 **Described by:** BE
MGA Zone: 50 **Easting:** 712667 **Northing:** 7449624
Habitat: Hillcrest
Soil: Brown sandy loam
Rock type: Calcrete
Vegetation code: H10
Vegetation: *Eucalyptus repullulans* low open mallee woodland over *Acacia bivenosa*, *Corchorus lasiocarpus* subsp. *parvus* scattered low shrubs over *Triodia wiseana* open hummock grassland with *Paraneurachne muelleri* scattered tussock grasses
Vegetation Condition: Excellent
Fire Age: 0-2 years



Species List:

Name	Cover (%)	Height (m)
Acacia bivenosa	0.5	0.7
Acacia pyrifolia	0.1	1.7
Amphipogon sericeus	0.1	0.3
Capparis lasiantha	0.1	0.6
Codonocarpus cotinifolius	0.1	1.4
Corchorus lasiocarpus subsp. *parvus*	0.5	0.3
Dampiera candicans	0.1	0.3
Eucalyptus gamophylla	0.1	1.7
Eucalyptus leucophloia subsp. *leucophloia*	0.1	2.2
Eucalyptus repullulans	5	1.8
Goodenia stobbsiana	0.1	0.3
Hibiscus sturtii var. *platychlamys*	0.1	0.6
Indigofera monophylla	0.1	0.2
Paraneurachne muelleri	0.5	0.4
Ptilotus calostachyus	0.1	1.2

Name	Cover (%)	Height (m)
Ptilotus exaltatus	0.1	0.4
Senna artemisioides subsp. *oligophylla*	0.1	0.5
Senna ferraria	0.1	1.2
Senna glutinosa subsp. *glutinosa*	0.1	1.6
Solanum phlomoides	0.1	0.8
Triodia wiseana	22	0.5

Site: HDR02
Location: HD2 Detailed Survey Area **Type:** Relevé
Phase 1 Date: 4/11/2017 **Phase 2 Date:** 22/05/2018 **Described by:** BE
MGA Zone: 50 **Easting:** 711579 **Northing:** 7449411
Habitat: Hillcrest
Soil: Dark reddish brown sandy loam
Rock type: Ironstone
Vegetation code: H8
Vegetation: *Hakea chordophylla* scattered tall shrubs over *Triodia vanleeuwenii* hummock grassland with *Amphipogon sericeus* scattered tussock grasses
Vegetation Condition: Excellent
Fire Age: 5-10 years



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	0.1	2.3
Acacia bivenosa	0.1	1.6
Acacia dictyophleba	0.1	1.3
Acacia hilliana	0.1	0.5
Amphipogon sericeus	0.5	0.4
Codonocarpus cotinifolius	0.1	0.8
Eriachne mucronata	0.1	0.3
Eucalyptus gamophylla	0.1	3.2
Eucalyptus leucophloia subsp. *leucophloia*	0.1	3.5
Goodenia stobbsiana	0.1	0.2
Hakea chordophylla	0.5	3.5
Maireana tomentosa subsp. *tomentosa*	0.1	0.2
Polycarpaea holtzei	0.1	0.02
Polycarpaea longiflora	0.1	0.1
Pterocaulon sphacelatum	0.1	0.05
Ptilotus calostachyus	0.1	1.2

Name	Cover (%)	Height (m)
Senna artemisioides subsp. *oligophylla*	0.1	0.6
Senna glutinosa subsp. *glutinosa*	0.1	1.4
Seringia elliptica	0.1	0.2
Sida echinocarpa	0.1	0.2
Solanum lasiophyllum	0.1	0.5
Stackhousia muricata subsp. annual (W.R. Barker 2172)	0.1	0.3
Triodia vanleeuwenii	40	0.4

Site: HDR03
Location: HD2 Detailed Survey Area **Type:** Relevé
Phase 1 Date: 5/11/2017 **Phase 2 Date:** 20/05/2018 **Described by:** LD
MGA Zone: 50 **Easting:** 703055 **Northing:** 7444913
Habitat: Hillslope
Soil: Dark reddish brown sandy loam
Rock type: Ironstone
Vegetation code: H6
Vegetation: *Acacia aptaneura* tall shrubland over *Eremophila jucunda* subsp. *pulcherrima* scattered shrubs over *Senna stricta* low open shrubland over *Triodia wiseana* very open hummock grassland with *Eriachne pulchella* scattered tussock grasses
Vegetation Condition: Excellent
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	13	4.5
Acacia catenulata subsp. *occidentalis*	0.1	2.3
Acacia incurvaneura	0.1	4.0
Aristida contorta	0.1	0.2
Aristida inaequiglumis	0.1	0.5
Aristida obscura	0.1	0.3
Capparis lasiantha	0.1	0.4
Cymbopogon ambiguus	0.1	0.4
Dichanthium sericeum subsp. *humilius*	0.1	0.6
Dodonaea pachyneura	0.1	0.8
Duperreya commixta	0.1	twiner
Enneapogon caerulescens	0.1	0.1
Enneapogon lindleyanus	0.1	0.4
Enneapogon polyphyllus	0.1	0.1
Eremophila jucunda subsp. *pulcherrima*	0.5	1.2

Name	Cover (%)	Height (m)
Eremophila phyllopoda subsp. *obliqua*	0.1	1.6
Eremophila platycalyx subsp. *pardalota*	0.1	1.6
Eriachne mucronata	0.1	0.3
Eriachne pulchella	1	0.2
Eucalyptus leucophloia subsp. *leucophloia*	0.1	5.0
Euphorbia biconvexa/coghlanii/trigonosperma	0.1	0.2
Hibiscus sturtii var. *campylochlamys*	0.1	0.4
Iseilema eremaeum	0.1	0.1
Maireana georgei	0.1	0.2
Paspalidium clementii	0.1	0.1
Perotis rara	0.1	0.1
Ptilotus obovatus	0.1	0.5
Scaevola acacioides	0.1	0.4
Schizachyrium fragile	0.1	0.1
Senna stricta	3	0.7
Sida fibulifera	0.1	0.3
Solanum horridum	0.1	0.1
Sporobolus australasicus	0.1	0.1
Triodia pungens	0.1	0.4
Triodia vanleeuwenii	0.1	0.3
Triodia wiseana	7	0.4

Site: HDR04
Location: HD2 Detailed Survey Area **Type:** Relevé
Phase 1 Date: 6/11/2017 **Phase 2 Date:** 24/05/2018 **Described by:** DL
MGA Zone: 50 **Easting:** 719839 **Northing:** 7450422
Habitat: Hillcrest
Soil: Dark reddish brown sandy loam
Rock type: Ironstone
Vegetation code: H4
Vegetation: *Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Triodia vanleeuwenii*, *T. pungens* open hummock grassland
Vegetation Condition: Excellent
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Acacia bivenosa	0.1	2.5
Acacia pruinocarpa	0.1	1.2
Duperreya commixta	0.1	twiner
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.1
Enchylaena tomentosa var. *tomentosa*	0.1	0.6
Eremophila latrobei subsp. *glabra*	0.1	1.8
Eriachne mucronata	0.1	0.2
Eucalyptus leucophloia subsp. *leucophloia*	8	5.5
Goodenia stobbsiana	0.1	0.3
Ptilotus calostachyus	0.1	0.5
Ptilotus exaltatus	0.1	0.2
Ptilotus obovatus	0.1	0.4
Scaevola acacioides	0.1	1.6
Senna glutinosa subsp. *glutinosa*	0.1	0.9
Senna glutinosa subsp. *pruinosa*	0.1	2.2
Senna sp. Meekatharra (E. Bailey 1-26)	0.1	0.5

Name	Cover (%)	Height (m)
Senna stricta	0.1	0.4
Sida echinocarpa	0.1	0.2
Sida sp. Excedentifolia (J.L. Egan 1925)	0.1	0.2
Solanum lasiophyllum	0.1	0.5
Tribulus suberosus	0.1	0.3
Triodia pungens	10	0.4
Triodia vanleeuwenii	15	0.3

Site: HDR05
Location: HD2 Detailed Survey Area **Type:** Relevé
Phase 1 Date: 5/11/2017 **Phase 2 Date:** 20/05/2018 **Described by:** LV
MGA Zone: 50 **Easting:** 706635 **Northing:** 7445519
Habitat: Hillslope
Soil: Reddish brown sandy clay
Rock type: Ironstone
Vegetation code: H7
Vegetation: *Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Ptilotus obovatus* scattered low shrubs over *Triodia wiseana*, *T. pungens* open hummock grassland with *Eriachne mucronata*, (*Cymbopogon ambiguus*) very open tussock grassland
Vegetation Condition: Excellent
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Acacia bivenosa	0.1	0.7
Acacia tenuissima	0.1	0.8
Aristida contorta	0.1	0.1
Cheilanthes lasiophylla	0.1	0.15
Cleome viscosa	0.1	0.2
Cucumis variabilis	0.1	twiner
Cymbopogon ambiguus	2	0.6
Duperreya commixta	0.1	twiner
Enchylaena tomentosa var. *tomentosa*	0.1	0.7
Enneapogon caerulescens	0.1	0.3
Enneapogon polyphyllus	0.1	0.2
Enneapogon robustissimus	0.1	0.4
Eremophila platycalyx subsp. *pardalota*	0.1	0.6
Eriachne mucronata	6	0.4
Eucalyptus leucophloia subsp. *leucophloia*	5	5.0

Name	Cover (%)	Height (m)
Hibiscus sturtii var. *campylochlamys*	0.1	0.2
Indigofera monophylla	0.1	0.2
Lepidium phlebopetalum	0.1	0.5
Maireana tomentosa subsp. *tomentosa*	0.1	0.1
Paraneurachne muelleri	0.1	0.2
Paspalidium clementii	0.1	0.1
Polycarpaea longiflora	0.1	0.1
Ptilotus obovatus	1	0.6
Rhagodia eremaea	0.1	0.7
Salsola australis	0.1	0.4
Schizachyrium fragile	0.1	0.1
Senna glutinosa subsp. *glutinosa*	0.1	1.3
Senna glutinosa subsp. x *luerssenii*	0.1	1.5
Senna stricta	0.1	0.4
Sida echinocarpa	0.1	0.4
Sida sp. Excedentifolia (J.L. Egan 1925)	0.1	0.15
Solanum lasiophyllum	0.1	0.4
Themeda sp. Mt Barricade (M.E. Trudgen 2471)	0.1	0.4
Triodia pungens	10	0.5
Triodia wiseana	10	0.6

Site: HDR06
Location: HD2 Detailed Survey Area **Type:** Relevé
Phase 1 Date: 6/11/2017 **Phase 2 Date:** 23/05/2018 **Described by:** BE
MGA Zone: 50 **Easting:** 721335 **Northing:** 7451349
Habitat: Hillcrest
Soil: Dark reddish brown sandy loam
Rock type: Ironstone
Vegetation code: H6
Vegetation: *Acacia catenulata* subsp. *occidentalis*, (*A. aptaneura, A. mulganeura*) tall shrubland over *Eremophila latrobei* subsp. *glabra* scattered shrubs over *Triodia vanleeuwenii*, *T. pungens, T. wiseana* very open hummock grassland with *Eriachne mucronata* scattered tussock grasses
Vegetation Condition: Excellent
Fire Age: >10 years



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	4	5.0
Acacia ayersiana	0.1	4.0
Acacia catenulata subsp. *occidentalis*	10	4.0
Acacia mulganeura	4	4.5
Amphipogon sericeus	0.1	0.3
Bulbostylis barbata	0.1	0.05
Codonocarpus cotinifolius	0.1	1.3
Cymbopogon ambiguus	0.1	0.8
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.1
Enneapogon polyphyllus	0.1	0.2
Eremophila latrobei subsp. *glabra*	1	1.5
Eriachne mucronata	1	0.4
Eriachne pulchella	0.1	0.05
Eucalyptus leucophloia subsp. *leucophloia*	0.1	4.0
Grevillea berryana	0.1	4.0

Name	Cover (%)	Height (m)
Maireana georgei	0.1	0.2
Paspalidium clementii	0.1	0.1
Ptilotus calostachyus	0.1	1.1
Ptilotus exaltatus	0.1	0.3
Scaevola acacioides	0.1	0.9
Schizachyrium fragile	0.1	0.1
Senna glutinosa subsp. *glutinosa*	0.1	1.2
Senna glutinosa subsp. x *luerssenii*	0.1	1.2
Sida sp. Excedentifolia (J.L. Egan 1925)	0.1	0.3
Solanum horridum	0.1	0.2
Solanum phlomoides	0.1	0.5
Tribulus suberosus	0.1	0.8
Triodia pungens	2	0.4
Triodia vanleeuwenii	3	0.3
Triodia wiseana	1	0.4

Site: HDR07
Location: HD2 Detailed Survey Area **Type:** Relevé
Phase 1 Date: 5/11/2017 **Phase 2 Date:** 20/05/2018 **Described by:** DL
MGA Zone: 50 **Easting:** 705797 **Northing:** 7445560
Habitat: Hillcrest
Soil: Brown sandy loam
Rock type: Ironstone, Dolerite
Vegetation code: H10
Vegetation: *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia inaequilatera*, *A. synchronicia* open shrubland over *Eremophila jucunda* subsp. *pulcherrima*, *Senna artemisioides* subsp. *oligophylla* scattered low shrubs over *Triodia wiseana* hummock grassland with *Cymbopogon ambiguus*, *Eulalia aurea* very open tussock grassland
Vegetation Condition: Very Good
Fire Age: 5-10 years



Species List:

Name	Cover (%)	Height (m)
Acacia ?ancistrocarpa	0.1	1.7
Acacia aptaneura	0.1	2.2
Acacia bivenosa	0.1	0.4
Acacia ?catenulata	0.1	3.0
Acacia inaequilatera	1	1.9
Acacia synchronicia	1	1.7
Acacia tetragonophylla	0.1	1.6
Aristida contorta	0.1	0.15
Boerhavia coccinea	0.1	0.2
Capparis lasiantha	0.1	0.4
Corchorus lasiocarpus subsp. *parvus*	0.1	0.5
Cymbopogon ambiguus	1	0.5
Dipteracanthus australasicus subsp. *australasicus*	0.1	0.1
Enneapogon caerulescens	0.1	0.15
Enneapogon polyphyllus	0.1	0.2

Name	Cover (%)	Height (m)
Eremophila forrestii subsp. *forrestii*	0.1	0.4
Eremophila jucunda subsp. *pulcherrima*	0.5	1.0
Eriachne benthamii	0.1	0.4
Eucalyptus leucophloia subsp. *leucophloia*	0.5	3.0
Eucalyptus repullulans	0.1	3.0
Eulalia aurea	1	0.3
Euphorbia australis var. *subtomentosa*	0.1	0.05
Euphorbia sp.	0.1	0.2
Evolvulus alsinoides var. *villosicalyx*	0.1	0.1
Goodenia prostrata	0.1	0.2
Hakea lorea subsp. *lorea*	0.1	0.5
Hibiscus coatesii	0.1	0.4
Jasminum didymum subsp. *lineare*	0.1	twiner
Paraneurachne muelleri	0.1	0.15
Portulaca oleracea	0.1	0.1
Pterocaulon sp.	0.1	0.1
Ptilotus astrolasius	0.1	0.4
Ptilotus exaltatus	0.1	0.1
Ptilotus obovatus	0.1	0.35
Rhagodia eremaea	0.1	1.2
Rhynchosia minima	0.1	twiner
Salsola australis	0.1	0.2
Santalum lanceolatum	0.1	2.5
Senna artemisioides subsp. *oligophylla*	0.5	0.5
Senna glutinosa subsp. *glutinosa*	0.1	2.5
Sida fibulifera	0.1	0.2
Sida sp. Articulation below (A.A. Mitchell PRP 1605)	0.1	0.7
Solanum cleistogamum	0.1	0.25
Solanum lasiophyllum	0.1	0.4
Sporobolus australasicus	0.1	0.1
Stackhousia muricata subsp. annual (W.R. Barker 2172)	0.1	0.35
Streptoglossa bubakii	0.1	0.2
Swainsona maccullochiana	0.1	0.4
Themeda triandra	1	0.6
Triodia wiseana	30	0.4
**Vachellia farnesiana*	0.1	1.3

* denotes weed species
? denotes unconfirmed ID

Site: HDR08
Location: HD2 Detailed Survey Area **Type:** Relevé
Phase 1 Date: 6/11/2017 **Phase 2 Date:** 23/05/2018 **Described by:** BE
MGA Zone: 50 **Easting:** 718185 **Northing:** 7450490
Habitat: Gully
Soil: Dark reddish brown sandy loam
Rock type: Ironstone
Vegetation code: D3
Vegetation: *Eucalyptus leucophloia* subsp. *leucophloia*, *Corymbia ferriticola*, *C. opaca* low open woodland over *Grevillea wickhamii* subsp. *hispidula*, *Dodonaea viscosa* subsp. *spatulata*, *Acacia hamersleyensis* tall open shrubland over *Triodia pungens* very open hummock grassland with *Themeda* sp. Mt Barricade (M.E. Trudgen 2471), (*Eriachne mucronata*) open tussock grassland
Vegetation Condition: Excellent
Fire Age: No fire evident



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	0.1	2.6
Acacia bivenosa	0.1	1.3
Acacia hamersleyensis	2	3.2
Acacia pruinocarpa	0.1	0.6
Acacia pyrifolia	0.1	1.5
Acacia sibirica x	0.1	1.1
Androcalva luteiflora	0.1	1.4
Bulbostylis barbata	0.1	0.25
Cassytha capillaris	0.1	twiner
Clerodendrum tomentosum var. *lanceolatum*	0.1	0.3
Corchorus lasiocarpus subsp. *parvus*	0.1	0.2
Corymbia ferriticola	1	8.0
Corymbia hamersleyana sens. lat.	1	8.0
Cymbopogon ambiguus	0.1	0.7
Dodonaea pachyneura	0.1	1.5

Name	Cover (%)	Height (m)
Dodonaea viscosa subsp. *spatulata*	3	2.5
Duperreya commixta	0.1	twiner
Eremophila jucunda subsp. *pulcherrima*	0.1	0.5
Eriachne mucronata	1	0.4
Eucalyptus leucophloia subsp. *leucophloia*	1.5	5.0
Euphorbia coghlanii	0.1	0.2
Ficus brachypoda	0.1	2.2
Gompholobium oreophilum	0.1	0.8
Gossypium robinsonii	0.1	1.5
Grevillea wickhamii subsp. *hispidula*	4	2.5
Jasminum didymum subsp. *lineare*	0.1	twiner
Marsdenia australis	0.1	twiner
Maytenus sp. Mt Windell (S. van Leeuwen 846)	0.1	1.5
Pandorea pandorana	0.1	twiner
Petalostylis labicheoides	0.1	2.5
Psydrax latifolia	0.1	1.1
Ptilotus exaltatus	0.1	0.2
Santalum lanceolatum	0.1	2.1
Senna artemisioides subsp. *oligophylla*	0.1	0.3
Senna ferraria	0.1	1.3
Senna glutinosa subsp. *glutinosa*	0.1	1.2
Sida sp. Excedentifolia (J.L. Egan 1925)	0.1	0.2
Stylobasium spathulatum	0.1	3.0
Themeda sp. Mt Barricade (M.E. Trudgen 2471)	20	0.7
Triodia pungens	5	0.6

Site: HDR09
Location: HD2 Detailed Survey Area **Type:** Relevé
Phase 1 Date: 7/11/2017 **Phase 2 Date:** 28/05/2018 **Described by:** DL
MGA Zone: 50 **Easting:** 704557 **Northing:** 7444346
Habitat: Hillslope
Soil: Brown sandy clay loam
Rock type: Ironstone, Mudstone
Vegetation code: H7
Vegetation: *Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Acacia catenulata* subsp. *occidentalis* scattered tall shrubs over *Grevillea berryana*, *Scaevola acacioides* scattered shrubs *over Maireana georgei* scattered low shrubs over *Triodia wiseana*, *T. vanleeuwenii* open hummock grassland with *Goodenia stobbsiana* scattered herbs
Vegetation Condition: Excellent
Fire Age: 5-10 years



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	0.1	3.0
Acacia arida	0.1	0.7
Acacia catenulata subsp. *occidentalis*	0.5	4.0
Acacia incurvaneura	0.1	2.5
Acacia kempeana	0.1	1.4
Acacia maitlandii	0.1	1.8
Acacia pteraneura	0.1	2.0
Acacia sibirica	0.1	0.6
Acacia tenuissima	0.1	0.6
Acacia tetragonophylla	0.1	2.1
Aristida sp.	0.1	0.2
Capparis lasiantha	0.1	0.8
Codonocarpus cotinifolius	0.1	2.5
Eriachne pulchella subsp. *pulchella*	0.1	0.2
Eucalyptus leucophloia subsp. *leucophloia*	2	7.0

Name	Cover (%)	Height (m)
Goodenia stobbsiana	1	0.3
Grevillea berryana	0.5	1.5
Hibiscus coatesii	0.1	0.4
Maireana georgei	0.5	0.4
Ptilotus calostachyus	0.1	0.3
Scaevola acacioides	0.5	1.1
Senna glutinosa subsp. *glutinosa*	0.1	1.5
Senna glutinosa subsp. x *luerssenii*	0.1	1.9
Triodia vanleeuwenii	10	0.45
Triodia wiseana	10	0.5

Site: HDR10
Location: HD2 Detailed Survey Area **Type:** Relevé
Phase 1 Date: 9/11/2017 **Phase 2 Date:** 22/05/2018 **Described by:** LD
MGA Zone: 50 **Easting:** 710598 **Northing:** 7451383
Habitat: Hillslope
Soil: Dark reddish brown sandy loam
Rock type: Ironstone
Vegetation code: H4
Vegetation: *Senna sericea*, *Sida* sp. Excedentifolia (J.L. Egan 1925) low open shrubland over *Triodia wiseana* open hummock grassland
Vegetation Condition: Excellent
Fire Age: 0-2 years



Species List:

Name	Cover (%)	Height (m)
Aristida holathera var. *holathera*	0.1	0.2
Cymbopogon obtectus	0.1	0.4
Enneapogon polyphyllus	0.1	0.1
Eriachne aristidea	0.1	0.2
Eriachne pulchella	0.1	0.1
Eucalyptus leucophloia subsp. *leucophloia*	0.1	0.6
Gomphrena cunninghamii	0.1	0.1
Goodenia microptera	0.1	0.2
Goodenia stobbsiana	0.1	0.2
Lepidium pholidogynum	0.1	0.2
Maireana georgei	0.1	0.2
Oldenlandia crouchiana	0.1	0.1
Paraneurachne muelleri	0.1	0.4
Paspalidium clementii	0.1	0.1
Peripleura virgata	0.1	0.2
Pterocaulon sphacelatum	0.1	0.2

Name	Cover (%)	Height (m)
Ptilotus astrolasius	0.1	0.3
Ptilotus calostachyus	0.1	0.5
Ptilotus exaltatus	0.1	0.3
Schizachyrium fragile	0.1	0.1
Senna glutinosa subsp. *glutinosa*	0.1	1.2
Senna glutinosa subsp. *pruinosa*	0.1	0.7
Senna sericea	1	0.8
Sida sp. Excedentifolia (J.L. Egan 1925)	1	0.2
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	0.1	0.3
Tephrosia oxalidea	0.1	0.1
Triodia wiseana	18	0.8

Site: HDR11
Location: HD2 Detailed Survey Area **Type:** Relevé
Phase 1 Date: 6/11/2017 **Phase 2 Date:** 28/05/2018 **Described by:** LD
MGA Zone: 50 **Easting:** 716314 **Northing:** 7450887
Habitat: Hillslope
Soil: Dark reddish brown sandy clay loam
Rock type: Ironstone
Vegetation code: H4
Vegetation: *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Lepidium catapycnon* scattered low shrubs over *Triodia wiseana* very open hummock grassland
Vegetation Condition: Excellent
Fire Age: 0-2 years



Species List:

Name	Cover (%)	Height (m)
Acacia bivenosa	0.1	0.3
Acacia pruinocarpa	0.1	0.5
Acacia synchronicia	0.1	0.2
Amphipogon sericeus	0.1	0.2
Aristida contorta	0.1	0.1
Cymbopogon ambiguus	0.1	0.5
Dampiera candicans	0.1	0.3
Dodonaea coriacea	0.1	0.3
Enneapogon caerulescens	0.1	0.1
Enneapogon polyphyllus	0.1	0.1
Eriachne pulchella subsp. *pulchella*	0.1	0.1
Eucalyptus leucophloia subsp. *leucophloia*	0.5	1.2
Gomphrena cunninghamii	0.1	0.1
Goodenia stobbsiana	0.1	0.2
Lepidium catapycnon P4	0.5	0.5
Paraneurachne muelleri	0.1	0.3

Name	Cover (%)	Height (m)
Paspalidium clementii	0.1	0.1
Ptilotus astrolasius	0.1	0.3
Ptilotus calostachyus	0.1	0.4
Ptilotus exaltatus	0.1	0.3
Ptilotus mollis P4	0.1	0.5
Salsola australis	0.1	0.3
Schizachyrium fragile	0.1	0.1
Senna artemisioides subsp. *oligophylla*	0.1	0.5
Senna glutinosa subsp. *glutinosa*	0.1	0.7
Senna glutinosa subsp. *pruinosa*	0.1	0.4
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	0.1	0.3
Solanum cleistogamum	0.1	0.1
Tephrosia oxalidea	0.1	0.1
Triodia wiseana	8	0.1
Triumfetta chaetocarpa	0.1	0.2

Site: HDR12
Location: HD2 Detailed Survey Area **Type:** Relevé
Phase 1 Date: 10/11/2017 **Phase 2 Date:** 23/05/2018 **Described by:** BE
MGA Zone: 50 **Easting:** 720995 **Northing:** 7451577
Habitat: Hillslope
Soil: Dark reddish brown sandy loam
Rock type: Ironstone
Vegetation code: H4
Vegetation: *Senna glutinosa* subsp. *pruinosa* scattered shrubs over *Sida* sp. Pilbara (A.A. Mitchell PRP 1543) low open shrubland over *Triodia wiseana* open hummock grassland with *Amphipogon sericeus* scattered tussock grasses
Vegetation Condition: Excellent
Fire Age: 0-2 years



Species List:

Name	Cover (%)	Height (m)
Acacia bivenosa	0.1	0.6
Amphipogon sericeus	0.5	0.3
Cymbopogon ambiguus	0.1	0.7
Enneapogon caerulescens	0.1	0.1
Eriachne pulchella subsp. *dominii*	0.1	0.3
Eucalyptus leucophloia subsp. *leucophloia*	0.1	1.2
Gomphrena cunninghamii	0.1	0.1
Goodenia stobbsiana	0.1	0.3
Grevillea wickhamii subsp. *hispidula*	0.1	0.7
Lepidium catapycnon P4	0.1	0.2
Maireana georgei	0.1	0.2
Oldenlandia crouchiana	0.1	0.2
Paraneurachne muelleri	0.1	0.4
Paspalidium clementii	0.1	0.1
Peripleura virgata	0.1	0.2

Name	Cover (%)	Height (m)
Pluchea dentex	0.1	0.25
Pterocaulon sphacelatum	0.1	0.2
Ptilotus calostachyus	0.1	0.6
Ptilotus clementii	0.1	0.2
Ptilotus exaltatus	0.1	0.4
Schizachyrium fragile	0.1	0.1
Sclerolaena densiflora	0.1	0.1
Senna glutinosa subsp. *glutinosa*	0.1	1.2
Senna glutinosa subsp. *pruinosa*	1	1.2
Senna glutinosa subsp. x *luerssenii*	0.1	1.2
Sida sp. Excedentifolia (J.L. Egan 1925)	0.1	0.6
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	2	0.5
Solanum horridum	0.1	0.3
Solanum phlomoides	0.1	0.3
Streptoglossa sp.	0.1	0.1
Triodia vanleeuwenii	0.1	0.2
Triodia wiseana	15	0.3

Site: HDR13
Location: HD2 Detailed Survey Area **Type:** Relevé
Phase 1 Date: 7/11/2017 **Phase 2 Date:** 28/05/2018 **Described by:** DL
MGA Zone: 50 **Easting:** 699687 **Northing:** 7443423
Habitat: Hillcrest
Soil: Dark reddish brown sandy clay loam
Rock type: Ironstone
Vegetation code: H7
Vegetation: *Corymbia deserticola* subsp. *deserticola* scattered low trees with *Eucalyptus gamophylla* low open mallee woodland over *Acacia ancistrocarpa* tall open shrubland over *Gompholobium oreophilum* scattered low shrubs over *Triodia vanleeuwenii* open hummock grassland
Vegetation Condition: Excellent
Fire Age: 0-2 years



Species List:

Name	Cover (%)	Height (m)
Acacia ancistrocarpa	4	2.2
Acacia bivenosa	0.1	1.2
Amphipogon sericeus	0.1	0.2
Aristida holathera var. *holathera*	0.1	0.2
Calytrix carinata	0.1	0.4
Corchorus lasiocarpus subsp. *parvus*	0.1	0.2
Corymbia deserticola subsp. *deserticola*	1	4.0
Cucumis variabilis	0.1	twiner
Eucalyptus gamophylla	2	4.0
Eucalyptus leucophloia subsp. *leucophloia*	0.1	4.0
Gompholobium oreophilum	0.5	0.3
Goodenia stobbsiana	0.1	0.3
Goodenia triodiophila	0.1	0.2
Hakea chordophylla	0.1	2.5
Hibiscus coatesii	0.1	0.4

Name	Cover (%)	Height (m)
Indigofera monophylla	0.1	0.3
Jasminum didymum subsp. *lineare*	0.1	twiner
Ptilotus astrolasius	0.1	0.3
Ptilotus calostachyus	0.1	0.5
Scaevola acacioides	0.1	0.5
Scaevola parvifolia subsp. *pilbarae*	0.1	0.3
Senna glaucifolia	0.1	1.5
Senna notabilis	0.1	0.2
Seringia sp.	0.1	0.2
Solanum lasiophyllum	0.1	0.4
Solanum phlomoides	0.1	0.4
Triodia vanleeuwenii	20	0.5

Site: HDR14
Location: HD2 Detailed Survey Area **Type:** Relevé
Phase 1 Date: 10/11/2017 **Phase 2 Date:** 23/05/2018 **Described by:** DL
MGA Zone: 50 **Easting:** 720459 **Northing:** 7452184
Habitat: Hillslope
Soil: Dark reddish brown sandy loam
Rock type: Ironstone
Vegetation code: H3
Vegetation: *Acacia inaequilatera*, *Hakea chordophylla* tall open shrubland over *Gompholobium oreophilum*, *Dampiera candicans* low open shrubland over *Triodia vanleeuwenii* open hummock grassland with *Amphipogon sericeus* scattered tussock grasses
Vegetation Condition: Excellent
Fire Age: 0-2 years



Species List:

Name	Cover (%)	Height (m)
Acacia inaequilatera	2	3.0
Acacia marramamba	0.1	0.5
Acacia monticola	0.1	0.3
Acacia spondylophylla	0.1	0.3
Acacia tenuissima	0.1	0.5
Amphipogon sericeus	1	0.3
Bulbostylis barbata	0.1	0.1
Clerodendrum floribundum var. *angustifolium*	0.1	2.5
Corchorus lasiocarpus subsp. *parvus*	0.1	0.4
Cymbopogon obtectus	0.1	0.5
Dampiera candicans	1	0.3
Gompholobium oreophilum	2	0.3
Goodenia stobbsiana	0.1	0.3
Goodenia triodiophila	0.1	0.3
Grevillea wickhamii subsp. *hispidula*	0.1	1.2

Name	Cover (%)	Height (m)
Hakea chordophylla	1	3.2
Indigofera monophylla	0.1	0.2
Ptilotus calostachyus	0.1	0.4
Ptilotus rotundifolius	0.1	0.4
Senna glutinosa subsp. *glutinosa*	0.1	0.9
Senna glutinosa subsp. *pruinosa*	0.1	0.5
Senna notabilis	0.1	0.3
Sida arenicola	0.1	1.6
Solanum horridum	0.1	0.2
Solanum phlomoides	0.1	0.8
Triodia vanleeuwenii	12	0.2

Site: HDR16
Location: HD2 Detailed Survey Area **Type:** Relevé
Phase 1 Date: 11/11/2017 **Phase 2 Date:** 29/05/2018 **Described by:** DL
MGA Zone: 50 **Easting:** 708501 **Northing:** 7451135
Habitat: Hillslope
Soil: Dark reddish brown sandy loam
Rock type: Ironstone
Vegetation code: H3
Vegetation: *Acacia inaequilatera* scattered tall shrubs over *Senna glutinosa* subsp. *pruinosa* scattered shrubs over *A. bivenosa* scattered low shrubs over *Triodia vanleeuwenii* open hummock grassland with *Amphipogon sericeus*, *Themeda* sp. Mt Barricade (M.E. Trudgen 2471) very open tussock grassland
Vegetation Condition: Excellent
Fire Age: 0-2 years



Species List:

Name	Cover (%)	Height (m)
Acacia bivenosa	0.5	0.7
Acacia inaequilatera	1	2.1
Adriana tomentosa var. *tomentosa*	0.1	0.4
Amphipogon sericeus	2	0.4
Androcalva luteiflora	0.1	0.6
Cymbopogon obtectus	0.1	0.5
Enneapogon lindleyanus	0.1	0.4
Eucalyptus leucophloia subsp. *leucophloia*	0.1	3.0
Fimbristylis dichotoma	0.1	0.3
Goodenia sp.	0.1	0.3
Goodenia stobbsiana	0.1	0.3
Gossypium robinsonii	0.1	1.2
Hakea chordophylla	0.1	0.8
Heliotropium inexplicitum	0.1	0.05
Hibiscus sturtii var. *campylochlamys*	0.1	0.4

Name	Cover (%)	Height (m)
Hibiscus sturtii var. *platychlamys*	0.1	0.5
Indigofera monophylla	0.1	0.3
Paraneurachne muelleri	0.1	0.3
Paspalidium clementii	0.1	0.2
Polycarpaea holtzei	0.1	0.05
Ptilotus astrolasius	0.1	0.8
Ptilotus calostachyus	0.1	1.2
Ptilotus exaltatus	0.1	0.3
Ptilotus obovatus	0.1	0.5
Ptilotus rotundifolius	0.1	0.7
Senna artemisioides subsp. *oligophylla*	0.1	1.4
Senna glutinosa subsp. *glutinosa*	0.1	0.9
Senna glutinosa subsp. *pruinosa*	0.5	1.5
Senna notabilis	0.1	0.2
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	0.1	0.6
Solanum lasiophyllum	0.1	0.5
Themeda sp. Mt Barricade (M.E. Trudgen 2471)	0.5	0.6
Triodia vanleeuwenii	25	0.2
Triodia wiseana	0.1	0.3

Site: HDR18
Location: HD2 Detailed Survey Area **Type:** Relevé
Phase 2 Date: 28/05/2018 **Described by:** DL
MGA Zone: 50 **Easting:** 700267 **Northing:** 7444557
Habitat: Channel
Soil: Reddish brown sandy clay loam
Rock type: Ironstone
Vegetation code: D5
Vegetation: *Eucalyptus xerothermica*, (*E. camaldulensis* subsp. *obtusa*) low open woodland over *Dodonaea petiolaris* scattered low shrubs over *Themeda triandra*, (*Eulalia aurea*) tussock grassland
Vegetation Condition: Excellent
Fire Age: 5-10 years



Species List:

Name	Cover (%)	Height (m)
Abutilon otocarpum	0.1	0.6
Acacia bivenosa	0.1	1.0
Acacia dictyophleba	0.1	1.2
Acacia maitlandii	0.1	0.2
Androcalva luteiflora	0.1	0.7
Aristida contorta	0.1	0.3
Corchorus lasiocarpus subsp. *parvus*	0.1	0.2
Crotalaria medicaginea var. *neglecta*	0.1	0.5
Cymbopogon obtectus	0.1	0.6
Dodonaea petiolaris	1	0.7
Enneapogon lindleyanus	0.1	0.4
Eucalyptus camaldulensis subsp. *obtusa*	1	2.5
Eucalyptus xerothermica	6	8.0
Eulalia aurea	10	0.6
Euphorbia biconvexa/coghlanii/trigonosperma	0.1	0.3
Gossypium robinsonii	0.1	1.5

Name	Cover (%)	Height (m)
Gossypium sturtianum var. *sturtianum*	0.1	0.5
Indigofera monophylla	0.1	0.3
Jasminum didymum subsp. *lineare*	0.1	twiner
Petalostylis labicheoides	0.1	1.9
Pterocaulon sp.	0.1	0.4
Rhynchosia minima	0.1	twiner
Senna artemisioides subsp. x *artemisioides*	0.1	0.5
Stemodia grossa	0.1	0.2
Themeda triandra	35	0.8
Triodia longiceps	0.1	0.3

Site: HDR19
Location: HD2 Detailed Survey Area **Type:** Relevé
Phase 2 Date: 28/05/2018 **Described by:** DL
MGA Zone: 50 **Easting:** 702535 **Northing:** 7446647
Habitat: Drainage depression
Soil: Red brown silty clay
Rock type: Ironstone
Vegetation code: D2
Vegetation: *Acacia pruinocarpa*, (*A. catenulata* subsp. *occidentalis*, *A. aptaneura*) tall shrubland over *Psydrax latifolia* scattered low shrubs over *Triodia pungens* open hummock grassland
Vegetation Condition: Excellent
Fire Age: >10 years



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	3	3.0
Acacia ayersiana	0.1	3.0
Acacia catenulata subsp. *occidentalis*	3	4.0
Acacia citrinoviridis	0.1	1.9
Acacia incurvaneura	0.1	3.0
Acacia pruinocarpa	7.5	4.0
Acacia tenuissima	0.1	1.8
Aristida contorta	0.1	0.3
Aristida holathera var. *holathera*	0.1	0.2
Aristida inaequiglumis	0.1	0.6
**Bidens bipinnata*	0.1	0.2
Cymbopogon obtectus	0.1	0.3
Cymbopogon sp.	0.1	0.2
Duperreya commixta	0.1	twiner
Enchylaena tomentosa var. *tomentosa*	0.1	0.3
Enneapogon lindleyanus	0.1	0.5

Name	Cover (%)	Height (m)
Eriachne pulchella	0.1	0.2
Maireana tomentosa subsp. *tomentosa*	0.1	0.2
Paraneurachne muelleri	0.1	0.2
Petalostylis labicheoides	0.1	4.0
Psydrax latifolia	0.5	0.7
Ptilotus exaltatus	0.1	0.2
Ptilotus obovatus	0.1	0.4
Salsola australis	0.1	0.3
Santalum lanceolatum	0.1	2.0
Sida fibulifera	0.1	0.3
Solanum lasiophyllum	0.1	0.7
Sporobolus australasicus	0.1	0.3
Triodia pungens	25	0.7

* denotes weed species

Site: BHD05-AR
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 27/05/2019 **Described by:** KMc
MGA Zone: 50 **Easting:** 714531 **Northing:** 7453713
Habitat: Hillslope
Soil: Dark reddish brown Sandy clay loam
Rock type: Ironstone
Vegetation code: H7
Vegetation: *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* sens. lat. low open woodland over *Petalostylis labicheoides* and *Grevillea wickhamii* subsp. *hispidula* tall shrubland over *Mirbelia viminalis* low open shrubland over *Triodia wiseana* and *Triodia vanleeuwenii* very open hummock grassland
Vegetation Condition: Good
Fire Age: 2-5 years



Species List:

Name	Cover (%)	Height (m)
Acacia hamersleyensis	0.1	0.8
Acacia hilliana	0.1	0.3
Acacia maitlandii	0.1	0.8
Acacia monticola	0.1	1.9
Amphipogon sericeus	0.1	0.3
Corchorus lasiocarpus subsp. *lasiocarpus*	0.1	0.3
Corymbia hamersleyana sens lat.	1	5
Dampiera candicans	0.1	0.3
Dodonaea coriacea	0.1	0.7
Eriachne mucronata	0.1	0.2
Eucalyptus leucophloia subsp. *leucophloia*	1	5
Goodenia stobbsiana	0.1	0.1
Grevillea wickhamii subsp. *hispidula*	2	2.5
Mirbelia viminalis	6	0.5

Name	Cover (%)	Height (m)
Petalostylis labicheoides	9	3.5
Ptilotus calostachyus	0.1	0.5
Ptilotus exaltatus	0.1	0.5
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	0.1	0.3
Solanum lasiophyllum	0.1	0.6
Triodia vanleeuwenii	1	0.15
Triodia wiseana	5	0.2

Site: BHD10-AR
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 25/05/2019 **Described by:** KMc
MGA Zone: 50 **Easting:** 708769 **Northing:** 7452817
Habitat: Hillslope
Soil: Dark reddish brown Silty clay loam
Rock type: Ironstone
Vegetation code: H8
Vegetation: *Eucalyptus gamophylla* scattered low trees over *Acacia inaequilatera* tall open shrubland over *Triodia vanleeuwenii* and *Triodia pungens* open hummock grassland
Vegetation Condition: Poor
Fire Age: Very long unburnt



Species List:

Name	Cover (%)	Height (m)
Acacia adsurgens	0.1	1.1
Acacia bivenosa	0.1	1.8
Acacia inaequilatera	3	4
Acacia pruinocarpa	0.5	2.3
Amphipogon sericeus	0.1	0.2
Aristida contorta	0.1	0.4
Aristida holathera var. *holathera*	0.1	0.3
Codonocarpus cotinifolius	0.1	3
Corymbia deserticola subsp. *deserticola*	0.5	4
Cymbopogon obtectus	0.1	0.2
Duperreya commixta	0.1	0.3
Enneapogon caerulescens	0.1	0.2
Enneapogon lindleyanus	0.1	0.3
Eriachne mucronata	0.1	0.2
Eucalyptus gamophylla	1	3.8

Name	Cover (%)	Height (m)
Goodenia stobbsiana	0.1	0.3
Hakea chordophylla	0.1	2.7
Heliotropium sp.	0.1	0.2
Hybanthus aurantiacus	0.1	0.1
Indigofera monophylla	0.1	0.2
Ptilotus astrolasius	0.1	0.4
Ptilotus calostachyus	0.1	0.6
Ptilotus exaltatus	0.1	0.05
Ptilotus obovatus	0.1	0.5
Ptilotus rotundifolius	0.1	1.1
Rhagodia eremaea	0.1	0.6
Senna artemisioides subsp. *helmsii*	0.1	0.5
Senna artemisioides subsp. *oligophylla*	0.1	0.3
Senna glutinosa subsp. *× luerssenii*	0.1	1.9
Senna glutinosa subsp. *glutinosa*	0.1	2.6
Senna glutinosa subsp. *pruinosa*	0.1	1.2
Senna sp. Meekatharra (E. Bailey 1-26) × *glaucifolia*	0.1	1.4
Themeda triandra	0.1	0.2
Triodia pungens	4	0.4
Triodia vanleeuwenii	25	0.4

Site: GH01
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 21/05/2019 **Described by:** LD
MGA Zone: 50 **Easting:** 700354 **Northing:** 7446915
Habitat: Minor creek
Soil: Dark reddish brown Clay loam
Rock type: Ironstone
Vegetation code: D5
Vegetation: *Eucalyptus xerothermica* scattered low trees over *Acacia pyrifolia* var. *pyrifolia*, *Petalostylis labicheoides* and *Acacia maitlandii* tall open shrubland over **Bidens bipinnata* scattered low shrubs over *Triodia longiceps* very open hummock grassland with *Themeda triandra* and *Chrysopogon fallax* open tussock grassland
Vegetation Condition: Very Good
Fire Age: 5-10 years



Species List:

Name	Cover (%)	Height (m)
Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)	0.1	0.2
Acacia aptaneura	0.1	4
Acacia maitlandii	1	3
Acacia pruinocarpa	0.1	2.2
Acacia pyrifolia	4	2.2
Alternanthera nana	0.1	0.2
Androcalva luteiflora	0.1	1.1
**Bidens bipinnata*	1	0.2
Boerhavia coccinea	0.1	0
Bulbostylis turbinata	0.1	0.1
Chrysocephalum apiculatum subsp. *pilbarense*	0.1	0.1
Chrysopogon fallax	2	0.8
Cleome viscosa	0.1	0.2
Corchorus tridens	0.1	0.1

Name	Cover (%)	Height (m)
Crotalaria medicaginea var. *neglecta*	0.1	0.2
**Cynodon dactylon*	0.1	0.2
**Datura leichhardtii* subsp. *leichhardtii*	0.1	0.1
Dichanthium sericeum subsp. *humilius*	0.1	0.2
Duperreya commixta	0.1	0
Dysphania rhadinostachya subsp. *rhadinostachya*	0.1	0.1
Enneapogon polyphyllus	0.1	0.3
Eragrostis cumingii	0.1	0.1
Eragrostis tenellula	0.1	0.1
Eremophila longifolia	0.1	1.4
Eriachne pulchella subsp. *dominii*	0.1	0.1
Eucalyptus xerothermica	1	7
Eulalia aurea	0.1	0.8
Euphorbia biconvexa	0.1	0.1
Evolvulus alsinoides var. *decumbens*	0.1	0.1
Evolvulus alsinoides var. *villosicalyx*	0.1	0.1
**Flaveria trinervia*	0.1	0.2
Goodenia stellata	0.1	0.1
Haloragis odontocarpa	0.1	0.3
Indigofera georgei	0.1	0.4
Iseilema eremaeum	0.1	0.1
Isotropis sp. Arid zone (G. Byrne 2775)	0.1	0.4
Jasminum didymum subsp. *lineare*	0.1	0
**Malvastrum americanum*	0.1	0.2
Nicotiana sp.	0.1	0.2
Paraneurachne muelleri	0.1	0.2
Paspalidium clementii	0.1	0.1
Paspalidium rarum	0.1	0.1
Petalostylis labicheoides	2	3
Pluchea rubelliflora	0.1	0.2
Pterocaulon serrulatum var. *velutinum*	0.1	0.1
Pterocaulon sphacelatum	0.1	0.2
Ptilotus obovatus	0.1	0.1
Rhagodia sp. Hamersley (M. Trudgen 17794) P3	0.1	1.8
Rhynchosia minima	0.1	0
Scaevola amblyanthera var. *centralis*	0.1	0.2
Senna stricta	0.1	2.2
Sida fibulifera	0.1	0.2
Themeda triandra	12	0.8

Name	Cover (%)	Height (m)
Trigastrotheca molluginea	0.1	0.1
Triodia longiceps	7	1.1
Triodia pungens	0.1	0.3
Vigna lanceolata var. *lanceolata*	0.1	0

* denotes weed species

Site: GH02
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 21/05/2019 **Described by:** DR
MGA Zone: 50 **Easting:** 705808 **Northing:** 7448628
Habitat: Stony clay plain
Soil: Red brown Clay loam
Rock type: Ironstone
Vegetation code: P3
Vegetation: *Acacia aptaneura*, *Acacia catenulata* subsp. *occidentalis* and *Acacia pruinocarpa* tall shrubland over *Eremophila forrestii* subsp. *forrestii* open shrubland over *Triodia pungens* and *Triodia vanleeuwenii* open hummock grassland
Vegetation Condition: Excellent
Fire Age: >10 years



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	14	6.5
Acacia ayersiana	0.5	2
Acacia catenulata subsp. *occidentalis*	5	6.5
Acacia pachyacra	0.1	0.9
Acacia pruinocarpa	1.5	2.8
Corymbia deserticola subsp. *deserticola*	0.1	4
Eremophila forrestii subsp. *forrestii*	9	1.8
Jasminum didymum subsp. *lineare*	0.1	1
Sida fibulifera	0.1	0.1
Sida sp. dark green fruits (S. van Leeuwen 2260)	0.1	0.2
Triodia pungens	12	0.4
Triodia vanleeuwenii	1	0.2

Site: GH03
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 21/05/2019 **Described by:** LD
MGA Zone: 50 **Easting:** 706346 **Northing:** 7448780
Habitat: *Minor* drainage
Soil: Reddish brown Sandy clay
Rock type: Ironstone
Vegetation code: D2
Vegetation: *Eucalyptus xerothermica* x *Eucalyptus tephrodes* open woodland over *Acacia aptaneura* and *Acacia pruinocarpa* tall shrubland over *Triodia pungens* very open hummock grassland
Vegetation Condition: Very Good
Fire Age: 5-10 years



Species List:

Name	Cover (%)	Height (m)
Abutilon fraseri subsp. *fraseri*	0.1	0.1
Acacia aptaneura	26	9
Acacia pruinocarpa	2	3.2
Aristida sp.	0.1	0.2
**Bidens bipinnata*	0.1	0.2
Cheilanthes sieberi subsp. *sieberi*	0.1	0.2
Chrysopogon fallax	0.1	0.4
Duperreya commixta	0.1	0
Enchylaena tomentosa var. *tomentosa*	0.1	0.4
Enneapogon polyphyllus	0.1	0.1
Eragrostis setifolia	0.1	0.3
Eremophila lanceolata	0.1	0.2
Eucalyptus xerothermica x *Eucalyptus tephrodes*	3	11
Maireana villosa	0.5	0.3
Petalostylis labicheoides	0.1	2

Name	Cover (%)	Height (m)
Psydrax suaveolens	0.1	2.1
Ptilotus obovatus	0.1	0.4
Sclerolaena cornishiana	0.1	0.2
Sida fibulifera	0.1	0.1
Solanum lasiophyllum	0.1	0.5
Triodia pungens	6	0.5

* denotes weed species

Site: GH04
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 22/05/2019 **Described by:** KMc
MGA Zone: 50 **Easting:** 702240 **Northing:** 7442818
Habitat: *Minor* creek
Soil: Orange brown Clay loam
Rock type: Dolerite, Ironstone
Vegetation code: D4
Vegetation: *Corymbia hamersleyana* sens. lat. and *Eucalyptus victrix* low open woodland over *Petalostylis labicheoides* scattered tall shrubs over *Gossypium sturtianum* var. *sturtianum* and *Androcalva luteiflora* open shrubland over *Eulalia aurea*, *Themeda triandra* and **Cenchrus ciliaris* tussock grassland
Vegetation Condition: Good
Fire Age: 5-10 years



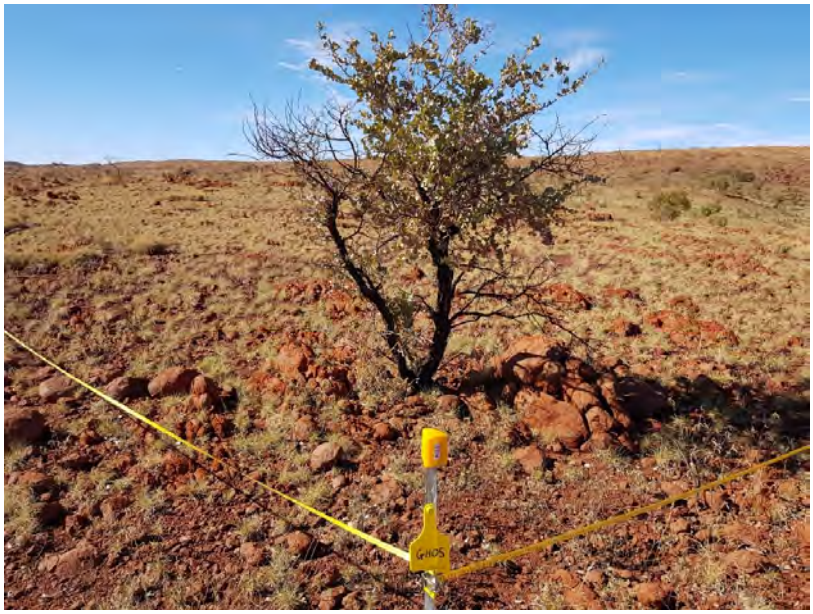
Species List:

Name	Cover (%)	Height (m)
Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)	0.1	1.6
Acacia bivenosa	0.1	2.3
Acacia dictyophleba	0.1	0.3
Acacia maitlandii	0.1	0.2
Acacia pyrifolia	0.1	1.4
Androcalva luteiflora	1	1.3
**Bidens bipinnata*	0.1	0.2
**Cenchrus ciliaris*	4	0.7
Cleome viscosa	0.1	0.1
Corchorus crozophorifolius	0.1	0.2
Corchorus tridens	0.1	0.05
Corymbia hamersleyana sens lat.	3	5
Cymbopogon ambiguus	1	0.8
Dodonaea lanceolata var. *lanceolata*	0.1	1.1

Name	Cover (%)	Height (m)
Duperreya commixta	0.1	0.4
Enneapogon caerulescens	0.1	0.3
Enneapogon polyphyllus	0.1	0.4
Eragrostis tenellula	0.1	0.1
Eremophila longifolia	0.1	1.6
Eriachne mucronata	0.1	0.4
Eucalyptus victrix	1	4
Eulalia aurea	25	0.8
Evolvulus alsinoides var. *decumbens*	0.1	0.1
**Flaveria trinervia*	0.1	0.1
Gossypium australe	0.1	0.4
Gossypium robinsonii	0.1	2.3
Gossypium sturtianum var. *sturtianum*	6	1.6
Grevillea wickhamii subsp. *hispidula*	0.1	1.8
Jasminum didymum subsp. *lineare*	0.1	0.6
Maytenus sp. Mt Windell (S. van Leeuwen 846)	0.1	1.1
Paraneurachne muelleri	0.1	0.3
Petalostylis labicheoides	1	2.3
Pluchea rubelliflora	0.1	0.2
Pterocaulon sphacelatum	0.1	0.3
Ptilotus obovatus	0.1	0.6
Rhynchosia minima	0.1	0.3
Santalum lanceolatum	0.1	1.3
Scaevola amblyanthera var. *centralis*	0.1	0.3
Senna glutinosa subsp. *glutinosa*	0.1	1.5
Sida sp. Articulation below (A.A. Mitchell PRP 1605)	0.4	0.3
Stemodia grossa	0.1	0.6
Themeda triandra	8	0.7
Triodia longiceps	0.1	0.4
Triodia wiseana	0.1	0.2

* denotes weed species

Site: GH05
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 22/05/2019 **Described by:** LD
MGA Zone: 50 **Easting:** 701982 **Northing:** 7442782
Habitat: Hillcrest
Soil: Reddish brown Silty clay loam
Rock type: Dolerite
Vegetation code: H12
Vegetation: *Acacia inaequilatera* scattered tall shrubs over *Corchorus lasiocarpus* subsp. *parvus* scattered low shrubs over *Triodia wiseana* open hummock grassland with *Cymbopogon ambiguus* scattered tussock grasses
Vegetation Condition: Excellent
Fire Age: 2-5 years



Species List:

Name	Cover (%)	Height (m)
Acacia bivenosa	0.1	1.1
Acacia dictyophleba	0.1	1.5
Acacia inaequilatera	0.5	2.5
Acacia maitlandii	0.1	0.6
Acacia marramamba	0.1	0.6
Acacia pyrifolia	0.1	1.2
Aristida contorta	0.1	0.2
Aristida holathera var. *holathera*	0.1	0.3
Bonamia pilbarensis	0.1	0.1
Cheilanthes lasiophylla	0.1	0.1
Corchorus lasiocarpus subsp. *parvus*	0.5	0.3
Cymbopogon ambiguus	0.5	0.5
Enneapogon caerulescens	0.1	0.1
Eriachne mucronata	0.1	0.3
Eucalyptus leucophloia subsp. *leucophloia*	0.1	0.8
Eulalia aurea	0.1	0.3

Name	Cover (%)	Height (m)
Euphorbia careyi	0.1	0.2
Goodenia stobbsiana	0.1	0.2
Hakea chordophylla	0.1	1
Heliotropium ovalifolium	0.1	0.2
Hibiscus sturtii var. *campylochlamys*	0.1	0.4
Pterocaulon sphacelatum	0.1	0.3
Ptilotus astrolasius	0.1	0.3
Ptilotus calostachyus	0.1	0.3
Senna artemisioides subsp. *oligophylla*	0.1	0.3
Senna glutinosa subsp. *glutinosa*	0.1	0.5
Senna glutinosa subsp. *pruinosa*	0.1	0.2
Solanum lasiophyllum	0.1	0.5
Themeda sp. Mt Barricade (M.E. Trudgen 2471)	0.1	0.3
Trichodesma zeylanicum var. *zeylanicum*	0.1	0.6
Tricoryne sp. Hamersley Range (S. van Leeuwen 915)	0.1	0.4
Triodia wiseana	20	0.1

Site: GH06
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 22/05/2019 **Described by:** DR
MGA Zone: 50 **Easting:** 701614 **Northing:** 7442789
Habitat: Hillslope
Soil: Brown Sandy loam
Rock type: Ironstone, Siltstone
Vegetation code: H10
Vegetation: *Eucalyptus socialis* subsp. *eucentrica* and *Eucalyptus repullulans* low open woodland over *Triodia wiseana* open hummock grassland
Vegetation Condition: Excellent
Fire Age: 2-5 years
Notes: Mallee resprouted from fire ca 3 years ago. Cover values lower than at climax community



Species List:

Name	Cover (%)	Height (m)
Acacia bivenosa	0.5	3.3
Cymbopogon ambiguus	0.1	0.5
Eucalyptus repullulans	2	3.5
Eucalyptus socialis subsp. *eucentrica*	4	3.5
Halgania cyanea	0.1	0.6
Hibiscus sp.	0.1	0.2
Paraneurachne muelleri	0.1	0.2
Ptilotus calostachyus	0.1	0.3
Ptilotus clementii	0.1	0.3
Ptilotus exaltatus	0.1	0.2
Senna artemisioides subsp. *oligophylla*	0.1	0.4
Triodia wiseana	20	0.4

Site: GH07
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 23/05/2019 **Described by:** KMc
MGA Zone: 50 **Easting:** 705303 **Northing:** 7446952
Habitat: Clay plain
Soil: Reddish brown Sandy clay
Rock type: Ironstone
Vegetation code: P3
Vegetation: *Acacia aptaneura*, *Acacia pruinocarpa* and *Acacia catenulata* subsp. *occidentalis* tall open scrub over *Triodia pungens* very open hummock grassland
Vegetation Condition: Very Good
Fire Age: >10 years



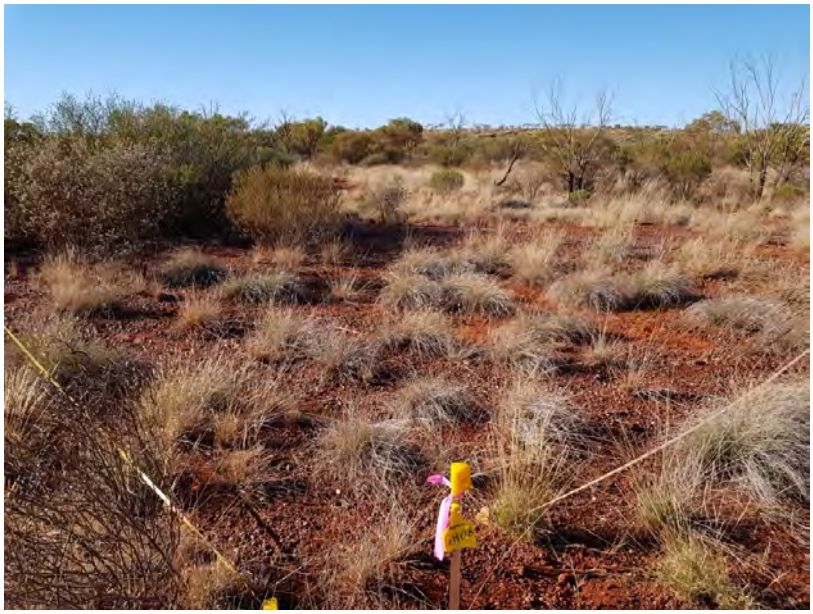
Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	1	2.9
Acacia ayersiana	0.1	2
Acacia catenulata subsp. *occidentalis*	5	5.5
Acacia pruinocarpa	8	6
Amyema hilliana	0.1	4
Aristida sp.	0.1	0.3
**Bidens bipinnata*	0.1	0.2
Cheilanthes sieberi subsp. *sieberi*	0.1	0.1
Eremophila aff. *clarkei*	0.1	1.7
Eremophila forrestii subsp. *forrestii*	0.1	0.5
Eremophila latrobei subsp. *filiformis*	0.1	1.6
Maireana villosa	0.1	0.3
Psydrax suaveolens	0.1	1.1
Ptilotus obovatus	0.1	0.5
Sida sp. dark green fruits (S. van Leeuwen 2260)	0.1	0.4
Solanum lasiophyllum	0.1	0.3

Name	Cover (%)	Height (m)
Triodia pungens	7	0.4

* denotes weed species

Site: GH08
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 23/05/2019 **Described by:** DR
MGA Zone: 50 **Easting:** 706745 **Northing:** 7446812
Habitat: Plain
Soil: Red brown Light clay
Rock type: Ironstone, Quartz
Vegetation code: P2
Vegetation: *Acacia tetragonophylla* and *Acacia aptaneura* tall open shrubland over *Eremophila forrestii* subsp. *forrestii* and *Senna artemisioides* subsp. x *artemisioides* open shrubland over *Aristida latifolia*, *Eragrostis xerophila* and *Eriachne obtusa* open tussock grassland
Vegetation Condition: Very Good
Fire Age: >10 years



Species List:

Name	Cover (%)	Height (m)
Abutilon malvifolium	0.1	0.05
Acacia aptaneura	1	3
Acacia pruinocarpa	0.1	4
Acacia synchronicia	0.1	0.3
Acacia tetragonophylla	2.5	2.8
Anthobolus leptomerioides	0.1	1.2
Aristida contorta	0.1	0.1
Aristida latifolia	15	0.5
Astrebla elymoides	0.1	0.5
Corchorus tridens	0.1	0.05
Crotalaria medicaginea var. *neglecta*	0.1	0.1
Cynodon convergens	0.1	0.01
**Datura leichhardtii* subsp. *leichhardtii*	0.1	0.1
Enchylaena tomentosa var. *tomentosa*	0.1	0.2
Enneapogon caerulescens	0.1	0.1

Name	Cover (%)	Height (m)
Enneapogon polyphyllus	0.1	0.1
Eragrostis xerophila	7	0.3
Eremophila forrestii subsp. *forrestii*	2	1.9
Eremophila latrobei subsp. *glabra*	0.1	0.5
Eriachne obtusa	5	0.4
Eucalyptus socialis subsp. *eucentrica*	0.1	3.2
Euphorbia biconvexa	0.1	0.01
Goodenia sp. (of interest)	0.1	0.01
Haloragis sp.	0.1	0.05
Hibiscus verdcourtii	0.1	0.1
Neptunia dimorphantha	0.1	0.1
Polymeria aff. *longifolia*	0.1	0.01
Ptilotus exaltatus	0.1	0.05
Ptilotus obovatus	0.1	0.2
Rhynchosia minima	0.1	0.1
Sclerolaena cornishiana	0.1	0.2
Senna artemisioides subsp. *× artemisioides*	2	1.9
Senna artemisioides subsp. *oligophylla*	0.1	0.3
Sida fibulifera	0.1	0.1
Solanum lasiophyllum	0.1	0.3
Sporobolus australasicus	0.1	0.1
Streptoglossa bubakii	0.1	0.3
Themeda triandra	0.1	0.7
Triodia wiseana	0.1	0.2
Vigna lanceolata var. *lanceolata*	0.1	0.1

* denotes weed species

Site: GH09
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 23/05/2019 **Described by:** KMc
MGA Zone: 50 **Easting:** 704696 **Northing:** 7446946
Habitat: Drainage depression
Soil: Reddish brown Clay loam
Rock type: Ironstone
Vegetation code: D2
Vegetation: *Eucalyptus xerothermica* scattered low trees over *Acacia aptaneura*, *Petalostylis labicheoides* and *Acacia catenulata* subsp. *occidentalis* tall open scrub over *Psydrax latifolia* scattered shrubs over *Triodia pungens* very open hummock grassland
Vegetation Condition: Very Good
Fire Age: >10 years



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	60	4
Acacia catenulata subsp. *occidentalis*	3	2.8
Aristida contorta	0.1	0.3
**Bidens bipinnata*	0.1	0.2
Cheilanthes sieberi subsp. *sieberi*	0.1	0.1
Chrysopogon fallax	0.1	0.2
Duperreya commixta	0.1	0.5
Eremophila aff. *clarkei*	0.1	0.5
Eucalyptus xerothermica	1	7
Maireana villosa	0.1	0.2
Petalostylis labicheoides	4	2.7
Psydrax latifolia	1	1.1
Psydrax suaveolens	0.1	0.5
Ptilotus obovatus	0.1	0.4
Senna artemisioides subsp. *filifolia*	0.1	1.7

Name	Cover (%)	Height (m)
Solanum ferocissimum	0.1	0.2
Teucrium teucriiflorum	0.1	0.3
Triodia pungens	4	0.4

* denotes weed species

Site: GH11
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 23/05/2019 **Described by:** KMc
MGA Zone: 50 **Easting:** 707864 **Northing:** 7450439
Habitat: Hillslope
Soil: Light reddish brown Silty clay
Rock type: Ironstone
Vegetation code: H2
Vegetation: *Acacia aptaneura* and *Acacia catenulata* subsp. *occidentalis* tall shrubland over *Dodonaea pachyneura* and *Senna stricta* open shrubland over *Triodia pungens* and *Triodia wiseana* very open hummock grassland with *Eriachne mucronata* and *Paraneurachne muelleri* very open tussock grassland
Vegetation Condition: Excellent
Fire Age: Very long unburnt



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	15	5
Acacia catenulata subsp. *occidentalis*	10	6.8
Acacia mulganeura	0.1	7
Acacia rhodophloia	0.1	5
**Bidens bipinnata*	0.1	0.1
Capparis lasiantha	0.1	0.8
Cheilanthes lasiophylla	0.1	0.5
Dodonaea pachyneura	1.5	1.8
Duperreya commixta	0.1	0
Enchylaena tomentosa var. *tomentosa*	0.1	0.3
Eremophila forrestii subsp. *forrestii*	0.1	0.8
Eremophila latrobei subsp. *filiformis*	0.1	1.6
Eremophila platycalyx subsp. *pardalota*	0.1	0.9
Eriachne mucronata	1	0.2
Eucalyptus leucophloia subsp. *leucophloia*	0.1	1.1

Name	Cover (%)	Height (m)
Grevillea saxicola P3	0.5	3.5
Hibiscus burtonii	0.1	0.4
Paraneurachne muelleri	1	0.2
Psydrax suaveolens	0.1	1.1
Ptilotus obovatus	0.1	0.9
Rhagodia sp. Hamersley (M. Trudgen 17794) P3	0.1	1.8
Santalum lanceolatum	0.1	2.1
Scaevola acacioides	0.1	2.1
Senna glutinosa subsp. *× luerssenii*	0.1	1.7
Senna stricta	1.5	1.9
Solanum lasiophyllum	0.1	0.2
Tribulus suberosus	0.1	1.2
Triodia pungens	2.5	0.4
Triodia wiseana	2.5	0.4

* denotes weed species

Site: GH12
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 23/05/2019 **Described by:** DR
MGA Zone: 50 **Easting:** 705873 **Northing:** 7448322
Habitat: Hillslope
Soil: Reddish brown Clay loam
Rock type: Ironstone
Vegetation code: H11
Vegetation: *Eucalyptus gamophylla* and *Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Acacia sibirica* tall open shrubland over *Triodia vanleeuwenii* open hummock grassland
Vegetation Condition: Excellent
Fire Age: Very long unburnt



Species List:

Name	Cover (%)	Height (m)
Acacia adoxa var. *adoxa*	0.1	0.3
Acacia aptaneura	0.1	2.3
Acacia bivenosa	0.1	0.6
Acacia hilliana	0.1	0.5
Acacia inaequilatera	0.1	2.7
Acacia maitlandii	0.5	2.5
Acacia marramamba	0.1	2.4
Acacia pruinocarpa	0.1	4.5
Acacia sibirica	1	2.3
Acacia tenuissima	0.1	1.4
Amphipogon sericeus	0.5	0.2
Anthobolus leptomerioides	0.1	0.3
Aristida holathera var. *holathera*	0.1	0.2
Aristida inaequiglumis	0.1	0.3
Corymbia deserticola subsp. *deserticola*	0.1	4.5
Cymbopogon ambiguus	0.1	0.1

Name	Cover (%)	Height (m)
Duperreya commixta	0.1	0.1
Enneapogon polyphyllus	0.1	0.2
Eragrostis eriopoda	0.1	0.2
Eremophila latrobei subsp. *latrobei*	0.1	0.5
Eucalyptus gamophylla	4	5
Eucalyptus leucophloia subsp. *leucophloia*	1.5	6
Fimbristylis sp.	0.1	0.1
Goodenia stobbsiana	0.1	0.3
Goodenia triodiophila	0.1	0.1
Hakea chordophylla	0.1	0.8
Halgania gustafsenii var. *gustafsenii*	0.1	0.5
Indigofera monophylla	0.1	0.4
Jasminum didymum subsp. *lineare*	0.1	0.3
Paraneurachne muelleri	0.1	0.4
Poaceae sp.	0.1	0.1
Polycarpaea longiflora	0.1	0.2
Psydrax suaveolens	0.1	2.1
Ptilotus calostachyus	0.1	0.4
Ptilotus rotundifolius	0.1	0.5
Senna glaucifolia	0.1	1.6
Senna glutinosa subsp. *× luerssenii*	0.1	0.1
Senna glutinosa subsp. *glutinosa*	0.1	1.6
Sida arenicola	0.1	0.3
Solanum lasiophyllum	0.1	1.6
Triodia pungens	0.5	0.6
Triodia vanleeuwenii	18	0.3

Site: GH13
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 24/05/2019 **Described by:** DR
MGA Zone: 50 **Easting:** 708216 **Northing:** 7448362
Habitat: Minor drainage
Soil: Brown Clay loam
Rock type: Ironstone
Vegetation code: D8
Vegetation: *Eucalyptus xerothermica* low open woodland over *Acacia aptaneura* tall open shrubland over *Themeda triandra* open tussock grassland
Vegetation Condition: Very Good
Fire Age: >10 years



Species List:

Name	Cover (%)	Height (m)
Abutilon fraseri subsp. *fraseri*	0.1	0.1
Acacia aptaneura	3	3.5
Alternanthera nana	0.1	0.1
**Bidens bipinnata*	0.1	0.05
Capparis lasiantha	0.1	0.2
Chrysopogon fallax	0.1	0.2
Cleome viscosa	0.1	0.1
Dipteracanthus australasicus subsp. *australasicus*	0.1	0.3
Duperreya commixta	0.1	0.3
Enneapogon caerulescens	0.1	0.1
Eucalyptus xerothermica	8	8.5
Euphorbia biconvexa	0.1	0.1
Evolvulus alsinoides var. *villosicalyx*	0.1	0.1
Goodenia stellata	0.1	0.01
Hakea lorea subsp. *lorea*	0.1	3.8
Indigofera linifolia	0.1	0.05

Name	Cover (%)	Height (m)
Maireana tomentosa subsp. *tomentosa*	0.1	0.1
**Malvastrum americanum*	0.1	0.1
Ptilotus obovatus	0.5	0.3
Sida aff. *fibulifera*	0.1	0.1
Solanum lasiophyllum	0.1	0.2
Themeda triandra	20	0.5
Triodia basedowii	0.1	0.05
Triraphis mollis	0.1	0.1
Yakirra australiensis var. *australiensis*	0.1	0.1

* denotes weed species

Site: GH15
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 24/05/2019 **Described by:** DR
MGA Zone: 50 **Easting:** 708078 **Northing:** 7448129
Habitat: Plain
Soil: Red brown Clay loam
Rock type: Ironstone
Vegetation code: P1
Vegetation: *Acacia aptaneura* and *Acacia pruinocarpa* tall open scrub over *Triodia pungens* very open hummock grassland
Vegetation Condition: Very Good
Fire Age: >10 years



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	33	6
Acacia pruinocarpa	2	3.7
Aristida sp.	0.1	0.2
**Bidens bipinnata*	0.1	0.1
Chrysopogon fallax	0.1	0.4
Commelina ensifolia	0.1	0.2
Eremophila aff. *clarkei*	0.1	0.8
Eriachne mucronata	0.1	0.2
Maireana tomentosa subsp. *tomentosa*	0.1	0.3
Psydrax suaveolens	0.1	1.5
Ptilotus obovatus	0.1	0.4
Sida sp.	0.1	0.1
Sida sp. dark green fruits (S. van Leeuwen 2260)	0.1	0.7
Solanum lasiophyllum	0.1	0.4
Themeda triandra	0.1	0.4
Triodia basedowii	0.1	0.3

Name	Cover (%)	Height (m)
Triodia pungens	6	0.5

* denotes weed species

Site: GH17
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 25/05/2019 **Described by:** KMc
MGA Zone: 50 **Easting:** 714668 **Northing:** 7452099
Habitat: *Minor* drainage
Soil: Reddish brown Clay loam
Rock type: Ironstone
Vegetation code: D8
Vegetation: *Eucalyptus xerothermica* scattered low trees over *Acacia catenulata* subsp. *occidentalis*, *Acacia aptaneura* and *Acacia pruinocarpa* tall open scrub over *Triodia pungens* very open hummock grassland with *Themeda triandra* very open tussock grassland
Vegetation Condition: Very Good
Fire Age: >10 years



Species List:

Name	Cover (%)	Height (m)
Abutilon sp.	0.1	0.4
Acacia aptaneura	20	5
Acacia catenulata subsp. *occidentalis*	25	8
Acacia dictyophleba	0.1	3.8
Acacia macraneura	0.1	2.2
Acacia pruinocarpa	1	2.7
Acacia pyrifolia	0.1	0.5
Alternanthera sp.	0.1	0.2
Androcalva luteiflora	0.1	1.5
**Bidens bipinnata*	0.1	0.4
Capparis lasiantha	0.1	2.7
Chrysopogon fallax	0.1	0.3
Cleome viscosa	0.1	0.4
Cymbopogon ambiguus	0.1	0.2
Dipteracanthus australasicus subsp. *australasicus*	0.1	0.3

Name	Cover (%)	Height (m)
Duperreya commixta	0.1	2
Enchylaena tomentosa var. *tomentosa*	0.1	0.8
Enneapogon lindleyanus	0.1	0.2
Eremophila forrestii subsp. *forrestii*	0.1	0.9
Eriachne mucronata	0.1	0.2
Eucalyptus leucophloia subsp. *leucophloia*	0.1	5
Eucalyptus xerothermica	1	6
Isotropis sp. Arid zone (G. Byrne 2775)	0.1	0.4
Maireana tomentosa subsp. *tomentosa*	0.1	0.2
**Malvastrum americanum*	0.1	0.3
Paraneurachne muelleri	0.1	0.1
Psydrax suaveolens	0.1	0.4
Pterocaulon sphaeranthoides	0.1	0.4
Ptilotus obovatus	0.1	0.9
Ptilotus sp.	0.1	0.3
Rhagodia eremaea	0.5	1.8
Senna artemisioides subsp. *helmsii*	0.1	1.1
Senna glutinosa subsp. *× luerssenii*	0.1	1.4
Sida aff. *fibulifera*	0.1	0.3
Themeda triandra	3	0.4
Triodia pungens	5	0.4

* denotes weed species

Site: GH19
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 25/05/2019 **Described by:** KMc
MGA Zone: 50 **Easting:** 717596 **Northing:** 7452467
Habitat: Footslope
Soil: Red brown Sandy clay loam
Rock type: Ironstone
Vegetation code: H3
Vegetation: *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees over *Acacia inaequilatera* tall open shrubland over *Triodia vanleeuwenii* open hummock grassland with *Amphipogon sericeus* scattered tussock grasses
Vegetation Condition: Excellent
Fire Age: 2-5 years



Species List:

Name	Cover (%)	Height (m)
Acacia adsurgens	0.1	0.4
Acacia bivenosa	0.1	0.3
Acacia inaequilatera	3	2.2
Amphipogon sericeus	1.5	0.3
Aristida contorta	0.1	0.2
Aristida sp.	0.1	0.5
Corchorus lasiocarpus subsp. *lasiocarpus*	0.5	0.5
Cymbopogon ambiguus	0.1	0.3
Duperreya commixta	0.1	0
Eremophila forrestii subsp. *forrestii*	0.5	1.8
Eucalyptus gamophylla	0.5	2.1
Eucalyptus leucophloia subsp. *leucophloia*	1	6
Goodenia sp.	0.1	0.1
Gossypium robinsonii	0.1	1.5
Hibiscus sturtii var. *platychlamys*	0.1	0.4

Name	Cover (%)	Height (m)
Indigofera monophylla	0.1	0.2
Paraneurachne muelleri	0.1	0.2
Ptilotus astrolasius	0.1	0.4
Ptilotus calostachyus	0.1	1.2
Ptilotus exaltatus	0.1	0.4
Ptilotus rotundifolius	0.1	1.1
Sclerolaena cornishiana	0.1	0.1
Senna artemisioides subsp. *helmsii*	0.1	0.4
Senna glutinosa subsp. *× luerssenii*	0.1	1.5
Senna glutinosa subsp. *pruinosa*	0.1	1.5
Seringia sp.	0.1	0.6
Sida arenicola	0.1	0.8
Solanum lasiophyllum	0.1	0.7
Themeda sp.	0.1	0.3
Triodia pungens	0.1	0.3
Triodia vanleeuwenii	15	0.2

Site: GH20
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 25/05/2019 **Described by:** LD
MGA Zone: 50 **Easting:** 719336 **Northing:** 7454644
Habitat: Plain
Soil: Red brown Sandy loam
Rock type: Ironstone
Vegetation code: P1
Vegetation: *Acacia pruinocarpa* open woodland over *Acacia catenulata* subsp. *occidentalis*, *Acacia aneura* and *Grevillea berryana* tall shrubland over *Sida calyxhymenia* scattered low shrubs over *Triodia wiseana* and *Triodia pungens* very open hummock grassland
Vegetation Condition: Very Good
Fire Age: Very long unburnt



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	0.5	3.5
Acacia aptaneura sens. lat.	3	6
Acacia ayersiana	0.5	5
Acacia catenulata subsp. *occidentalis*	13	7
Acacia pruinocarpa	6	11
Aristida obscura	0.1	0.3
**Bidens bipinnata*	0.1	0.1
Cheilanthes sieberi subsp. *sieberi*	0.1	0.1
Duperreya commixta	0.1	0.1
Eremophila latrobei subsp. *filiformis*	0.1	1.5
Grevillea berryana	2	6
Hibiscus burtonii	0.1	0.4
Maireana tomentosa subsp. *tomentosa*	0.1	0.1
Sida calyxhymenia	1.5	0.6
Triodia pungens	1	0.5

Name	Cover (%)	Height (m)
Triodia wiseana	5	0.6

* denotes weed species

Site: GH21
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 26/05/2019 **Described by:** DR
MGA Zone: 50 **Easting:** 718726 **Northing:** 7456934
Habitat: Clay plain
Soil: Red brown Silty clay
Rock type: Ironstone, Quartz
Vegetation code: P4
Vegetation: *Acacia pruinocarpa*, *Acacia aptaneura* and *Acacia catenulata* subsp. *occidentalis* tall shrubland
Vegetation Condition: Very Good
Fire Age: Very long unburnt
Notes: More low shrub, herb and tussock grass cover is likely in better season



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	3	5
Acacia catenulata subsp. *occidentalis*	3	6
Acacia citrinoviridis	0.1	3.8
Acacia pruinocarpa	7	5
Alternanthera sp.	0.1	0.1
Anthobolus leptomerioides	0.1	1.3
Aristida burbidgeae	0.1	0.3
Aristida obscura	0.1	0.1
**Bidens bipinnata*	0.1	0.1
Cheilanthes sieberi subsp. *sieberi*	0.1	0.1
Duperreya commixta	0.1	1
Eremophila forrestii subsp. *forrestii*	0.1	1.5
Eremophila latrobei subsp. *filiformis*	0.1	2
Grevillea berryana	2	5.5
Hakea lorea subsp. *lorea*	0.1	3.8
Hibiscus sturtii	0.1	0.2

Name	Cover (%)	Height (m)
Maireana tomentosa subsp. *tomentosa*	0.1	0.1
Ptilotus astrolasius	0.1	0.3
Ptilotus obovatus	0.1	0.3
Rhagodia eremaea	0.1	1.5
Sclerolaena cornishiana	0.1	0.1
Sida fibulifera	0.1	0.2
Sida platycalyx	0.1	0.01
Sida sp. Shovelanna Hill (S. van Leeuwen 3842)	0.1	1
Solanum lasiophyllum	0.1	0.5

* denotes weed species

Site: GH22
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 26/05/2019 **Described by:** DR
MGA Zone: 50 **Easting:** 718932 **Northing:** 7456688
Habitat: Floodplain
Soil: Reddish brown Silty clay
Rock type: Ironstone
Vegetation code: D7
Vegetation: *Acacia aptaneura* scattered tall shrubs over *Triodia longiceps* and *Triodia pungens* hummock grassland
Vegetation Condition: Very Good
Fire Age: Very long unburnt



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	1	3.8
Acacia pruinocarpa	0.5	3.5
Acacia pyrifolia	0.5	1.4
Androcalva luteiflora	0.1	1.9
Aristida obscura	0.1	0.1
**Bidens bipinnata*	0.1	0.4
Cleome viscosa	0.1	0.4
Corchorus lasiocarpus subsp. *parvus*	0.1	0.2
Cucumis variabilis	0.1	0.5
Duperreya commixta	0.1	0.8
Eremophila longifolia	0.1	1.4
Eriachne mucronata	0.1	0.2
Eulalia aurea	0.1	0.8
Euphorbia australis var. *subtomentosa*	0.1	0.05
Heliotropium tanythrix	0.1	0.1
Hibiscus sturtii	0.1	0.1

Name	Cover (%)	Height (m)
Indigofera georgei	0.1	0.3
**Malvastrum americanum*	0.1	0.4
Phyllanthus maderaspatensis	0.1	0.1
Poaceae sp.	0.1	0.05
Psydrax suaveolens	0.1	0.4
Pterocaulon sp.	0.1	0.4
Ptilotus astrolasius	0.1	0.3
Ptilotus obovatus	0.1	0.5
Rhagodia eremaea	0.1	0.5
Sclerolaena cornishiana	0.1	0.3
Senna artemisioides subsp. *oligophylla*	0.5	1.1
Sida fibulifera	0.1	0.2
Solanum lasiophyllum	0.1	0.4
Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)	0.1	0.5
Triodia longiceps	51	1.1
Triodia pungens	9	0.6

* denotes weed species

Site: GH23
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 26/05/2019 **Described by:** DR
MGA Zone: 50 **Easting:** 719018 **Northing:** 7456448
Habitat: Minor creek
Soil: Reddish brown Silty clay loam
Rock type: Ironstone, Quartz
Vegetation code: D4
Vegetation: *Acacia citrinoviridis* tall shrubland over *Corchorus lasiocarpus* subsp. *lasiocarpus* open shrubland over *Triodia longiceps* and *Triodia pungens* very open hummock grassland
Vegetation Condition: Very Good
Fire Age: Very long unburnt



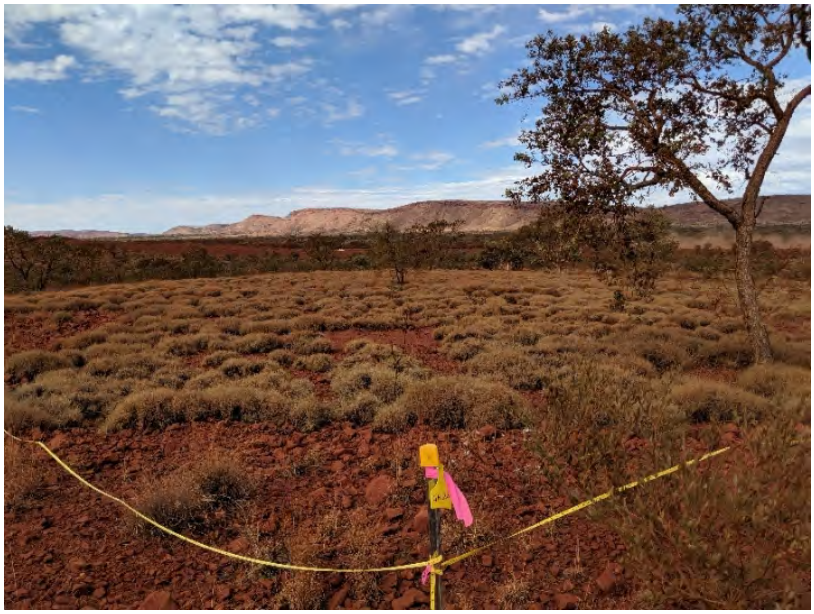
Species List:

Name	Cover (%)	Height (m)
Acacia citrinoviridis	27	7
Acacia pruinocarpa	0.1	6
Acacia pyrifolia	0.1	0.5
Acacia sp.	0.1	0.1
Alternanthera nana	0.1	0.1
Atalaya hemiglauca	0.5	3.8
**Bidens bipinnata*	0.1	0.6
Cleome viscosa	0.1	0.4
Corchorus lasiocarpus subsp. *lasiocarpus*	3	1.3
Cymbopogon ambiguus	0.1	0.3
Dicladanthera forrestii	0.1	0.1
Duperreya commixta	0.1	0.5
Enneapogon lindleyanus	0.1	0.2
Eriachne pulchella subsp. *dominii*	0.1	0.05
Eriachne tenuiculmis	0.1	0.2
Eucalyptus victrix	0.5	11

Name	Cover (%)	Height (m)
Eulalia aurea	0.1	0.3
Goodenia sp.	0.1	0.1
Heliotropium tanythrix	0.1	0.1
Hybanthus aurantiacus	0.1	0.1
Isotropis sp. Arid zone (G. Byrne 2775)	0.1	0.8
Lepidium sp.	0.1	0.1
**Malvastrum americanum*	0.1	0.1
Phyllanthus maderaspatensis	0.1	0.1
Polycarpaea corymbosa var. *corymbosa*	0.1	0.2
Ptilotus astrolasius	0.1	0.4
Rhagodia eremaea	0.1	1.7
Rhynchosia minima	0.1	0.2
Santalum spicatum	0.1	3
Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)	0.1	0.5
Themeda triandra	0.1	0.3
Triodia longiceps	3	0.9
Triodia pungens	2	0.3
Waltheria indica	0.1	0.2

* denotes weed species

Site: GH24
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 27/05/2019 **Described by:** KMc
MGA Zone: 50 **Easting:** 713803 **Northing:** 7452985
Habitat: Footslope
Soil: Reddish brown Silty clay loam
Rock type: Ironstone
Vegetation code: H8
Vegetation: *Corymbia deserticola* subsp. *deserticola* and *Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Triodia vanleeuwenii* and *Triodia pungens* hummock grassland
Vegetation Condition: Good
Fire Age: Very long unburnt



Species List:

Name	Cover (%)	Height (m)
Acacia adsurgens	0.1	0.8
Acacia bivenosa	0.1	1.1
Acacia inaequilatera	0.5	3
Acacia tenuissima	0.1	1.6
Acacia tumida var. *pilbarensis*	0.1	1.9
Amphipogon sericeus	0.1	0.4
Aristida sp.	0.1	0.4
Corymbia deserticola subsp. *deserticola*	1.5	5.5
Cymbopogon ambiguus	0.1	0.3
Duperreya commixta	0.1	1.8
Eriachne mucronata	0.1	0.3
Eucalyptus gamophylla	0.1	3
Eucalyptus leucophloia subsp. *leucophloia*	1	6.5
Fimbristylis sp.	0.1	0.05
Goodenia stobbsiana	0.1	0.2
Goodenia triodiophila	0.1	0.4

Name	Cover (%)	Height (m)
Hakea chordophylla	0.1	3
Indigofera monophylla	0.1	0.6
Peripleura obovata	0.1	0.5
Ptilotus calostachyus	0.1	0.5
Ptilotus rotundifolius	0.1	0.5
Senna artemisioides subsp. *oligophylla*	0.1	1.2
Senna glutinosa subsp. *× luerssenii*	0.1	1.2
Themeda sp. Mt Barricade (M.E. Trudgen 2471)	0.1	0.5
Triodia pungens	1	0.8
Triodia vanleeuwenii	38	0.3

Site: GH25
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 28/05/2019 **Described by:** KMc
MGA Zone: 50 **Easting:** 718388 **Northing:** 7455089
Habitat: Floodplain
Soil: Dark reddish brown Clay loam
Rock type: Ironstone
Vegetation code: D7
Vegetation: *Eucalyptus xerothermica* low open woodland over *Acacia citrinoviridis*, *Acacia pruinocarpa* and *Acacia aptaneura* tall shrubland over *Triodia longiceps* hummock grassland
Vegetation Condition: Very Good
Fire Age: >10 years



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	2	3
Acacia bivenosa	0.1	1.9
Acacia citrinoviridis	8	3.5
Acacia pruinocarpa	3	3.2
Acacia pyrifolia	0.1	1.2
Acacia tetragonophylla	0.1	3
Androcalva luteiflora	0.1	1
Aristida contorta	0.1	0.1
Capparis lasiantha	0.1	0.8
Cleome viscosa	0.1	0.3
Duperreya commixta	0.1	1
Enchylaena tomentosa var. *tomentosa*	0.1	0.9
Eremophila longifolia	0.1	1.8
Eucalyptus xerothermica	3	8
Hakea lorea subsp. *lorea*	0.1	3.5
Hibiscus sturtii	0.1	0.05

Name	Cover (%)	Height (m)
Indigofera georgei	0.1	0.5
Maireana tomentosa subsp. *tomentosa*	0.1	0.3
**Malvastrum americanum*	0.1	0.4
Paraneurachne muelleri	0.1	0.3
Ptilotus obovatus	0.1	0.8
Rhagodia eremaea	0.1	1.1
Salsola australis	0.1	0.2
Senna artemisioides subsp. *helmsii*	0.1	1.5
Senna artemisioides subsp. *oligophylla*	0.1	0.9
Sida fibulifera	0.1	0.2
Solanum lasiophyllum	0.1	0.7
Themeda triandra	0.1	0.7
Triodia longiceps	40	1

* denotes weed species

Site: GH26
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 28/05/2019 **Described by:** KMc
MGA Zone: 50 **Easting:** 718084 **Northing:** 7455393
Habitat: Plain
Soil: Reddish brown Silty clay loam
Rock type: Ironstone
Vegetation code: P4
Vegetation: *Eucalyptus xerothermica* scattered low trees over *Eremophila longifolia*, *Acacia pruinocarpa* and *Acacia catenulata* subsp. *occidentalis* tall closed scrub
Vegetation Condition: Very Good
Fire Age: >10 years

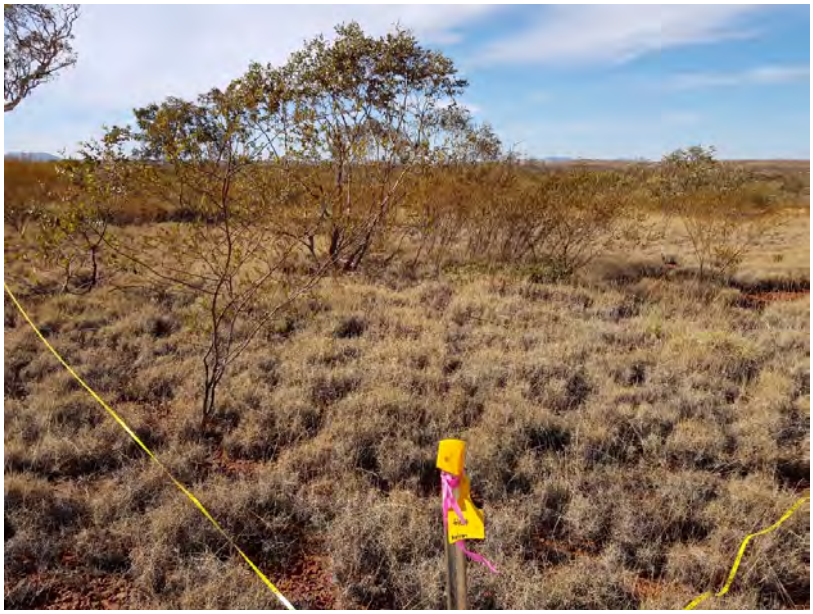


Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	0.5	4
Acacia aptaneura sens. lat.	0.1	2
Acacia catenulata subsp. *occidentalis*	1	5
Acacia macraneura	0.1	1
Acacia pruinocarpa	3	4
Anthobolus leptomerioides	0.1	0.5
Aristida contorta	0.1	0.1
Aristida ingrata	0.1	1
Cheilanthes sieberi subsp. *sieberi*	0.1	0.2
Cleome viscosa	0.1	0.3
Cymbopogon ambiguus	0.1	0.2
Duperreya commixta	0.1	0.6
Enchylaena tomentosa var. *tomentosa*	0.1	0.4
Enneapogon lindleyanus	0.1	0.5
Eremophila forrestii subsp. *forrestii*	0.1	0.6
Eremophila longifolia	0.1	2.1

Name	Cover (%)	Height (m)
Eucalyptus xerothermica	1	6
Evolvulus alsinoides var. *villosicalyx*	0.1	0.2
Glycine canescens	0.1	0.05
Hibiscus sturtii	0.1	0.2
Maireana tomentosa subsp. *tomentosa*	0.1	0.2
Paraneurachne muelleri	0.1	0.3
Ptilotus obovatus	0.1	0.4
Rhagodia eremaea	0.5	1.1
Salsola australis	0.1	0.2
Sclerolaena cornishiana	0.1	0.1
Sida calyxhymenia	0.1	1.3
Sida fibulifera	0.1	0.1
Sida platycalyx	0.1	0.05
Solanum lasiophyllum	0.1	0.2
Themeda triandra	0.1	0.4

Site: GH27
Location: HD2 Detailed Survey Area **Type:** Quadrat
Phase 3 Date: 29/05/2019 **Described by:** DR
MGA Zone: 50 **Easting:** 702178 **Northing:** 7447593
Habitat: Riseslope
Soil: Red brown Silty clay loam
Rock type: Ironstone
Vegetation code: H11
Vegetation: *Eucalyptus gamophylla* and *Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Acacia pachyacra* scattered tall shrubs over *Acacia hilliana* scattered low shrubs over *Triodia vanleeuwenii* and *Triodia wiseana* hummock grassland
Vegetation Condition: Excellent
Fire Age: Very long unburnt



Species List:

Name	Cover (%)	Height (m)
Acacia adoxa var. *adoxa*	0.5	0.5
Acacia adsurgens	0.1	2
Acacia bivenosa	0.1	1.5
Acacia hamersleyensis	0.1	1.9
Acacia hilliana	1	0.7
Acacia maitlandii	0.5	2.2
Acacia pachyacra	1	2.1
Capparis lasiantha	0.1	1
Dodonaea lanceolata var. *lanceolata*	0.1	1.8
Eucalyptus gamophylla	5	5
Eucalyptus leucophloia subsp. *leucophloia*	1	6
Gompholobium oreophilum	0.1	0.5
Hakea chordophylla	0.1	4
Halgania gustafsenii var. *gustafsenii*	0.1	0.4
Indigofera monophylla	0.1	0.3

Name	Cover (%)	Height (m)
Themeda triandra	0.1	0.6
Triodia vanleeuwenii	49	0.4
Triodia wiseana	6	0.5

Site: GHR10
Location: HD2 Detailed Survey Area **Type:** Relevé
Phase 3 Date: 23/05/2019 **Described by:** DR
MGA Zone: 50 **Easting:** 702598 **Northing:** 7448426
Habitat: Gorge
Soil: Reddish brown Sandy loam
Rock type: Ironstone
Vegetation code: D3
Vegetation: *Corymbia ferriticola* low open woodland over *Dodonaea pachyneura* tall open shrubland over *Triodia pungens* very open hummock grassland with *Eriachne mucronata* scattered tussock grasses
Vegetation Condition: Excellent
Fire Age: >10 years
Notes: 15x166 m



Species List:

Name	Cover (%)	Height (m)
Acacia aptaneura	0.1	1
Acacia hamersleyensis	0.5	5.5
Acacia monticola	0.1	3
Acacia mulganeura	0.5	5.5
Aristida burbidgeae	0.1	0.4
Bulbostylis barbata	0.1	0.3
Capparis lasiantha	0.1	0.6
Clerodendrum tomentosum var. *lanceolatum*	0.1	0.1
Corymbia ferriticola	9	7
Cymbopogon ambiguus	0.5	0.5
Dodonaea pachyneura	4	2.2
Dodonaea viscosa subsp. *spatulata*	0.1	2.2
Duperreya commixta	0.1	0.2
Eremophila jucunda subsp. *pulcherrima*	0.1	1.2
Eriachne mucronata	1.5	0.3

Name	Cover (%)	Height (m)
Eucalyptus leucophloia subsp. *leucophloia*	0.5	6
Ficus brachypoda	0.1	1.8
Gossypium robinsonii	0.1	2
Grevillea wickhamii subsp. *hispidula*	0.1	2.8
Indigofera fractiflexa subsp. *fractiflexa*	0.1	0.2
Indigofera georgei	0.1	0.1
Jasminum didymum subsp. *lineare*	0.1	0.8
Petalostylis labicheoides	0.1	3.6
Psydrax latifolia	0.1	0.3
Pterocaulon sp.	0.1	0.2
Sida sp. Shovelanna Hill (S. van Leeuwen 3842)	0.1	0.3
Solanum cleistogamum	0.1	0.05
Themeda triandra	0.1	0.4
Triodia pungens	9	0.3
Vigna lanceolata var. *lanceolata*	0.1	0.1

Site: GHR16
Location: HD2 Detailed Survey Area **Type:** Relevé
Phase 3 Date: 24/05/2019 **Described by:** DR
MGA Zone: 50 **Easting:** 709786 **Northing:** 7451537
Habitat: Breakaway
Soil: Red brown Silty clay loam
Rock type: Ironstone
Vegetation code: H6
Vegetation: *Acacia catenulata* subsp. *occidentalis*, *Grevillea saxicola* P3 and *Grevillea berryana* tall shrubland over *Triodia pungens* very open hummock grassland with *Amphipogon sericeus* scattered tussock grasses
Vegetation Condition: Excellent
Fire Age: >10 years



Species List:

Name	Cover (%)	Height (m)
Acacia catenulata subsp. *occidentalis*	8	5.5
Acacia pruinocarpa	0.1	3.7
Amphipogon sericeus	1	0.5
Amyema sp.	0.1	0
Capparis lasiantha	0.1	1.2
Corymbia hamersleyana sens lat.	0.1	4.5
Eremophila forrestii subsp. *forrestii*	0.1	0.5
Eremophila latrobei subsp. *filiformis*	0.1	1.9
Eriachne lanata	0.1	0.2
Eriachne mucronata	0.5	0.2
Eucalyptus leucophloia subsp. *leucophloia*	0.1	5.8
Grevillea berryana	1	2.2
Grevillea saxicola P3	3	8
Psydrax suaveolens	0.1	3
Rhagodia eremaea	0.1	1
Triodia pungens	4	0.4

Name	Cover (%)	Height (m)
Triodia vanleeuwenii	0.1	0.3

Site: GHR28
Location: HD2 Detailed Survey Area **Type:** Relevé
Phase 3 Date: 29/05/2019 **Described by:** DR
MGA Zone: 50 **Easting:** 702014 **Northing:** 7447685
Habitat: Minor drainage
Soil: Red brown Silty clay loam
Rock type: Ironstone
Vegetation code: D1
Vegetation: *Corymbia hamersleyana* sens. lat. and *Eucalyptus leucophloia* subsp. *leucophloia* low open woodland over *Acacia monticola*, *Acacia maitlandii* and *Santalum lanceolatum* tall shrubland over *Triodia pungens* and *Triodia wiseana* very open hummock grassland with *Themeda triandra* very open tussock grassland
Vegetation Condition: Excellent
Fire Age: Very long unburnt



Species List:

Name	Cover (%)	Height (m)
Acacia adoxa var. *adoxa*	0.1	0.7
Acacia hamersleyensis	0.1	2.1
Acacia maitlandii	5	2.8
Acacia monticola	15	3.5
Acacia pachyacra	0.1	0.5
Acacia pyrifolia	0.1	0.4
Androcalva luteiflora	0.5	1.7
Capparis lasiantha	0.1	1
Cassytha capillaris	0.1	0.2
Corymbia hamersleyana sens lat.	4	6.5
Cymbopogon ambiguus	0.1	0.8
Dipteracanthus australasicus subsp. *australasicus*	0.1	0.3
Dodonaea lanceolata var. *lanceolata*	0.1	1.6
Dodonaea pachyneura	0.1	0.7
Duperreya commixta	0.1	1

Name	Cover (%)	Height (m)
Eremophila jucunda subsp. *pulcherrima*	0.1	0.6
Eremophila latrobei subsp. *filiformis*	0.1	0.7
Eriachne tenuiculmis	0.1	0.5
Eucalyptus leucophloia subsp. *leucophloia*	2	6
Gossypium robinsonii	0.1	2.8
Indigofera fractiflexa subsp. *fractiflexa*	0.1	1
Jasminum didymum subsp. *lineare*	0.1	0.8
Paraneurachne muelleri	0.1	0.3
Petalostylis labicheoides	0.1	1.6
Santalum lanceolatum	2	2.1
Senna glutinosa subsp. *glutinosa*	0.1	0.8
Sida sp. Articulation below (A.A. Mitchell PRP 1605)	0.1	0.5
Sida sp. Excedentifolia (J.L. Egan 1925)	0.1	0.2
Themeda triandra	3	0.7
Triodia pungens	6	0.3
Triodia wiseana	3	0.4

Site: GHR30
Location: HD2 Detailed Survey Area **Type:** Relevé
Phase 3 Date: 29/05/2019 **Described by:** KMc
MGA Zone: 50 **Easting:** 707880 **Northing:** 7450520
Habitat: Hillslope
Soil: Reddish brown Silty clay loam
Rock type: Ironstone
Vegetation code: H4
Vegetation: *Triodia wiseana* closed hummock grassland
Vegetation Condition: Excellent
Fire Age: Very long unburnt



Species List:

Name	Cover (%)	Height (m)
Acacia pachyacra	0.1	0.9
Acacia pruinocarpa	0.1	0.7
Amphipogon sericeus	0.1	0.2
Cymbopogon ambiguus	0.1	0.3
Enneapogon lindleyanus	0.1	0.5
Eremophila latrobei subsp. *filiformis*	0.1	1.2
Eriachne mucronata	0.1	0.2
Eucalyptus leucophloia subsp. *leucophloia*	0.1	1.4
Lepidium sp.	0.1	0.3
Maireana georgei	0.1	0.4
Maireana tomentosa subsp. *tomentosa*	0.1	0.3
Ptilotus obovatus	0.1	0.9
Ptilotus rotundifolius	0.1	0.8
Scaevola acacioides	0.1	1.1
Senna artemisioides subsp. *oligophylla*	0.1	0.9
Senna glaucifolia	0.1	1.2
Senna glutinosa subsp. *× luerssenii*	0.1	1.5

Name	Cover (%)	Height (m)
Senna glutinosa subsp. *glutinosa*	0.1	1.4
Senna glutinosa subsp. *pruinosa*	0.1	1.6
Senna stricta	0.1	0.8
Tribulus suberosus	0.1	0.6
Triodia wiseana	71	0.5

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Appendix J: Vegetation Condition Mapping

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695000 700000 705000 710000 715000 720000

7460000 7455000 7450000 7445000

Map Extent
Survey Area

Vegetation Condition

Excellent
Very Good
Good
Completely Degraded

J.1 J.2 J.3 J.4 J.5 J.6 J.7 J.8 J.9 J.10 J.11 J.12 J.13 J.14 J.15 J.16 J.17 J.18 J.19 J.20 J.21 J.22 J.23 J.24 J.25 J.26

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Figure J: Vegetation condition mapping - Overview

Scale: 1:80,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 1 2 3 4 5 Kilometres

N

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694000 695000 696000 697000

7447000

7446000

7445000

J.20 J.21 J.17 J.22 J.10 J.15 J.18 J.23 J.25 J.6 J.11 J.16 J.19 J.24 J.26 J.3 J.7 J.12 J.1 J.4 J.8 J.13 J.2 J.5 J.9 J.14

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Figure J.1: Vegetation condition mapping

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

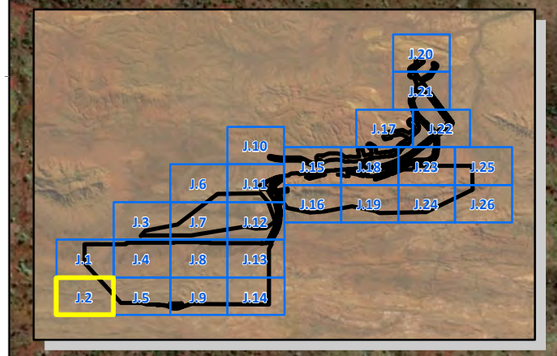
0 100 200 300 400 500 Metres

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694000
695000
696000
697000
7444000
7443000



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Figure J.2: Vegetation condition mapping

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

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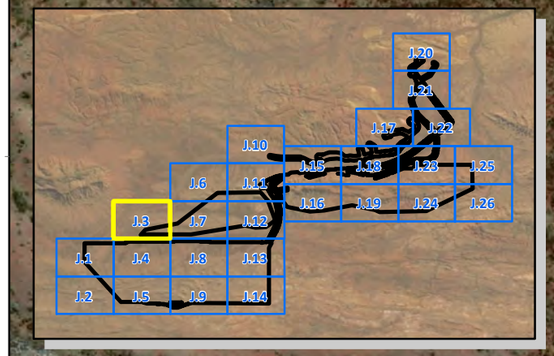
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697000 698000 699000 700000

7449000

7448000



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Figure J.3: Vegetation condition mapping

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

N

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697000 698000 699000 700000

7447000

7446000

7445000

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Figure J.4: Vegetation condition mapping

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

Metres

0 100 200 300 400 500

N

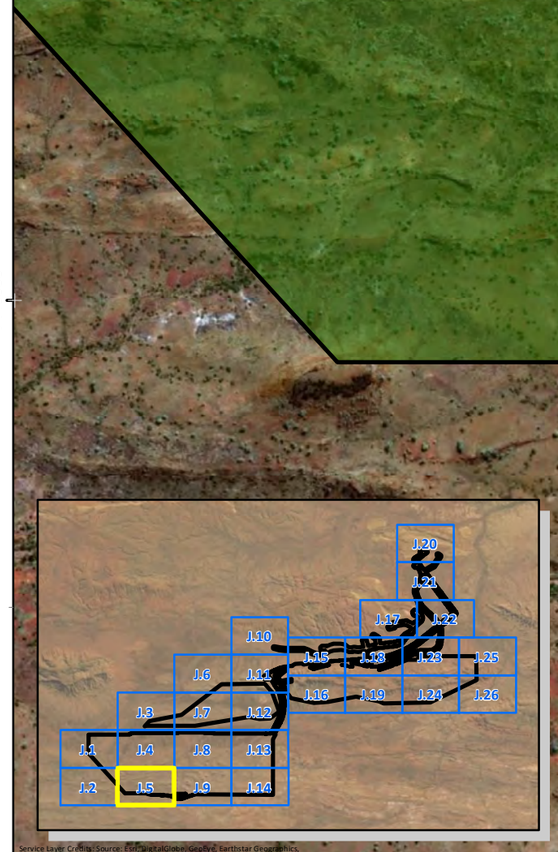
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697000 698000 699000 700000

7444000

7443000



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Figure J.5: Vegetation condition mapping

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

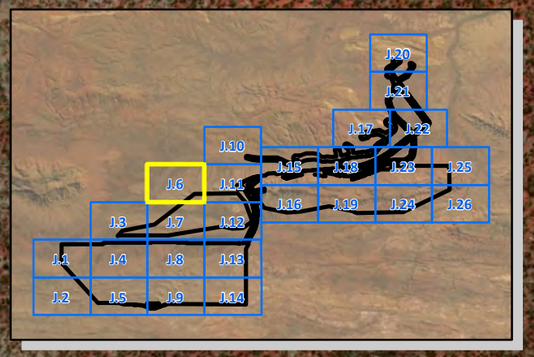
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701000
702000
703000
704000
7452000
7451000
7450000



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Figure J.6: Vegetation condition mapping

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

N

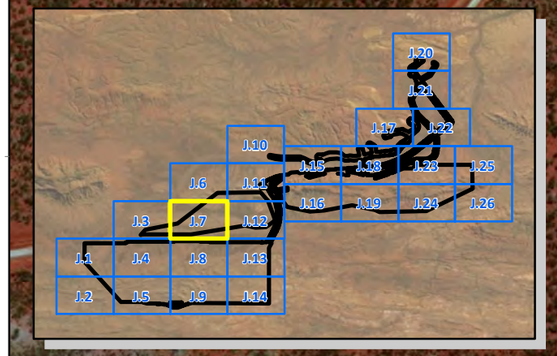
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701000 702000 703000 704000

7449000

7448000



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Figure J.7: Vegetation condition mapping

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

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701000 702000 703000 704000

7447000

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Figure J.8: Vegetation condition mapping

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

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701000
702000
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Figure J.9: Vegetation condition mapping

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

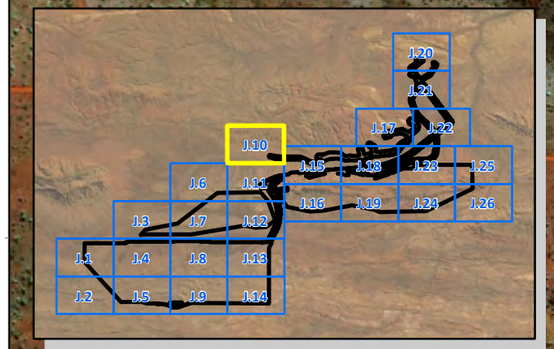
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705000
706000
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7454000
7453000



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Figure J.10: Vegetation condition mapping

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

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705000 706000 707000 708000

7452000

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J.20 J.21 J.17 J.22 J.10 J.15 J.18 J.23 J.25 J.6 J.11 J.16 J.19 J.24 J.26 J.3 J.7 J.12 J.1 J.4 J.8 J.13 J.2 J.5 J.9 J.14

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Figure J.11: Vegetation condition mapping

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

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Figure J.12: Vegetation condition mapping

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

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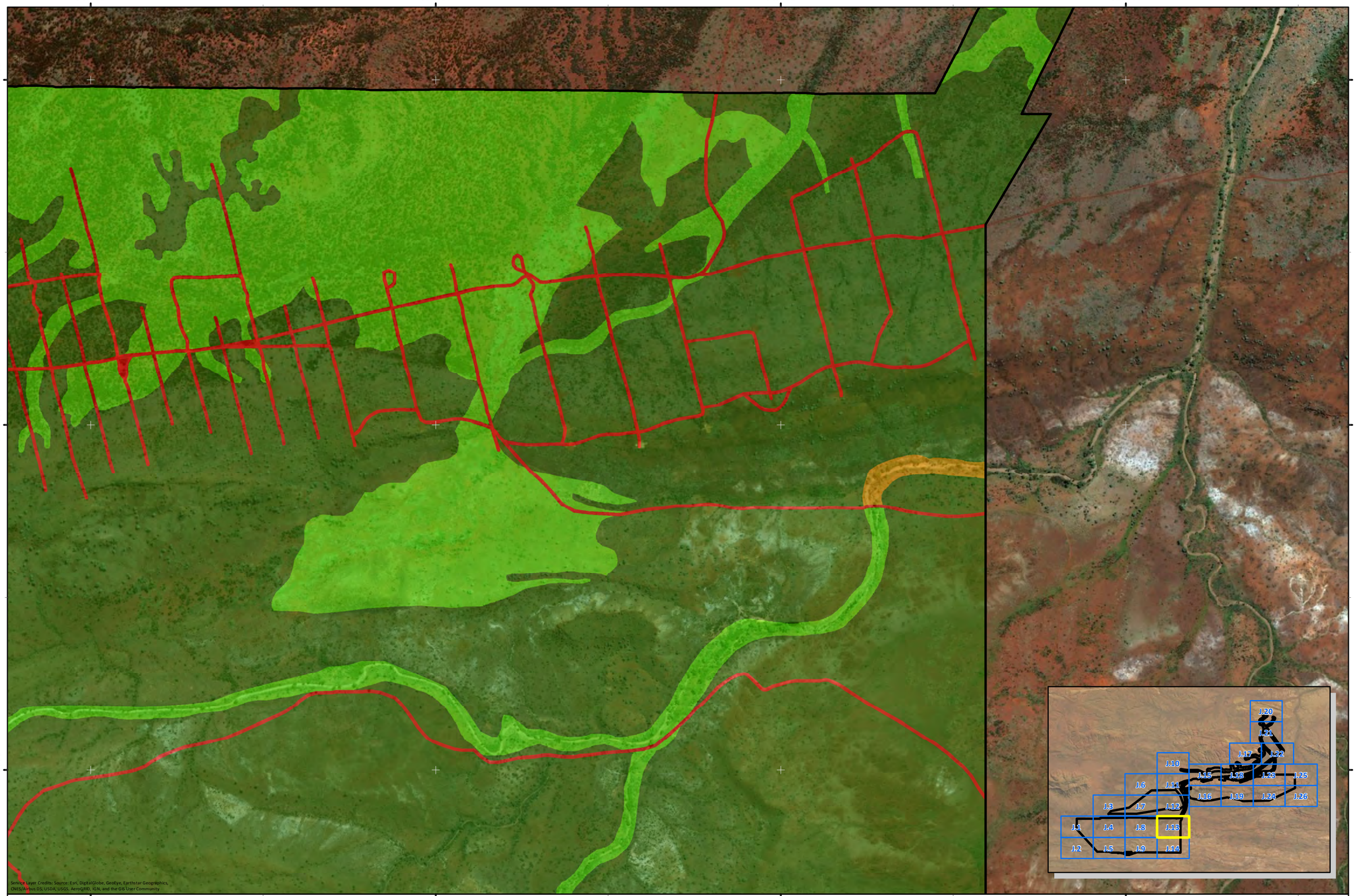
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7447000

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Figure J.13: Vegetation condition mapping

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

N

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Figure J.14: Vegetation condition mapping

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

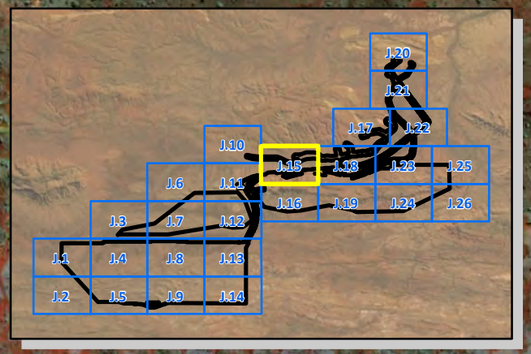
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709000 710000 711000 712000

7453000 7452000 7451000



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Figure J.15: Vegetation condition mapping

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

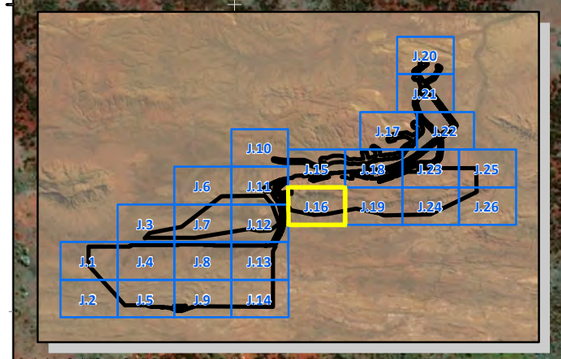
0 100 200 300 400 500 Metres

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Author: B. Eckermann | Drawn: C. Dyde | Date: 07-11-2019 | Figure Ref: 14292A-19-BIDR-3RevB_191107_VegCond_FigJ

709000
710000
711000
712000
7450000
7449000



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Figure J.16: Vegetation condition mapping

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

N

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714000
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717000
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7454000
J.1
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J.3
J.4
J.5
J.6
J.7
J.8
J.9
J.10
J.11
J.12
J.13
J.14
J.15
J.16
J.17
J.18
J.19
J.20
J.21
J.22
J.23
J.24
J.25
J.26
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Figure J.17: Vegetation condition mapping
Scale: 1:10,000 at A3
Coordinate System: GDA 1994 MGA Zone 50
0 100 200 300 400 500 Metres
N
astron
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Author: B. Eckermann
Drawn: C. Dyde
Date: 07-11-2019
Figure Ref: 14292A-19-BIDR-3RevB_191107_VegCond_FigJ

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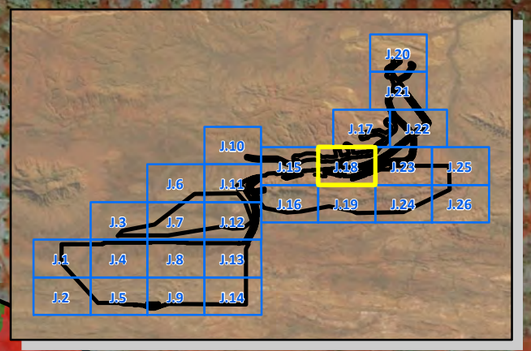
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Figure J.18: Vegetation condition mapping

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

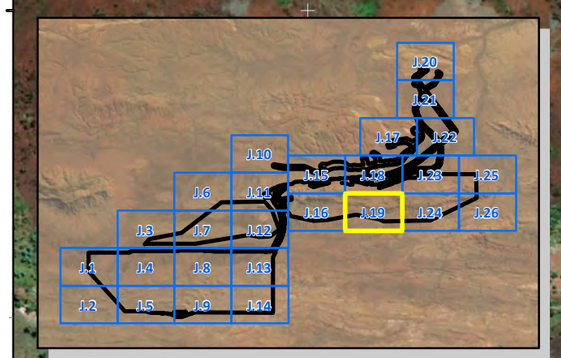
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Figure J.19: Vegetation condition mapping

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

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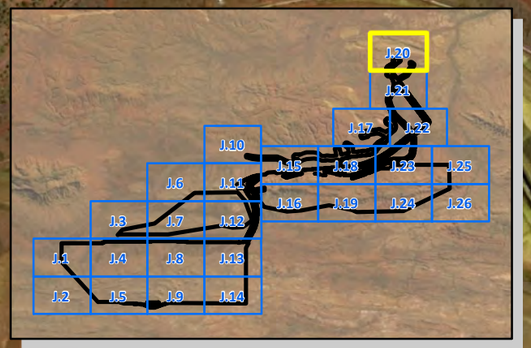
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Figure J.20: Vegetation condition mapping

Scale: 1:10,000 at A3

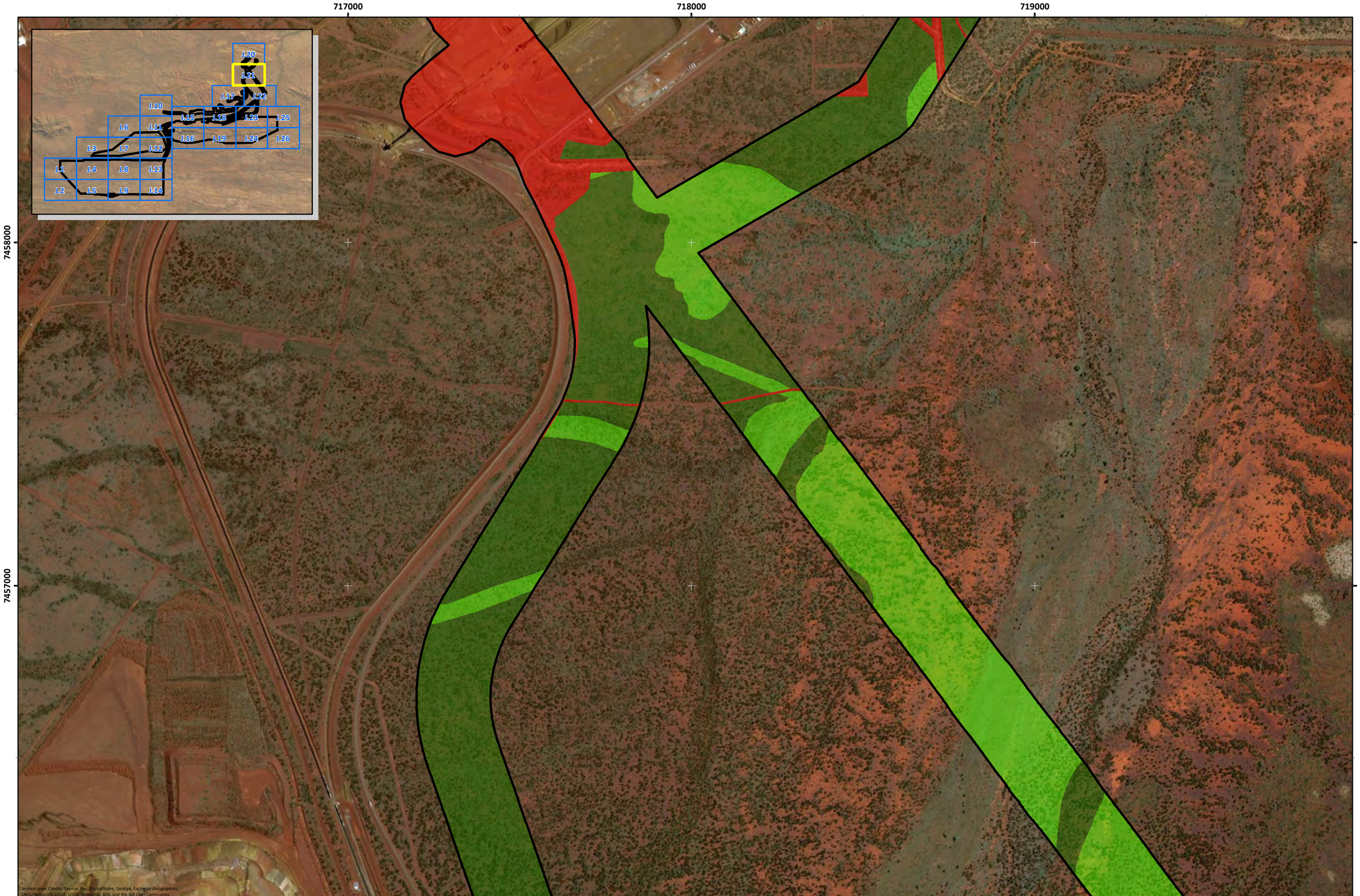
Coordinate System: GDA 1994 MGA Zone 50

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Figure J.21: Vegetation condition mapping

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

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J.20 J.21 J.17 J.22 J.10 J.15 J.18 J.23 J.25 J.6 J.11 J.16 J.19 J.24 J.26 J.3 J.7 J.12 J.1 J.4 J.8 J.13 J.2 J.5 J.9 J.14

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Figure J.22: Vegetation condition mapping

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

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Author: B. Eckermann Drawn: C. Dyde Date: 07-11-2019 Figure Ref: 14292A-19-BIDR-3RevB_191107_VegCond_FigJ

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Figure J.23: Vegetation condition mapping

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

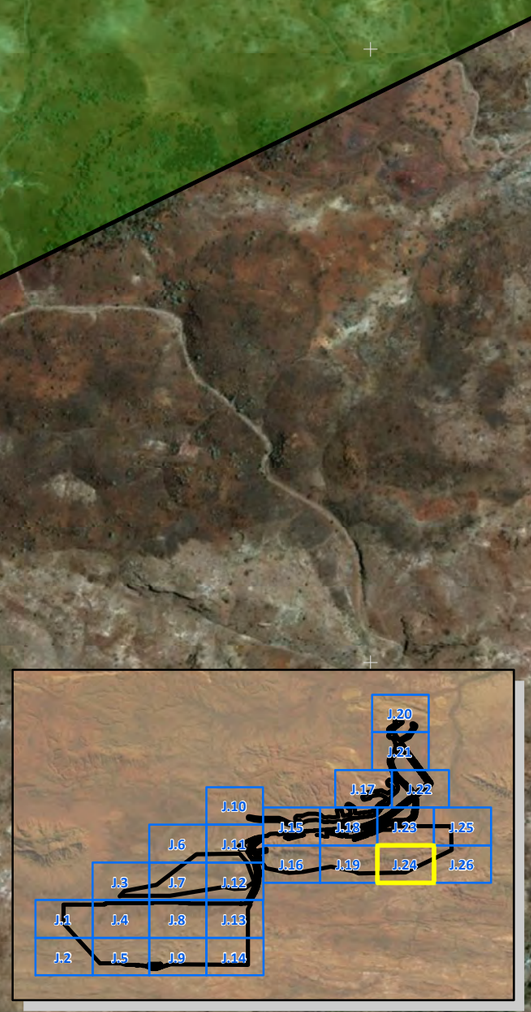
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Figure J.24: Vegetation condition mapping

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

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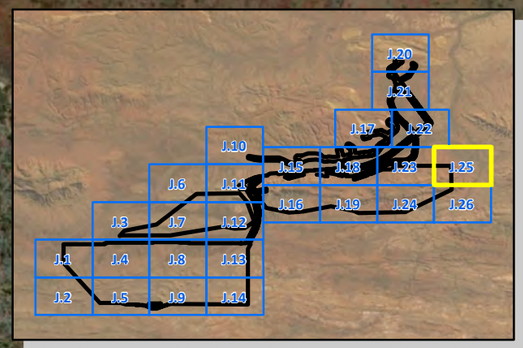
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721000 722000 723000 724000

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Figure J.25: Vegetation condition mapping

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

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Figure J.26: Vegetation condition mapping

Scale: 1:10,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 100 200 300 400 500 Metres

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Appendix K: Floristic Analysis

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1 Floristic Analysis

1.1 Sampling Effort

Sampling effort was assessed using a species accumulation curve and modelled estimates of the total species pool. Species accumulation curves are created by randomly sampling an incremental number of samples, and plotting the mean number of species sampled at each sample size. Species estimators are particular statistical models of species accumulation which are used to estimate the total species pool available. Four different species estimators were compared: Chao 2, Jackknife 1, Jackknife 2, and Bootstrap (Colwell and Coddington 1994). All analysis was performed in R 3.6.0 (R Development Core Team 2015) using the package 'Vegan'.

1.2 Vegetation Classification

Similarity amongst vegetation sites was assessed using a dendrogram which was based on Sorensen's index of Similarity (equivalent to Bray-Curtis similarity when applied to presence-absence data). The dendrogram was constructed using the UPGMA (Unweighted Pair Group Method with Arithmetic Mean) method (or 'group average' method), within Primer. Significant clusters of samples were identified using the Simprof test (Clarke, Somerfield, and Gorley 2008). In order to understand the current survey in regional context, a separate analysis was carried out with permanent sites from five previous surveys in the locality (Biota Environmental Sciences 2006; Mattiske Consulting 2008, 2009, 2010; Ecologia Environment 2013).

1.3 Floristic Community Groups

1.3.1 Sampling Effort

A total of 397 taxa from the Astron surveys were included in the floristic analysis. Quadrat and relevé data from the Phase 1, Phase 2 and Phase 3 surveys were included (opportunistic records were excluded), names not confirmed to species level and hybrids were removed from the analysis. The species accumulation curve indicates that the total number of species has reached an asymptote, and that sampling has been near-exhaustive (Figure K.1). This is highlighted by the fact that the final 10% increase in sampling effort only led to a 3% increase in species sampled.

The species estimators suggest that there were between 438 and 520 species available in the pool at the time of the surveys. This suggests that between 76% and 90% of the total species pool has been sampled from quadrats and relevés (Table K.1). Including opportunistic observations, 435 confirmed species were recorded within the survey area, indicating that between 84% and 99% of the potential total species pool available at the time of the surveys were recorded.

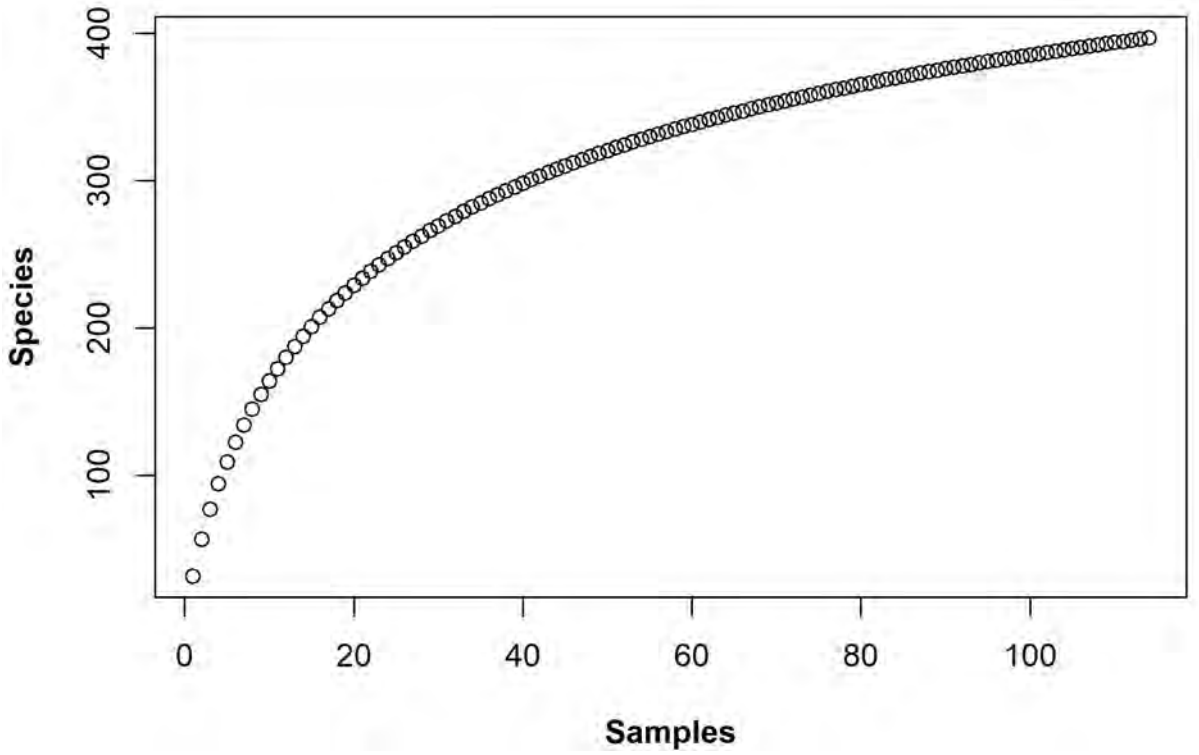


Figure K.1: Species accumulation curve for all Astron quadrats and relevés surveyed.

Table K.1: Total number of taxa sampled in comparison to estimates of the total species pool based on several models.

	Observed	Chao2	Jackknife 1	Jackknife 2	Bootstrap
Number of species	397	472	483	520	438
Estimated % of total flora sampled	-	84	82	76	90

1.3.2 Vegetation Classification

Prior to analysis, the species lists from all projects used in the analyses were reconciled to provide consistency in nomenclature. For instance, changes were made for current taxonomic revision; all mulga taxa were grouped as *Acacia aneura* sens. lat. and where multiple variants or subspecies were recorded within a species, these were reduced to the species level. Where possible, names were corrected for previous identification errors and any taxa not confirmed to species level were removed from the analyses (Table K.2). Singletons (species recorded from only one site) were retained. Some of the datasets (Mattiske Consulting 2008, 2009, 2010; Ecologia Environment 2013) listed a number of taxa which had questionable identification. Any obvious nomenclature errors were corrected where possible (Table K.2), however where there were doubts as to a correct identification, vetting of species data involved removing the taxon from the analysis dataset or assigning it a likely new name (Mattiske Consulting 2008, 2009, 2010; Ecologia Environment 2013).

1.3.2.1 Detailed survey area

Dendrogram production was combined with the Simprof statistical test using two separate datasets, the square-root transformed percentage foliar cover (PFC) data of perennial native taxa and the presence/absence of perennial native taxa from 99 quadrats and relevés occurring in the survey area. This led to the identification of 23 significant clusters for the PFC data (Figure K.2), with eight being formed by individual sites: BHD05-AR, GH13, HD16, HD29, HD42, HD44, HDR07 and HDR14. The presence/absence dataset presented 21 significant clusters (Figure K.3), with eight being formed by individual sites: GH06, GH13, GH23, HD16, HD21, HD29, HD33, and HDR07. Clusters generally showed some pattern of grouping according to the structural vegetation units described within the survey area and related to similar landforms.

The presence/absence data of perennial native taxa within the 99 quadrats and relevés from the current survey were combined with a further 757 permanent sites from a selection of projects from the surrounding area to provide a broader regional context (Biota Environmental Sciences 2006; Mattiske Consulting 2008, 2009, 2010; Ecologia Environment 2013; Biota Environmental Sciences 2014). Multivariate floristic analysis of this combined dataset led to identification of 118 significant clusters of sites (Figure K.4a). Twelve of the significant clusters were made up exclusively from sites within the current survey. Of these clusters, five were formed by an individual site: GH23, GH34, GH36, GH37, HD29; three were formed by two sites: GH33 and GH38, HD06 and HD37, GH03 and GH32; two were formed by three sites: GH08, HD09 and HD30; and HD19, HD47 and GH05.

Table K.2: Changes made to species names within the broader regional dataset prior to use in the floristic analysis.

Species name as reported	Species name used in analysis	Removed for analysis	Astron (2018)	Astron (2019)	Biota (2006)	Biota (2014)	Mattiske (2008)	Mattiske (2009)	Mattiske (2010)	Ecologia (2013)
Abutilon aff. sp. Dioicum (A.A. Mitchell PRP 1618)	N/A	Y				X				
Abutilon ?*cunninghamii*	N/A	Y								X
Abutilon ?*dioicum*	N/A	Y								X
Abutilon dioicum	*Abutilon* sp. Dioicum (A.A. Mitchell PRP 1618)						X			X
Abutilon ?*fraseri*	N/A	Y								X
Abutilon fraseri subsp. *fraseri*	*Abutilon fraseri*			X						X
Abutilon ?*lepidum*	N/A	Y	X							X
Abutilon sp.	N/A	Y		X			X			
Abutilon sp. (indet.)	N/A	Y								X
Abutilon trudgenii	*Abutilon* sp. Pilbara (W.R. Barker 2025)									X
Acacia aff. *aneura*	*Acacia aneura* sens. lat.					X				
Acacia aff. *aneura* (grey flat recurved tips; MET 15,828)	*Acacia aneura* sens. lat.				X					
Acacia aff. *aneura* (long, flat, recurved; FMR 35.3)	*Acacia aneura* sens. lat.				X					
Acacia aff. *aneura* (narrow fine veined; site 1259)	*Acacia aneura* sens. lat.				X					
Acacia aff. *aneura* (scythe-shaped; MET 15,743)	*Acacia aneura* sens. lat.				X					
Acacia aff. *aneura* (subterete long; site 1245)	*Acacia aneura* sens. lat.				X					

Species name as reported	Species name used in analysis	Removed for analysis	Astron (2018)	Astron (2019)	Biota (2006)	Biota (2014)	Mattiske (2008)	Mattiske (2009)	Mattiske (2010)	Ecologia (2013)
Acacia aff. *ayersiana* (narrow form; MET 15,786)	*Acacia aneura* sens. lat.				X					
Acacia ?*ancistrocarpa*	N/A	Y	X							
Acacia aneura	*Acacia aneura* sens. lat.		X	X						
Acacia aneura (flat curved; MET 15 548)	*Acacia aneura* sens. lat.				X					
Acacia aneura var. (green flat; MET 15 946)	*Acacia aneura* sens. lat.				X					
Acacia aneura var. aff. *longicarpa* (MET 16,050)	*Acacia aneura* sens. lat.				X					
Acacia aneura var. *aneura*	*Acacia aneura* sens. lat.						X	X	X	
Acacia aneura var. *conifera*	*Acacia aneura* sens. lat.						X	X	X	
Acacia aneura var. *intermedia*	*Acacia aneura* sens. lat.						X	X	X	
Acacia aneura var. *longicarpa*	*Acacia aneura* sens. lat.				X					
Acacia aptaneura	*Acacia aneura* sens. lat.		X	X		X				X
Acacia aptaneura x	*Acacia aneura* sens. lat.		X			X				
Acacia aptaneura x *aneura*	*Acacia aneura* sens. lat.					X				
Acacia arida X	N/A	Y	X							
Acacia arrecta	*Acacia hilliana*								X	
Acacia ?*ayersiana*	N/A	Y								X
Acacia ayersiana X	N/A	Y	X							
Acacia bivenosa (narrow)	*Acacia bivenosa*								X	
Acacia bivenosa (wispy/weeping form)	*Acacia bivenosa*				X	X				
Acacia ?*catenulata*	N/A	Y	X							X

Species name as reported	Species name used in analysis	Removed for analysis	Astron (2018)	Astron (2019)	Biota (2006)	Biota (2014)	Mattiske (2008)	Mattiske (2009)	Mattiske (2010)	Ecologia (2013)
Acacia cuthbertsonii subsp. *cuthbertsonii*	N/A	Y						X		
Acacia ?*hamersleyensis*	N/A	Y								X
Acacia hamersleyensis sens. lat.	N/A	Y	X							
Acacia ? *hilliana* x *hamersleyensis*	N/A	Y				X				
Acacia holosericea	N/A	Y						X		
Acacia incurvaneura	*Acacia aneura* sens. lat.		X	X						X
Acacia macraneura	*Acacia aneura* sens. lat.		X	X						X
Acacia mulganeura	*Acacia aneura* sens. lat.		X	X						
Acacia paraneura	*Acacia aneura* sens. lat.					X				
Acacia pteraneura	*Acacia aneura* sens. lat.		X	X						X
Acacia pyrifolia var. *pyrifolia*	*Acacia pyrifolia*			X		X				X
Acacia ?*sibirica*	N/A	Y								X
Acacia sibirica x	N/A	Y	X							
Acacia sibirica x (? *rhodophloia*)	N/A	Y			X					
Acacia sp.	N/A	Y	X	X			X	X	X	
Acacia ?*tenuissima*	N/A	Y	X							
Acacia trachycarpa x *tumida* var.*pilbarensis*	N/A	Y						X		
Acacia tumida var. *pilbarensis*	*Acacia tumida*		X							
Acacia validinervia	N/A	Y								X
Adriana urticoides var. *urticoides*	*Adriana tomentosa* var. *tomentosa*							X		
Alternanthera sp.	N/A	Y		X						
Amaranthus sp.	N/A	Y	X							

Species name as reported	Species name used in analysis	Removed for analysis	Astron (2018)	Astron (2019)	Biota (2006)	Biota (2014)	Mattiske (2008)	Mattiske (2009)	Mattiske (2010)	Ecologia (2013)
Amyema sp.	N/A	Y		X						
Aristida ?jerichoensis var. *subspinulifera*	N/A	Y								X
Aristida sp.	N/A	Y	X	X			X			
Asteraceae sp.	N/A	Y	X	X			X	X		
Atriplex vesicaria	N/A	Y						X		
Austrostipa sp.	N/A	Y					X			
Boerhavia ?coccinea	N/A	Y	X							
Boerhavia sp.	N/A	Y				X				
Capparis spinosa	*Capparis spinosa* subsp. *nummularia*						X	X	X	
Cassytha sp.	N/A	Y	X							
Cheilanthes austrotenuifolia	*Cheilanthes sieberi*						X	X	X	
Cheilanthes sieberi subsp. *pseudovellea*	*Cheilanthes sieberi*					X				
Cheilanthes sieberi subsp. *sieberi*	*Cheilanthes sieberi*		X	X	X		X	X		X
Chrysocephalum apiculatum	*Chrysocephalum apiculatum* subsp. *pilbarense*				X		X	X		X
Chrysocephalum ?eremaeum	N/A	Y								X
Convolvulus ?clementii	N/A	Y								X
Corchorus lasiocarpus subsp. *lasiocarpus*	*Corchorus lasiocarpus*			X		X	X	X	X	
Corchorus lasiocarpus subsp. *parvus*	*Corchorus lasiocarpus*		X	X		X	X			X
Corchorus parviflorus	*Corchorus lasiocarpus*						X			
Corchorus walcottii	*Corchorus crozophorifolius*						X	X	X	

Species name as reported	Species name used in analysis	Removed for analysis	Astron (2018)	Astron (2019)	Biota (2006)	Biota (2014)	Mattiske (2008)	Mattiske (2009)	Mattiske (2010)	Ecologia (2013)
Corymbia candida subsp. *candida*	*Corymbia candida*			X						
Corymbia ?*deserticola*	N/A	Y	X							
Corymbia hamersleyana	*Corymbia hamersleyana* sens. lat.		X	X	X	X	X	X	X	X
Corymbia opaca	*Corymbia hamersleyana* sens. lat.		X				X			
Corymbia sp.	N/A	Y	X							
Corymbia zygophylla	N/A	Y								
Corynotheca micrantha	*Tricoryne* sp. Hamersley Range (S. van Leeuwen 915)									X
Crotalaria novae-hollandiae subsp. *novae-hollandiae*	*Crotalaria novae-hollandiae*			X						X
Cymbopogon ?*ambiguus*	N/A	Y								X
Cymbopogon ?*obtectus*	N/A	Y								X
Cymbopogon ? *procerus*	*Cymbopogon obtectus*					X				
Cymbopogon procerus	*Cymbopogon obtectus*					X	X		X	X
Cymbopogon sp.	N/A	Y	X							
Cyperus cunninghamii	*Cyperus cunninghamii* subsp. *cunninghamii*						X			
Cyperus sp.	N/A	Y					X			
Denhamia cunninghamii	*Maytenus* sp. Mt Windell (S. van Leeuwen 846)									X
Dodonaea ?*coriacea*	N/A	Y								X
Dodonaea ?*pachyneura*	N/A	Y								X
Dodonaea viscosa subsp. *mucronata*	*Dodonaea viscosa*				X	X				X

Species name as reported	Species name used in analysis	Removed for analysis	Astron (2018)	Astron (2019)	Biota (2006)	Biota (2014)	Mattiske (2008)	Mattiske (2009)	Mattiske (2010)	Ecologia (2013)
Dodonaea viscosa subsp. *spatulata*	*Dodonaea viscosa*		X	X						X
Enchylaena tomentosa	*Enchylaena tomentosa* var. *tomentosa*						X	X	X	
Enneapogon sp.	N/A	Y	X	X						
Eragrostis sp.	N/A	Y		X			X			
Eremophila aff. *clarkei*	N/A	Y		X						
Eremophila ?*forrestii*	N/A	Y								X
Eremophila forrestii	*Eremophila forrestii* subsp. *forrestii*						X			
Eremophila fraseri	*Eremophila fraseri* subsp. *fraseri*						X	X	X	
Eremophila jucunda subsp. *jucunda*	*Eremophila jucunda*						X	X	X	
Eremophila jucunda subsp. *pulcherrima*	*Eremophila jucunda*		X	X		X				X
Eremophila latrobei subsp. *filiformis*	*Eremophila latrobei*		X	X	X		X	X	X	X
Eremophila latrobei subsp. *glabra*	*Eremophila latrobei*		X	X	X		X			
Eremophila latrobei subsp. *latrobei*	*Eremophila latrobei*		X	X			X	X		X
Eremophila sp.	N/A	Y	X				X			X
Eremophila ?*tietkensii*	N/A	Y								X
Eremophila youngii	*Eremophila youngii* subsp. *lepidota*							X		
Eriachne ?*benthamii*	N/A	Y	X							

Species name as reported	Species name used in analysis	Removed for analysis	Astron (2018)	Astron (2019)	Biota (2006)	Biota (2014)	Mattiske (2008)	Mattiske (2009)	Mattiske (2010)	Ecologia (2013)
Eriachne mucronata (arid form) (MET 12 736)	*Eriachne mucronata*				X					
Eriachne mucronata (typical form)	*Eriachne mucronata*					X				
Eriachne sp.	N/A	Y	X				X			
Eucalyptus camaldulensis subsp. *obtusa*	*Eucalyptus camaldulensis*		X	X						
Eucalyptus leucophloia	*Eucalyptus leucophloia* subsp. *leucophloia*						X	X	X	X
Eucalyptus ?sheathiana	*Eucalyptus trivalva*						X	X		
Eucalyptus socialis	*Eucalyptus socialis* subsp. *eucentrica*						X	X	X	
Eucalyptus socialis subsp. *?eucentrica*	N/A	Y	X							
Eucalyptus sp.	N/A	Y					X			
Eucalyptus ?trivalva	N/A	Y								X
Eucalyptus ?victrix	N/A	Y								X
Eucalyptus ?xerothermica	N/A	Y								X
Eucalyptus xerothermica x *Eucalyptus tephrodes*	N/A	Y								X
?Eulalia aurea	N/A	Y								X
Evolvulus alsinoides var. *decumbens*	*Evolvulus alsinoides*		X	X		X				X
Evolvulus alsinoides var. *villosicalyx*	*Evolvulus alsinoides*		X	X	X	X	X			X
Exocarpos aphyllus	*Exocarpus sparteus*						X	X		
Fimbristylis sp.	N/A	Y	X	X						

Species name as reported	Species name used in analysis	Removed for analysis	Astron (2018)	Astron (2019)	Biota (2006)	Biota (2014)	Mattiske (2008)	Mattiske (2009)	Mattiske (2010)	Ecologia (2013)
Frankenia ?magnifica	N/A	Y						X		
Gompholobium polyzygum	*Gompholobium oreophilum*						X	X	X	
Goodenia ?nuda	N/A	Y								X
Goodenia sp.	N/A	Y	X	X			X	X		
Goodenia sp. (of interest)	N/A	Y		X						
Goodenia ?triodiophila	N/A	Y								X
Gossypium australe (Burrup Peninsula form)	*Gossypium australe*				X					
Gossypium sturtianum	*Gossypium sturtianum* var. *sturtianum*						X			
Grevillea wickhamii subsp. *aprica*	*Grevillea wickhamii*						X		X	
Grevillea wickhamii subsp. *hispidula*	*Grevillea wickhamii*		X	X						X
Halgania gustafsenii var. Mid West (G. Perry 370)	*Halgania gustafsenii*				X					
Halgania solanacea var. Mt. Doreen (G.M. Chippendale 4206)	*Halgania solanacea*						X			
Heliotropium sp.	N/A	Y		X			X			
Hibiscus ?coatesii	N/A	Y	X							
Hibiscus gardneri	*Hibiscus* sp. Gardneri (A.L. Payne PRP 1435)									X
Hibiscus sp.	N/A	Y		X						
Hibiscus sturtii var. aff. *campylochlamys* (site 1398)	*Hibiscus sturtii*				X					

Species name as reported	Species name used in analysis	Removed for analysis	Astron (2018)	Astron (2019)	Biota (2006)	Biota (2014)	Mattiske (2008)	Mattiske (2009)	Mattiske (2010)	Ecologia (2013)
Hibiscus sturtii var. aff. *grandiflorus*	*Hibiscus sturtii*				X					
Hibiscus sturtii var. *campylochlamys*	*Hibiscus sturtii*		X	X	X	X	X	X		X
Hibiscus sturtii var. *platychlamys*	*Hibiscus sturtii*		X	X	X	X	X			X
Hibiscus sturtii var. *truncatus*	*Hibiscus sturtii*						X			
Hibiscus trionum	*Hibiscus verdcourtii*									X
Indigofera fractiflexa	*Indigofera fractiflexa* subsp. *fractiflexa*						X		X	X
Indigofera gilesii subsp. *gilesii*	*Indigofera gilesii*									X
Indigofera monophylla (small leaflet form)	*Indigofera monophylla*				X					
Indigofera sp. *Fractiflexa* (S. van Leeuwen 3773) PN	*Indigofera fractiflexa subsp. fractiflexa*					X				
Isotropis cuneifolia	*Isotropis* sp. Arid zone (G. Byrne 2775)							X		
Isotropis forrestii	*Isotropis* sp. Arid zone (G. Byrne 2775)				X	X		X	X	
Keraudrenia nephrosperma	*Seringia nephrosperma*				X		X	X	X	
Keraudrenia ?velutina	N/A	Y								X
Keraudrenia velutina	*Seringia elliptica*									X
Keraudrenia velutina subsp. *elliptica*	*Seringia elliptica*				X	X	X	X		
Lepidium sp.	N/A	Y		X						
Maireana planifolia x *villosa*	N/A	Y			X					
Maireana sp.	N/A	Y			X		X		X	

Species name as reported	Species name used in analysis	Removed for analysis	Astron (2018)	Astron (2019)	Biota (2006)	Biota (2014)	Mattiske (2008)	Mattiske (2009)	Mattiske (2010)	Ecologia (2013)
Maireana tomentosa	*Maireana tomentosa* subsp. *tomentosa*						X	X	X	X
Malvaceae sp.	N/A	Y		X						
Marsdenia sp.	N/A	Y	X							
Melaleuca lasiandra	*Melaleuca glomerata*						X	X	X	
?*Melhania oblongifolia*	N/A	Y								X
Panicum ?*decompositum*	N/A	Y	X							
Papilionaceae sp. (juvenile)	N/A	Y						X		
Phyllanthus sp.	N/A	Y	X							
Pluchea sp.	N/A	Y	X							
Poaceae sp.	N/A	Y	X	X			X		X	
Polycarpaea corymbosa	*Polycarpaea corymbosa* var. *corymbosa*									X
Polymeria aff. *longifolia*	N/A	Y		X						
Pterocaulon serrulatum var. *velutinum*	*Pterocaulon serrulatum*		X							
Pterocaulon sp.	N/A	Y	X	X	X					
Ptilotus astrolasius var. *astrolasius*	*Ptilotus astrolasius*						X	X	X	
?*Ptilotus calostachyus*	N/A	Y								X
Ptilotus calostachyus var. *calostachyus*	*Ptilotus calostachyus*						X	X		
?*Ptilotus clementii*	N/A	Y								X
Ptilotus ?*fusiformis*	N/A	Y								X
Ptilotus obovatus var. *obovatus*	*Ptilotus obovatus*						X	X	X	

Species name as reported	Species name used in analysis	Removed for analysis	Astron (2018)	Astron (2019)	Biota (2006)	Biota (2014)	Mattiske (2008)	Mattiske (2009)	Mattiske (2010)	Ecologia (2013)
Ptilotus schwartzii	*Ptilotus schwartzii* var. *schwartzii*							X		
Ptilotus sp.	N/A	Y	X	X				X	X	
Rhyncharrhena linearis	*Vincetoxicum lineare*									X
Rulingia loxophylla	*Androcalva loxophylla*						X			
Rulingia luteiflora	*Androcalva luteiflora*						X	X	X	
Sarcostemma viminale subsp. *australe*	*Cynanchum viminale* subsp. *australe*				X		X		X	X
Scaevola amblyanthera var. *centralis*	*Scaevola amblyanthera*		X	X	X					
Scaevola browniana subsp. *browniana*	*Scaevola browniana*			X			X	X	X	X
Scaevola parvifolia	*Scaevola parvifolia* subsp. *pilbarae*									X
?*Scaevola spinescens*	N/A	Y						X		
Sclerolaena ?*gardneri*	N/A	Y	X							
Senna artemisioides subsp. *oligophylla* x *helmsii*	N/A	Y	X				X	X	X	
Senna artemisioides subsp. *oligophylla* x subsp. *helmsii*	N/A	Y			X	X				
Senna artemisioides subsp. x *sturtii* x	*Senna artemisioides* subsp. x *sturtii*					X				
Senna charlesiana	N/A	Y						X		
Senna glaucifolia x ? (site 626)	N/A	Y			X					
Senna glaucifolia x *S. artemisioides* subsp. *oligophylla*	N/A	Y			X					

Species name as reported	Species name used in analysis	Removed for analysis	Astron (2018)	Astron (2019)	Biota (2006)	Biota (2014)	Mattiske (2008)	Mattiske (2009)	Mattiske (2010)	Ecologia (2013)
Senna glaucifolia x *S. glutinosa* subsp. *glutinosa*	N/A	Y			X					
Senna glaucifolia x *S. glutinosa* subsp. x *luerssenii*	N/A	Y			X					
Senna glutinosa subsp. *glutinosa* x subsp. x *luerssenii*	N/A	Y			X					
Senna glutinosa subsp. x *luerssenii* x *S. stricta*	N/A	Y			X					
Senna sp.	N/A	Y					X	X		
Senna sp. Meekatharra (E. Bailey 1-26) ×	N/A	Y			X					
Senna sp. Meekatharra (E. Bailey 1-26) × *glaucifolia*	N/A	Y		X						
Senna ?*stricta*	N/A	Y								X
Seringia sp.	N/A	Y	X	X						
Sida aff. *fibulifera*	N/A	Y		X						
Sida aff. *fibulifera*	*Sida fibulifera*				X					
Sida aff. *fibulifera* (grey; MET 15 783)	*Sida fibulifera*				X					
Sida aff. *fibulifera* (oblong; MET 15 220)	*Sida fibulifera*				X					
Sida aff. *fibulifera* (site 1394)	*Sida fibulifera*				X					
Sida ?*ammophila*	N/A	Y					X			
Sida ?*arsiniata*	N/A	Y								X
Sida ?*echinocarpa*	N/A	Y								X
Sida ?*ectogama*	N/A	Y	X							X

Species name as reported	Species name used in analysis	Removed for analysis	Astron (2018)	Astron (2019)	Biota (2006)	Biota (2014)	Mattiske (2008)	Mattiske (2009)	Mattiske (2010)	Ecologia (2013)
Sida excedentifolia ms	*Sida* sp. Excedentifolia (J.L. Egan 1925)						X			
Sida sp.	N/A	Y	X	X			X		X	X
Sida sp. 3	N/A	Y					X			
Sida ?sp. B Kimberley Flora (A.A. Mitchell 2745)	N/A	Y					X			
Sida ?sp. dark green fruits (S. van Leeuwen 2260)	N/A	Y	X							
Sida sp. excedentifolia (J.L. Egan 1925)	Sida sp. Excedentifolia (J.L. Egan 1925)						X	X	X	
Sida ?sp. Golden calyces glabrous (H.N. Foote 32)	N/A	Y								X
Sida sp. (MET 16,086)	N/A	Y			X					
Sida ?sp. Shovelanna Hill (S. van Leeuwen 3842)	N/A	Y								X
Sida ?sp. spiciform panicles (E. Leyland s.n. 14/8/1990 PN	N/A	Y								X
Sida ?sp. verrucose glands (F.H. Mollemans 2423)	N/A	Y								X
Sida ?trichopoda	N/A	Y								X
Solanum ellipticum	*Solanum cleistogamum*						X			
Solanum ?horridum	N/A	Y								X
Solanum ?lasiophyllum	N/A	Y								X
Solanum ?phlomoides	N/A	Y								X
Solanum sp.	N/A	Y					X			
Spartothamnella teucriiflora	*Teucrium teucriiflorum*									X
Stemodia sp.	N/A	Y		X						

Species name as reported	Species name used in analysis	Removed for analysis	Astron (2018)	Astron (2019)	Biota (2006)	Biota (2014)	Mattiske (2008)	Mattiske (2009)	Mattiske (2010)	Ecologia (2013)
Streptoglossa ?bubakii	N/A	Y								X
Streptoglossa sp.	N/A	Y	X							
Stylidium sp.	N/A	Y					X			
Tephrosia densa	*Tephrosia* sp. Fortescue (A.A. Mitchell 606)									X
Tephrosia rosea var. *clementii*	*Tephrosia rosea* var. Fortescue creeks (M.I.H. Brooker 2186)						X	X	X	
Tephrosia rosea var. *glabrior*	*Tephrosia rosea* var. Fortescue creeks (M.I.H. Brooker 2186)									X
Themeda sp.	N/A	Y		X						
Trianthema glossostigma	*Trianthema glossostigmum*						X	X		X
Triodia aff. *wiseana* (JDMM-35)	N/A	Y			X					
Triodia ?basedowii	N/A	Y								X
Triodia epactia	*Triodia pungens*						X	X	X	
Triodia ?pungens	N/A	Y								X
Triodia sp.	N/A	Y					X			
Triodia sp. Shovelanna Hill (S. van Leeuwen 3835)	*Triodia vanleeuwenii*				X	X				
Triumfetta sp.	N/A	Y					X		X	
Tylophora flexuosa	*Vincetoxicum flexuosum*					X				
Vigna lanceolata var. *lanceolata*	*Vigna lanceolata*			X						

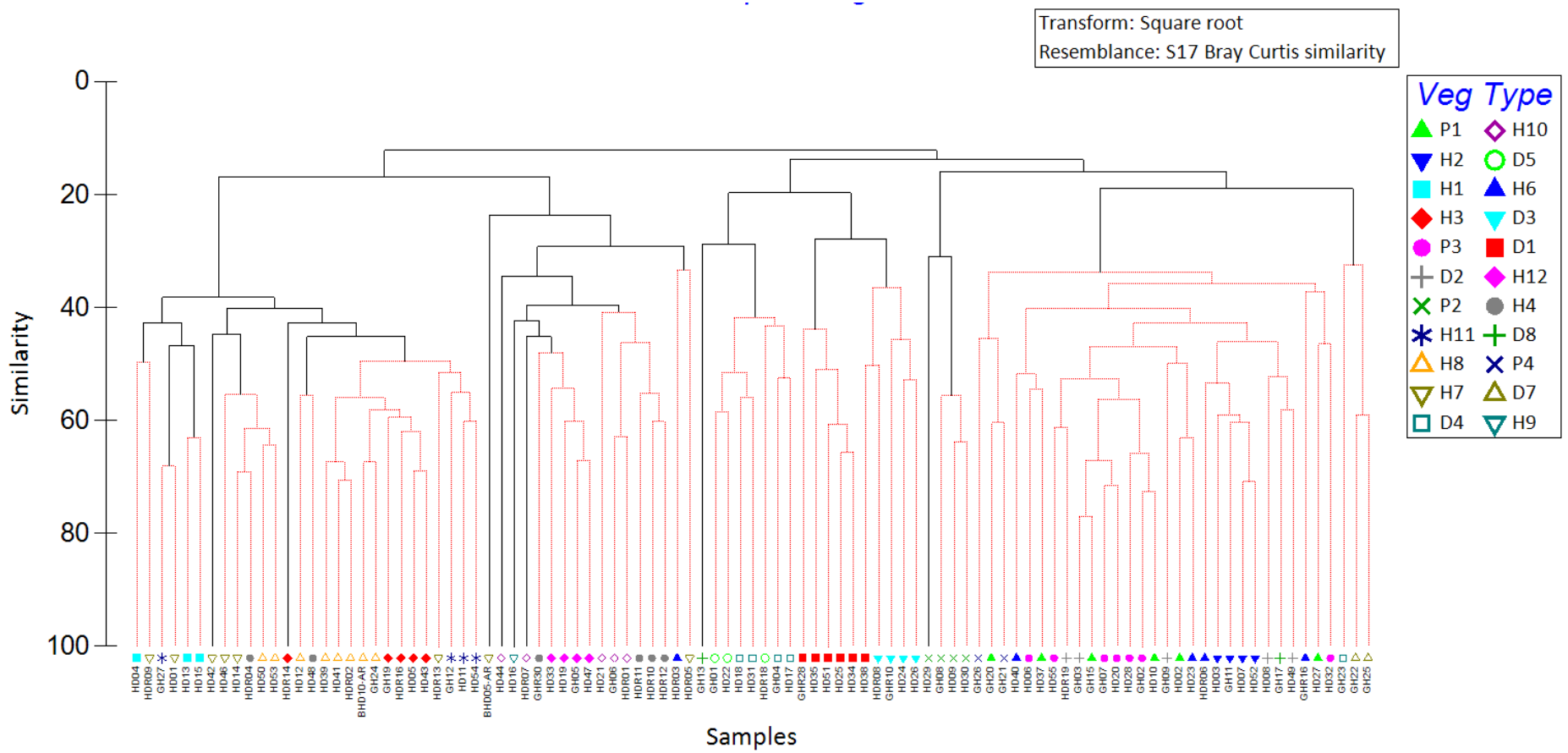


Figure K.2: Detailed survey area dendrogram showing relationship between Astron quadrats and relevés according to the degree of shared species (Sorensen's Index based on square root percentage foliar cover data). Significant clusters are separated by solid black lines.

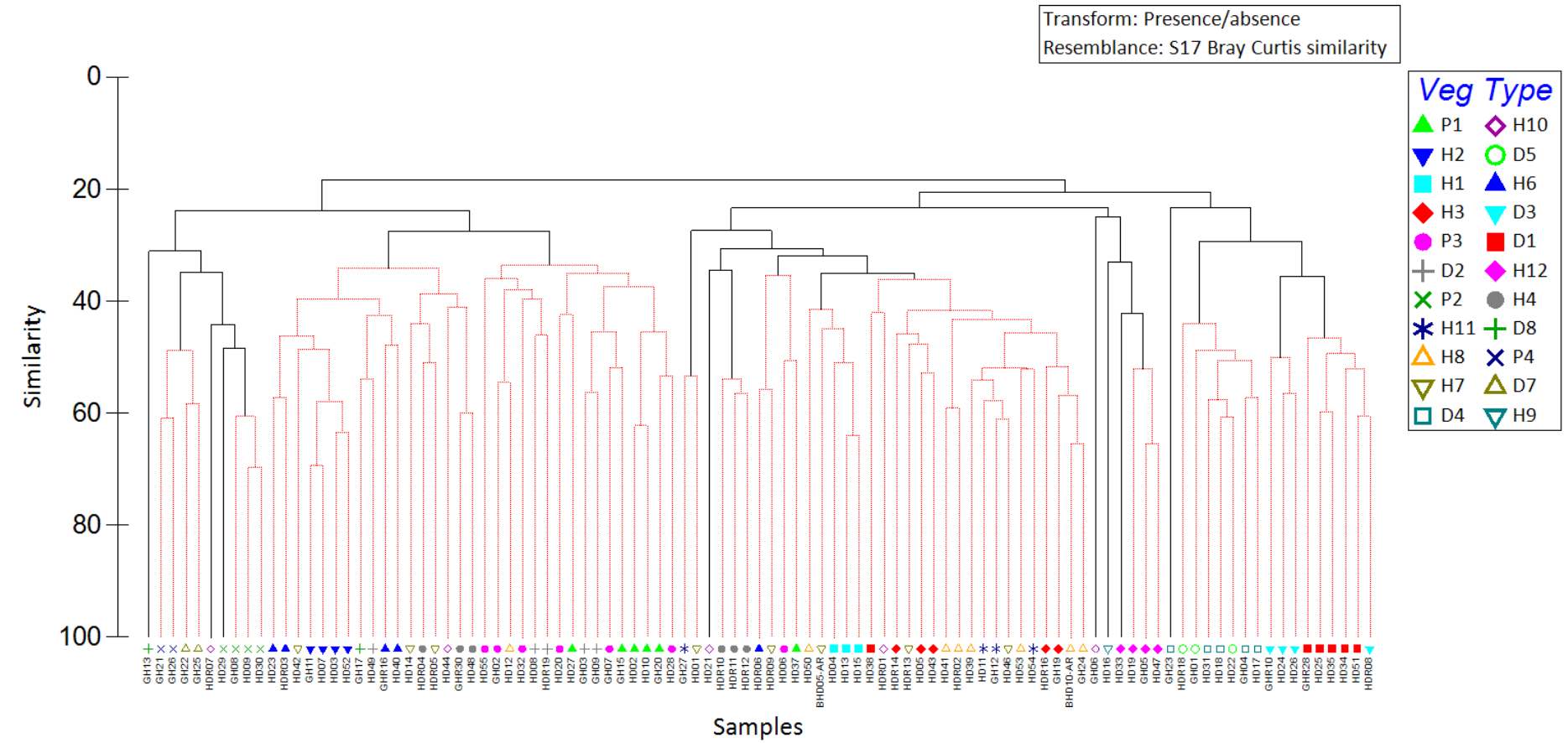


Figure K.3: Dendrogram showing relationship between Astron quadrats and relevés according to the degree of shared species. (Sorensen's Index based on presence-absence data). Significant clusters are separated by solid black lines.



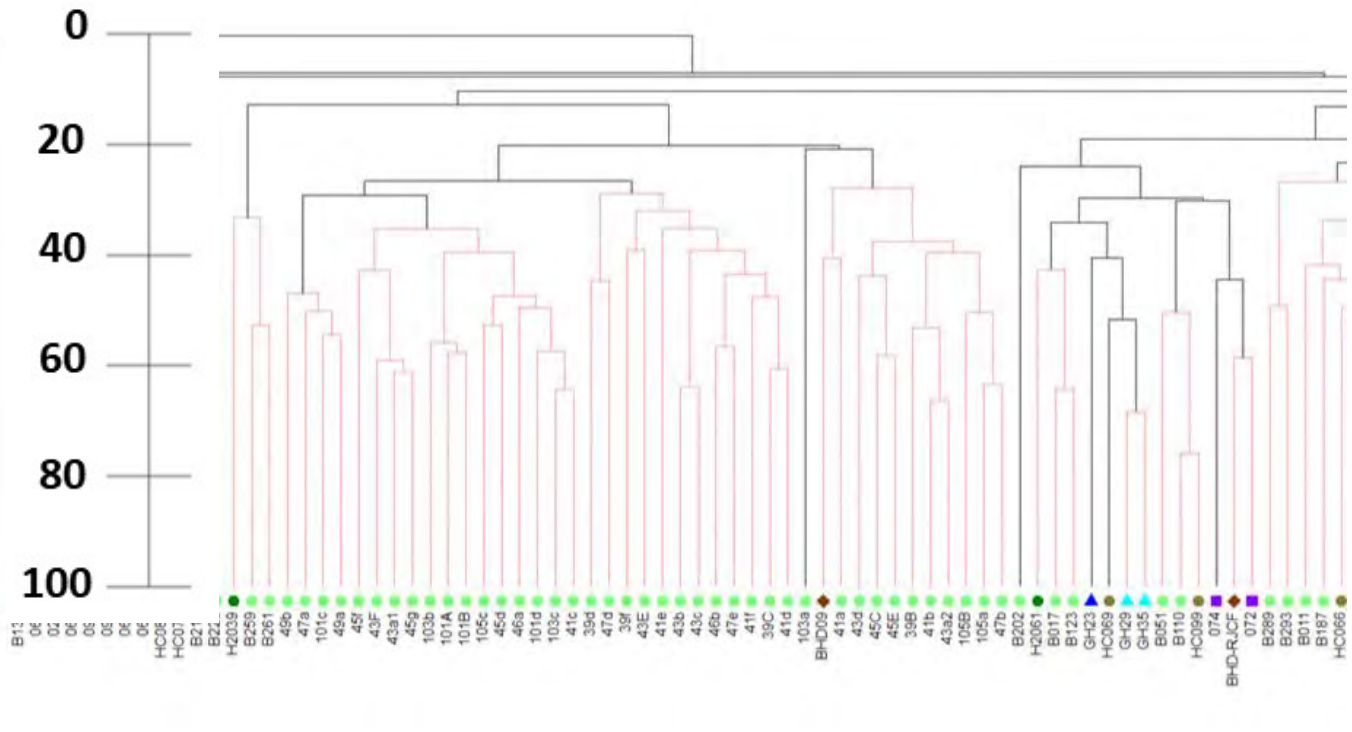


Figure K.4a: Dendrogram showing broader regional dataset according to the degree of shared species (Sorensen's Index based on presence-absence data). Significant clusters are separated by solid black lines.

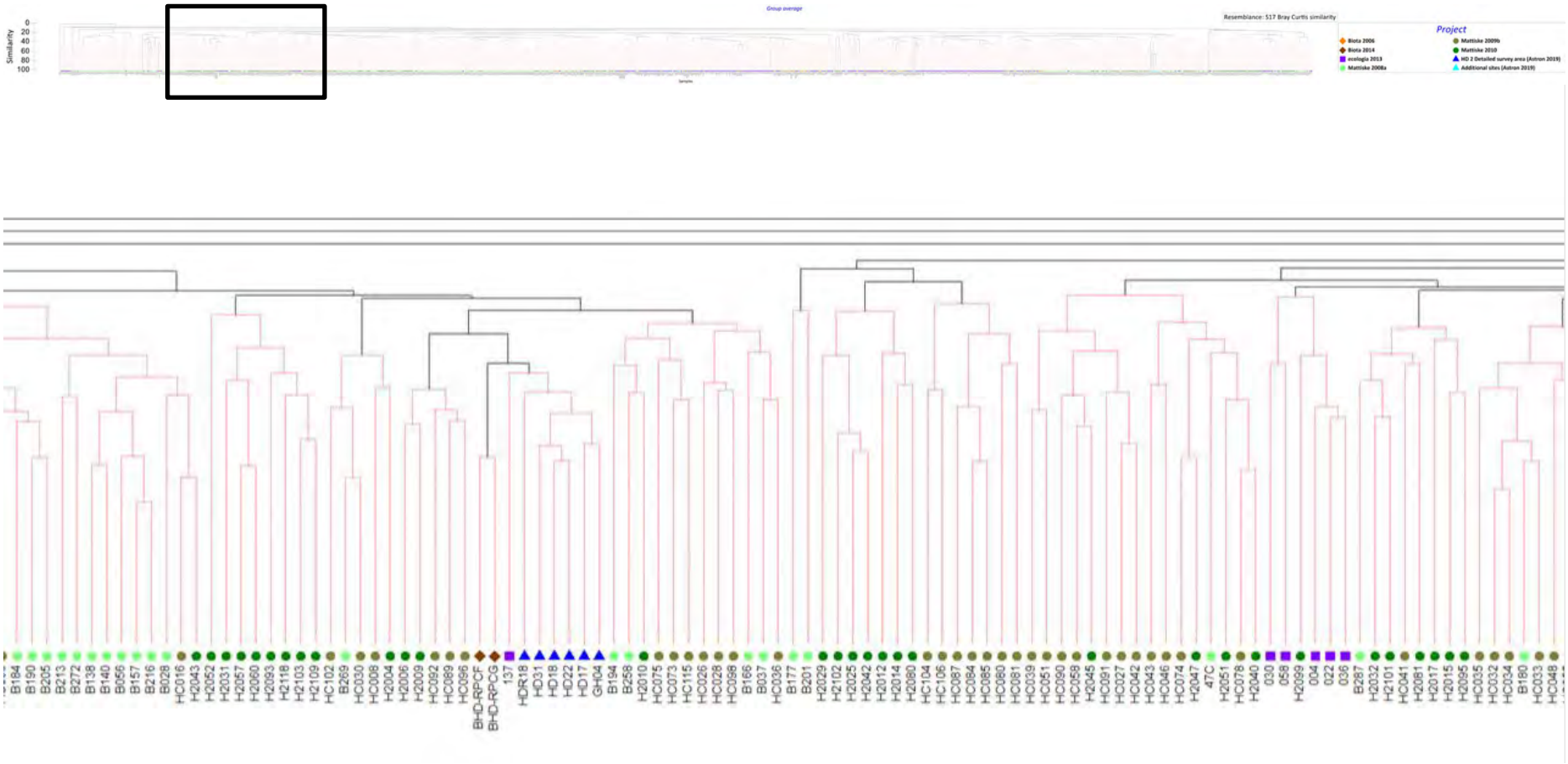


Figure K.4b: Dendrogram showing broader regional dataset according to the degree of shared species (Sorensen's Index based on presence-absence data). Significant clusters are separated by solid black lines.

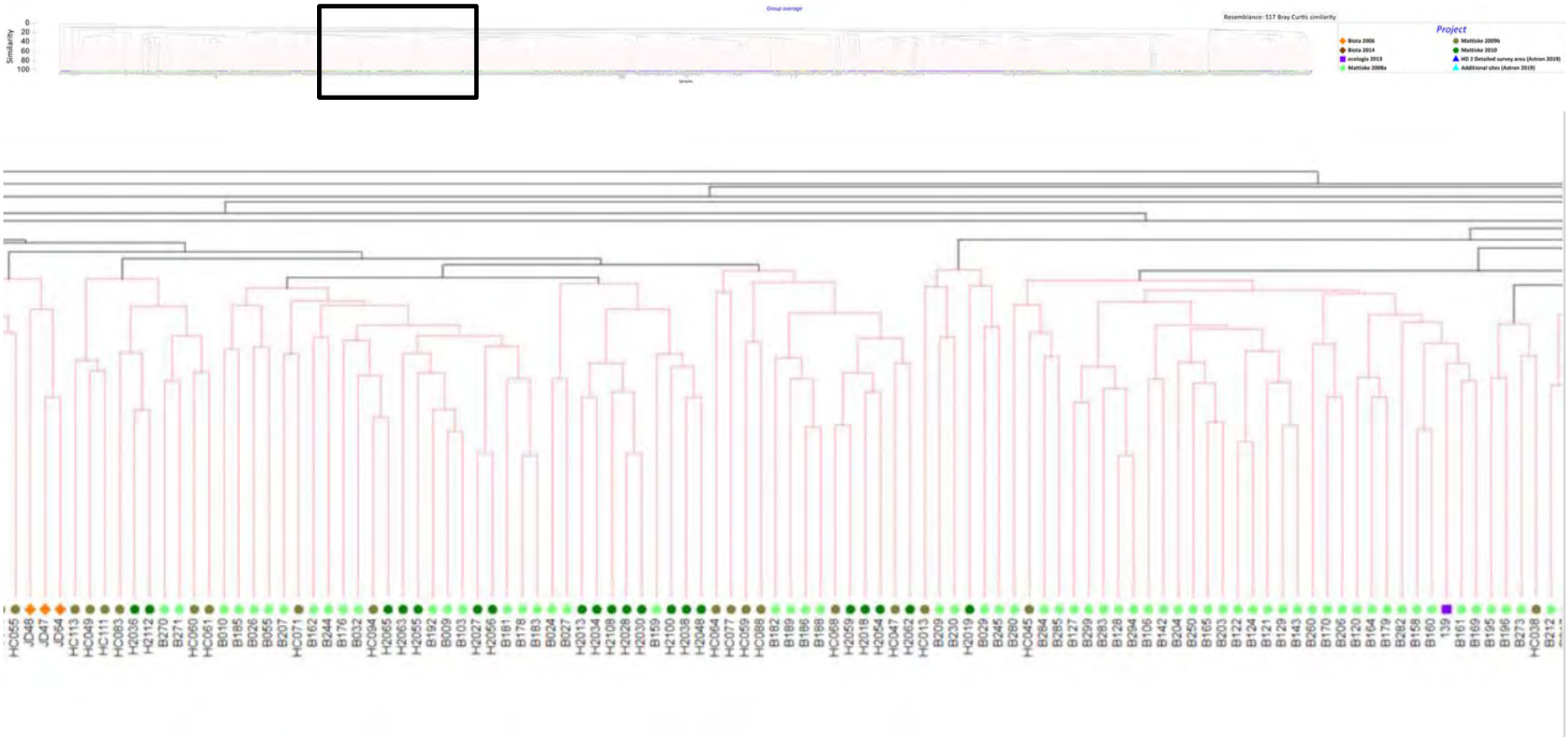


Figure K.4c: Dendrogram showing broader regional dataset according to the degree of shared species (Sorensen's Index based on presence-absence data). Significant clusters are separated by solid black lines.

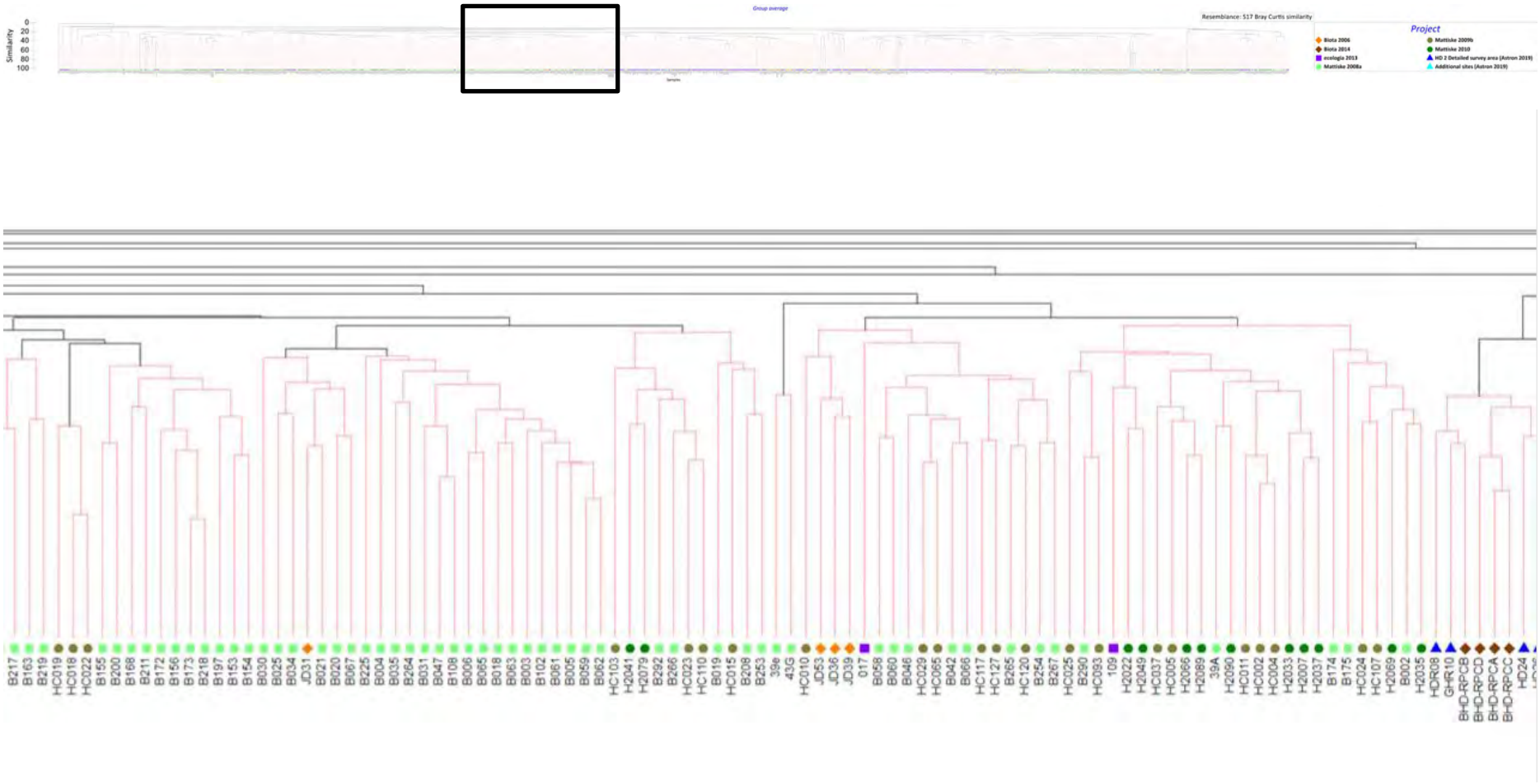


Figure K.4d: Dendrogram showing broader regional dataset according to the degree of shared species (Sorensen's Index based on presence-absence data). Significant clusters are separated by solid black lines.

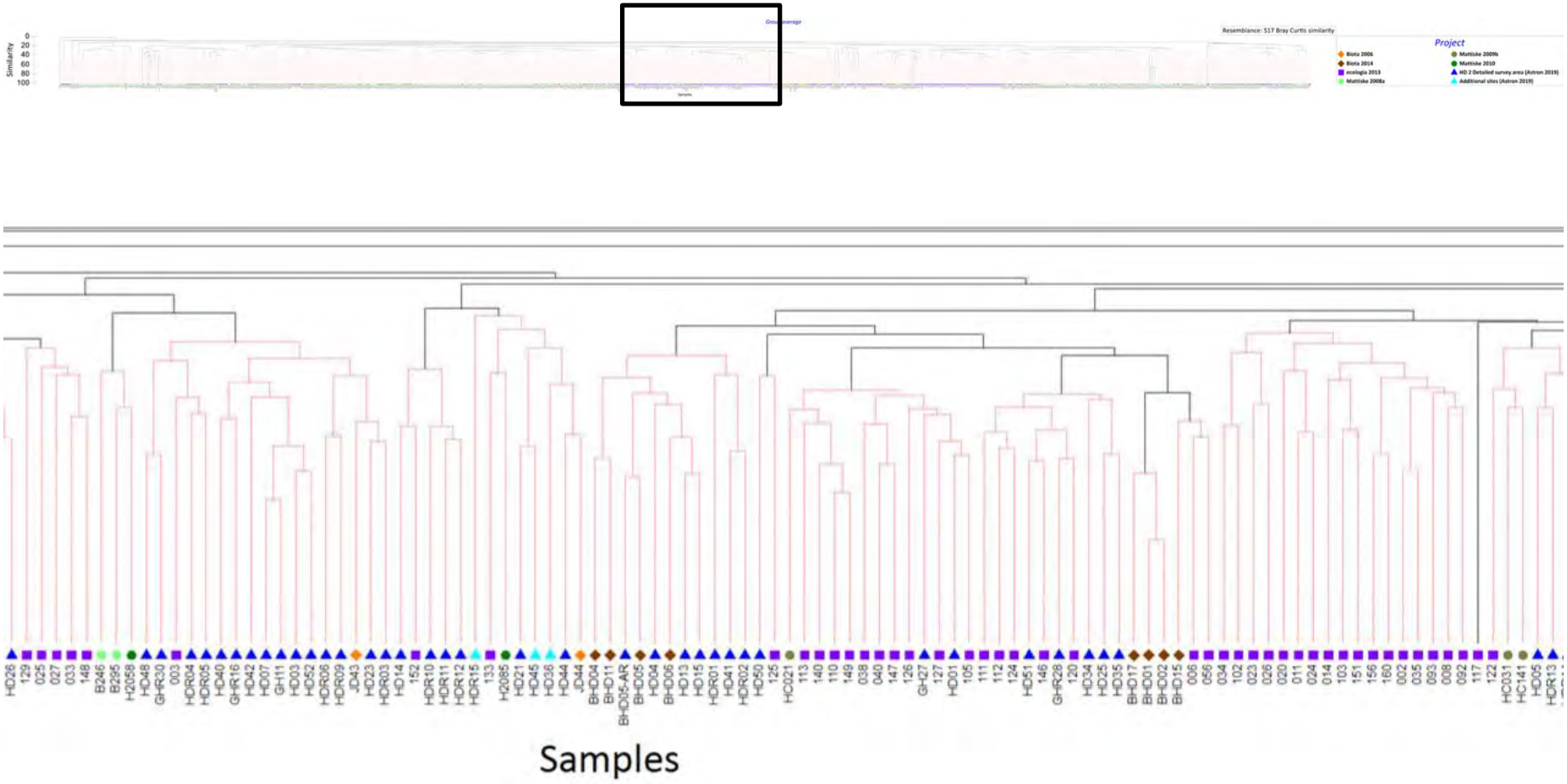


Figure K.4e: Dendrogram showing broader regional dataset according to the degree of shared species (Sorensen's Index based on presence-absence data). Significant clusters are separated by solid black lines.

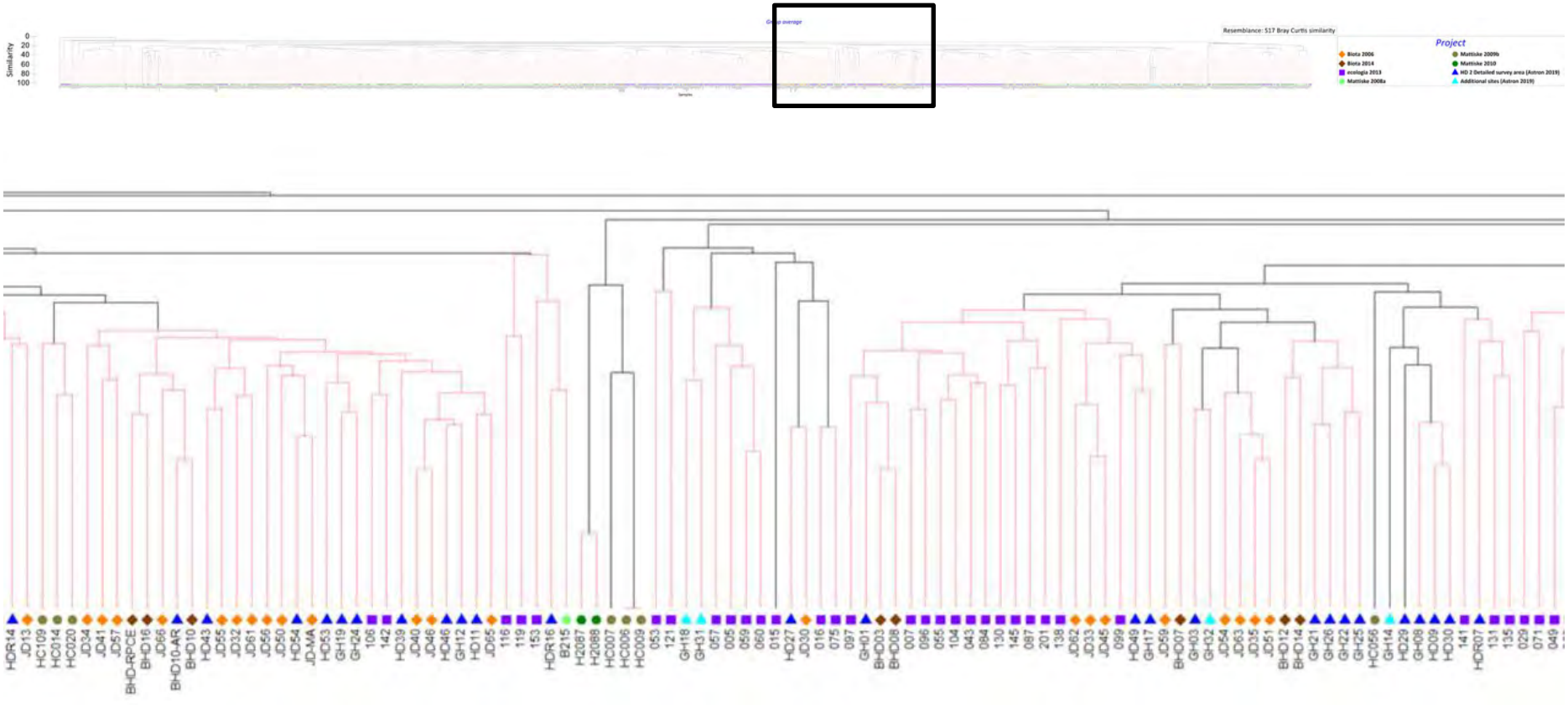


Figure K.4f: Dendrogram showing broader regional dataset according to the degree of shared species (Sorensen's Index based on presence-absence data). Significant clusters are separated by solid black lines.

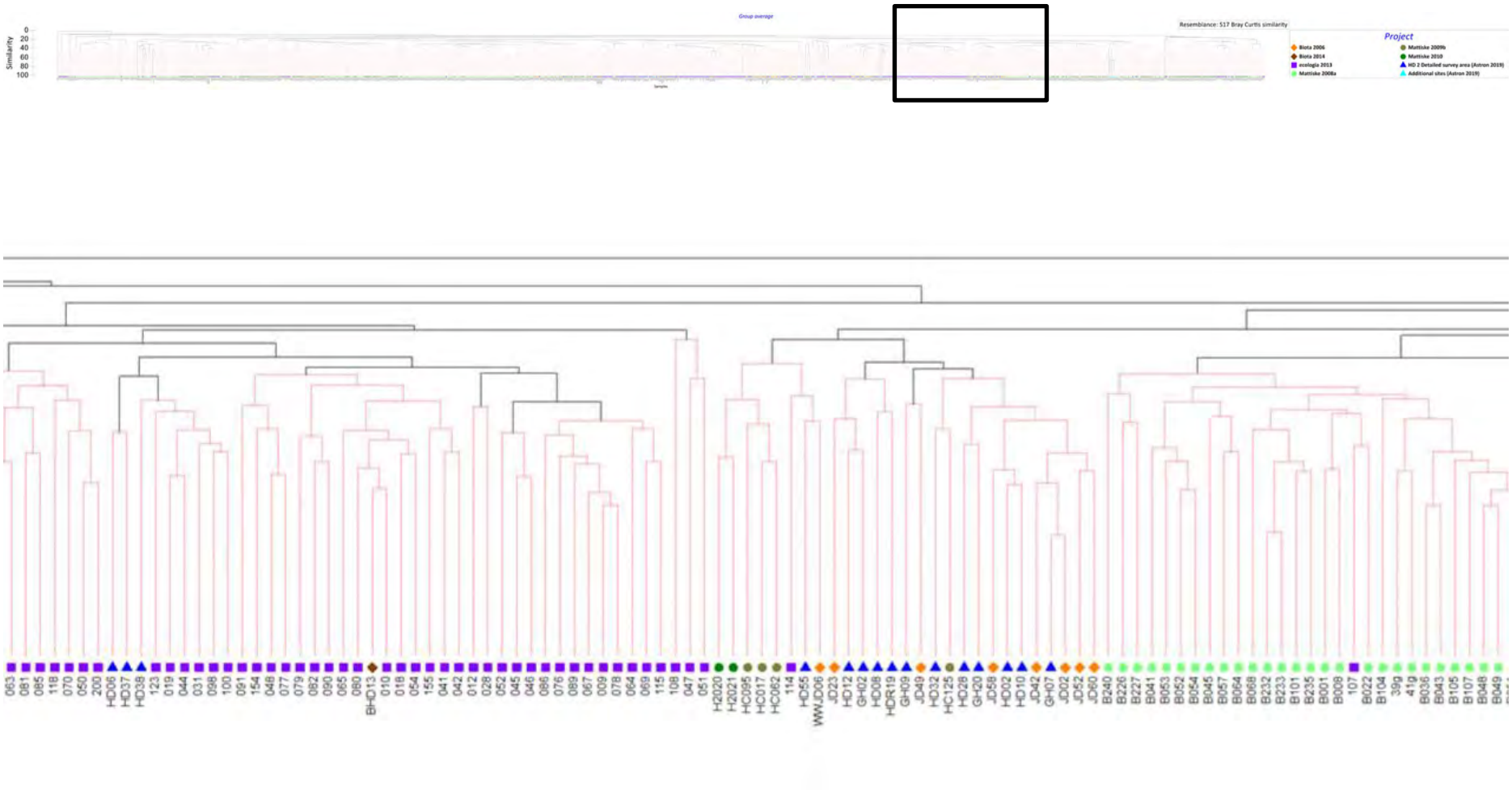


Figure K.4g: Dendrogram showing broader regional dataset according to the degree of shared species (Sorensen's Index based on presence-absence data). Significant clusters are separated by solid black lines.

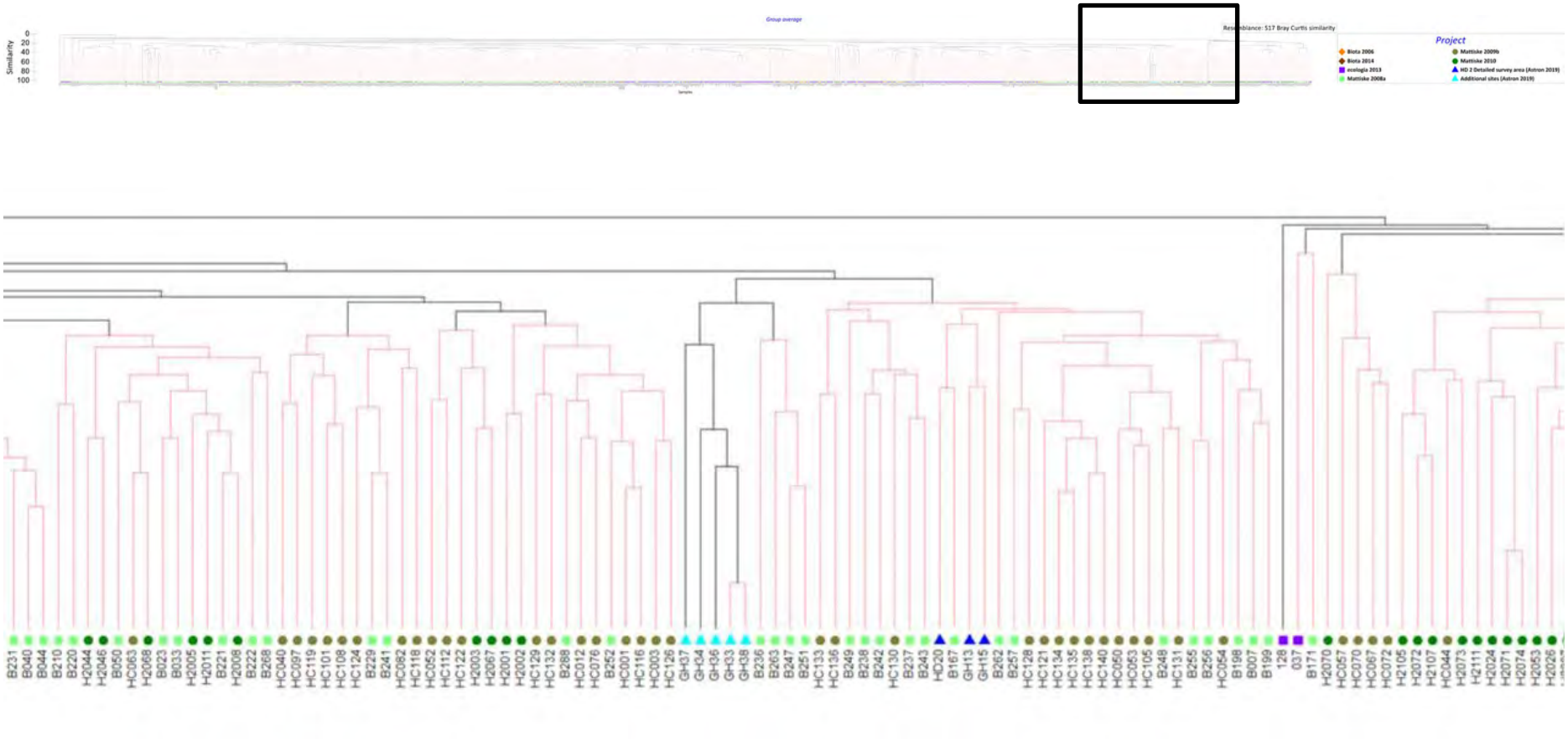


Figure K.4h: Dendrogram showing broader regional dataset according to the degree of shared species (Sorensen's Index based on presence-absence data). Significant clusters are separated by solid black lines.



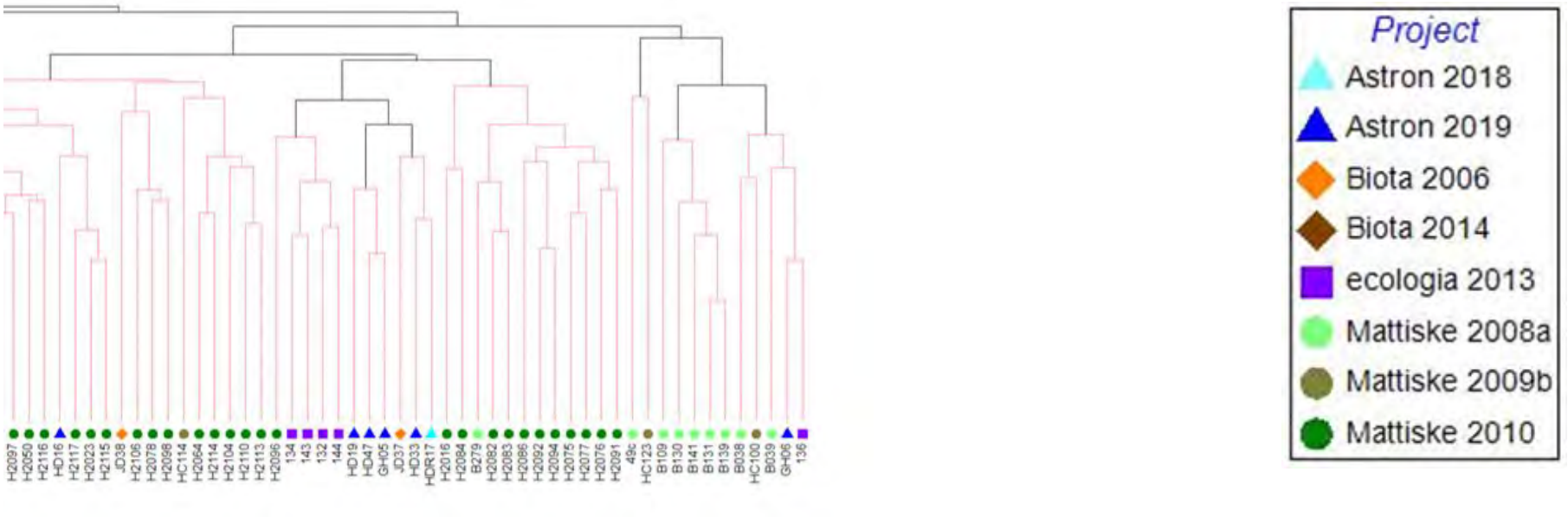


Figure K.4i: Dendrogram showing broader regional dataset according to the degree of shared species (Sorensen's Index based on presence-absence data). Significant clusters are separated by solid black lines.

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Appendix L: Vascular Flora Species List, Project by Species Matrix and Site by Species Matrix

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Table L.1: Vascular flora species recorded in the survey area.

Family	Species name	Conservation status	Weed
Acanthaceae	*Dicladanthera forrestii*		
	Dipteracanthus australasicus subsp. *australasicus*		
	Rostellularia adscendens var. *latifolia*	P3	
Aizoaceae	*Trianthema glossostigmum*		
Amaranthaceae	*Alternanthera denticulata*		
	Alternanthera nana		
	Alternanthera sp.		
	Amaranthus sp.		
	Gomphrena cunninghamii		
	Ptilotus aervoides		
	Ptilotus astrolasius		
	Ptilotus auriculifolius		
	Ptilotus calostachyus		
	Ptilotus clementii		
	Ptilotus exaltatus		
	Ptilotus fusiformis		
	Ptilotus helipteroides		
	Ptilotus incanus		
	Ptilotus mollis	P4	
	Ptilotus obovatus		
	Ptilotus polystachyus		
	Ptilotus rotundifolius		
	Ptilotus schwartzii var. *schwartzii*		
	Ptilotus sp.		
Apocynaceae	*Cynanchum floribundum*		
	Cynanchum viminale		
	Marsdenia australis		
	Marsdenia sp.		
Araliaceae	*Astrotricha hamptonii*		
	Trachymene oleracea subsp. *oleracea*		
Asteraceae	**Bidens bipinnata*		*
	Centipeda minima subsp. *macrocephala*		
	Chrysocephalum apiculatum subsp. *pilbarense*		
	Chrysocephalum gilesii		
	**Conyza bonariensis*		*
	**Flaveria trinervia*		*
	Peripleura arida		
	Peripleura obovata		

Family	Species name	Conservation status	Weed
Asteraceae	*Peripleura virgata*		
	Pluchea dentex		
	Pluchea rubelliflora		
	Pluchea sp.		
	Pterocaulon serrulatum var. *velutinum*		
	Pterocaulon sp.		
	Pterocaulon sphacelatum		
	Pterocaulon sphaeranthoides		
	Rhodanthe margarethae		
	**Sigesbeckia orientalis*		*
	**Sonchus oleraceus*		*
	Streptoglossa bubakii		
	Streptoglossa decurrens		
	Streptoglossa sp.		
	**Tridax procumbens*		*
	Vittadinia eremaea		
Bignoniaceae	*Pandorea pandorana*		
Boraginaceae	*Halgania cyanea*		
	Halgania gustafsenii var. *gustafsenii*		
	Heliotropium inexplicitum		
	Heliotropium ovalifolium		
	Heliotropium pachyphyllum		
	Heliotropium sp.		
	Heliotropium tanythrix		
	Heliotropium tenuifolium		
	Trichodesma zeylanicum var. *zeylanicum*		
Brassicaceae	*Lepidium catapycnon*	P4	
	Lepidium pedicellosum		
	Lepidium phlebopetalum		
	Lepidium pholidogynum		
	Lepidium sp.		
Campanulaceae	*Lobelia heterophylla* subsp. *pilbarensis*		
	Wahlenbergia sp.		
	Wahlenbergia tumidifructa		
Capparaceae	*Capparis lasiantha*		
	Capparis spinosa subsp. *nummularia*		
	Capparis umbonata		
Caryophyllaceae	*Polycarpaea corymbosa* var. *corymbosa*		
	Polycarpaea holtzei		

Family	Species name	Conservation status	Weed
Caryophyllaceae	*Polycarpaea longiflora*		
Celastraceae	*Maytenus* sp. Mt Windell (S. van Leeuwen 846)		
	Stackhousia muricata subsp. annual (W.R. Barker 2172)		
Chenopodiaceae	*Dysphania kalpari*		
	Dysphania plantaginella		
	Dysphania rhadinostachya subsp. *rhadinostachya*		
	Enchylaena tomentosa var. *tomentosa*		
	Maireana carnosa		
	Maireana eriosphaera		
	Maireana georgei		
	Maireana melanocoma		
	Maireana tomentosa subsp. *tomentosa*		
	Maireana triptera		
	Maireana villosa		
	Rhagodia eremaea		
	Rhagodia sp. Hamersley (M. Trudgen 17794)	P3	
	Salsola australis		
	Sclerolaena cornishiana		
	Sclerolaena cuneata		
	Sclerolaena densiflora		
	Sclerolaena ?gardneri		
Cleomaceae	*Cleome viscosa*		
Commelinaceae	*Commelina ensifolia*		
Convolvulaceae	*Bonamia pilbarensis*		
	Convolvulus clementii		
	Cuscuta victoriana		
	Duperreya commixta		
	Evolvulus alsinoides var. *decumbens*		
	Evolvulus alsinoides var. *villosicalyx*		
	Polymeria aff. *longifolia*		
	Polymeria ambigua		
Cucurbitaceae	*Cucumis melo*		
	Cucumis variabilis		
Cyperaceae	*Bulbostylis barbata*		
	Bulbostylis turbinata		
	Cyperus cunninghamii subsp. *cunninghamii*		
	Cyperus difformis		
	Cyperus vaginatus		
	Fimbristylis dichotoma		

Family	Species name	Conservation status	Weed
Cyperaceae	*Fimbristylis simulans*		
	Fimbristylis sp.		
Euphorbiaceae	*Adriana tomentosa* var. *tomentosa*		
	Euphorbia australis var. *subtomentosa*		
	Euphorbia biconvexa		
	Euphorbia biconvexa/coghlanii/trigonosperma		
	Euphorbia boophthona		
	Euphorbia careyi		
	Euphorbia coghlanii		
	Euphorbia sp.		
	Euphorbia trigonosperma		
Fabaceae	*Acacia adoxa* var. *adoxa*		
	Acacia adsurgens		
	Acacia ancistrocarpa		
	Acacia ?ancistrocarpa		
	Acacia aptaneura		
	Acacia aptaneura sens. lat.		
	Acacia aptaneura x		
	Acacia arida		
	Acacia arida x		
	Acacia ayersiana		
	Acacia ayersiana x		
	Acacia bivenosa		
	Acacia bromilowiana	P4	
	Acacia ?catenulata		
	Acacia catenulata subsp. *occidentalis*		
	Acacia citrinoviridis		
	Acacia colei		
	Acacia coriacea subsp. *pendens*		
	Acacia dictyophleba		
	Acacia hamersleyensis		
	Acacia hilliana		
	Acacia inaequilatera		
	Acacia incurvaneura		
	Acacia kempeana		
	Acacia macraneura		
	Acacia maitlandii		
	Acacia marramamba		
	Acacia minyura		

Family	Species name	Conservation status	Weed
Fabaceae	*Acacia monticola*		
	Acacia mulganeura		
	Acacia pachyacra		
	Acacia pruinocarpa		
	Acacia pteraneura		
	Acacia pteraneura x aptaneura		
	Acacia pyrifolia		
	Acacia rhodophloia		
	Acacia sibirica		
	Acacia sibirica x		
	Acacia sp.		
	Acacia spondylophylla		
	Acacia steedmanii subsp. borealis		
	Acacia subtiliformis	P3	
	Acacia synchronicia		
	Acacia tenuissima		
	Acacia tetragonophylla		
	Acacia tumida var. *pilbarensis*		
	Crotalaria medicaginea var. *neglecta*		
	Cullen leucochaites		
	Glycine canescens		
	Gompholobium oreophilum		
	Indigofera fractiflexa subsp. *fractiflexa*		
	Indigofera georgei		
	Indigofera linifolia		
	Indigofera monophylla		
	Indigofera rugosa		
	Isotropis sp. Arid zone (G. Byrne 2775)		
	Mirbelia viminalis		
	Neptunia dimorphantha		
	Petalostylis labicheoides		
	Rhynchosia minima		
	Senna artemisioides subsp. × *artemisioides*		
	Senna artemisioides subsp. *filifolia*		
	Senna artemisioides subsp. *helmsii*		
	Senna artemisioides subsp. *oligophylla*		
	Senna artemisioides subsp. *oligophylla* x *helmsii*		
	Senna artemisioides subsp. x *artemisioides*		
	Senna ferraria		

Family	Species name	Conservation status	Weed
Fabaceae	*Senna glaucifolia*		
	Senna glutinosa		
	Senna glutinosa subsp. *× luerssenii*		
	Senna glutinosa subsp. *glutinosa*		
	Senna glutinosa subsp. *pruinosa*		
	Senna notabilis		
	Senna pleurocarpa var. *angustifolia*		
	Senna sericea		
	Senna sp. Meekatharra (E. Bailey 1-26)		
	Senna sp. Meekatharra (E. Bailey 1-26) ×		
	Senna stricta		
	Senna venusta		
	Swainsona maccullochiana		
	Templetonia egena		
	Tephrosia oxalidea		
	Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)		
	Tephrosia sp. Fortescue (A.A. Mitchell 606)		
	**Vachellia farnesiana*		*
	Vigna lanceolata var. *lanceolata*		
Gentianaceae	*Schenkia australis*		
Goodeniaceae	*Dampiera candicans*		
	Goodenia cusackiana		
	Goodenia lamprosperma		
	Goodenia microptera		
	Goodenia muelleriana		
	Goodenia prostrata		
	Goodenia sp.		
	Goodenia sp. (of interest)		
	Goodenia stellata		
	Goodenia stobbsiana		
	Goodenia tenuiloba		
	Goodenia triodiophila		
	Scaevola acacioides		
	Scaevola amblyanthera var. *centralis*		
	Scaevola browniana		
	Scaevola parvifolia subsp. *pilbarae*		
	Scaevola spinescens		
	Velleia connata		
Gyrostemonaceae	*Codonocarpus cotinifolius*		

Family	Species name	Conservation status	Weed
Haloragaceae	*Haloragis gossei*		
	Haloragis odontocarpa		
	Haloragis sp.		
Hemerocallidaceae	*Tricoryne* sp. Hamersley Range (S. van Leeuwen 915)		
Lamiaceae	*Clerodendrum floribundum* var. *angustifolium*		
	Clerodendrum tomentosum var. *lanceolatum*		
	Newcastelia sp. Hamersley Range (S. van Leeuwen 4264)		
	Teucrium teucriiflorum		
Lauraceae	*Cassytha capillaris*		
	Cassytha filiformis		
	Cassytha sp.		
Loranthaceae	*Amyema fitzgeraldii*		
	Amyema hilliana		
	Amyema miquelii		
	Amyema sp.		
Malvaceae	*Abutilon amplum*		
	Abutilon cryptopetalum		
	Abutilon fraseri subsp. *fraseri*		
	Abutilon lepidum		
	Abutilon ?lepidum		
	Abutilon macrum		
	Abutilon malvifolium		
	Abutilon otocarpum		
	Abutilon sp.		
	Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)		
	Androcalva luteiflora		
	Brachychiton acuminatus		
	Corchorus crozophorifolius		
	Corchorus lasiocarpus subsp. *lasiocarpus*		
	Corchorus lasiocarpus subsp. *parvus*		
	Corchorus tridens		
	Gossypium australe		
	Gossypium robinsonii		
	Gossypium sturtianum var. *sturtianum*		
	Hibiscus burtonii		
	Hibiscus coatesii		
	Hibiscus ?coatesii		
	Hibiscus leptocladus		
	Hibiscus sp.		

Family	Species name	Conservation status	Weed
Malvaceae	*Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708)	P2	
	Hibiscus sturtii		
	Hibiscus sturtii var. *campylochlamys*		
	Hibiscus sturtii var. *platychlamys*		
	Hibiscus verdcourtii		
	**Malvastrum americanum*		*
	Melhania oblongifolia		
	Seringia elliptica		
	Seringia nephrosperma		
	Seringia sp.		
	Sida arenicola		
	Sida calyxhymenia		
	Sida cardiophylla		
	Sida echinocarpa		
	Sida ?ectogama		
	Sida fibulifera		
	Sida platycalyx		
	Sida sp.		
	Sida sp. Articulation below (A.A. Mitchell PRP 1605)		
	Sida sp. dark green fruits (S. van Leeuwen 2260)		
	Sida ?sp. dark green fruits (S. van Leeuwen 2260)		
	Sida sp. *Excedentifolia (J.L. Egan 1925)*		
	Sida sp. Golden calyces glabrous (H.N. Foote 32)		
	Sida sp. Pilbara (A.A. Mitchell PRP 1543)		
	Sida sp. Shovelanna Hill (S. van Leeuwen 3842)		
	Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)		
	Triumfetta chaetocarpa		
	Waltheria indica		
Menispermaceae	*Tinospora smilacina*		
Molluginaceae	*Trigastrotheca molluginea*		
Moraceae	*Ficus brachypoda*		
Myrtaceae	*Calytrix carinata*		
	Corymbia deserticola		
	Corymbia deserticola subsp. *deserticola*		
	Corymbia ferriticola		
	Corymbia hamersleyana		
	Corymbia hamersleyana sens lat.		
	Corymbia opaca		
	Corymbia sp.		

Family	Species name	Conservation status	Weed
Myrtaceae	*Eucalyptus camaldulensis* subsp. *obtusa*		
	Eucalyptus gamophylla		
	Eucalyptus kingsmillii		
	Eucalyptus leucophloia subsp. *leucophloia*		
	Eucalyptus pilbarensis		
	Eucalyptus repullulans		
	Eucalyptus socialis subsp. *eucentrica*		
	Eucalyptus socialis subsp. *?eucentrica*		
	Eucalyptus victrix		
	Eucalyptus xerothermica		
	Eucalyptus xerothermica x *Eucalyptus tephrodes*		
	Melaleuca bracteata		
	Melaleuca eleuterostachya		
	Melaleuca glomerata		
Nyctaginaceae	*Boerhavia coccinea*		
	Boerhavia ?coccinea		
Oleaceae	*Jasminum didymum* subsp. *lineare*		
Phyllanthaceae	*Phyllanthus erwinii*		
	Phyllanthus maderaspatensis		
Plantaginaceae	*Stemodia grossa*		
Poaceae	*Acrachne racemosa*		
	Amphipogon sericeus		
	Aristida burbidgeae		
	Aristida contorta		
	Aristida holathera var. *holathera*		
	Aristida inaequiglumis		
	Aristida ?inaequiglumis		
	Aristida ingrata		
	Aristida latifolia		
	Aristida lazaridis	P2	
	Aristida obscura		
	Aristida sp.		
	Astrebla elymoides		
	Astrebla sp.		
	Bothriochloa ewartiana		
	**Cenchrus ciliaris*		*
	**Cenchrus setiger*		*
	**Chloris virgata*		*
	Chrysopogon fallax		

Family	Species name	Conservation status	Weed
Poaceae	*Cymbopogon ambiguus*		
	Cymbopogon obtectus		
	Cymbopogon sp.		
	Cynodon convergens		
	**Cynodon dactylon*		*
	Cynodon prostratus		
	Dactyloctenium radulans		
	Dactyloctenium ?radulans		
	Dichanthium sericeum subsp. *humilius*		
	Dichanthium sp.		
	Digitaria ammophila		
	Digitaria brownii		
	**Echinochloa colona*		*
	Enneapogon caerulescens		
	Enneapogon lindleyanus		
	Enneapogon polyphyllus		
	Enneapogon robustissimus		
	Enneapogon sp.		
	Enteropogon ramosus		
	Eragrostis cumingii		
	Eragrostis eriopoda		
	Eragrostis setifolia		
	Eragrostis tenellula		
	Eragrostis xerophila		
	Eriachne aristidea		
	Eriachne benthamii		
	Eriachne ?benthamii		
	Eriachne lanata		
	Eriachne mucronata		
	Eriachne obtusa		
	Eriachne pulchella		
	Eriachne pulchella subsp. *dominii*		
	Eriachne pulchella subsp. *pulchella*		
	Eriachne tenuiculmis		
	Eulalia aurea		
	Iseilema eremaeum		
	Iseilema membranaceum		
	Iseilema sp.		
	Iseilema vaginiflorum		

Family	Species name	Conservation status	Weed
Poaceae	*Panicum decompositum*		
	Panicum effusum		
	Paraneurachne muelleri		
	Paspalidium clementii		
	Paspalidium jubiflorum		
	Paspalidium rarum		
	Perotis rara		
	Schizachyrium fragile		
	Setaria dielsii		
	**Setaria verticillata*		*
	Sporobolus australasicus		
	Themeda avenacea		
	Themeda sp.		
	Themeda sp. Mt Barricade (M.E. Trudgen 2471)		
	Themeda triandra		
	Tragus australianus		
	Triodia angusta		
	Triodia ?angusta		
	Triodia basedowii		
	Triodia brizoides		
	Triodia longiceps		
	Triodia pungens		
	Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	
	Triodia vanleeuwenii		
	Triodia ?vanleeuwenii		
	Triodia wiseana		
	Triraphis mollis		
	Urochloa ?occidentalis		
	Yakirra australiensis var. *australiensis*		
Polygalaceae	*Polygala isingii*		
Portulacaceae	*Portulaca oleracea*		
Proteaceae	*Grevillea berryana*		
	Grevillea saxicola	P3	
	Grevillea wickhamii subsp. *hispidula*		
	Hakea chordophylla		
	Hakea lorea subsp. *lorea*		
Pteridaceae	*Cheilanthes lasiophylla*		
Pteridaceae	*Cheilanthes sieberi* subsp. *sieberi*		
Rhamnaceae	*Cryptandra monticola*		

Family	Species name	Conservation status	Weed
Rubiaceae	*Oldenlandia crouchiana*		
	Psydrax latifolia		
	Psydrax suaveolens		
Santalaceae	*Anthobolus leptomerioides*		
	Santalum lanceolatum		
	Santalum spicatum		
Sapindaceae	*Atalaya hemiglauca*		
	Dodonaea coriacea		
	Dodonaea lanceolata var. *lanceolata*		
	Dodonaea pachyneura		
	Dodonaea petiolaris		
	Dodonaea viscosa subsp. *spatulata*		
Scrophulariaceae	*Eremophila* aff. *clarkei*		
	Eremophila canaliculata		
	Eremophila forrestii subsp. *forrestii*		
	Eremophila fraseri		
	Eremophila fraseri subsp. *fraseri*		
	Eremophila jucunda subsp. *pulcherrima*		
	Eremophila lanceolata		
	Eremophila latrobei		
	Eremophila latrobei subsp. *filiformis*		
	Eremophila latrobei subsp. *glabra*		
	Eremophila latrobei subsp. *latrobei*		
	Eremophila longifolia		
	Eremophila magnifica subsp. *magnifica*	P4	
	Eremophila phyllopoda subsp. *obliqua*		
	Eremophila platycalyx subsp. *pardalota*		
	Eremophila sp. Hamersley Range (K. Walker KW 136)	P3	
	Eremophila sp. West Angelas (S. van Leeuwen 4068)	P1	
Solanaceae	**Datura leichhardtii*		*
	**Datura leichhardtii* subsp. *leichhardtii*		*
	Nicotiana benthamiana		
	Nicotiana sp.		
	Solanum cleistogamum		
	Solanum ferocissimum		
	Solanum gabrielae		
	Solanum horridum		
	Solanum lasiophyllum		
	Solanum phlomoides		

Family	Species name	Conservation status	Weed
Solanaceae	*Solanum* sp.		
Surianaceae	*Stylobasium spathulatum*		
Violaceae	*Hybanthus aurantiacus*		
Zygophyllaceae	*Tribulus platypterus*		
	Tribulus suberosus		

Table M.2: Vascular flora species list from previous projects in the vicinity of the survey area.

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Abutilon amplum		X		X		X		X
Abutilon cryptopetalum		X	X	X		X		X
Abutilon cunninghamii	X	X		X		X		
Abutilon fraseri	X		X					X
Abutilon fraseri subsp. *fraseri*						X		
Abutilon ?lepidum								X
Abutilon lepidum	X		X	X		X	X	X
Abutilon leucopetalum		X				X		X
Abutilon macrum	X					X	X	X
Abutilon malvifolium								X
Abutilon otocarpum	X	X	X	X		X	X	X
Abutilon oxycarpum		X		X	X	X		
Abutilon sp.		X	X					X
Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)		X		X		X	X	X
Abutilon sp. Pilbara (W.R. Barker 2025)						X		
Acacia acradenia		X		X	X			
Acacia adoxa var. *adoxa*	X	X	X	X		X	X	X
Acacia adsurgens	X	X	X	X		X	X	X
Acacia aff. *aneura* (grey flat recurved tips; MET 15,828)	X							
Acacia aff. *aneura* (long, flat, recurved; FMR 35.3)	X							
Acacia aff. *aneura* (narrow fine veined; site 1259)	X							
Acacia aff. *aneura* (scythe-shaped; MET 15,743)	X							
Acacia aff. *aneura* (subterete long; site 1245)	X							
Acacia aff. *ayersiana* (narrow form; MET 15,786)	X							
Acacia aff. *subtiliformis*						X		
Acacia ampliceps		X	X		X			X

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Acacia ?ancistrocarpa								X
Acacia ancistrocarpa	X	X	X	X	X	X		X
Acacia ancistrocarpa x trachycarpa				X				
Acacia aneura	X	X	X	X	X			
Acacia aneura sens lat.		X	X	X	X		X	X
Acacia aneura var. aff. *longicarpa* (MET 16,050)	X							
Acacia aneura var. *longicarpa*	X							
Acacia aptaneura						X		X
Acacia aptaneura x								X
Acacia arida	X	X		X	X			X
Acacia arida x								X
Acacia arrecta		X			X			
Acacia atkinsiana		X		X		X		
Acacia ayersiana	X	X		X	X	X		X
Acacia ayersiana x								X
Acacia bivenosa	X	X	X	X	X	X	X	X
Acacia bromilowiana P4								X
Acacia ?catenulata								X
Acacia catenulata	X							
Acacia catenulata subsp. *occidentalis*		X		X		X	X	X
Acacia citrinoviridis		X	X	X	X	X	X	X
Acacia colei				X				X
Acacia colei var. *colei*						X		
Acacia coriacea subsp. *pendens*		X	X	X				X
Acacia cowleana	X	X		X	X	X		
Acacia cuthbertsonii subsp. *cuthbertsonii*		X		X				
Acacia dictyophleba	X	X	X	X	X	X		X
Acacia distans		X	X	X				
Acacia elachantha		X		X			X	
Acacia eriopoda						X		
Acacia hamersleyensis		X	X	X		X	X	X

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Acacia hilliana	X	X	X	X	X		X	X
Acacia holosericea		X		X				
Acacia inaequilatera	X	X	X	X	X	X	X	X
Acacia incurvaneura						X		X
Acacia kempeana	X	X						X
Acacia ligulata				X				
Acacia macraneura						X		X
Acacia maitlandii	X	X	X	X	X	X	X	X
Acacia marramamba		X		X		X		X
Acacia minyura						X		X
Acacia monticola	X	X	X	X	X	X	X	X
Acacia mulganeura								X
Acacia orthocarpa				X				
Acacia pachyacra	X	X		X		X	X	X
Acacia paraneura	X							
Acacia pruinocarpa	X	X	X	X	X	X	X	X
Acacia pteraneura		X	X	X	X	X		X
Acacia pteraneura x aptaneura								X
Acacia pyrifolia	X	X	X	X	X	X	X	X
Acacia pyrifolia var. *pyrifolia*						X		
Acacia rhodophloia		X		X		X	X	X
Acacia sclerosperma subsp. *sclerosperma*		X		X	X			
Acacia sericophylla		X		X				
Acacia sibirica		X		X	X	X	X	X
Acacia sibirica x								X
Acacia sp.		X		X	X			X
Acacia spondylophylla		X	X				X	X
Acacia steedmanii	X							
Acacia steedmanii subsp. *borealis*								X
Acacia synchronicia	X	X		X	X	X		X
Acacia tenuissima	X	X	X	X	X	X	X	X

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Acacia tetragonophylla	X	X		X	X	X	X	X
Acacia trachycarpa x tumida var. *pilbarensis*		X						
Acacia tumida		X	X	X				X
Acacia tumida var. *pilbarensis*								X
Acacia validinervia						X		
Acacia victoriae		X		X	X			
Achyranthes aspera						X		
Acrachne racemosa				X		X	X	X
Adriana tomentosa var. *tomentosa*		X	X	X		X		X
**Aerva javanica*		X	X					
Alternanthera denticulata								X
Alternanthera nana	X	X		X		X	X	X
Alternanthera nodiflora		X	X	X			X	
**Alternanthera pungens*		X						
Amaranthus cuspidifolius						X		
Amaranthus mitchellii		X	X	X		X		
Amaranthus sp.								X
Amaranthus undulatus			X	X				X
Amphipogon caricinus		X						
Amphipogon caricinus var. *caricinus*		X						
Amphipogon sericeus	X	X		X		X	X	X
Amyema fitzgeraldii				X				X
Amyema hilliana		X				X		X
Amyema miquelii		X	X	X		X		X
Amyema sanguinea		X						
Amyema sanguinea var. *pulchra*		X						
Androcalva loxophylla		X		X				
Androcalva luteiflora	X	X	X	X	X	X	X	X
Anthobolus leptomerioides	X	X	X	X	X		X	X
**Argemone ochroleuca*		X	X					
Aristida burbidgeae						X	X	X

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Aristida contorta	X	X	X	X	X	X	X	X
Aristida holathera		X						
Aristida holathera var. *holathera*	X	X	X	X	X	X	X	X
Aristida ?inaequiglumis								X
Aristida inaequiglumis	X	X		X			X	X
Aristida ingrata						X	X	X
Aristida jerichoensis var. *subspinulifera* P3						X		
Aristida latifolia		X	X	X		X		X
Aristida lazaridis P2						X		X
Aristida obscura	X	X				X		X
Aristida pruinosa	X	X		X				
Aristida sp.		X		X				X
Asteraceae sp.		X	X	X				
Astrebla elymoides								X
Astrebla pectinata						X		
Astrebla sp.								X
Astrotricha hamptonii		X		X	X	X	X	X
Atalaya hemiglauca		X	X	X				X
Atriplex vesicaria		X						
Austrostipa sp.		X						
Bergia pedicellaris		X						
**Bidens bipinnata*	X	X	X	X	X	X	X	X
Blumea tenella		X						
Boerhavia burbidgeana		X		X				
Boerhavia ?coccinea								X
Boerhavia coccinea		X		X		X		X
Boerhavia gardneri		X		X				
Boerhavia paludosa						X		
Boerhavia sp.		X	X	X				
Bonamia erecta		X						
Bonamia media	X	X						

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Bonamia pilbarensis								X
Bonamia rosea	X	X		X				
Bothriochloa ewartiana	X					X	X	X
Brachyachne ciliaris						X		
Brachychiton acuminatus								X
Brachyscome iberidifolia		X		X				
Brunonia australis	X	X			X			
Brunonia sp. Long hairs (D.E. Symon 2440)						X		
Bulbostylis barbata		X		X		X	X	X
Bulbostylis turbinata		X		X				X
Cajanus marmoratus				X				
Calandrinia ?eremaea		X						
Calandrinia ptychosperma	X							
Calandrinia quadrivalvis		X						
Calandrinia sp. The Pink Hills (F. Obbens FO 19/06)						X		
Calocephalus knappii	X					X		
Calotis hispidula	X							
Calotis multicaulis						X		
Calotis plumulifera	X							
Calotis porphyroglossa						X		
Calytrix carinata		X		X		X		X
Capparis lasiantha	X	X	X	X	X	X	X	X
Capparis mitchellii						X		
Capparis spinosa		X	X	X	X			
Capparis spinosa subsp. *nummularia*						X	X	X
Capparis umbonata		X	X	X	X			X
Cassytha capillaris		X		X		X	X	X
Cassytha filiformis								X
Cassytha sp.			X	X				X
**Cenchrus ciliaris*	X	X	X	X		X		X
**Cenchrus setiger*				X				X

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Centipeda minima subsp. *macrocephala*		X					X	X
Cheilanthes austrotenuifolia		X		X	X			
Cheilanthes lasiophylla						X		X
Cheilanthes sieberi							X	X
Cheilanthes sieberi subsp. *sieberi*	X	X		X		X		X
Chloris pectinata						X		
**Chloris virgata*		X		X			X	X
Chrysocephalum apiculatum	X	X	X	X		X		
Chrysocephalum apiculatum subsp. *pilbarensis*								X
Chrysocephalum eremaeum			X			X		
Chrysocephalum gilesii	X	X		X		X		X
Chrysocephalum pterochaetum	X	X			X	X		
Chrysopogon fallax	X	X		X	X	X	X	X
Cleome oxalidea		X		X				
Cleome viscosa	X	X	X	X	X	X	X	X
Clerodendrum floribundum						X		
Clerodendrum floribundum var. *angustifolium*		X	X	X	X	X	X	X
Clerodendrum ?tomentosum			X					
Clerodendrum tomentosum var. *lanceolatum*								X
Codonocarpus cotinifolius	X	X	X	X	X	X	X	X
Commelina ensifolia		X		X				X
Convolvulaceae sp.			X					
Convolvulus angustissimus subsp. *angustissimus*	X							
Convolvulus clementii						X		X
**Conyza bonariensis*								X
Corchorus crozophorifolius						X	X	X
Corchorus lasiocarpus	X	X	X	X		X	X	X
Corchorus lasiocarpus subsp. *lasiocarpus*		X		X	X			
Corchorus lasiocarpus subsp. *parvus*		X				X		X
Corchorus parviflorus		X						
Corchorus sidoides subsp. *sidoides*						X		

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Corchorus sp.				X				
Corchorus sp. 1		X						
Corchorus sp. B		X						
Corchorus tridens				X		X		X
Corchorus walcottii		X	X	X	X			
Corymbia aspera		X		X				
Corymbia candida						X		X
Corymbia deserticola	X	X						X
Corymbia deserticola subsp. *deserticola*		X	X	X	X	X	X	X
Corymbia ferriticola		X	X				X	X
Corymbia hamersleyana	X	X	X	X	X	X		X
Corymbia hamersleyana sens. lat.							X	X
Corymbia opaca		X						X
Corymbia sp.								X
Corymbia sp. (seedlings)				X				
Corymbia zygophylla		X				X		
Corynotheca micrantha						X		
Crotalaria cunninghamii		X		X				
Crotalaria medicaginea		X	X	X				
Crotalaria medicaginea var. *neglecta*						X		X
Crotalaria novae-hollandiae		X			X			X
Crotalaria novae-hollandiae subsp. *novae-hollandiae*						X		
Cryptandra monticola		X				X		X
Cucumis argenteus	X	X	X	X	X			
Cucumis melo								X
Cucumis variabilis						X	X	X
Cullen lachnostachys		X	X		X			
Cullen leucanthum		X		X				
Cullen leucochaites				X		X	X	X
Cullen martinii		X			X			
Cullen pogonocarpum		X		X	X			

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Cuscuta victoriana								X
Cymbopogon ambiguus	X	X	X	X	X	X	X	X
Cymbopogon bombycinus		X						
Cymbopogon obtectus	X	X		X		X	X	X
Cymbopogon procerus		X		X	X	X		
Cymbopogon sp.		X						X
Cynanchum floribundum						X	X	X
Cynanchum viminale								X
Cynanchum viminale subsp. *australe*	X	X			X	X		
Cynodon convergens		X	X	X		X	X	X
**Cynodon dactylon*								X
Cynodon prostratus								X
Cyperus cunninghamii		X						
Cyperus cunninghamii subsp. *cunninghamii*						X	X	X
Cyperus difformis								X
Cyperus iria			X					
Cyperus sp.		X						
Cyperus vaginatus		X	X	X	X			X
Dactyloctenium ?radulans								X
Dactyloctenium radulans	X	X		X				X
Dampiera candicans		X	X	X	X	X		X
**Datura leichhardtii*		X	X	X				X
**Datura leichhardtii* subsp. *leichhardtii*								X
Dichanthium sericeum		X		X	X	X		X
Dichanthium sericeum subsp. *humilius*								X
Dichanthium sp.								X
Dicladanthera forrestii		X				X	X	X
Dicrastylis cordifolia		X		X				
Digitaria ammophila	X	X	X	X	X			X
Digitaria brownii	X	X		X		X	X	X
Digitaria ctenantha		X		X		X	X	X

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Diplopeltis stuartii var. *stuartii*		X						
Dipteracanthus australasicus subsp. *australasicus*	X	X				X	X	X
Dissocarpus paradoxus						X		
Dodonaea coriacea	X	X		X	X	X		X
Dodonaea lanceolata var. *lanceolata*	X	X	X	X		X		X
Dodonaea pachyneura		X	X	X		X		X
Dodonaea petiolaris		X		X				X
Dodonaea sp.				X				
Dodonaea viscosa		X	X				X	X
Dodonaea viscosa subsp. *mucronata*	X		X			X		
Dodonaea viscosa subsp. *spatulata*						X		X
Duperreya commixta	X	X	X	X	X	X	X	X
Dysphania glomulifera						X		
Dysphania glomulifera subsp. *eremaea*						X		
Dysphania kalpari	X	X		X		X		X
Dysphania melanocarpa	X							X
Dysphania plantaginella								X
Dysphania rhadinostachya		X					X	X
Dysphania rhadinostachya subsp. *rhadinostachya*	X	X	X	X	X	X		X
**Echinochloa colona*								X
Ehretia saligna				X				
Enchylaena tomentosa		X	X	X	X			
Enchylaena tomentosa var. *tomentosa*	X					X	X	X
Enneapogon avenaceus						X		
Enneapogon caerulescens	X	X	X	X	X	X	X	X
Enneapogon intermedius						X		
Enneapogon lindleyanus	X	X		X		X	X	X
Enneapogon pallidus						X		
Enneapogon polyphyllus	X	X		X	X	X	X	X
Enneapogon purpurascens			X	X				

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Enneapogon robustissimus						X	X	X
Enneapogon sp.								X
Enteropogon ramosus		X		X	X		X	X
Eragrostis cumingii		X	X	X	X	X	X	X
Eragrostis desertorum						X		
Eragrostis dielsii		X		X		X		
Eragrostis eriopoda	X	X		X	X	X		X
Eragrostis falcata		X		X		X		
Eragrostis leptocarpa		X		X				
Eragrostis pergracilis		X		X		X		
Eragrostis setifolia		X			X	X	X	X
Eragrostis sp.		X		X				
Eragrostis tenellula		X			X	X	X	X
Eragrostis xerophila						X		X
Eremophila aff. *clarkei*								X
Eremophila caespitosa						X		
Eremophila canaliculata								X
Eremophila clarkei						X		
Eremophila cuneifolia		X		X		X		
Eremophila exilifolia		X		X		X		
Eremophila forrestii	X	X						
Eremophila forrestii subsp. *forrestii*	X	X	X	X	X	X	X	X
Eremophila ?forrestii subsp. *viridis*		X						
Eremophila forrestii subsp. *viridis* P3		X						
Eremophila fraseri		X			X			X
Eremophila fraseri subsp. *fraseri*	X	X				X	X	X
Eremophila galeata		X	X	X		X		
Eremophila jucunda							X	X
Eremophila jucunda subsp. *jucunda*		X		X	X			
Eremophila jucunda subsp. *pulcherrima*						X		X
Eremophila lanceolata	X	X		X		X		X

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Eremophila latrobei		X	X	X	X	X		X
Eremophila latrobei subsp. aff. *filiformis*	X							
Eremophila ?latrobei subsp. *filiformis*		X						
Eremophila latrobei subsp. *filiformis*	X	X		X	X	X		X
Eremophila latrobei subsp. *glabra*	X	X						X
Eremophila latrobei subsp. *latrobei*		X		X		X		X
Eremophila longifolia	X	X	X	X	X	X	X	X
Eremophila maculata		X		X				
Eremophila magnifica subsp. *magnifica* P4							X	
Eremophila magnifica subsp. *velutina* P3			X				X	
Eremophila phyllopoda subsp. *obliqua*						X		X
Eremophila platycalyx subsp. *pardalota*	X					X		X
Eremophila pusilliflora P2						X		
Eremophila sp.		X		X				
Eremophila sp. Hamersley Range (K. Walker KW 136) P3							X	X
Eremophila sp. West Angelas (S. van Leeuwen 4068) P1								X
Eremophila tietkensii						X	X	
Eremophila youngii		X		X				
Eremophila youngii subsp. *lepidota* P4		X		X				
Eriachne aristidea	X	X		X				X
Eriachne ?benthamii								X
Eriachne benthamii								X
Eriachne ciliata		X						
Eriachne flaccida			X					
Eriachne helmsii						X		
Eriachne lanata		X	X	X		X	X	X
Eriachne melicacea		X						
Eriachne mucronata	X	X	X	X	X	X	X	X
Eriachne obtusa		X		X	X			X
Eriachne ovata		X						

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Eriachne pulchella		X	X	X	X		X	X
Eriachne pulchella subsp. *dominii*	X		X			X		X
Eriachne pulchella subsp. *pulchella*						X		X
Eriachne sp.		X		X				
Eriachne tenuiculmis	X	X					X	X
Eucalyptus camaldulensis		X	X	X				X
Eucalyptus camaldulensis subsp. *obtusa*								X
Eucalyptus gamophylla	X	X	X	X	X	X	X	X
Eucalyptus kingsmillii		X						X
Eucalyptus leucophloia		X	X	X	X	X		
Eucalyptus leucophloia subsp. *leucophloia*	X	X				X	X	X
Eucalyptus pilbarensis						X		X
Eucalyptus repullulans								X
Eucalyptus ?sheathiana		X		X				
Eucalyptus socialis		X		X	X			
Eucalyptus socialis subsp. *?eucentrica*		X						X
Eucalyptus socialis subsp. *eucentrica*						X		X
Eucalyptus sp.		X	X	X				
Eucalyptus striaticalyx		X		X				
Eucalyptus trivalva	X	X		X	X	X		
Eucalyptus victrix		X	X	X	X	X	X	X
Eucalyptus xerothermica	X	X	X	X	X	X	X	X
Eucalyptus xerothermica x Eucalyptus tephrodes								X
Eulalia ?aurea								X
Eulalia aurea	X	X	X	X	X	X	X	X
Euphorbia aff. coghlanii (HD186-18)	X							
Euphorbia alsiniflora						X		
Euphorbia australis	X	X	X	X	X	X	X	X
Euphorbia australis var. *subtomentosa*								X
Euphorbia biconvexa		X			X	X		X
Euphorbia biconvexa/coghlanii/trigonosperma								X

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Euphorbia boophthona	X	X	X	X	X	X	X	X
Euphorbia careyi	X							X
Euphorbia coghlanii		X	X	X	X			X
Euphorbia drummondii		X	X	X		X		
Euphorbia myrtoides		X		X				
Euphorbia schultzii		X			X	X		
Euphorbia sp.								X
Euphorbia sp. (site 1089)	X							
Euphorbia tannensis subsp. *eremophila*	X		X	X				
Euphorbia trigonosperma							X	X
Evolvulus alsinoides		X	X	X	X	X	X	X
Evolvulus alsinoides var. *decumbens*						X		X
Evolvulus alsinoides var. *villosicalyx*	X	X				X		X
Exocarpos aphyllus		X		X				
Exocarpos sparteus		X				X		
Ficus brachypoda		X		X		X	X	X
Fimbristylis dichotoma		X	X	X		X	X	X
Fimbristylis simulans		X		X		X		X
Fimbristylis sp.		X						X
**Flaveria trinervia*	X	X	X	X	X	X	X	X
Frankenia ?magnifica		X		X				
Frankenia setosa		X						
Gastrolobium grandiflorum		X				X		
Glycine canescens		X		X		X	X	X
Gnephosis arachnoidea	X							
Gompholobium karijini P2	X	X		X	X			
Gompholobium oreophilum						X		X
Gompholobium polyzygum		X	X	X	X			
Gomphrena affinis subsp. *pilbarensis*						X		
Gomphrena canescens		X				X		
Gomphrena canescens subsp. *canescens*		X		X				

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Gomphrena cunninghamii		X		X	X	X	X	X
Gomphrena kanisii						X		
Goodenia ? prostrata		X						
Goodenia cusackiana		X		X	X			X
Goodenia ?krauseana			X					
Goodenia lamprosperma		X		X				X
Goodenia microptera	X	X	X	X	X	X	X	X
Goodenia muelleriana		X	X	X	X	X	X	X
Goodenia nuda P4						X		
Goodenia ?prostrata				X				
Goodenia prostrata	X	X						X
Goodenia purpurascens P3		X						
Goodenia scaevolina						X		
Goodenia sp.		X	X	X				X
Goodenia sp. (of interest)								X
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727) P3		X		X				
Goodenia stellata	X	X				X		X
Goodenia stobbsiana	X	X	X	X	X	X	X	X
Goodenia tenuiloba						X		X
Goodenia triodiophila	X	X		X	X	X	X	X
Gossypium australe	X	X	X	X	X	X	X	X
Gossypium robinsonii		X	X	X	X	X	X	X
Gossypium sturtianum		X						
Gossypium sturtianum var. *sturtianum*								X
Grevillea berryana	X	X		X		X		X
Grevillea pyramidalis		X		X				
Grevillea saxicola P3								X
Grevillea stenobotrya		X		X		X		
Grevillea striata		X						
Grevillea wickhamii	X	X	X	X	X	X	X	X
Grevillea wickhamii subsp. *aprica*		X			X			

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Grevillea wickhamii subsp. *hispidula*						X		X
Gymnanthera cunninghamii P3		X						
Hakea chordophylla	X	X	X	X	X	X	X	X
Hakea lorea subsp. *lorea*	X	X		X	X	X	X	X
Halgania cyanea								X
Halgania cyanea var. Allambi Stn (B.W. Strong 676)		X						
Halgania erecta		X						
Halgania gustafsenii	X					X		X
Halgania gustafsenii var. *gustafsenii*								X
Halgania gustafsenii var. *Mid West (G. Perry 370)*		X						
Halgania solanacea		X		X				
Halgania solanacea var. Mt Doreen (G.M. Chippendale 4206)		X						
Haloragis gossei	X	X				X		X
Haloragis gossei var. *gossei*						X		
Haloragis gossei var. *inflata*						X		
Haloragis odontocarpa								X
Haloragis sp.								X
Harnieria kempeana subsp. *muelleri*						X		
Heliotropium chrysocarpum	X					X		
Heliotropium cunninghamii		X	X	X	X	X	X	
Heliotropium heteranthum	X	X	X	X	X	X	X	
Heliotropium inexplicitum	X	X		X		X	X	X
Heliotropium ovalifolium		X		X	X			X
Heliotropium pachyphyllum		X				X		X
Heliotropium sp.		X						
Heliotropium tanythrix								X
Heliotropium tenuifolium			X			X	X	X
Heteropogon contortus		X						
Hibiscus aff. *coatesii*	X							

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Hibiscus burtonii	X	X	X	X	X	X	X	X
Hibiscus ?coatesii								X
Hibiscus coatesii		X		X	X	X	X	X
Hibiscus leptocladus		X		X				X
Hibiscus sp.		X						
Hibiscus sp. Gardneri (A.L. Payne PRP 1435)						X		
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2							X	X
Hibiscus sp. Mt Robinson (G. Byrne 3537)							X	
Hibiscus sturtii						X	X	X
Hibiscus sturtii var *?sturtii*		X						
Hibiscus sturtii var. aff. *grandiflorus*	X							
Hibiscus sturtii var. *campylochlamys*	X	X		X		X		X
Hibiscus sturtii var. *platychlamys*	X	X				X		X
Hibiscus sturtii var. *truncatus*		X						
**Hibiscus tridactylites*						X		
Hibiscus verdcourtii								X
Hybanthus aurantiacus		X	X	X		X	X	X
Indigofera brevidens	X	X		X	X			
Indigofera colutea		X	X	X				
Indigofera fractiflexa		X		X	X	X		
Indigofera fractiflexa subsp. *fractiflexa*							X	X
Indigofera georgei	X	X		X		X	X	X
Indigofera gilesii P3						X		
Indigofera linifolia		X		X				X
Indigofera monophylla	X	X	X	X	X	X	X	X
Indigofera rugosa						X		X
Indigofera trita				X				
Ipomoea coptica		X		X				
Ipomoea muelleri		X	X	X		X		
Ipomoea polymorpha						X		
Ischaemum albovillosum						X		

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Iseilema dolichotrichum		X		X				
Iseilema eremaeum						X		X
Iseilema membranaceum		X		X		X	X	X
Iseilema sp.								X
Iseilema vaginiflorum				X		X		X
Isotoma petraea						X		
Isotropis cuneifolia		X		X				
Isotropis forrestii P1	X	X		X	X	X		
Isotropis sp. Arid zone (G. Byrne 2775)							X	X
Ixiochlamys cuneifolia			X					
Jacksonia aculeata		X						
Jasminum didymum subsp. *lineare*	X	X	X	X	X	X	X	X
Josephinia eugeniae								X
**Lactuca serriola*			X					X
Lamarchea sulcata		X						
Lepidium catapycnon P4		X		X		X		X
Lepidium echinatum		X						
Lepidium muelleri-ferdinandii	X							
Lepidium pedicellosum		X	X	X	X	X		X
Lepidium phlebopetalum	X					X		X
Lepidium pholidogynum						X		X
Lepidium platypetalum						X		
Lepidium sp.								X
Lobelia arnhemiaca			X					X
Lobelia heterophylla		X			X	X		
Lobelia heterophylla subsp. *pilbarensis*							X	X
Lotus cruentus	X							
Lysiana casuarinae		X		X				
Maireana aphylla		X						
Maireana carnosa		X		X				X
Maireana eriosphaera								X

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Maireana georgei	X	X		X	X	X		X
Maireana lanosa						X		
Maireana melanocoma	X	X				X		X
Maireana planifolia	X	X		X		X	X	
Maireana planifolia x villosa	X							
Maireana sp.	X	X		X	X			
Maireana thesioides	X	X		X				
Maireana tomentosa		X	X	X	X	X		
Maireana tomentosa subsp. *tomentosa*								X
Maireana triptera	X	X		X		X		X
Maireana villosa	X	X	X	X		X	X	X
Malvaceae sp.		X	X	X				
**Malvastrum americanum*	X		X	X		X	X	X
Marsdenia australis		X				X		X
Marsdenia sp.								X
Marsilea hirsuta				X		X		
Maytenus sp. Mt Windell (S. van Leeuwen 846)						X		X
Melaleuca argentea		X	X	X				X
Melaleuca bracteata		X			X			X
Melaleuca eleuterostachya		X		X	X	X		X
Melaleuca glomerata		X			X			X
Melaleuca lasiandra		X		X	X			
Melhania oblongifolia		X		X		X	X	X
**Melinis repens*								X
Menkea villosula	X							
Mirbelia viminalis	X	X	X	X		X	X	X
Monachather paradoxus			X					
Myoporum montanum		X						
Neobassia astrocarpa		X						
Neptunia dimorphantha								X

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Newcastelia sp. Hamersley Range (S. van Leeuwen 4264)						X	X	X
Nicotiana benthamiana		X		X	X	X		X
Nicotiana occidentalis		X		X		X		
Nicotiana occidentalis subsp. *obliqua*		X						
Nicotiana rosulata subsp. *ingulba*			X					
Nicotiana rosulata subsp. *rosulata*	X	X		X				
Nicotiana simulans						X		
Nicotiana sp.								X
Notoleptopus decaisnei						X		
Notoleptopus decaisnei var. Orbicularis (A.B. Craig 428)								X
Oldenlandia crouchiana		X	X	X		X	X	X
Olearia fluvialis		X	X	X				
Olearia stuartii	X							
Olearia xerophila	X							
Operculina aequisepala						X		
Oxalis aff. *corniculata* (site 654)	X							
Pandorea pandorana								X
Panicum decompositum		X			X	X		X
Panicum effusum		X		X		X		X
Panicum laevinode						X		
Papilionaceae sp. (juvenile)		X		X				
Paraneurachne muelleri	X	X	X	X	X	X	X	X
Paspalidium basicladum	X		X			X		
Paspalidium clementii						X	X	X
Paspalidium constrictum						X		
Paspalidium jubiflorum								X
Paspalidium rarum						X		X
Paspalidium sp.		X		X				
Peripleura arida						X		X
Peripleura hispidula var. *setosa*						X		

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Peripleura obovata						X		X
Peripleura virgata		X			X			X
Perotis rara		X	X	X		X		X
Petalostylis labicheoides	X	X	X	X	X	X	X	X
**Phoenix dactylifera*			X					
Phyllanthus erwinii	X					X	X	X
Phyllanthus maderaspatensis		X		X		X	X	X
Pittosporum angustifolium		X		X	X	X		
Pluchea dentex		X	X	X	X	X	X	X
Pluchea dunlopii		X				X		
Pluchea rubelliflora		X						X
Pluchea sp.								X
Poaceae sp.		X	X		X			
Polycarpaea corymbosa						X		
Polycarpaea corymbosa var. *corymbosa*		X					X	X
Polycarpaea holtzei						X	X	X
Polycarpaea longiflora	X	X	X	X		X	X	X
Polygala isingii						X		X
Polymeria aff. *longifolia*								X
Polymeria ambigua	X	X	X	X		X	X	X
Portulaca oleracea		X		X		X		X
**Portulaca pilosa*		X		X				
Prostanthera albiflora							X	
Pseudognaphalium luteoalbum		X	X					
Psydrax latifolia	X	X	X	X	X	X	X	X
Psydrax rigidula		X						
Psydrax suaveolens	X	X		X	X	X	X	X
Pterocaulon serrulatum		X	X	X	X	X		X
Pterocaulon serrulatum var. *velutinum*								X
Pterocaulon sp.	X		X					X
Pterocaulon sphacelatum		X		X	X	X	X	X

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Pterocaulon sphaeranthoides	X	X		X				X
Ptilotus ? incanus var. *incanus*		X						
Ptilotus aervoides	X	X		X		X		X
Ptilotus astrolasius	X	X	X	X	X	X	X	X
Ptilotus auriculifolius		X		X	X	X		X
Ptilotus calostachyus	X	X	X	X	X	X	X	X
Ptilotus carinatus		X		X		X		
Ptilotus clementii		X		X		X		X
Ptilotus drummondii		X						
Ptilotus exaltatus	X	X	X	X	X		X	X
Ptilotus fusiformis		X		X		X		X
Ptilotus gaudichaudii	X	X		X				
Ptilotus gomphrenoides		X				X		
Ptilotus helipteroides	X	X	X	X	X	X	X	X
Ptilotus incanus				X				X
Ptilotus macrocephalus	X							
Ptilotus mollis P4								X
Ptilotus nobilis						X		
Ptilotus obovatus		X				X	X	X
Ptilotus obovatus var. *obovatus*	X	X	X	X	X			
Ptilotus polystachyus	X	X		X	X	X		
Ptilotus roei		X		X		X		X
Ptilotus rotundifolius	X	X	X	X	X	X	X	X
Ptilotus schwartzii		X						
Ptilotus schwartzii var. *schwartzii*				X		X		X
Ptilotus sp.		X		X	X			X
Rhagodia eremaea	X	X	X	X	X	X	X	X
Rhagodia sp. Hamersley (M. Trudgen 17794) P3	X	X		X		X		X
Rhagodia sp.1		X						
Rhagodia sp.2		X						
Rhodanthe charsleyae	X							

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Rhodanthe citrina						X		
Rhodanthe floribunda	X	X			X	X		
Rhodanthe humboldtiana	X							
Rhodanthe margarethae	X					X	X	X
Rhodanthe propinqua	X							
Rhodanthe sp.	X	X						
Rhynchosia minima		X	X	X	X	X	X	X
Roebuckiella ciliocarpa	X	X		X				
Roebuckiella similis						X		
Roepera eichleri						X		
Roepera iodocarpum	X	X			X	X		
Rostellularia adscendens			X					
Rostellularia adscendens var. *clementii*								X
Rostellularia adscendens var. *pogonanthera*		X						
Rutidosis helichrysoides subsp. *helichrysoides*		X		X	X		X	
Salsola australis	X	X		X	X	X	X	X
Santalum acuminatum		X						
Santalum lanceolatum	X	X		X		X	X	X
Santalum spicatum		X				X	X	X
Scaevola acacioides	X	X		X				X
Scaevola amblyanthera		X		X	X			X
Scaevola amblyanthera var. *centralis*	X							X
Scaevola browniana								X
Scaevola browniana subsp. *browniana*		X		X	X	X		
Scaevola parvifolia				X		X		
Scaevola parvifolia subsp. *pilbarae*	X	X	X	X	X	X	X	X
?Scaevola spinescens		X		X				
Scaevola spinescens		X		X		X		X
Schenkia australis								X
Schizachyrium fragile			X				X	X
Sclerolaena convexula		X		X		X		

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Sclerolaena cornishiana	X	X		X		X	X	X
Sclerolaena costata	X							
Sclerolaena cuneata		X		X				X
Sclerolaena densiflora	X							X
Sclerolaena deserticola		X		X				
Sclerolaena eriacantha	X	X		X		X		
Sclerolaena ?gardneri								X
Sclerolaena tetragona						X		
Senna artemisioides	X							
Senna artemisioides subsp. *filifolia*		X		X		X		X
Senna artemisioides subsp. *helmsii*	X	X		X	X	X	X	X
Senna artemisioides subsp. *helmsii x oligophylla*		X						
Senna artemisioides subsp. *oligophylla*		X	X	X	X	X	X	X
Senna artemisioides subsp. *oligophylla x helmsii*		X	X	X	X			X
Senna artemisioides subsp. *x artemisioides*		X		X	X	X		X
Senna artemisioides subsp. *x sturtii*		X		X	X		X	
Senna charlesiana	X	X		X				
Senna ferraria		X			X	X	X	X
Senna glaucifolia	X	X		X	X			X
Senna glaucifolia x ? (site 626)	X							
Senna glaucifolia x glutinosa	X							
Senna glaucifolia x helmsii	X							
Senna glaucifolia x luerssenii	X							
Senna glaucifolia x oligophylla	X							
Senna glutinosa	X	X						X
Senna glutinosa subsp. *chatelainiana*		X			X			
Senna glutinosa subsp. *glutinosa*		X	X	X	X	X	X	X
Senna glutinosa subsp. *pruinosa*		X	X	X	X	X	X	X
Senna glutinosa subsp. *x luerssenii*	X	X		X	X	X	X	X
Senna glutinosa x luerssenii	X							

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Senna hamersleyensis		X				X		
Senna luerssenii x 'stricta'	X							
Senna notabilis	X	X	X	X	X	X	X	X
Senna oligophylla x helmsii	X							
Senna pleurocarpa var. *angustifolia*		X		X		X		X
Senna sericea		X		X	X	X		X
Senna sp.		X		X				
Senna sp. Meekatharra (E. Bailey 1-26)	X					X		X
Senna sp. Meekatharra (E. Bailey 1-26) ×								X
Senna stricta	X	X		X		X		X
Senna symonii		X		X		X		
Senna venusta		X		X	X		X	X
Seringia elliptica	X	X		X			X	X
Seringia nephrosperma	X	X		X	X			X
Seringia sp.								X
Seringia velutina		X				X		
Sesbania cannabina		X	X					X
Setaria dielsii	X	X				X	X	X
Setaria surgens						X		
**Setaria verticillata*								X
Sida ? sp. Dark Green Fruits(S. van Leeuwen 2260)			X					
Sida aff. cardiophylla (site 1215)	X							
Sida aff. *fibulifera*	X							
Sida ?ammophila		X						
Sida arenicola	X	X		X	X	X	X	X
Sida arsiniata						X		
Sida calyxhymenia		X	X					X
Sida cardiophylla	X	X	X	X	X			X
Sida clementii			X					
Sida echinocarpa	X	X	X			X	X	X
Sida ?ectogama								X

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Sida ectogama	X	X				X		
Sida fibulifera		X	X	X		X	X	X
Sida platycalyx	X	X	X	X	X		X	X
Sida rohlenae		X	X	X	X			
Sida sp.		X	X	X	X			X
Sida sp. (DM194)		X						
Sida sp. (MET 16,086)	X							
Sida sp. (SC078)		X						
Sida sp. (SC092)		X						
Sida sp. 1		X						
Sida sp. 3		X						
Sida sp. 4		X						
Sida sp. Articulation below (A.A. Mitchell PRP 1605)								X
*Sida ?*sp. B Kimberley Flora (A.A. Mitchell 2745)		X						
Sida sp. Barlee Range (S. van Leeuwen 1642) P3						X		
*Sida ?*sp. dark green fruits (S. van Leeuwen 2260)								X
Sida sp. dark green fruits (S. van Leeuwen 2260)	X	X		X		X		X
Sida sp. Excedentifolia (J.L. Egan 1925)		X	X	X	X		X	X
Sida sp. Golden calyces glabrous (H.N. Foote 32)						X		X
Sida sp. L (A.M. Ashby 4202)						X		
Sida sp. Pilbara (A.A. Mitchell PRP 1543)		X				X	X	X
*Sida ?*sp. Pilbara (A.A.Mitchell PRP1543)				X				
Sida sp. Shovelanna Hill (S. van Leeuwen 3842)						X	X	X
*Sida ?*sp. spiciform panicles (E. Leyland s.n. 14/8/90)		X						

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)	X	X				X	X	X
Sida sp. Supplejack Station (T.S. Henshall 2345)						X		
Sida sp.2		X						
Sida spinosa						X		
Sida trichopoda						X		
**Sigesbeckia orientalis*		X				X	X	X
Solanum centrale	X	X	X	X	X	X		
Solanum cleistogamum								X
Solanum ellipticum		X						
Solanum esuriale		X		X				
Solanum ferocissimum	X							X
Solanum gabrielae		X	X				X	X
Solanum horridum	X	X			X	X	X	X
Solanum lasiophyllum	X	X	X	X	X	X	X	X
**Solanum nigrum*								X
Solanum phlomoides		X		X	X	X		X
Solanum sp.		X						X
Solanum sturtianum		X			X	X		
**Sonchus oleraceus*		X		X	X			X
Sonchus sp.		X	X					
Sorghum plumosum		X	X	X				
Spermacoce brachystema		X				X		
Sporobolus actinocladus		X						
Sporobolus australasicus		X	X	X	X	X	X	X
Stackhousia intermedia	X	X	X	X		X		
Stackhousia muricata subsp. annual (W.R. Barker 2172)								X
Stemodia grossa	X	X	X	X	X		X	X
Stemodia sp.		X						
Stemodia viscosa		X						

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Stenopetalum anfractum	X							
Stenopetalum decipiens							X	
Stenopetalum nutans	X							
Stenopetalum velutinum	X							
?Streptoglossa bubakii				X				
Streptoglossa ?bubakii			X					
Streptoglossa bubakii	X	X		X	X	X		X
Streptoglossa decurrens		X	X		X	X	X	X
Streptoglossa liatroides		X	X	X	X	X		
Streptoglossa odora		X				X		
Streptoglossa sp.		X						X
Streptoglossa tenuiflora		X		X		X		
Stylidium sp.		X						
Stylidium weeliwolli P3		X	X					
Stylobasium spathulatum		X	X	X	X	X	X	X
Swainsona kingii	X					X		
Swainsona maccullochiana		X		X	X	X		X
Swainsona sp.			X					
Templetonia egena	X	X				X		X
Tephrosia clementii		X				X		
Tephrosia densa						X		X
Tephrosia oxalidea	X						X	X
Tephrosia rosea		X		X				
Tephrosia rosea var. *clementii*		X	X	X	X			
Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)	X	X				X	X	X
Tephrosia rosea var. *rosea*			X					
Tephrosia sp. Bungaroo Creek (M.E. Trudgen 11601)		X						
Tephrosia ?supina			X					
Tephrosia supina		X				X		
Termites		X						

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Teucrium teucriiflorum		X				X		X
Themeda avenacea								X
Themeda sp.								X
Themeda sp. ?Hamersley Station (M.E. Trudgen 11431) (P3)		X						
Themeda sp. Hamersley Station (M.E. Trudgen 11431) P3						X		
Themeda sp. Mt Barricade (M.E. Trudgen 2471)		X	X	X				X
Themeda triandra	X	X	X	X	X	X	X	X
Tinospora smilacina							X	X
Trachymene bialata		X						
Trachymene oleracea		X	X	X	X			
Trachymene oleracea subsp. *oleracea*	X	X		X		X	X	X
Trachymene pilbarensis						X		
Tragus australianus	X					X		X
Trianthema glossostigmum		X		X		X		X
Trianthema pilosum				X				
Trianthema triquetrum				X				
Tribulus astrocarpus		X		X	X	X		
Tribulus cistoides		X		X				
Tribulus hirsutus		X		X	X	X		
Tribulus macrocarpus						X		
Tribulus occidentalis			X	X		X		
Tribulus platypterus		X			X			X
Tribulus suberosus	X	X		X	X	X		X
**Tribulus terrestris*		X		X				
Trichodesma zeylanicum		X				X		
Trichodesma zeylanicum var. *zeylanicum*	X	X	X	X	X	X	X	X
Tricoryne sp. Hamersley Range (S. van Leeuwen 915)	X	X	X		X			X
**Tridax procumbens*								X

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Trigastrotheca molluginea			X	X				X
Triodia aff. *basedowii*	X							
Triodia aff. *wiseana*	X	X						
Triodia ?angusta								X
Triodia angusta		X	X	X	X			X
Triodia basedowii		X	X	X	X	X		X
Triodia brizoides	X	X		X		X		X
Triodia epactia		X	X	X	X			
Triodia lanigera		X		X				
Triodia longiceps	X	X	X	X		X	X	X
Triodia melvillei	X	X		X		X		X
Triodia pungens	X	X	X	X	X	X	X	X
Triodia sp.		X						
Triodia sp. Mt Ella (M.E. Trudgen 12739) P3						X		X
Triodia ?vanleeuwenii								X
Triodia vanleeuwenii							X	X
Triodia wiseana	X	X	X	X	X	X	X	X
Tripogonella loliiformis		X				X		
Triraphis mollis						X		X
Triumfetta chaetocarpa		X		X				X
Triumfetta clementii		X			X			
Triumfetta leptacantha						X	X	
Triumfetta maconochieana				X			X	
Triumfetta propinqua		X						
Triumfetta ramosa		X	X	X				
Triumfetta sp.		X	X		X			
Typha domingensis		X	X	X	X			X
Urochloa ?occidentalis								X
Urochloa occidentalis var. *occidentalis*						X		
Urochloa piligera		X		X				
**Vachellia farnesiana*		X	X	X	X	X		X

Species	Biota (2006)	Mattiske (2008)	Mattiske (2009a)	Mattiske (2009b)	Mattiske (2010)	Ecologia (2013)	Biota (2014)	Survey area
Velleia connata	X	X			X		X	X
Ventilago viminalis						X		
Vigna lanceolata		X	X	X	X			X
Vigna lanceolata var. *lanceolata*								X
Vigna sp. Hamersley Clay (A.A. Mitchell PRP 113)						X		
Vincetoxicum flexuosum							X	
Vincetoxicum lineare			X			X		
Vittadinia eremaea						X		X
Wahlenbergia sp.								X
Wahlenbergia tumidifructa	X	X		X		X		X
Waltheria indica		X	X	X	X	X	X	X
Xerochrysum bracteatum	X	X		X				
Yakirra australiensis						X		
Yakirra australiensis var. *australiensis*						X		X

[1] - also presented 4 sites from (Halpern Glick Maunsell 2000)

[2]- expanding work presented in Mattiske Consulting (2005)

[3]- expanding work presented in Mattiske Consulting (1995, 2005, 2008b, 2008c, 2009c)

[4]- expanding work presented in Mattiske Consulting (2005, 2008b, 2008c)

[5]- expanding work presented in Mattiske Consulting 1995, 2005, 2008b, 2008c, 2009a, 2009c)

* denotes weed species

Table M.3: Species by site matrix for vascular flora species for the survey area.

Taxa	BHD05.AR	BHD10.AR	GH01	GH02	GH03	GH04	GH05	GH06	GH07	GH08	GH09	GH11	GH12	GH13	GH15	GH17	GH19	GH20	GH21	GH22	GH23	GH24	GH25	GH26	GH27	GHR10	GHR16	GHR28	GHR30
Abutilon amplum																													
Abutilon cryptopetalum																													
Abutilon fraseri subsp. *fraseri*					X									X															
Abutilon ?lepidum																													
Abutilon lepidum																													
Abutilon leucopetalum																													
Abutilon macrum																													
Abutilon malvifolium										X																			
Abutilon otocarpum																													
Abutilon sp.																X													
Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)			X			X																							
Acacia adoxa var. *adoxa*													X												X			X	
Acacia adsurgens		X															X					X			X				
Acacia ampliceps																													
Acacia ?ancistrocarpa																													
Acacia ancistrocarpa																													
Acacia aptaneura			X	X	X				X	X	X	X	X	X	X	X		X	X	X			X	X		X			
Acacia aptaneura sens. lat.																		X						X					
Acacia aptaneura x																													
Acacia arida																													
Acacia arida x																													
Acacia ayersiana				X					X									X											
Acacia ayersiana x																													
Acacia bivenosa		X				X	X	X					X				X					X	X		X				
Acacia bromilowiana P4																													
Acacia ?catenulata																													
Acacia catenulata subsp. *occidentalis*				X					X		X	X				X		X	X					X			X		
Acacia citrinoviridis																			X		X		X						
Acacia colei																													
Acacia coriacea subsp. *pendens*																													
Acacia dictyophleba						X	X									X													
Acacia hamersleyensis	X																								X	X		X	
Acacia hilliana	X												X												X				
Acacia inaequilatera		X					X						X				X					X							
Acacia incurvaneura																													
Acacia kempeana																													
Acacia macraneura																X								X					
Acacia maitlandii	X		X			X	X						X												X			X	
Acacia marramamba							X						X																
Acacia minyura																													
Acacia monticola	X																									X		X	
Acacia mulganeura												X														X			
Acacia pachyacra				X																					X			X	X
Acacia pruinocarpa		X	X	X	X				X	X			X		X	X		X	X	X	X		X	X			X		X
Acacia pteraneura																													
Acacia pteraneura x aptaneura																													
Acacia pyrifolia			X			X	X									X				X	X		X					X	
Acacia rhodophloia												X																	
Acacia sibirica													X																
Acacia sibirica x																													
Acacia sp.																					X								
Acacia spondylophylla																													
Acacia steedmanii subsp. *borealis*																													

Taxa	BHD05.AR	BHD10.AR	GH01	GH02	GH03	GH04	GH05	GH06	GH07	GH08	GH09	GH11	GH12	GH13	GH15	GH17	GH19	GH20	GH21	GH22	GH23	GH24	GH25	GH26	GH27	GHR10	GHR16	GHR28	GHR30
Acacia subtiliformis P3																													
Acacia synchronicia										X																			
Acacia tenuissima													X									X							
Acacia tetragonophylla										X													X						
Acacia tumida var. *pilbarensis*																						X							
Acrachne racemosa																													
Adriana tomentosa var. *tomentosa*																													
Alternanthera denticulata																													
Alternanthera nana			X											X							X								
Alternanthera sp.																X			X										
Amaranthus mitchellii																													
Amaranthus sp.																													
Amaranthus undulatus																													
Amphipogon sericeus	X	X											X				X					X					X		X
Amyema fitzgeraldii																													
Amyema hilliana									X																				
Amyema miquelii																													
Amyema sp.																											X		
Androcalva luteiflora			X			X										X				X			X					X	
Anthobolus leptomerioides										X			X						X						X				
Aristida burbidgeae																			X							X			
Aristida contorta		X					X			X	X						X						X	X					
Aristida holathera var. *holathera*		X					X						X																
Aristida inaequiglumis													X																
Aristida ingrata																								X					
Aristida latifolia										X																			
Aristida lazaridis P2																													
Aristida obscura																		X	X	X									
Aristida sp.					X				X						X		X					X							
Asteraceae sp.																													
Astrebla elymoides										X																			
Astrebla sp.																													
Astrotricha hamptonii																													
Atalaya hemiglauca																					X								
**Bidens bipinnata*			X		X	X			X		X	X		X	X	X		X	X	X	X								
Boerhavia ?coccinea																													
Boerhavia coccinea			X																										
Boerhavia schomburgkiana																													
Bonamia pilbarensis							X																						
Bothriochloa ewartiana																													
Brachychiton acuminatus																													
Bulbostylis barbata																										X			
Bulbostylis turbinata			X																										
Calytrix carinata																													
Capparis lasiantha												X		X		X							X		X	X	X	X	
Capparis spinosa subsp. *nummularia*																													
Capparis umbonata																													
Cassytha capillaris																												X	
Cassytha filiformis																													
Cassytha sp.																													
**Cenchrus ciliaris*						X																							
**Cenchrus setiger*																													
Centipeda minima subsp. *macrocephala*																													
Cheilanthes lasiophylla							X					X																	
Cheilanthes sieberi subsp. *sieberi*					X				X		X							X	X					X					

Taxa	BHD05.AR	BHD10.AR	GH01	GH02	GH03	GH04	GH05	GH06	GH07	GH08	GH09	GH11	GH12	GH13	GH15	GH17	GH19	GH20	GH21	GH22	GH23	GH24	GH25	GH26	GH27	GHR10	GHR16	GHR28	GHR30
**Chloris virgata*																													
Chrysocephalum apiculatum subsp. *pilbarense*			X																										
Chrysocephalum gilesii																													
Chrysopogon fallax			X		X						X			X	X	X													
Cleome viscosa			X			X								X		X				X	X		X	X					
Clerodendrum floribundum var. *angustifolium*																													
Clerodendrum tomentosum var. *lanceolatum*																										X			
Codonocarpus cotinifolius		X																											
Commelina ensifolia															X														
Convolvulus clementii																													
**Conyza bonariensis*																													
Corchorus crozophorifolius						X																							
Corchorus lasiocarpus subsp. *lasiocarpus*	X																X				X								
Corchorus lasiocarpus subsp. *parvus*							X													X									
Corchorus tridens			X			X				X																			
Corymbia candida																													
Corymbia deserticola																													
Corymbia deserticola subsp. *deserticola*		X		X									X									X							
Corymbia ferriticola																										X			
Corymbia hamersleyana																													
Corymbia hamersleyana sens. lat.	X					X																					X	X	
Corymbia opaca																													
Corymbia sp.																													
Crotalaria medicaginea var. *neglecta*			X							X																			
Crotalaria novae-hollandiae subsp. *novae-hollandiae*																													
Cryptandra monticola																													
Cucumis melo																													
Cucumis variabilis																				X									
Cullen leucochaites																													
Cuscuta victoriana																													
Cymbopogon ambiguus						X	X	X					X			X	X				X	X		X		X		X	X
Cymbopogon obtectus		X																											
Cymbopogon sp.																													
Cynanchum floribundum																													
Cynanchum viminale																													
Cynodon convergens										X																			
**Cynodon dactylon*			X																										
Cynodon prostratus																													
Cyperus cunninghamii subsp. *cunninghamii*																													
Cyperus difformis																													
Cyperus vaginatus																													
Dactyloctenium ?radulans																													
Dactyloctenium radulans																													
Dampiera candicans	X																												
**Datura leichhardtii*																													
**Datura leichhardtii* subsp. *leichhardtii*			X							X																			
Dichanthium sericeum subsp. *humilius*			X																										
Dichanthium sp.																													
Dicladanthera forrestii																					X								
Digitaria ammophila																													
Digitaria brownii																													
Digitaria ctenantha																													
Dipteracanthus australasicus subsp. *australasicus*														X		X												X	
Dodonaea coriacea	X																												
Dodonaea lanceolata var. *lanceolata*						X																			X			X	

Taxa	BHD05.AR	BHD10.AR	GH01	GH02	GH03	GH04	GH05	GH06	GH07	GH08	GH09	GH11	GH12	GH13	GH15	GH17	GH19	GH20	GH21	GH22	GH23	GH24	GH25	GH26	GH27	GHR10	GHR16	GHR28	GHR30
Dodonaea pachyneura												X														X		X	
Dodonaea petiolaris																													
Dodonaea viscosa subsp. *spatulata*																										X			
Duperreya commixta		X	X		X	X					X	X	X	X		X	X	X	X	X	X	X	X	X		X		X	
Dysphania kalpari																													
Dysphania melanocarpa forma *melanocarpa*																													
Dysphania plantaginella																													
Dysphania rhadinostachya subsp. *rhadinostachya*			X																										
**Echinochloa colona*																													
Enchylaena tomentosa var. *tomentosa*					X					X		X				X							X	X					
Enneapogon caerulescens		X				X	X			X				X															
Enneapogon lindleyanus		X														X					X			X					X
Enneapogon polyphyllus			X		X	X				X			X																
Enneapogon robustissimus																													
Enneapogon sp.																													
Enteropogon ramosus																													
Eragrostis cumingii			X																										
Eragrostis eriopoda													X																
Eragrostis setifolia					X																								
Eragrostis sp.																													
Eragrostis tenellula			X			X																							
Eragrostis xerophila										X																			
Eremophila aff. *clarkei*									X		X				X														
Eremophila canaliculata																													
Eremophila forrestii subsp. *forrestii*				X					X	X		X				X	X		X					X			X		
Eremophila fraseri																													
Eremophila fraseri subsp. *fraseri*																													
Eremophila jucunda subsp. *pulcherrima*																										X		X	
Eremophila lanceolata					X																								
Eremophila latrobei																													
Eremophila latrobei subsp. *filiformis*									X			X						X	X								X	X	X
Eremophila latrobei subsp. *glabra*										X																			
Eremophila latrobei subsp. *latrobei*													X																
Eremophila longifolia			X			X														X			X	X					
Eremophila magnifica subsp. *magnifica* P4																													
Eremophila phyllopoda subsp. *obliqua*																													
Eremophila platycalyx subsp. *pardalota*												X																	
Eremophila sp. Hamersley Range (K. Walker KW 136) P3																													
Eremophila sp. West Angelas (S. van Leeuwen 4068) P1																													
Eriachne aristidea																													
Eriachne ?benthamii																													
Eriachne benthamii																													
Eriachne lanata																											X		
Eriachne mucronata	X	X				X	X					X			X	X				X		X				X	X		X
Eriachne obtusa										X																			
Eriachne pulchella																													
Eriachne pulchella subsp. *dominii*			X																		X								
Eriachne pulchella subsp. *pulchella*																													
Eriachne tenuiculmis																					X							X	
Eucalyptus camaldulensis subsp. *obtusa*																													
Eucalyptus gamophylla		X											X				X					X			X				
Eucalyptus kingsmillii																													
Eucalyptus leucophloia subsp. *leucophloia*	X						X					X	X			X	X					X			X	X	X	X	X
Eucalyptus pilbarensis																													
Eucalyptus repullulans								X																					

Taxa	BHD05.AR	BHD10.AR	GH01	GH02	GH03	GH04	GH05	GH06	GH07	GH08	GH09	GH11	GH12	GH13	GH15	GH17	GH19	GH20	GH21	GH22	GH23	GH24	GH25	GH26	GH27	GHR10	GHR16	GHR28	GHR30
Eucalyptus socialis subsp. *?eucentrica*								X		X																			
Eucalyptus socialis subsp. *eucentrica*						X															X								
Eucalyptus victrix			X								X			X		X							X	X					
Eucalyptus xerothermica					X																								
Eucalyptus xerothermica x *Eucalyptus tephrodes*			X			X	X													X	X								
Eulalia aurea			X																	X									
Euphorbia australis var. *subtomentosa*										X				X															
Euphorbia biconvexa			X																										
Euphorbia biconvexa/coghlanii/trigonosperma																													
Euphorbia boophthona																													
Euphorbia careyi							X																						
Euphorbia coghlanii																													
Euphorbia sp.																													
Euphorbia trigonosperma																													
Evolvulus alsinoides var. *decumbens*			X			X																							
Evolvulus alsinoides var. *villosicalyx*			X											X										X					
Ficus brachypoda																										X			
Fimbristylis dichotoma																													
Fimbristylis simulans																													
Fimbristylis sp.													X									X							
**Flaveria trinervia*			X			X																							
Glycine canescens																								X					
Gompholobium oreophilum																									X				
Gomphrena cunninghamii																													
Gomphrena sp.																													
Goodenia cusackiana																													
Goodenia lamprosperma																													
Goodenia microptera																													
Goodenia muelleriana																													
Goodenia prostrata																													
Goodenia sp.																	X				X								
Goodenia sp. (of interest)										X																			
Goodenia stellata			X											X															
Goodenia stobbsiana	X	X					X						X									X							
Goodenia tenuiloba																													
Goodenia triodiophila													X									X							
Gossypium australe						X																							
Gossypium robinsonii						X										X									X		X		
Gossypium sturtianum var. *sturtianum*						X																							
Grevillea berryana																	X	X									X		
Grevillea saxicola P3												X															X		
Grevillea wickhamii subsp. *hispidula*	X					X																				X			
Hakea chordophylla		X					X						X									X			X				
Hakea lorea subsp. *lorea*														X					X				X						
Halgania cyanea								X																					
Halgania gustafsenii var. *gustafsenii*													X												X				
Haloragis gossei																													
Haloragis odontocarpa			X																										
Haloragis sp.										X																			
Heliotropium inexplicitum																													
Heliotropium ovalifolium							X																						
Heliotropium pachyphyllum																													
Heliotropium sp.		X																											
Heliotropium tanythrix																				X	X								
Heliotropium tenuifolium																													

Taxa	BHD05.AR	BHD10.AR	GH01	GH02	GH03	GH04	GH05	GH06	GH07	GH08	GH09	GH11	GH12	GH13	GH15	GH17	GH19	GH20	GH21	GH22	GH23	GH24	GH25	GH26	GH27	GHR10	GHR16	GHR28	GHR30
Hibiscus burtonii												X						X											
Hibiscus ?coatesii																													
Hibiscus coatesii																													
Hibiscus leptocladus																													
Hibiscus sp.								X																					
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2																													
Hibiscus sturtii																			X	X			X	X					
Hibiscus sturtii var. *campylochlamys*							X																						
Hibiscus sturtii var. *platychlamys*																	X												
Hibiscus verdcourtii										X																			
Hybanthus aurantiacus		X																			X								
Indigofera fractiflexa subsp. *fractiflexa*																										X		X	
Indigofera georgei			X																	X			X			X			
Indigofera linifolia														X															
Indigofera monophylla		X											X				X					X			X				
Indigofera rugosa																													
Iseilema eremaeum			X																										
Iseilema membranaceum																													
Iseilema sp.																													
Iseilema vaginiflorum																													
Isotropis sp. Arid zone (G. Byrne 2775)			X													X					X								
Jasminum didymum subsp. *lineare*			X	X		X							X													X		X	
Josephinia eugeniae																													
**Lactuca serriola*																													
Lepidium catapycnon P4																													
Lepidium pedicellosum																													
Lepidium phlebopetalum																													
Lepidium pholidogynum																													
Lepidium sp.																					X								X
Lobelia arnhemiaca																													
Lobelia heterophylla subsp. *pilbarensis*																													
Maireana carnosa																													
Maireana eriosphaera																													
Maireana georgei																													X
Maireana melanocoma																													
Maireana tomentosa subsp. *tomentosa*														X	X	X		X	X				X	X					X
Maireana triptera																													
Maireana villosa					X				X		X																		
Malvaceae sp.																													
**Malvastrum americanum*			X											X		X				X	X		X						
Marsdenia australis																													
Marsdenia sp.																													
Maytenus sp. Mt Windell (S. van Leeuwen 846)						X																							
Melaleuca argentea																													
Melaleuca bracteata																													
Melaleuca eleuterostachya																													
Melaleuca glomerata																													
Melhania oblongifolia																													
**Melinis repens*																													
Mirbelia viminalis	X																												
Neptunia dimorphantha										X																			
Newcastelia sp. Hamersley Range (S. van Leeuwen 4264)																													
Nicotiana benthamiana																													
Nicotiana sp.			X																										
Notoleptopus decaisnei var. Orbicularis (A.B. Craig 428)																													

Taxa	BHD05.AR	BHD10.AR	GH01	GH02	GH03	GH04	GH05	GH06	GH07	GH08	GH09	GH11	GH12	GH13	GH15	GH17	GH19	GH20	GH21	GH22	GH23	GH24	GH25	GH26	GH27	GHR10	GHR16	GHR28	GHR30
Oldenlandia crouchiana																													
Pandorea pandorana																													
Panicum decompositum																													
Panicum effusum																													
Paraneurachne muelleri			X			X		X				X	X			X	X						X	X				X	
Paspalidium clementii			X																										
Paspalidium jubiflorum																													
Paspalidium rarum			X																										
Peripleura arida																													
Peripleura obovata																						X							
Peripleura virgata																													
Perotis rara																													
Petalostylis labicheoides	X		X		X	X					X															X		X	
Phyllanthus erwinii																													
Phyllanthus maderaspatensis																				X	X								
Pluchea dentex																													
Pluchea rubelliflora			X			X																							
Pluchea sp.																													
Poaceae sp.													X							X									
Polycarpaea corymbosa var. *corymbosa*																					X								
Polycarpaea holtzei																													
Polycarpaea longiflora													X																
Polygala isingii																													
Polymeria aff. *longifolia*										X																			
Polymeria ambigua																													
Portulaca oleracea																													
Psydrax latifolia											X															X			
Psydrax suaveolens					X				X		X	X	X		X	X				X							X		
Pterocaulon serrulatum var. *velutinum*			X																										
Pterocaulon sp.																				X						X			
Pterocaulon sphacelatum			X			X	X																						
Pterocaulon sphaeranthoides																X													
Ptilotus aervoides																													
Ptilotus astrolasius		X					X										X		X	X	X								
Ptilotus calostachyus	X	X					X	X					X				X					X							
Ptilotus clementii								X																					
Ptilotus exaltatus	X	X						X		X							X												
Ptilotus fusiformis																													
Ptilotus helipteroides																													
Ptilotus incanus																													
Ptilotus mollis P4																													
Ptilotus obovatus		X	X		X	X			X	X	X	X		X	X	X			X	X			X	X					X
Ptilotus polystachyus																													
Ptilotus roei																													
Ptilotus rotundifolius		X											X				X					X							X
Ptilotus schwartzii var. *schwartzii*																													
Ptilotus sp.																X													
Rhagodia eremaea		X														X			X	X	X		X	X			X		
Rhagodia sp. Hamersley (M. Trudgen 17794) P3			X									X																	
Rhodanthe margarethae																													
Rhynchosia minima			X			X				X										X									
Rostellularia adscendens var. *clementii*																													
Rostellularia adscendens var. *latifolia* P3																													
Salsola australis																							X	X					
Santalum lanceolatum						X						X																X	

Taxa	BHD05.AR	BHD10.AR	GH01	GH02	GH03	GH04	GH05	GH06	GH07	GH08	GH09	GH11	GH12	GH13	GH15	GH17	GH19	GH20	GH21	GH22	GH23	GH24	GH25	GH26	GH27	GHR10	GHR16	GHR28	GHR30
Santalum spicatum																					X								
Scaevola acacioides												X																	X
Scaevola amblyanthera var. *centralis*			X			X																							
Scaevola browniana																													
Scaevola browniana subsp. *browniana*																													
Scaevola parvifolia subsp. *pilbarae*																													
Scaevola spinescens																													
Schenkia australis																													
Schizachyrium fragile																													
Sclerolaena cornishiana					X					X							X		X	X				X					
Sclerolaena cuneata																													
Sclerolaena densiflora																													
Sclerolaena ?gardneri																													
Senna artemisioides subsp. × *artemisioides*										X																			
Senna artemisioides subsp. *filifolia*											X																		
Senna artemisioides subsp. *helmsii*		X														X	X						X						
Senna artemisioides subsp. *oligophylla*		X					X	X		X										X		X	X						X
Senna artemisioides subsp. *oligophylla x helmsii*																													
Senna ferraria																													
Senna glaucifolia													X																X
Senna glutinosa subsp. *glutinosa*		X				X	X						X															X	X
Senna glutinosa subsp. ×*luerssenii*		X										X	X			X	X					X							X
Senna glutinosa subsp. *pruinosa*		X					X										X												X
Senna notabilis																													
Senna pleurocarpa var. angustifolia																													
Senna sericea																													
Senna sp. Meekatharra (E. Bailey 1-26)																													
Senna sp. Meekatharra (E. Bailey 1-26) ×																													
Senna sp. Meekatharra (E. Bailey 1-26) × *glaucifolia*		X																											
Senna stricta			X									X																	X
Senna venusta																													
Seringia elliptica																													
Seringia nephrosperma																													
Seringia sp.																	X												
Sesbania cannabina																													
Setaria dielsii																													
**Setaria verticillata*																													
Sida aff. *fibulifera*														X		X													
Sida arenicola													X				X												
Sida calyxhymenia																		X						X					
Sida cardiophylla																													
Sida echinocarpa																													
Sida ?ectogama																													
Sida fibulifera			X	X	X					X									X	X			X	X					
Sida platycalyx																			X					X					
Sida sp.															X														
Sida sp. Articulation below (A.A. Mitchell PRP 1605)						X																						X	
Sida ?sp. dark green fruits (S. van Leeuwen 2260)																													
Sida sp. dark green fruits (S. van Leeuwen 2260)				X					X						X														
Sida sp. Excedentifolia (J.L. Egan 1925)																												X	
Sida sp. Golden calyces glabrous (H.N. Foote 32)																													
Sida sp. Pilbara (A.A. Mitchell PRP 1543)	X																												
Sida sp. Shovelanna Hill (S. van Leeuwen 3842)																			X							X			
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)																													
**Sigesbeckia orientalis*																													

Taxa	BHD05.AR	BHD10.AR	GH01	GH02	GH03	GH04	GH05	GH06	GH07	GH08	GH09	GH11	GH12	GH13	GH15	GH17	GH19	GH20	GH21	GH22	GH23	GH24	GH25	GH26	GH27	GHR10	GHR16	GHR28	GHR30
Solanum cleistogamum																										X			
Solanum ferocissimum											X																		
Solanum gabrielae																													
Solanum horridum																													
Solanum lasiophyllum	X				X		X		X	X		X	X	X	X		X		X	X			X	X					
**Solanum nigrum*																													
Solanum phlomoides																													
**Sonchus oleraceus*																													
sp. indet																													
Sporobolus australasicus										X																			
Stackhousia muricata subsp. annual (W.R. Barker 2172)																													
Stemodia grossa						X																							
Stemodia sp.																													
Streptoglossa bubakii										X																			
Streptoglossa decurrens																													
Streptoglossa sp.																													
Stylobasium spathulatum																													
Swainsona maccullochiana																													
Templetonia egena																													
Tephrosia oxalidea																													
Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)																				X	X								
Teucrium teucriiflorum											X																		
Themeda avenacea																													
Themeda sp.																	X												
Themeda sp. Mt Barricade (M.E. Trudgen 2471)							X															X							
Themeda triandra		X	X			X				X				X	X	X					X		X	X	X	X		X	
Tinospora smilacina																													
Trachymene oleracea subsp. *oleracea*																													
Tragus australianus																													
Trianthema glossostigmum																													
Tribulus platypterus																													
Tribulus suberosus												X																	X
Trichodesma zeylanicum var. *zeylanicum*							X																						
Tricoryne sp. Hamersley Range (S. van Leeuwen 915)							X																						
**Tridax procumbens*																													
Trigastrotheca molluginea			X																										
Triodia ?angusta																													
Triodia angusta																													
Triodia basedowii														X	X														
Triodia brizoides																													
Triodia longiceps			X			X														X	X		X						
Triodia melvillei																													
Triodia pungens		X	X	X	X				X		X	X	X		X	X	X	X		X	X	X				X	X	X	
Triodia sp. Mt Ella (M.E. Trudgen 12739) P3																													
Triodia vanleeuwenii	X	X		X									X				X					X			X		X		
Triodia wiseana	X					X	X	X		X		X						X							X			X	X
Triraphis mollis														X															
Triumfetta chaetocarpa																													
Typha domingensis																													
Urochloa ?occidentalis																													
**Vachellia farnesiana*																													
Velleia connata																													
Vigna lanceolata var. *lanceolata*			X							X																X			
Vittadinia eremaea																													
Wahlenbergia sp.																													

Taxa	BHD05.AR	BHD10.AR	GH01	GH02	GH03	GH04	GH05	GH06	GH07	GH08	GH09	GH11	GH12	GH13	GH15	GH17	GH19	GH20	GH21	GH22	GH23	GH24	GH25	GH26	GH27	GHR10	GHR16	GHR28	GHR30
Wahlenbergia tumidifructa																													
Waltheria indica																					X								
Yakirra australiensis var. *australiensis*														X															

*Denotes weed species

Taxa	HD01	HD02	HD03	HD04	HD05	HD06	HD07	HD08	HD09	HD10	HD11	HD12	HD13	HD14	HD15	HD16	HD17	HD18	HD19	HD20	HD21	HD22	HD23	HD24	HD25	HD26	HD27	HD28	HD29	HD30	HD31	HD32	HD33	HD34	HD35	HD37	HD38	HD39	HD40	HD41
Abutilon amplum																		X																						
Abutilon cryptopetalum																													X											
Abutilon fraseri subsp. *fraseri*																																								
Abutilon ?lepidum						X																																		
Abutilon lepidum						X								X							X					X														
Abutilon leucopetalum																																								
Abutilon macrum						X																																		
Abutilon malvifolium																																								
Abutilon otocarpum						X			X	X								X				X			X				X							X				
Abutilon sp.																								X																
Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)																																					X			
Acacia adoxa var. *adoxa*	X													X																								X		
Acacia adsurgens	X				X																												X							
Acacia ampliceps																																								
Acacia ?ancistrocarpa																																								
Acacia ancistrocarpa											X														X															
Acacia aptaneura		X	X	X	X	X	X	X	X	X	X	X								X		X	X	X	X	X	X	X	X	X		X		X		X	X	X	X	
Acacia aptaneura sens. lat.																																								
Acacia aptaneura x										X																													X	
Acacia arida																X			X																				
Acacia arida x																X																								
Acacia ayersiana			X			X		X		X		X																X				X								
Acacia ayersiana x																				X																				
Acacia bivenosa	X					X											X	X	X		X	X											X	X	X	X	X			X
Acacia bromilowiana P4																										X														
Acacia ?catenulata																																								
Acacia catenulata subsp. *occidentalis*		X	X	X		X	X	X		X										X		X	X			X	X	X				X			X	X			X	
Acacia citrinoviridis								X									X	X																						
Acacia colei																																								
Acacia coriacea subsp. *pendens*																																					X			
Acacia dictyophleba																		X	X			X										X		X						
Acacia hamersleyensis				X			X																	X									X	X						
Acacia hilliana	X										X		X		X																				X						
Acacia inaequilatera					X											X																	X							
Acacia incurvaneura							X			X																						X								X
Acacia kempeana																			X																					
Acacia macraneura																																								
Acacia maitlandii	X					X					X			X			X	X				X			X							X			X	X	X		X		
Acacia marramamba																																								
Acacia minyura																																								
Acacia monticola						X																			X											X				
Acacia mulganeura			X				X																			X														
Acacia pachyacra	X								X		X			X						X													X							
Acacia pruinocarpa	X		X	X		X		X	X		X	X		X						X				X	X	X	X	X			X		X		X	X	X	X	
Acacia pteraneura																													X							X		X		
Acacia pteraneura x aptaneura														X																										
Acacia pyrifolia	X			X									X				X		X			X				X					X				X		X			
Acacia rhodophloia																																								
Acacia sibirica																			X			X			X						X						X			
Acacia sibirica x																																								
Acacia sp.									X																															
Acacia spondylophylla													X		X																						X			
Acacia steedmanii subsp. *borealis*																																		X						
Acacia subtiliformis P3																																								
Acacia synchronicia									X												X								X							X				

Taxa	HD01	HD02	HD03	HD04	HD05	HD06	HD07	HD08	HD09	HD10	HD11	HD12	HD13	HD14	HD15	HD16	HD17	HD18	HD19	HD20	HD21	HD22	HD23	HD24	HD25	HD26	HD27	HD28	HD29	HD30	HD31	HD32	HD33	HD34	HD35	HD37	HD38	HD39	HD40	HD41
Acacia tenuissima						X					X																								X					
Acacia tetragonophylla									X	X													X					X		X									
Acacia tumida var. *pilbarensis*																																		X					
Acrachne racemosa																															X								
Adriana tomentosa var. *tomentosa*																																							
Alternanthera denticulata																															X								
Alternanthera nana									X													X							X	X	X								
Alternanthera sp.																																							
Amaranthus mitchellii																																							
Amaranthus sp.																													X										
Amaranthus undulatus																																							
Amphipogon sericeus					X	X					X		X		X																				X	X		X		X
Amyema fitzgeraldii																																							
Amyema hilliana																																							
Amyema miquelii				X																																			
Amyema sp.																																							
Androcalva luteiflora						X										X	X	X				X			X						X			X	X				
Anthobolus leptomerioides									X		X														X		X												
Aristida burbidgeae																								X																
Aristida contorta		X	X			X	X	X	X	X	X			X				X	X	X	X	X	X		X			X	X	X	X	X	X	X	X	X			X	
Aristida holathera var. *holathera*											X			X	X	X		X	X		X	X			X						X	X	X	X	X				
Aristida inaequiglumis		X				X					X		X							X	X				X						X	X						X	
Aristida ingrata																						X																	
Aristida latifolia									X																				X	X		X							
Aristida lazaridis P2																		X													X								
Aristida obscura		X								X																		X	X			X							
Aristida sp.			X																				X			X			X	X		X							
Asteraceae sp.							X		X																					X										
Astrebla elymoides																																							
Astrebla sp.									X																				X	X									
Astrotricha hamptonii																										X													
Atalaya hemiglauca																																							
**Bidens bipinnata*		X	X			X			X	X								X	X			X							X		X				X		X	
Boerhavia ?coccinea																															X								
Boerhavia coccinea		X							X													X										X			X				
Boerhavia schomburgkiana																																							
Bonamia pilbarensis					X									X				X														X							
Bothriochloa ewartiana																	X	X																					
Brachychiton acuminatus																																							
Bulbostylis barbata		X		X	X				X					X												X											X	X	
Bulbostylis turbinata																																							
Calytrix carinata																																							
Capparis lasiantha								X			X			X							X				X	X			X					X	X		X		X	
Capparis spinosa subsp. *nummularia*																								X																
Capparis umbonata																																							
Cassytha capillaris																																							
Cassytha filiformis																																							
Cassytha sp.																	X																						
**Cenchrus ciliaris*																	X	X				X																	
**Cenchrus setiger*																	X	X																					
Centipeda minima subsp. *macrocephala*																														X	X								
Cheilanthes lasiophylla			X				X									X			X																			X	
Cheilanthes sieberi subsp. *sieberi*		X				X				X					X							X		X			X	X	X									X	
**Chloris virgata*																													X		X								
Chrysocephalum apiculatum subsp. *pilbarense*																						X									X								

Taxa	HD01	HD02	HD03	HD04	HD05	HD06	HD07	HD08	HD09	HD10	HD11	HD12	HD13	HD14	HD15	HD16	HD17	HD18	HD19	HD20	HD21	HD22	HD23	HD24	HD25	HD26	HD27	HD28	HD29	HD30	HD31	HD32	HD33	HD34	HD35	HD37	HD38	HD39	HD40	HD41
Chrysocephalum gilesii																													X											
Chrysopogon fallax		X							X	X								X		X		X							X		X							X	
Cleome viscosa						X			X								X					X				X			X	X	X					X			
Clerodendrum floribundum var. *angustifolium*	X			X													X																		X		X			
Clerodendrum tomentosum var. *lanceolatum*																								X		X														
Codonocarpus cotinifolius					X	X							X		X						X							X				X							X
Commelina ensifolia																																								
Convolvulus clementii																		X																						
**Conyza bonariensis*																		X																						
Corchorus crozophorifolius																																					X			
Corchorus lasiocarpus subsp. *lasiocarpus*																																								
Corchorus lasiocarpus subsp. *parvus*				X	X	X					X		X				X	X							X		X						X	X	X	X	X			
Corchorus tridens																																								
Corymbia candida																																								
Corymbia deserticola																																								
Corymbia deserticola subsp. *deserticola*					X					X				X																			X							
Corymbia ferriticola																								X		X														
Corymbia hamersleyana				X				X					X			X										X							X	X			X			
Corymbia hamersleyana sens. lat.																																								
Corymbia opaca															X										X										X					X
Corymbia sp.																								X																
Crotalaria medicaginea var. *neglecta*									X									X				X								X	X						X			
Crotalaria novae-hollandiae subsp. *novae-hollandiae*																																								
Cryptandra monticola																																								
Cucumis melo																															X									
Cucumis variabilis						X											X	X			X	X		X		X											X		X	
Cullen leucochaites																																								
Cuscuta victoriana																													X											
Cymbopogon ambiguus			X	X	X			X	X		X		X	X		X	X	X	X			X		X	X	X					X	X	X		X	X	X	X	X	X
Cymbopogon obtectus											X										X				X															
Cymbopogon sp.																																								
Cynanchum floribundum																										X														
Cynanchum viminale																																								
Cynodon convergens		X							X													X							X										
**Cynodon dactylon*																																								
Cynodon prostratus																																								
Cyperus cunninghamii subsp. *cunninghamii*																								X																
Cyperus difformis																															X									
Cyperus vaginatus																	X	X													X									
Dactyloctenium ?radulans									X																															
Dactyloctenium radulans																													X											
Dampiera candicans					X																																X			
**Datura leichhardtii*																																								
**Datura leichhardtii* subsp. *leichhardtii*																																								
Dichanthium sericeum subsp. *humilius*									X									X				X								X	X						X			
Dichanthium sp.										X																														
Dicladanthera forrestii																																								
Digitaria ammophila											X																													
Digitaria brownii						X					X									X		X																		
Digitaria ctenantha																																								
Dipteracanthus australasicus subsp. *australasicus*																														X										
Dodonaea coriacea																			X																			X		
Dodonaea lanceolata var. *lanceolata*			X																						X										X					
Dodonaea pachyneura							X																																	
Dodonaea petiolaris								X																X		X									X					

Taxa	HD01	HD02	HD03	HD04	HD05	HD06	HD07	HD08	HD09	HD10	HD11	HD12	HD13	HD14	HD15	HD16	HD17	HD18	HD19	HD20	HD21	HD22	HD23	HD24	HD25	HD26	HD27	HD28	HD29	HD30	HD31	HD32	HD33	HD34	HD35	HD37	HD38	HD39	HD40	HD41
Dodonaea viscosa subsp. *spatulata*																										X											X				
Duperreya commixta		X	X	X				X			X		X					X		X	X	X	X	X	X	X					X			X		X	X	X	
Dysphania kalpari																						X																		
Dysphania melanocarpa forma *melanocarpa*																																								
Dysphania plantaginella		X																																			X			
Dysphania rhadinostachya subsp. *rhadinostachya*			X		X	X	X								X									X		X											X	X	X	
**Echinochloa colona*																																								
Enchylaena tomentosa var. *tomentosa*						X	X		X	X																X				X							X			
Enneapogon caerulescens		X							X	X	X			X									X			X				X			X			X		X	
Enneapogon lindleyanus		X	X			X												X				X	X			X	X		X						X		X		
Enneapogon polyphyllus		X	X			X	X		X	X	X			X						X	X	X			X	X			X	X	X	X				X	X		
Enneapogon robustissimus																									X						X								
Enneapogon sp.																																					X		X	
Enteropogon ramosus																		X													X								
Eragrostis cumingii		X																		X		X									X						X		
Eragrostis eriopoda																		X									X					X						X		
Eragrostis setifolia									X																					X										
Eragrostis sp.																																								
Eragrostis tenellula									X									X				X	X							X	X						X			
Eragrostis xerophila									X																		X		X	X										
Eremophila aff. *clarkei*																																								
Eremophila canaliculata																	X																							
Eremophila forrestii subsp. *forrestii*		X				X			X	X	X												X						X	X		X				X		X	
Eremophila fraseri																																								
Eremophila fraseri subsp. *fraseri*														X		X				X							X													
Eremophila jucunda subsp. *pulcherrima*															X									X		X				X										
Eremophila lanceolata																													X											
Eremophila latrobei		X																																						
Eremophila latrobei subsp. *filiformis*			X				X			X																	X													
Eremophila latrobei subsp. *glabra*	X													X																							X		X	
Eremophila latrobei subsp. *latrobei*																																						X		
Eremophila longifolia									X		X						X	X							X				X	X	X		X						
Eremophila magnifica subsp. *magnifica* P4																																								
Eremophila phyllopoda subsp. *obliqua*																																								
Eremophila platycalyx subsp. *pardalota*							X	X															X													X			
Eremophila sp. Hamersley Range (K. Walker KW 136) P3			X																							X													
Eremophila sp. West Angelas (S. van Leeuwen 4068) P1																																								
Eriachne aristidea															X																									
Eriachne ?benthamii									X		X																													
Eriachne benthamii																									X				X		X									
Eriachne lanata				X																																				
Eriachne mucronata	X		X				X	X			X			X	X	X		X	X			X	X	X	X	X					X	X		X	X		X		X	
Eriachne obtusa									X																			X	X	X									X	
Eriachne pulchella	X	X	X			X	X			X				X							X	X	X	X				X										X	
Eriachne pulchella subsp. *dominii*													X																	X							X		X
Eriachne pulchella subsp. *pulchella*					X						X														X		X				X				X				
Eriachne tenuiculmis																																								
Eucalyptus camaldulensis subsp. *obtusa*																	X	X																						
Eucalyptus gamophylla								X			X		X												X							X		X	X		X			
Eucalyptus kingsmillii																																								
Eucalyptus leucophloia subsp. *leucophloia*	X			X				X			X		X	X	X			X				X	X		X	X									X	X	X	X	X	X
Eucalyptus pilbarensis																					X																			
Eucalyptus repullulans			X				X																												X					
Eucalyptus socialis subsp. *?eucentrica*																																								
Eucalyptus socialis subsp. *eucentrica*																					X															X				

Taxa	HD01	HD02	HD03	HD04	HD05	HD06	HD07	HD08	HD09	HD10	HD11	HD12	HD13	HD14	HD15	HD16	HD17	HD18	HD19	HD20	HD21	HD22	HD23	HD24	HD25	HD26	HD27	HD28	HD29	HD30	HD31	HD32	HD33	HD34	HD35	HD37	HD38	HD39	HD40	HD41
Eucalyptus victrix																	X	X													X									
Eucalyptus xerothermica																		X				X									X									
Eucalyptus xerothermica x *Eucalyptus tephrodes*																																								
Eulalia aurea																	X	X				X									X		X		X					X
Euphorbia australis var. *subtomentosa*						X								X								X											X							
Euphorbia biconvexa																	X					X				X														
Euphorbia biconvexa/coghlanii/trigonosperma																							X	X		X											X			
Euphorbia boophthona																		X																			X			
Euphorbia careyi																			X																					
Euphorbia coghlanii																								X							X									
Euphorbia sp.		X	X			X			X																X					X	X						X			
Euphorbia trigonosperma										X												X																		
Evolvulus alsinoides var. *decumbens*																																								
Evolvulus alsinoides var. *villosicalyx*		X				X			X									X				X							X	X						X			
Ficus brachypoda																								X		X														
Fimbristylis dichotoma									X																				X	X									
Fimbristylis simulans					X																																X			
Fimbristylis sp.															X																									
**Flaveria trinervia*																	X	X				X															X			
Glycine canescens										X							X	X				X									X									
Gompholobium oreophilum	X				X						X		X		X										X									X	X					
Gomphrena cunninghamii						X																		X		X											X			
Gomphrena sp.																																								
Goodenia cusackiana																			X																					
Goodenia lamprosperma																		X																						
Goodenia microptera																																								
Goodenia muelleriana																					X																X			
Goodenia prostrata																			X																		X			
Goodenia sp.												X												X													X			
Goodenia sp. (of interest)																																								
Goodenia stellata																																								
Goodenia stobbsiana				X	X	X					X			X	X									X												X	X	X	X	X
Goodenia tenuiloba														X																							X			
Goodenia triodiophila													X		X																							X		X
Gossypium australe																X	X																X							
Gossypium robinsonii						X											X	X							X						X			X		X	X			
Gossypium sturtianum var. *sturtianum*																	X	X				X			X						X				X					
Grevillea berryana																							X													X			X	
Grevillea saxicola P3			X				X						X											X												X		X	
Grevillea wickhamii subsp. *hispidula*													X			X								X												X			
Hakea chordophylla	X			X	X						X		X		X				X		X	X			X				X				X		X	X		X		X
Hakea lorea subsp. *lorea*																		X																						
Halgania cyanea																																								
Halgania gustafsenii var. *gustafsenii*	X																																							
Haloragis gossei																						X																		
Haloragis odontocarpa																																								
Haloragis sp.																																								
Heliotropium inexplicitum																																								
Heliotropium ovalifolium																			X																					
Heliotropium pachyphyllum																																								
Heliotropium sp.																																								
Heliotropium tanythrix																																								
Heliotropium tenuifolium																															X		X							
Hibiscus burtonii		X				X				X										X												X				X		X	
Hibiscus ?coatesii													X																											

Taxa	HD01	HD02	HD03	HD04	HD05	HD06	HD07	HD08	HD09	HD10	HD11	HD12	HD13	HD14	HD15	HD16	HD17	HD18	HD19	HD20	HD21	HD22	HD23	HD24	HD25	HD26	HD27	HD28	HD29	HD30	HD31	HD32	HD33	HD34	HD35	HD37	HD38	HD39	HD40	HD41
Hibiscus coatesii						X																		X		X					X				X	X				
Hibiscus leptocladus		X																											X										
Hibiscus sp.																																								
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2																								X																
Hibiscus sturtii																																								
Hibiscus sturtii var. *campylochlamys*					X	X												X														X				X	X			
Hibiscus sturtii var. *platychlamys*																																				X				
Hibiscus verdcourtii																																								
Hybanthus aurantiacus																									X											X	X	X		
Indigofera fractiflexa subsp. *fractiflexa*																								X		X														
Indigofera georgei																						X																		
Indigofera linifolia									X																					X										
Indigofera monophylla					X	X					X			X				X				X										X	X	X			X	X		
Indigofera rugosa																																								
Iseilema eremaeum									X																															
Iseilema membranaceum																															X									
Iseilema sp.															X																									
Iseilema vaginiflorum		X				X				X										X		X							X	X								X	
Isotropis sp. Arid zone (G. Byrne 2775)																															X									
Jasminum didymum subsp. *lineare*	X				X			X			X	X			X		X	X			X	X		X	X						X		X	X	X		X			
Josephinia eugeniae																																								
**Lactuca serriola*																																								
Lepidium catapycnon P4																																					X			
Lepidium pedicellosum														X																										
Lepidium phlebopetalum																																								
Lepidium pholidogynum																																								
Lepidium sp.																																								
Lobelia arnhemiaca																																								
Lobelia heterophylla subsp. *pilbarensis*							X																																	
Maireana carnosa																																								
Maireana eriosphaera																																								
Maireana georgei																					X																			
Maireana melanocoma																							X																	
Maireana tomentosa subsp. *tomentosa*		X			X					X										X				X			X		X			X							
Maireana triptera														X																										
Maireana villosa									X											X																				
Malvaceae sp.																																								
**Malvastrum americanum*									X									X				X								X	X								
Marsdenia australis																																			X					
Marsdenia sp.																	X																							
Maytenus sp. Mt Windell (S. van Leeuwen 846)																																								
Melaleuca argentea																																								
Melaleuca bracteata																		X																						
Melaleuca eleuterostachya																																								
Melaleuca glomerata																	X																							
Melhania oblongifolia																		X				X																		
**Melinis repens*																																								
Mirbelia viminalis	X			X															X																					
Neptunia dimorphantha																																								
Newcastelia sp. Hamersley Range (S. van Leeuwen 4264)																								X																
Nicotiana benthamiana																																								
Nicotiana sp.			X				X																																	
Notoleptopus decaisnei var. Orbicularis (A.B. Craig 428)																																								
Oldenlandia crouchiana																																								
Pandorea pandorana																																								

Taxa	HD01	HD02	HD03	HD04	HD05	HD06	HD07	HD08	HD09	HD10	HD11	HD12	HD13	HD14	HD15	HD16	HD17	HD18	HD19	HD20	HD21	HD22	HD23	HD24	HD25	HD26	HD27	HD28	HD29	HD30	HD31	HD32	HD33	HD34	HD35	HD37	HD38	HD39	HD40	HD41
Panicum decompositum		X							X													X							X	X	X									
Panicum effusum																						X			X					X		X								
Paraneurachne muelleri			X			X			X		X			X	X			X			X	X			X						X	X	X		X		X	X		X
Paspalidium clementii		X	X			X	X			X				X										X		X	X						X			X	X			
Paspalidium jubiflorum																				X																	X			
Paspalidium rarum																		X																						
Peripleura arida																	X					X																		
Peripleura obovata																																		X						
Peripleura virgata																									X	X														
Perotis rara		X				X				X												X					X		X											
Petalostylis labicheoides				X				X					X		X		X	X				X		X	X	X		X			X			X	X		X			
Phyllanthus erwinii																						X																		
Phyllanthus maderaspatensis																	X														X									
Pluchea dentex																	X					X																		
Pluchea rubelliflora																	X	X																						
Pluchea sp.																	X																							
Poaceae sp.																			X																					
Polycarpaea corymbosa var. *corymbosa*		X		X	X	X								X				X				X						X					X					X		
Polycarpaea holtzei		X		X	X	X																																X	X	
Polycarpaea longiflora		X																																			X			
Polygala isingii																		X	X																					
Polymeria aff. *longifolia*																																								
Polymeria ambigua																																	X							
Portulaca oleracea																																								
Psydrax latifolia								X				X												X		X		X											X	
Psydrax suaveolens		X	X				X			X										X			X	X								X						X	
Pterocaulon serrulatum var. *velutinum*																									X															
Pterocaulon sp.																																								
Pterocaulon sphacelatum		X				X			X		X						X	X				X		X	X	X			X		X				X		X	X	X	
Pterocaulon sphaeranthoides																																								
Ptilotus aervoides									X																				X											
Ptilotus astrolasius		X				X					X			X				X		X	X								X				X						
Ptilotus calostachyus				X	X	X					X	X	X		X										X	X						X		X		X	X	X		X
Ptilotus clementii																																					X			
Ptilotus exaltatus		X	X		X	X	X		X		X			X				X		X	X	X		X	X	X				X					X	X			
Ptilotus fusiformis						X									X																									
Ptilotus helipteroides						X			X													X							X											
Ptilotus incanus																										X														
Ptilotus mollis P4																																								
Ptilotus obovatus		X	X				X		X					X				X		X		X	X	X	X	X			X	X	X	X	X		X		X			
Ptilotus polystachyus																																								
Ptilotus roei																																								
Ptilotus rotundifolius	X										X																X											X		
Ptilotus schwartzii var. *schwartzii*																											X													
Ptilotus sp.																													X											
Rhagodia eremaea			X			X			X																	X			X	X							X			
Rhagodia sp. Hamersley (M. Trudgen 17794) P3									X											X																				
Rhodanthe margarethae																								X																
Rhynchosia minima									X								X	X				X							X	X										
Rostellularia adscendens var. *clementii*																																								
Rostellularia adscendens var. *latifolia* P3																																								
Salsola australis									X					X				X			X					X			X		X	X					X		
Santalum lanceolatum							X						X					X				X			X						X			X	X		X			
Santalum spicatum																																								
Scaevola acacioides			X				X																X																	

Taxa	HD01	HD02	HD03	HD04	HD05	HD06	HD07	HD08	HD09	HD10	HD11	HD12	HD13	HD14	HD15	HD16	HD17	HD18	HD19	HD20	HD21	HD22	HD23	HD24	HD25	HD26	HD27	HD28	HD29	HD30	HD31	HD32	HD33	HD34	HD35	HD37	HD38	HD39	HD40	HD41
Scaevola amblyanthera var. *centralis*																	X	X				X											X							
Scaevola browniana				X									X		X		X																							
Scaevola browniana subsp. *browniana*	X																																							
Scaevola parvifolia subsp. *pilbarae*					X						X											X			X										X					
Scaevola spinescens																																				X				
Schenkia australis																														X										
Schizachyrium fragile			X		X	X					X			X	X							X			X							X	X			X		X	X	
Sclerolaena cornishiana									X																					X										
Sclerolaena cuneata																																								
Sclerolaena densiflora																														X										
Sclerolaena ?gardneri																																								
Senna artemisioides subsp. × *artemisioides*									X									X				X								X	X									
Senna artemisioides subsp. *filifolia*																																	X							
Senna artemisioides subsp. *helmsii*						X	X													X						X									X				
Senna artemisioides subsp. *oligophylla*	X				X			X	X		X								X			X										X		X		X		X	X	
Senna artemisioides subsp. *oligophylla x helmsii*																									X															
Senna ferraria	X										X																	X							X		X		
Senna glaucifolia				X			X								X																	X						X	
Senna glutinosa subsp. *glutinosa*	X			X							X		X	X	X	X					X			X	X	X								X		X	X		X	
Senna glutinosa subsp. ×*luerssenii*					X	X	X							X							X		X						X					X	X			X	
Senna glutinosa subsp. *pruinosa*														X					X		X				X														X	
Senna notabilis						X																		X											X	X				
Senna pleurocarpa var. angustifolia																		X															X							
Senna sericea																																								
Senna sp. Meekatharra (E. Bailey 1-26)																					X																			
Senna sp. Meekatharra (E. Bailey 1-26) ×																																				X				
Senna sp. Meekatharra (E. Bailey 1-26) × *glaucifolia*																																								
Senna stricta							X																X	X		X										X				
Senna venusta																									X	X														
Seringia elliptica																									X										X	X				X
Seringia nephrosperma																																								X
Seringia sp.																																								
Sesbania cannabina																																								
Setaria dielsii																		X													X									
**Setaria verticillata*																														X	X					X				
Sida aff. *fibulifera*																																								
Sida arenicola															X																					X		X		X
Sida calyxhymenia																																								
Sida cardiophylla																									X															
Sida echinocarpa				X														X												X				X					
Sida ?ectogama										X																	X													
Sida fibulifera						X			X	X								X				X								X	X	X					X			
Sida platycalyx																														X										
Sida sp.		X						X		X															X	X														
Sida sp. Articulation below (A.A. Mitchell PRP 1605)																																								
Sida ?sp. dark green fruits (S. van Leeuwen 2260)																				X																				
Sida sp. dark green fruits (S. van Leeuwen 2260)		X				X				X																														
Sida sp. Excedentifolia (J.L. Egan 1925)				X										X	X						X																	X	
Sida sp. Golden calyces glabrous (H.N. Foote 32)																																X								
Sida sp. Pilbara (A.A. Mitchell PRP 1543)						X								X																		X				X	X			
Sida sp. Shovelanna Hill (S. van Leeuwen 3842)				X																				X		X														
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)						X					X							X				X												X			X			
**Sigesbeckia orientalis*																	X																							
Solanum cleistogamum																									X					X	X	X				X				
Solanum ferocissimum																										X															

Taxa	HD01	HD02	HD03	HD04	HD05	HD06	HD07	HD08	HD09	HD10	HD11	HD12	HD13	HD14	HD15	HD16	HD17	HD18	HD19	HD20	HD21	HD22	HD23	HD24	HD25	HD26	HD27	HD28	HD29	HD30	HD31	HD32	HD33	HD34	HD35	HD37	HD38	HD39	HD40	HD41
Solanum gabrielae																										X														
Solanum horridum												X												X	X	X														
Solanum lasiophyllum	X		X		X	X	X		X		X	X		X	X		X				X	X			X				X	X		X				X		X	X
**Solanum nigrum*																																								
Solanum phlomoides						X												X																		X	X			
**Sonchus oleraceus*																						X																		
sp. indet																																								
Sporobolus australasicus		X			X	X			X	X				X				X				X				X	X		X	X					X	X			
Stackhousia muricata subsp. annual (W.R. Barker 2172)																																						X		
Stemodia grossa																	X					X		X													X			
Stemodia sp.																																								
Streptoglossa bubakii									X																					X										
Streptoglossa decurrens						X																																		
Streptoglossa sp.																								X		X											X			
Stylobasium spathulatum																																					X			
Swainsona maccullochiana																			X														X							
Templetonia egena																					X																			
Tephrosia oxalidea																																								X
Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)																									X						X					X			
Teucrium teucriiflorum						X																																		
Themeda avenacea																																								
Themeda sp.																																								
Themeda sp. Mt Barricade (M.E. Trudgen 2471)																X			X					X													X			
Themeda triandra	X							X						X			X	X				X			X				X	X	X			X	X				
Tinospora smilacina																										X														
Trachymene oleracea subsp. *oleracea*																			X																		X			
Tragus australianus									X																				X	X										
Trianthema glossostigmum																									X															
Tribulus platypterus																																								
Tribulus suberosus						X																																		
Trichodesma zeylanicum var. *zeylanicum*						X					X						X	X	X					X		X											X			
Tricoryne sp. Hamersley Range (S. van Leeuwen 915)																	X	X	X																					
**Tridax procumbens*																																								
Trigastrotheca molluginea																																								
Triodia ?angusta																																								
Triodia angusta																					X																			
Triodia basedowii																																								
Triodia brizoides																																								
Triodia longiceps																	X	X				X								X	X								
Triodia melvillei																																								
Triodia pungens		X	X	X	X	X	X	X		X	X	X	X	X	X					X		X	X	X	X	X	X	X			X	X		X	X	X	X		X	
Triodia sp. Mt Ella (M.E. Trudgen 12739) P3																																								
Triodia vanleeuwenii	X		X	X	X	X	X			X	X	X	X	X	X						X				X			X					X	X	X		X	X	X
Triodia wiseana	X		X	X					X		X		X		X	X		X	X		X		X								X		X			X	X			
Triraphis mollis																															X									
Triumfetta chaetocarpa																																								
Typha domingensis																																								
Urochloa ?occidentalis																																								
**Vachellia farnesiana*																		X													X									
Velleia connata																																								
Vigna lanceolata var. *lanceolata*																																								
Vittadinia eremaea																														X										
Wahlenbergia sp.																																								
Wahlenbergia tumidifructa		X																X				X																	
Waltheria indica						X																																		

Taxa	HD01	HD02	HD03	HD04	HD05	HD06	HD07	HD08	HD09	HD10	HD11	HD12	HD13	HD14	HD15	HD16	HD17	HD18	HD19	HD20	HD21	HD22	HD23	HD24	HD25	HD26	HD27	HD28	HD29	HD30	HD31	HD32	HD33	HD34	HD35	HD37	HD38	HD39	HD40	HD41
Yakirra australiensis var. *australiensis*																																								

*Denotes weed species

Taxa	HD42	HD43	HD44	HD46	HD47	HD48	HD49	HD50	HD51	HD52	HD53	HD54	HD55	HDR01	HDR02	HDR03	HDR04	HDR05	HDR06	HDR07	HDR08	HDR09	HDR10	HDR11	HDR12	HDR13	HDR14	HDR16	HDR18	HDR19	OPPS
Abutilon amplum																															
Abutilon cryptopetalum																															
Abutilon fraseri subsp. *fraseri*																															
Abutilon ?lepidum																															X
Abutilon lepidum																															
Abutilon leucopetalum																															
Abutilon macrum																															
Abutilon malvifolium																															
Abutilon otocarpum																												X			
Abutilon sp.							X																								
Abutilon sp. Dioicum (A.A. Mitchell PRP 1618)																															X
Acacia adoxa var. *adoxa*											X																				
Acacia adsurgens	X																														X
Acacia ampliceps																															
Acacia ?ancistrocarpa																				X											
Acacia ancistrocarpa		X										X														X					
Acacia aptaneura	X		X	X		X	X		X	X		X	X		X	X			X	X	X	X								X	
Acacia aptaneura sens. lat.																															
Acacia aptaneura x							X																								
Acacia arida					X																	X									
Acacia arida x																															
Acacia ayersiana													X						X											X	
Acacia ayersiana x																															
Acacia bivenosa			X	X					X		X	X	X	X	X		X	X		X	X			X	X	X		X	X		
Acacia bromilowiana P4																															X
Acacia ?catenulata																				X											
Acacia catenulata subsp. *occidentalis*	X			X			X			X			X			X			X			X							X	X
Acacia citrinoviridis																														X	
Acacia colei																															X
Acacia coriacea subsp. *pendens*																															
Acacia dictyophleba				X			X	X					X		X														X		X
Acacia hamersleyensis									X												X										X
Acacia hilliana								X							X																
Acacia inaequilatera		X			X															X							X	X			
Acacia incurvaneura	X	X														X						X								X	
Acacia kempeana																						X									
Acacia macraneura	X																														
Acacia maitlandii				X			X		X				X									X							X		
Acacia marramamba		X																									X				X
Acacia minyura																															X
Acacia monticola									X																		X				

Taxa	HD42	HD43	HD44	HD46	HD47	HD48	HD49	HD50	HD51	HD52	HD53	HD54	HD55	HDR01	HDR02	HDR03	HDR04	HDR05	HDR06	HDR07	HDR08	HDR09	HDR10	HDR11	HDR12	HDR13	HDR14	HDR16	HDR18	HDR19	OPPS
Acacia mulganeura																			X												
Acacia pachyacra			X										X																		X
Acacia pruinocarpa	X		X	X		X	X	X	X	X	X	X	X				X				X			X						X	
Acacia pteraneura																						X									X
Acacia pteraneura x aptaneura																															
Acacia pyrifolia				X	X			X						X							X										
Acacia rhodophloia								X																							X
Acacia sibirica	X		X										X									X									X
Acacia sibirica x																					X										
Acacia sp.	X																														
Acacia spondylophylla																											X				X
Acacia steedmanii subsp. *borealis*																															X
Acacia subtiliformis P3																															X
Acacia synchronicia			X																	X				X							X
Acacia tenuissima				X			X				X	X						X				X					X			X	
Acacia tetragonophylla	X																			X		X									
Acacia tumida var. *pilbarensis*											X																				
Acrachne racemosa																															
Adriana tomentosa var. *tomentosa*																												X			
Alternanthera denticulata																															
Alternanthera nana																															
Alternanthera sp.																															
Amaranthus mitchellii																															
Amaranthus sp.																															
Amaranthus undulatus																															
Amphipogon sericeus		X		X								X		X	X				X					X	X	X	X	X			
Amyema fitzgeraldii							X																								
Amyema hilliana																															
Amyema miquelii																															X
Amyema sp.																															
Androcalva luteiflora									X												X							X	X		
Anthobolus leptomerioides																															
Aristida burbidgeae																															
Aristida contorta	X		X		X		X		X							X		X		X				X					X	X	
Aristida holathera var. *holathera*	X				X			X				X											X			X				X	
Aristida inaequiglumis	X	X							X							X														X	
Aristida ingrata																															
Aristida latifolia																															
Aristida lazaridis P2																															X
Aristida obscura							X			X		X				X															X
Aristida sp.							X															X									

Taxa	HD42	HD43	HD44	HD46	HD47	HD48	HD49	HD50	HD51	HD52	HD53	HD54	HD55	HDR01	HDR02	HDR03	HDR04	HDR05	HDR06	HDR07	HDR08	HDR09	HDR10	HDR11	HDR12	HDR13	HDR14	HDR16	HDR18	HDR19	OPPS
Asteraceae sp.							X																								
Astrebla elymoides																															
Astrebla sp.																															
Astrotricha hamptonii																															X
Atalaya hemiglauca																															X
**Bidens bipinnata*							X																							X	X
Boerhavia ?coccinea																															
Boerhavia coccinea																				X											
Boerhavia schomburgkiana																															
Bonamia pilbarensis					X																										
Bothriochloa ewartiana																															
Brachychiton acuminatus																															X
Bulbostylis barbata																			X		X						X				
Bulbostylis turbinata																															
Calytrix carinata																										X					X
Capparis lasiantha			X	X			X							X		X				X		X									X
Capparis spinosa subsp. *nummularia*																															
Capparis umbonata									X																						
Cassytha capillaris					X																X										
Cassytha filiformis																					X										
Cassytha sp.																															
**Cenchrus ciliaris*																															X
**Cenchrus setiger*																															X
Centipeda minima subsp. *macrocephala*																															
Cheilanthes lasiophylla	X				X					X								X													
Cheilanthes sieberi subsp. *sieberi*	X																														
**Chloris virgata*																															
Chrysocephalum apiculatum subsp. *pilbarense*																															X
Chrysocephalum gilesii																															
Chrysopogon fallax							X																								
Cleome viscosa							X											X													X
Clerodendrum floribundum var. *angustifolium*																											X				
Clerodendrum tomentosum var. *lanceolatum*																					X										
Codonocarpus cotinifolius		X		X										X	X				X			X									
Commelina ensifolia																															X
Convolvulus clementii																															
**Conyza bonariensis*																															
Corchorus crozophorifolius																															
Corchorus lasiocarpus subsp. *lasiocarpus*																															
Corchorus lasiocarpus subsp. *parvus*		X			X			X	X					X						X	X					X	X		X		
Corchorus tridens																															

Taxa	HD42	HD43	HD44	HD46	HD47	HD48	HD49	HD50	HD51	HD52	HD53	HD54	HD55	HDR01	HDR02	HDR03	HDR04	HDR05	HDR06	HDR07	HDR08	HDR09	HDR10	HDR11	HDR12	HDR13	HDR14	HDR16	HDR18	HDR19	OPPS
Corymbia candida																															
Corymbia deserticola																															X
Corymbia deserticola subsp. *deserticola*		X																								X					
Corymbia ferriticola																					X										
Corymbia hamersleyana																															X
Corymbia hamersleyana sens. lat.																															
Corymbia opaca									X												X										X
Corymbia sp.																															X
Crotalaria medicaginea var. *neglecta*																													X		
Crotalaria novae-hollandiae subsp. *novae-hollandiae*																															
Cryptandra monticola																															X
Cucumis melo																															
Cucumis variabilis	X																	X								X					
Cullen leucochaites																															X
Cuscuta victoriana																															
Cymbopogon ambiguus	X		X	X	X			X	X		X	X	X			X		X	X	X	X			X	X						
Cymbopogon obtectus		X		X		X																	X				X	X	X	X	
Cymbopogon sp.																														X	
Cynanchum floribundum																															
Cynanchum viminale																															X
Cynodon convergens																															
**Cynodon dactylon*																															
Cynodon prostratus			X																												
Cyperus cunninghamii subsp. *cunninghamii*																															
Cyperus difformis																															
Cyperus vaginatus																															
Dactyloctenium ?radulans																															
Dactyloctenium radulans																															
Dampiera candicans														X										X			X				
**Datura leichhardtii*																															X
**Datura leichhardtii* subsp. *leichhardtii*																															
Dichanthium sericeum subsp. *humilius*																X															
Dichanthium sericeum subsp. *humilius*																															
Dichanthium sp.																															
Dicladanthera forrestii																															
Digitaria ammophila																															
Digitaria brownii																															
Digitaria ctenantha																															
Dipteracanthus australasicus subsp. *australasicus*																					X										
Dodonaea coriacea				X	X																			X							X
Dodonaea lanceolata var. *lanceolata*									X																						

Taxa	HD42	HD43	HD44	HD46	HD47	HD48	HD49	HD50	HD51	HD52	HD53	HD54	HD55	HDR01	HDR02	HDR03	HDR04	HDR05	HDR06	HDR07	HDR08	HDR09	HDR10	HDR11	HDR12	HDR13	HDR14	HDR16	HDR18	HDR19	OPP5
Dodonaea pachyneura										X						X					X										X
Dodonaea petiolaris																													X		
Dodonaea viscosa subsp. *spatulata*																					X										X
Duperreya commixta		X		X			X		X		X	X				X	X	X			X									X	
Dysphania kalpari																															
Dysphania melanocarpa forma *melanocarpa*																															
Dysphania plantaginella									X																						
Dysphania rhadinostachya subsp. *rhadinostachya*	X									X							X		X												
**Echinochloa colona*																															X
Enchylaena tomentosa var. *tomentosa*							X										X	X												X	
Enneapogon caerulescens			X		X	X	X									X		X		X				X	X						
Enneapogon lindleyanus	X									X						X												X	X	X	
Enneapogon polyphyllus	X	X					X			X						X		X	X	X			X	X							
Enneapogon robustissimus									X									X													
Enneapogon sp.																															
Enteropogon ramosus																															
Eragrostis cumingii																															
Eragrostis eriopoda																															
Eragrostis setifolia																															
Eragrostis sp.																															
Eragrostis tenellula																															
Eragrostis xerophila																															
Eremophila aff. *clarkei*																															
Eremophila canaliculata																															
Eremophila forrestii subsp. *forrestii*							X														X										
Eremophila fraseri																															X
Eremophila fraseri subsp. *fraseri*																															X
Eremophila jucunda subsp. *pulcherrima*																X				X	X										
Eremophila lanceolata																															
Eremophila latrobei																															
Eremophila latrobei subsp. *filiformis*																															X
Eremophila latrobei subsp. *glabra*				X													X		X												
Eremophila latrobei subsp. *latrobei*	X		X	X		X				X	X		X																		
Eremophila longifolia		X											X																		
Eremophila magnifica subsp. *magnifica* P4																															X
Eremophila phyllopoda subsp. *obliqua*																X															
Eremophila platycalyx subsp. *pardalota*			X													X		X													
Eremophila sp. Hamersley Range (K. Walker KW 136) P3																															X
Eremophila sp. West Angelas (S. van Leeuwen 4068) P1																															X
Eriachne aristidea																							X								
Eriachne ?benthamii																															

Taxa	HD42	HD43	HD44	HD46	HD47	HD48	HD49	HD50	HD51	HD52	HD53	HD54	HD55	HDR01	HDR02	HDR03	HDR04	HDR05	HDR06	HDR07	HDR08	HDR09	HDR10	HDR11	HDR12	HDR13	HDR14	HDR16	HDR18	HDR19	OPPS
Eriachne benthamii																				X											X
Eriachne lanata				X							X																				
Eriachne mucronata	X			X	X		X		X	X					X	X	X	X	X		X										
Eriachne obtusa							X																								
Eriachne pulchella				X			X	X								X			X				X							X	
Eriachne pulchella subsp. *dominii*	X																								X						
Eriachne pulchella subsp. *pulchella*	X			X		X				X			X									X		X							
Eriachne tenuiculmis																															
Eucalyptus camaldulensis subsp. *obtusa*																													X		
Eucalyptus gamophylla				X							X	X		X	X											X					
Eucalyptus kingsmillii																															X
Eucalyptus leucophloia subsp. *leucophloia*	X		X	X		X	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X		X			
Eucalyptus pilbarensis																															
Eucalyptus repullulans			X							X				X						X											X
Eucalyptus socialis subsp. ?*eucentrica*													X																		X
Eucalyptus socialis subsp. *eucentrica*			X																												X
Eucalyptus victrix																															
Eucalyptus xerothermica							X																						X		
Eucalyptus xerothermica x *Eucalyptus tephrodes*																															
Eulalia aurea							X													X								X		
Euphorbia australis var. *subtomentosa*																				X											
Euphorbia biconvexa																															
Euphorbia biconvexa/coghlanii/trigonosperma							X									X													X		X
Euphorbia boophthona																															X
Euphorbia careyi																															X
Euphorbia coghlanii																					X										
Euphorbia sp.			X																	X											
Euphorbia trigonosperma																															
Evolvulus alsinoides var. *decumbens*																															
Evolvulus alsinoides var. *villosicalyx*							X		X											X											
Ficus brachypoda																					X										X
Fimbristylis dichotoma																												X			
Fimbristylis simulans		X																													
Fimbristylis sp.																															
**Flaveria trinervia*																															X
Glycine canescens																															
Gompholobium oreophilum				X																	X					X	X				
Gomphrena cunninghamii																							X	X	X						X
Gomphrena sp.																															
Goodenia cusackiana																															X
Goodenia lamprosperma																															

Taxa	HD42	HD43	HD44	HD46	HD47	HD48	HD49	HD50	HD51	HD52	HD53	HD54	HD55	HDR01	HDR02	HDR03	HDR04	HDR05	HDR06	HDR07	HDR08	HDR09	HDR10	HDR11	HDR12	HDR13	HDR14	HDR16	HDR18	HDR19	OPP5
Goodenia microptera																							X								
Goodenia muelleriana					X																										
Goodenia prostrata					X															X											X
Goodenia sp.																												X			
Goodenia sp. (of interest)																															X
Goodenia stellata																															
Goodenia stobbsiana		X		X	X			X						X	X		X					X	X	X	X	X	X	X			
Goodenia tenuiloba																															
Goodenia triodiophila		X		X	X						X															X	X				X
Gossypium australe																															X
Gossypium robinsonii									X												X							X	X		
Gossypium sturtianum var. *sturtianum*																													X		X
Grevillea berryana																			X			X									X
Grevillea saxicola P3										X																					X
Grevillea wickhamii subsp. *hispidula*								X	X												X				X		X			
Hakea chordophylla				X	X			X			X	X			X											X	X	X			
Hakea lorea subsp. *lorea*										X										X											
Halgania cyanea																															
Halgania gustafsenii var. *gustafsenii*																															
Haloragis gossei																															X
Haloragis odontocarpa																															
Haloragis sp.																															
Heliotropium inexplicitum																												X			
Heliotropium ovalifolium					X																										
Heliotropium pachyphyllum																															X
Heliotropium sp.																															
Heliotropium tanythrix																															
Heliotropium tenuifolium																															
Hibiscus burtonii																															
Hibiscus ?coatesii																															
Hibiscus coatesii																				X		X				X					
Hibiscus leptocladus																															
Hibiscus sp.																															
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2																															X
Hibiscus sturtii																															
Hibiscus sturtii var. *campylochlamys*		X														X		X										X			
Hibiscus sturtii var. *platychlamys*														X														X			
Hibiscus verdcourtii																															
Hybanthus aurantiacus																															
Indigofera fractiflexa subsp. *fractiflexa*																															X
Indigofera georgei																															X

Taxa	HD42	HD43	HD44	HD46	HD47	HD48	HD49	HD50	HD51	HD52	HD53	HD54	HD55	HDR01	HDR02	HDR03	HDR04	HDR05	HDR06	HDR07	HDR08	HDR09	HDR10	HDR11	HDR12	HDR13	HDR14	HDR16	HDR18	HDR19	OPPS
Indigofera linifolia																															
Indigofera monophylla		X			X						X	X		X				X								X	X	X	X		
Indigofera rugosa																															X
Iseilema eremaeum																X															
Iseilema membranaceum						X				X																					
Iseilema sp.																															
Iseilema vaginiflorum							X																								
Isotropis sp. Arid zone (G. Byrne 2775)																															
Jasminum didymum subsp. *lineare*	X			X	X			X	X		X									X	X					X			X		
Josephinia eugeniae																															
**Lactuca serriola*																															
Lepidium catapycnon P4																								X	X						X
Lepidium pedicellosum	X		X																												X
Lepidium phlebopetalum																		X													
Lepidium pholidogynum																							X								
Lepidium sp.																															
Lobelia arnhemiaca																															
Lobelia heterophylla subsp. *pilbarensis*																															
Maireana carnosa			X																												X
Maireana eriosphaera			X																												
Maireana georgei	X		X			X										X			X			X	X		X						X
Maireana melanocoma			X																												X
Maireana tomentosa subsp. *tomentosa*															X			X												X	
Maireana triptera			X																												X
Maireana villosa																															
Malvaceae sp.																															
**Malvastrum americanum*																															X
Marsdenia australis									X												X										
Marsdenia sp.																															
Maytenus sp. Mt Windell (S. van Leeuwen 846)																					X										
Melaleuca argentea																															
Melaleuca bracteata																															
Melaleuca eleuterostachya																															X
Melaleuca glomerata																															
Melhania oblongifolia																															
**Melinis repens*																															
Mirbelia viminalis																															
Neptunia dimorphantha																															
Newcastelia sp. Hamersley Range (S. van Leeuwen 4264)																															X
Nicotiana benthamiana																															X
Nicotiana sp.																															

Taxa	HD42	HD43	HD44	HD46	HD47	HD48	HD49	HD50	HD51	HD52	HD53	HD54	HD55	HDR01	HDR02	HDR03	HDR04	HDR05	HDR06	HDR07	HDR08	HDR09	HDR10	HDR11	HDR12	HDR13	HDR14	HDR16	HDR18	HDR19	OPPS
Notoleptopus decaisnei var. Orbicularis (A.B. Craig 428)																															
Oldenlandia crouchiana					X																		X		X						X
Pandorea pandorana																					X										
Panicum decompositum																															
Panicum effusum							X																								
Paraneurachne muelleri	X	X		X	X		X					X		X				X		X			X	X	X			X		X	
Paspalidium clementii	X	X				X	X			X						X		X	X				X	X	X			X			
Paspalidium jubiflorum																															
Paspalidium rarum																															
Peripleura arida																															
Peripleura obovata																															
Peripleura virgata																							X		X						X
Perotis rara										X						X															
Petalostylis labicheoides							X		X				X								X								X	X	
Phyllanthus erwinii																															
Phyllanthus maderaspatensis																															
Pluchea dentex																									X						
Pluchea rubelliflora																															
Pluchea sp.																															
Poaceae sp.																															
Polycarpaea corymbosa var. *corymbosa*		X			X		X																								
Polycarpaea holtzei		X			X										X													X			
Polycarpaea longiflora															X			X													
Polygala isingii																															
Polymeria aff. *longifolia*																															
Polymeria ambigua																															
Portulaca oleracea																				X											
Psydrax latifolia							X														X								X	X	
Psydrax suaveolens										X			X																		
Pterocaulon serrulatum var. *velutinum*																															
Pterocaulon sp.																				X									X		
Pterocaulon sphacelatum					X	X	X	X	X		X	X			X								X		X						
Pterocaulon sphaeranthoides																															
Ptilotus aervoides																															
Ptilotus astrolasius		X			X		X			X										X			X	X		X		X			X
Ptilotus calostachyus		X		X	X						X	X		X	X		X		X			X	X	X	X	X	X	X			
Ptilotus clementii																									X						X
Ptilotus exaltatus	X	X	X							X				X			X		X	X	X		X	X	X			X		X	
Ptilotus fusiformis																															X
Ptilotus helipteroides																															X
Ptilotus incanus						X																									

Taxa	HD42	HD43	HD44	HD46	HD47	HD48	HD49	HD50	HD51	HD52	HD53	HD54	HD55	HDR01	HDR02	HDR03	HDR04	HDR05	HDR06	HDR07	HDR08	HDR09	HDR10	HDR11	HDR12	HDR13	HDR14	HDR16	HDR18	HDR19	OPP5
Ptilotus mollis P4																								X							X
Ptilotus obovatus	X		X			X	X	X								X	X	X		X								X		X	X
Ptilotus polystachyus																															X
Ptilotus roei																															
Ptilotus rotundifolius		X				X		X				X															X	X			
Ptilotus schwartzii var. *schwartzii*																															
Ptilotus sp.																															
Rhagodia eremaea							X											X		X											X
Rhagodia sp. Hamersley (M. Trudgen 17794) P3																															X
Rhodanthe margarethae																															
Rhynchosia minima																				X									X		
Rostellularia adscendens var. *clementii*																															
Rostellularia adscendens var. *latifolia P3*																															X
Salsola australis	X		X				X											X		X				X						X	
Santalum lanceolatum									X											X	X									X	X
Santalum spicatum																															
Scaevola acacioides	X			X		X				X						X	X		X			X				X					
Scaevola amblyanthera var. *centralis*																															X
Scaevola browniana								X			X																				X
Scaevola browniana subsp. *browniana*																															
Scaevola parvifolia subsp. *pilbarae*												X														X					
Scaevola spinescens																															
Schenkia australis																															
Schizachyrium fragile		X		X	X				X							X		X	X				X	X	X					
Sclerolaena cornishiana																															
Sclerolaena cuneata			X																												
Sclerolaena densiflora			X																						X						X
Sclerolaena ?gardneri			X																												
Senna artemisioides subsp. × *artemisioides*							X																						X		
Senna artemisioides subsp. *filifolia*																															
Senna artemisioides subsp. *helmsii*											X																				
Senna artemisioides subsp. *oligophylla*					X		X							X	X					X	X			X				X			
Senna artemisioides subsp. *oligophylla x helmsii*																															
Senna ferraria									X		X			X							X										
Senna glaucifolia		X		X																						X					
Senna glutinosa subsp. *glutinosa*	X	X	X	X	X	X		X	X	X	X			X	X		X	X	X	X	X	X	X	X	X		X	X			
Senna glutinosa subsp. ×*luerssenii*		X	X			X					X							X	X			X			X						X
Senna glutinosa subsp. *pruinosa*		X				X					X						X						X	X	X		X	X			X
Senna notabilis																										X	X	X			
Senna pleurocarpa var. angustifolia																															
Senna sericea																							X								

Taxa	HD42	HD43	HD44	HD46	HD47	HD48	HD49	HD50	HD51	HD52	HD53	HD54	HD55	HDR01	HDR02	HDR03	HDR04	HDR05	HDR06	HDR07	HDR08	HDR09	HDR10	HDR11	HDR12	HDR13	HDR14	HDR16	HDR18	HDR19	OPPS
Senna sp. Meekatharra (E. Bailey 1-26)																	X														
Senna sp. Meekatharra (E. Bailey 1-26) ×																															
Senna sp. Meekatharra (E. Bailey 1-26) × *glaucifolia*																															
Senna stricta	X		X			X	X									X	X	X													
Senna venusta																															
Seringia elliptica									X				X		X																
Seringia nephrosperma																															
Seringia sp.	X						X																			X					
Sesbania cannabina																															
Setaria dielsii																															
**Setaria verticillata*																															X
Sida aff. *fibulifera*																															
Sida arenicola		X				X																					X				X
Sida calyxhymenia																															
Sida cardiophylla																															
Sida echinocarpa					X										X		X	X													
Sida ?ectogama																															
Sida fibulifera			X													X				X										X	
Sida platycalyx																															
Sida sp.						X							X																		
Sida sp. Articulation below (A.A. Mitchell PRP 1605)																				X											
Sida ?sp. dark green fruits (S. van Leeuwen 2260)																															
Sida sp. dark green fruits (S. van Leeuwen 2260)							X																								
Sida sp. Excedentifolia (J.L. Egan 1925)																	X	X	X		X		X		X						X
Sida sp. Golden calyces glabrous (H.N. Foote 32)																															
Sida sp. Pilbara (A.A. Mitchell PRP 1543)				X				X															X	X	X						X
Sida sp. Shovelanna Hill (S. van Leeuwen 3842)						X																									X
Sida sp. spiciform panicles (E. Leyland s.n. 14/8/90)									X																		X				
**Sigesbeckia orientalis*																															
Solanum cleistogamum	X							X												X				X							
Solanum ferocissimum																															
Solanum gabrielae																															
Solanum horridum			X													X			X						X		X				
Solanum lasiophyllum	X	X	X	X			X			X					X		X	X		X							X		X		X	
**Solanum nigrum*																															
Solanum phlomoides					X									X					X						X	X	X				X
**Sonchus oleraceus*																															X
sp. indet																															
Sporobolus australasicus	X		X			X	X									X				X										X	
Stackhousia muricata subsp. annual (W.R. Barker 2172)					X										X					X											
Stemodia grossa																												X			

Taxa	HD42	HD43	HD44	HD46	HD47	HD48	HD49	HD50	HD51	HD52	HD53	HD54	HD55	HDR01	HDR02	HDR03	HDR04	HDR05	HDR06	HDR07	HDR08	HDR09	HDR10	HDR11	HDR12	HDR13	HDR14	HDR16	HDR18	HDR19	OPPS
Stemodia sp.																															
Streptoglossa bubakii																				X											
Streptoglossa decurrens																															
Streptoglossa sp.																									X						
Stylobasium spathulatum																					X										
Swainsona maccullochiana					X															X											X
Templetonia egena	X																														X
Tephrosia oxalidea		X																					X	X							
Tephrosia rosea var. Fortescue creeks (M.I.H. Brooker 2186)																															
Teucrium teucriiflorum																															
Themeda avenacea																															X
Themeda sp.																															
Themeda sp. Mt Barricade (M.E. Trudgen 2471)					X													X			X							X			X
Themeda triandra							X		X			X								X									X		
Tinospora smilacina																															
Trachymene oleracea subsp. *oleracea*																															X
Tragus australianus																															
Trianthema glossostigmum																															
Tribulus platypterus																															X
Tribulus suberosus						X											X		X												X
Trichodesma zeylanicum var. *zeylanicum*					X	X																									
Tricoryne sp. Hamersley Range (S. van Leeuwen 915)					X																										X
**Tridax procumbens*																															X
Trigastrotheca molluginea																															
Triodia ?angusta																															X
Triodia angusta	X																														
Triodia basedowii																															
Triodia brizoides			X																												
Triodia longiceps																													X		X
Triodia melvillei																															
Triodia pungens	X			X			X	X	X	X	X	X	X			X	X	X	X		X									X	
Triodia sp. Mt Ella (M.E. Trudgen 12739) P3																															X
Triodia vanleeuwenii	X	X		X		X	X	X		X	X	X			X	X	X		X			X			X	X	X	X			
Triodia wiseana			X		X						X			X		X		X	X	X		X	X	X	X			X			
Triraphis mollis																															
Triumfetta chaetocarpa																								X							
Typha domingensis																															
Urochloa ?occidentalis																															X
**Vachellia farnesiana*																				X											X
Velleia connata																															X
Vigna lanceolata var. *lanceolata*																															

Taxa	HD42	HD43	HD44	HD46	HD47	HD48	HD49	HD50	HD51	HD52	HD53	HD54	HD55	HDR01	HDR02	HDR03	HDR04	HDR05	HDR06	HDR07	HDR08	HDR09	HDR10	HDR11	HDR12	HDR13	HDR14	HDR16	HDR18	HDR19	OPPS
Vittadinia eremaea																															
Wahlenbergia sp.										X																					
Wahlenbergia tumidifructa																															
Waltheria indica																															
Yakirra australiensis var. *australiensis*																															

*Denotes weed species

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Appendix M: Survey Effort

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695000 700000 705000

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N.2

N.1

MNBE13 MNBE14 MNBE11 MNBE12 MNBE10 MNBE15 MNBE08 HDR16 MNBE07 MNBE09

HD53 HD48 HD52 HD46 HD40 HD39 HD54 HD55 HD49 HD02 GH03 GH02 GH12 GH11 GHR30

GHR10 GHMNBE005 GHMNBE008 GHMNKM05 GH13 GH15

GHMNBE007 HD01 GH27 GHR28

GHMNBE004 GHMNBE006 GH01 HD20 HDR19 GH09 GH07 GH08 HD12 HD10 HD09 HD11 HD28 HD08

HD29 HD31 HD27 HD22 HD14 MNMH01 MNMH27 HD18 HD30 MNMH07

HD32 HD25 HD34 MNMH28 MNLV02 HDR07 HDR05 HD51 MNLV13 MNLV12 MNMH03 MNMH02 MNMH06 HD16 MNMH05

HD50 HDR03 MNBE02 MNMH04

HD21 HDR18 MNLV05 HDR09

MNMH34 MNMH37 MNMH19 MNMH18 MNLV04

MNMH33 HD23 MNLV06 MNMH17 MNMH16

HD42 HD33 MNMH15

MNMH32 MNMH35 HD44 MNMH10 MNMH14

MNMH36 HDR13 MNMH09 HD19 HD17 MNMH11 HD47

MNLV07 MNMH12 MNMH13

GH06 GH05 GH04

GHMNBE003

Survey Area

Sampling Site

- Quadrat
- Relevé
- Vegetation Mapping Note

GPS Tracklogs

- FV 3 - 2019
- FV 2 - 2018
- FV 1 - 2017

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Rio Tinto

Hope Downs 2 Proposal – Flora and Vegetation Survey

Figure M.1: Survey effort

Scale: 1:41,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 500 1,000 1,500 2,000 2,500 3,000 Metres

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7455000

7450000

N.2

N.1

Survey Area

Sampling Site

Quadrat

Relevé

Vegetation Mapping Note

GPS Tracklogs

FV 3 - 2019

FV 2 - 2018

FV 1 - 2017

GH21 GH22 GH23 GHMNKM07 GHMNKM08 GH26 GHMNKM10 GHMNKM09 GHMNKM11 GHMNDR02 GH25 GHMNKM12 GHMNBE010 GHMNDR01 GH20 BHD05-AR GHMNKM13 GH24 GH19 GH17 HD43 MNBE06 HDR14 MNBE04 HD06 MNBE05 HD38 HD37 HDR12 HDR06 GHR16 HDR10 HD26 MNBE08 HDR16 MNBE07 MNBE03 HD24 HD04 HD05 MNMH08 MNLV03 HDR11 MNBE01 GH11 GHR30 HD03 HD07 HD15 HDR08 HD13 HDR04 HD48 HD52 HD45 MNMH23 MNMH24 MNMH22 MNMH21 HD40 HD39 MNBE09 MNMH25 MNMH20 HD35 HDR01 MNMH26 MNLV09 HD41 MNLV08 HDR02

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Hope Downs 2 Proposal – Flora and Vegetation Survey

Figure M.2: Survey effort

Scale: 1:41,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 500 1,000 1,500 2,000 2,500 3,000 Metres

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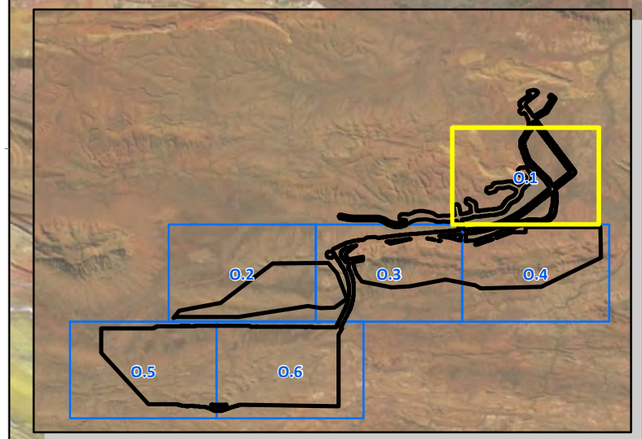
Appendix N: Conservation Significant Flora Locations and Descriptions

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Survey Area

Priority Flora - Recorded by Astron

Eremophila magnifica subsp. *magnifica* P4

Priority Flora - Previously Recorded

Eremophila magnifica subsp. *magnifica* P4

Goodenia lyrata P3

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Hope Downs 2 Proposal – Flora and Vegetation Survey

Figure N.1: Conservation significant flora locations

Scale: 1:20,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

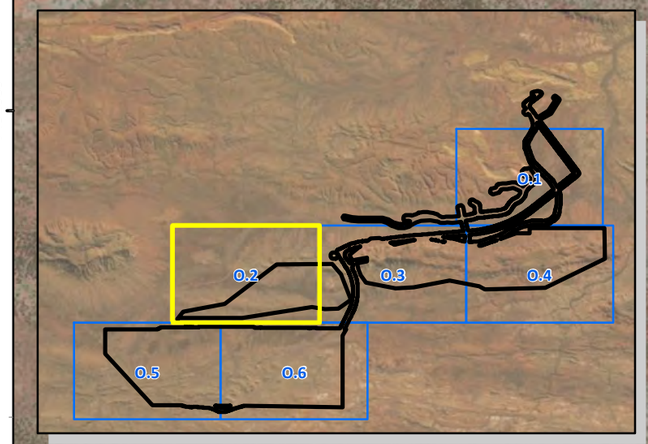
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Author: B. Eckermann Drawn: C. Dyde Date: 07-11-2019 Figure Ref: 14292A-19-BIDR-3RevB_191107_PriFlora_FigN

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702000
704000
706000
7452000
7450000
7448000



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Survey Area

Priority Flora - Recorded by Astron

■ *Grevillea saxicola* P3

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Hope Downs 2 Proposal – Flora and Vegetation Survey

Figure N.2: Conservation significant flora locations

Scale: 1:20,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 200 400 600 800 1,000 Metres

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Author: B. Eckermann | Drawn: C. Dyde | Date: 07-11-2019 | Figure Ref: 14292A-19-BIDR-3RevB_191107_PriFlora_FigN

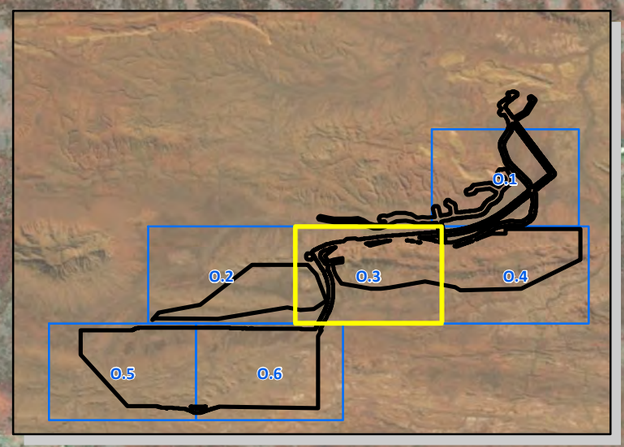
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7452000

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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



Survey Area

Priority Flora - Recorded by Astron

- *Acacia bromilowiana* P4
- *Eremophila* sp. Hamersley Range (K. Walker KW 136) P1
- *Eremophila* sp. West Angelas (S. van Leeuwen 4068) P1
- *Grevillea saxicola* P3
- *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2
- *Lepidium catapycnon* P4
- *Ptilotus mollis* P4
- *Rhagodia* sp. Hamersley (M. Trudgen 17794) P3

Priority Flora - Previously Recorded

- *Acacia bromilowiana* P4
- *Eremophila* sp. Hamersley Range (K. Walker KW 136) P1
- *Eremophila* sp. West Angelas (S. van Leeuwen 4068) P1
- *Grevillea saxicola* P3
- *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2
- *Lepidium catapycnon* P4
- *Ptilotus mollis* P4

Priority Flora - WA Herbarium and TPFL

- *Grevillea saxicola* P3

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Hope Downs 2 Proposal – Flora and Vegetation Survey

Figure N.3: Conservation significant flora locations

Scale: 1:20,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 200 400 600 800 1,000 Metres

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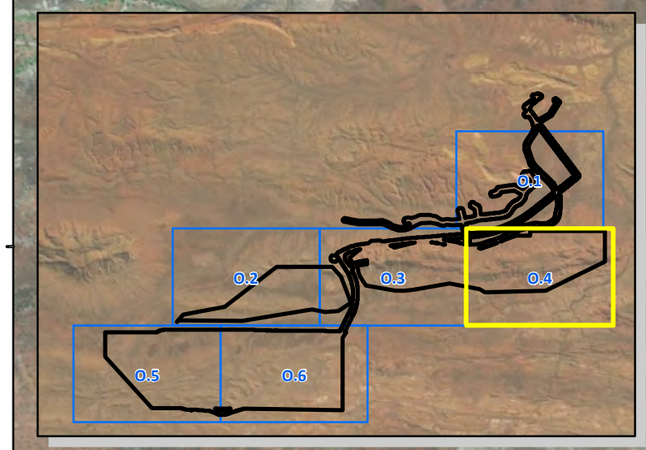
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Survey Area

Priority Flora - Recorded by Astron

- *Acacia bromilowiana* P4
- *Eremophila* sp. West Angelas (S. van Leeuwen 4068) P1
- *Grevillea saxicola* P3
- *Lepidium catapycnon* P4
- *Ptilotus mollis* P4
- *Triodia* sp. Mt Ella (M.E. Trudgen 12739) P3

Priority Flora - Previously Recorded

- *Acacia bromilowiana* P4
- *Acacia subtiliformis* P3
- *Eremophila* sp. Hamersley Range (K. Walker KW 136) P1
- *Eremophila* sp. West Angelas (S. van Leeuwen 4068) P1
- *Grevillea saxicola* P3
- *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2
- *Lepidium catapycnon* P4
- *Ptilotus mollis* P4
- *Triodia* sp. Mt Ella (M.E. Trudgen 12739) P3

Priority Flora - WA Herbarium and TPFL

- *Acacia subtiliformis* P3
- *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2
- *Lepidium catapycnon* P4
- *Triodia* sp. Mt Ella (M.E. Trudgen 12739) P3

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Hope Downs 2 Proposal – Flora and Vegetation Survey

Figure N.4: Conservation significant flora locations

Scale: 1:20,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

Metres

0 200 400 600 800 1,000

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694000 696000 698000 700000

7446000

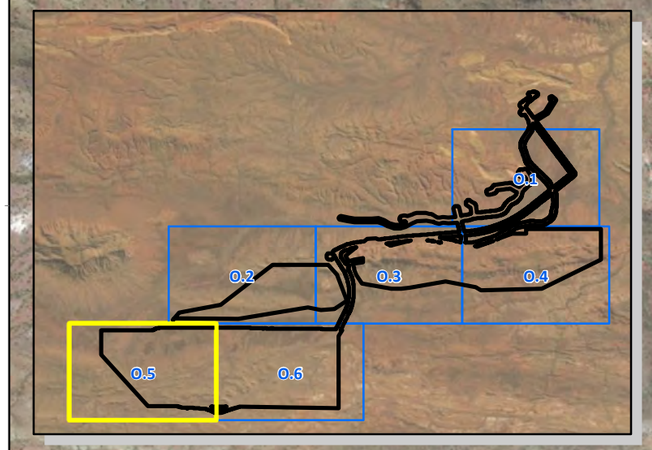
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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Survey Area

Priority Flora - Recorded by Astron

- *Aristida lazaridis* P2
- *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2
- *Rhagodia* sp. Hamersley (M. Trudgen 17794) P3



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Hope Downs 2 Proposal – Flora and Vegetation Survey

Figure N.5: Conservation significant flora locations

Scale: 1:20,000 at A3

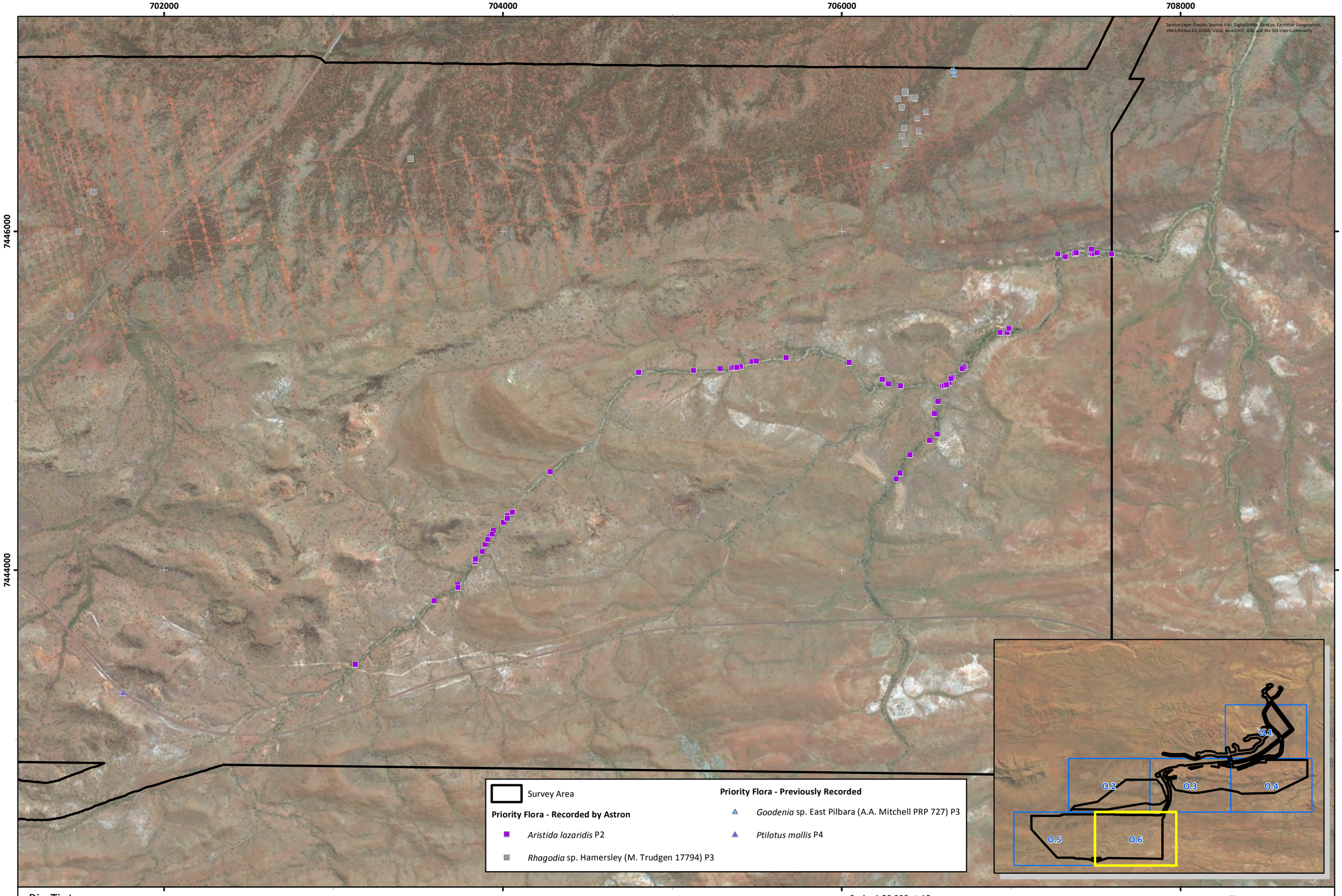
Coordinate System: GDA 1994 MGA Zone 50

0 200 400 600 800 1,000 Metres

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Hope Downs 2 Proposal – Flora and Vegetation Survey

Figure N.6: Conservation significant flora locations

Scale: 1:20,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

0 200 400 600 800 1,000 Metres

N

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Table N.1: Conservation significant flora recorded in the survey area.

Species	Description[1]	Habitat[1]
Eremophila sp. West Angelas (S. van Leeuwen 4068) P1 	Erect-branched spindly whip shrub with narrow leaves to 3 m high. Flower purple with corolla medial lobe of lower lip completely closes the throat.	Rocky hills or ridges and mulga bands in clay soil between rocky ridges. Very steep hillslope of brown silty loam. Breakaways, skeletal red gritty soil over massive banded iron.
Aristida lazaridis P2 	Densely clumped grass with clumps to 1.4 m high. Leaf-blade surface scaberulous. Flowers April.	Sand, loam, clayey soils. Plains, ironstone hills in *Triodia* spp. hummock grassland with sparse overstorey of *Eucalyptus leucophloia*. Mulga Shrublands
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2 	Spindly upright shrub to 3 m high. Flowers May to July.	Near summit of hill, high in landscape, skeletal red-brown stony soil over massive ironstone of the Brockman Iron Formation. Sheltered or rocky drainage lines below associated cliff lines or rocky ridges.

Species	Description[1]	Habitat[1]
Acacia subtiliformis P3 	Spindly, slender, erect shrub, to 3.5 m high, new growth slightly viscid, resinous, aromatic. Flowers yellow, June.	Low, undulating country on calcareous rises adjacent to drainage lines.
Eremophila sp. Hamersley Range (K. Walker KW 136) P3 	Erect shrub. Flowers white-cream-yellow-pink-purple, August to September.	High in the landscape, cliff tops, gorge tops, steep rocky slopes, gullies and rock faces associated with large hills and cliffs. Skeletal red-brown soils.
Goodenia lyrata P3[2] 	Prostrate herb, with lyrate leaves. Flowers yellow, August.	Red sandy loam. Near claypan. In sand and clay on poorly drained flats often occurring with various *Calandrinia* spp. and *Eucalyptus victrix.*

Species	Description[1]	Habitat[1]
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727) P3[2] 	Small rosetted herb (with spathulata leaves), to 0.2 m high. Flowers yellow, March to September.	Red-brown clay soil, calcrete pebbles. Low undulating plain, swampy plains, stony plains, hill slopes.
Grevillea saxicola P3 	Erect shrub to 2.5 m high. Flowers February, April, November.	Low rocky hill, red-brown sandy loam with ironstone pebble cover, steep scree slopes often associated with banded iron formation. Mulga woodlands.
Rhagodia sp. Hamersley (M. Trudgen 17794) P3 	Shrub, 2.5 m high. Leaves small lanceolate, not aromatic. Flowers yellow. Fruit small red drupelets.	Mulga plains. Alluvial plains. Red brown clay to loamy clay. Occasionally on slopes.

Species	Description[1]	Habitat[1]
Triodia sp. Mt Ella (M.E. Trudgen 12739) P3 	Grass-like or herb, 0.4 m high.	Light orange-brown, pebbly loam. Amongst rocks and outcrops, gully slopes.
Acacia bromilowiana P4 	Tree or shrub, to 12 m high. Flowers yellow/pink, July to August.	Red skeletal stony loam, orange-brown pebbly, gravel loam, laterite, banded ironstone, basalt. Rocky hills, breakaways, scree slopes, gorges, creek beds.
Eremophila magnifica subsp. *magnifica* P4 	Shrub, 0.5 m to 1.5 m high. Flowers blue, August to November.	Skeletal soils on the slopes and summits of ironstone hills in the Hamersley Range area.

Species	Description[1]	Habitat[1]
Lepidium catapycnon P4 	Open, woody herb or shrub, 0.2 m to 0.3 m high, stems zigzag. Flowers white, October.	Occurs on hillsides in skeletal soils, shale, ironstone.
Ptilotus mollis P4 	Compact shrub, to 0.5 m high, soft grey foliage. Flowers white/pink, May or September.	Stony hills, steep rocky sites and screes. Usually in full sun on massive ironstone formations.

[1] – Florabase (Western Australian Herbarium 1998-2019).
[2] – Species not observed in current survey, but previously recorded within survey area. For project presence see Table N.2.

Table N.2: Conservation significant flora recorded in HD2 Detailed Survey Area (GDA94, Zone 50).

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
Acacia bromilowiana P4	A	0.1	1	711093	7451039
		0.1	1	711160	7450834
		0.1	7	711149	7450896
		0.1	15	711157	7450865
		0.5	1	711232	7450605
		0.5	2	712732	7450829
		0.5	5	712294	7450505
		0.5	5	712431	7450522
		0.5	5	712540	7450565
		0.5	5	713675	7450561
		0.5	5	718147	7450395
		0.5	5	718157	7450409
		0.5	5	718178	7450430
		0.5	5	718184	7450442
		0.5	5	718185	7450336
		0.5	5	718185	7450337
		0.5	5	718188	7450457
		0.5	10	712356	7450513
		0.5	10	712490	7450663
		0.5	10	713652	7450547
		1	20	710953	7450902
	D	-	10	714676	7450002
		-	14	714675	7450020
	E	-	1	713995	7450670
		-	3	714190	7450728
		-	4	714005	7450658
		-	6	714068	7450750
		-	11	713782	7450811
		-	11	714023	7450734
		-	15	714047	7450744
		-	28	713836	7450802
		-	40	714040	7450649
	H	-	1	711133	7451044
		-	1	717889	7450991
		-	10	711099	7450984
		-	25	711203	7450770
		-	50	710959	7450876
Acacia subtiliformis P3	C	-	1	715227	7449939
	D	-	1	715227	7449939

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
		-	5	696277	7445914
		-	6	696296	7445922
		-	10	695879	7445560
		-	10	695897	7445559
		-	10	695913	7445787
		-	10	696001	7445751
		-	10	696146	7445827
		-	15	696114	7445840
		-	15	696557	7445946
		-	20	695910	7445760
		-	20	695972	7445757
		-	25	696546	7445948
		-	40	696203	7445876
		-	40	696236	7445888
		-	100	696260	7445903
		0.1	1	696621	7446050
		0.1	1	704026	7444305
		0.1	1	704057	7444342
		0.1	1	706322	7444540
		0.1	1	707470	7445869
Aristida lazaridis P2	A	0.1	1	707471	7445873
		0.1	1	707473	7445896
		0.1	2	695495	7445213
		0.1	2	695510	7445229
		0.1	2	695670	7445366
		0.1	2	696682	7446140
		0.1	2	696792	7446151
		0.1	2	696851	7446461
		0.1	2	696861	7446598
		0.1	2	696883	7446651
		0.1	2	696884	7446710
		0.1	2	696894	7446731
		0.1	2	696903	7446731
		0.1	2	696979	7446814
		0.1	2	697069	7446747
		0.1	2	697122	7446742
		0.1	2	697132	7446724
		0.1	2	697171	7446721
		0.1	2	697177	7446722
		0.1	2	697181	7446854
		0.1	2	697190	7446865

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
		0.1	2	697230	7446863
		0.1	2	697232	7446869
		0.1	2	697238	7446872
		0.1	2	705125	7445179
		0.1	2	705380	7445196
		0.1	2	706274	7445100
		0.1	2	706518	7444764
		0.1	2	706547	7444924
		0.1	2	707319	7445850
		0.1	2	707383	7445873
		0.1	2	707480	7445870
		0.1	2	707507	7445876
		0.1	3	695561	7445259
		0.1	3	695614	7445317
		0.1	3	695738	7445408
		0.1	3	695818	7445426
		0.1	3	696334	7445971
		0.1	3	696340	7445967
		0.1	3	696512	7445971
		0.1	3	696572	7445981
Aristida lazaridis P2	A	0.1	3	696579	7445976
		0.1	3	696603	7445978
		0.1	3	696729	7446148
		0.1	3	696758	7446156
		0.1	3	696802	7446369
		0.1	3	704802	7445168
		0.1	3	706711	7445189
		0.1	3	707376	7445869
		0.1	4	696482	7445964
		0.1	4	705672	7445256
		0.1	4	706044	7445225
		0.1	4	706567	7444995
		0.1	4	706935	7445402
		0.1	4	707472	7445874
		0.1	4	707593	7445867
		0.1	5	695578	7445287
		0.1	5	696608	7445991
		0.1	5	696837	7446408
		0.1	5	696842	7446413
		0.1	5	696844	7446427
		0.1	5	696907	7446733

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
		0.1	5	703733	7443913
		0.1	5	703735	7443897
		0.1	5	706723	7445199
		0.1	5	707491	7445868
		0.1	6	695640	7445336
		0.1	6	696763	7446192
		0.1	6	706344	7444571
		0.1	6	706562	7444803
		0.1	6	706646	7445132
		0.1	8	695613	7445318
		0.1	8	695641	7445341
		0.1	8	696792	7446172
		0.1	8	696856	7446581
		0.1	8	696943	7446704
		0.1	8	704026	7444323
		0.1	8	705403	7445203
		0.1	8	706619	7445095
		0.1	8	706634	7445107
		0.1	8	706977	7445402
		0.1	8	706988	7445428
Aristida lazaridis P2	A	0.1	9	703876	7444110
		0.1	9	705363	7445198
		0.1	10	695444	7445199
		0.1	10	695588	7445300
		0.1	10	695639	7445339
		0.1	10	703594	7443817
		0.1	10	705283	7445187
		0.1	10	706239	7445126
		0.1	10	706607	7445087
		0.1	12	696723	7446179
		0.1	12	696824	7446424
		0.1	12	704278	7444580
		0.1	12	705495	7445235
		0.1	13	706403	7444681
		0.1	15	696749	7446204
		0.1	15	696819	7446228
		0.1	15	703936	7444213
		0.1	15	706348	7445088
		0.1	18	696711	7446134
		0.1	20	696819	7446308
		0.1	20	697122	7446813

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
		0.1	20	697183	7446794
		0.1	20	704002	7444282
		0.1	20	705352	7445192
		0.1	20	706596	7445086
		0.1	20	707275	7445867
		0.1	24	696932	7446737
		0.1	25	696822	7446455
		0.1	25	696899	7446713
		0.1	25	696969	7446764
		0.1	25	696984	7446788
		0.1	25	703840	7444063
		0.1	30	696781	7446203
		0.1	30	696981	7446726
		0.1	30	697100	7446801
		0.1	30	703835	7444048
		0.1	30	703945	7444232
		0.1	35	697231	7446841
		0.1	35	705472	7445231
		0.1	35	706654	7445138
		0.1	40	696998	7446746
Aristida lazaridis P2	A	0.1	40	697275	7446899
		0.1	50	696906	7446668
		0.5	10	695446	7445221
		0.5	20	696428	7445960
		0.5	40	703911	7444182
		1	2	695767	7445374
		1	2	695776	7445377
		1	2	703129	7443442
		1	5	696723	7446147
		1	5	696737	7446142
		1	5	696748	7446140
		1	5	696755	7446145
		1	5	696758	7446148
		1	5	696836	7446364
		1	5	696844	7446366
		1	5	696858	7446440
		1	5	696919	7446744
		1	5	696930	7446748
		1	5	696931	7446741
		1	5	696936	7446760
		1	5	696940	7446772

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
		1	5	696947	7446789
		1	5	696948	7446696
		1	5	696962	7446796
		1	5	697132	7446723
		1	5	697265	7446849
		1	5	697266	7446873
		1	5	697271	7446859
		1	6	696559	7445946
		1	6	696576	7445944
		1	6	696646	7446072
		1	6	696675	7446096
		1	8	695765	7445373
		1	10	695736	7445370
		1	10	695827	7445421
		1	10	695984	7445453
		1	12	695714	7445378
		1	20	695674	7445366
		1	25	695467	7445222
		1	60	703895	7444151
		1	60	703925	7444201
Aristida lazaridis P2	A	10	35	695621	7445355
		15	40	696693	7446106
		15	40	696702	7446128
		15	50	696526	7445982
		2	10	696334	7445965
		2	10	696335	7445971
		2	10	696346	7445973
		2	10	696355	7445976
		2	10	696363	7445978
		2	10	696371	7445976
		2	10	696372	7445973
		2	10	696428	7445960
		2	10	696982	7446709
		2	10	696990	7446731
		2	10	696998	7446731
		2	10	697008	7446731
		2	10	697014	7446726
		2	20	695507	7445242
		2	20	695580	7445319
		2	20	695848	7445460
		2	20	696715	7446146

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
Aristida lazaridis P2	A	3	25	695596	7445333
		40	100	695743	7445401
		40	150	695650	7445384
		5	20	696651	7446081
		5	20	696662	7446086
		5	20	696687	7446110
		5	20	697235	7446881
		5	20	697240	7446889
		5	50	695517	7445268
Eremophila magnifica subsp. *magnifica* P4	A	0.1	1	714576	7453661
		0.1	2	714770	7453603
	F	-	19	714765	7453592
Eremophila sp. Hamersley Range (K. Walker KW 136) P1	A	0.1	1	711128	7451062
		0.1	2	711612	7450384
		0.1	11	710874	7450417
		0.1	11	711144	7451009
		0.2	4	711423	7450384
		0.2	5	711405	7450389
		0.5	1	710738	7450523
		0.5	1	710819	7450499
		0.5	1	710951	7450528
		0.5	1	710959	7450528
		0.5	1	710972	7450503
		0.5	1	711012	7450523
		0.5	1	711026	7450526
		0.5	1	711053	7450527
		0.5	1	711071	7450527
		0.5	1	711074	7450529
		0.5	1	711099	7450540
		0.5	1	711112	7450472
		0.5	1	711131	7450470
		0.5	1	711135	7450501
		0.5	1	711139	7450500
		0.5	1	711140	7450429
		0.5	1	711141	7450501
		0.5	1	711160	7450426
		0.5	1	711166	7450489
		0.5	1	711169	7450453
		0.5	1	711193	7450480
		0.5	1	711205	7450479
		0.5	1	711206	7450484

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
Eremophila sp. Hamersley Range (K. Walker KW 136) P1	A	0.5	1	711210	7450444
		0.5	1	711230	7450429
		0.5	1	711242	7450422
		0.5	1	711259	7450423
		0.5	2	710953	7450505
		0.5	2	710955	7450511
		0.5	2	710956	7450506
		0.5	2	710956	7450522
		0.5	2	710975	7450502
		0.5	2	710998	7450510
		0.5	2	710999	7450514
		0.5	2	711038	7450461
		0.5	2	711067	7450530
		0.5	2	711120	7450500
		0.5	2	711131	7450502
		0.5	2	711172	7450452
		0.5	2	711173	7450484
		0.5	2	711249	7450417
		0.5	2	711292	7450446
		0.5	2	711297	7450425
		0.5	2	711311	7450440
		0.5	2	712518	7450592
		0.5	2	712559	7450660
		0.5	3	710953	7450502
		0.5	3	710953	7450514
		0.5	3	710968	7450509
		0.5	3	711034	7450501
		0.5	3	711036	7450497
		0.5	3	711080	7450535
		0.5	3	711082	7450513
		0.5	3	711083	7450490
		0.5	3	711091	7450486
		0.5	3	711108	7450480
		0.5	3	711125	7450500
		0.5	3	711186	7450453
		0.5	3	711197	7450483
		0.5	3	711226	7450434
		0.5	3	711264	7450431
		0.5	3	711307	7450441
		0.5	3	711507	7450302
		0.5	3	712533	7450631

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
Eremophila sp. Hamersley Range (K. Walker KW 136) P1	A	0.5	4	711004	7450485
		0.5	4	711042	7450524
		0.5	4	711047	7450396
		0.5	4	711127	7450503
		0.5	4	711189	7450447
		0.5	4	711199	7450473
		0.5	4	711204	7450467
		0.5	4	711207	7450468
		0.5	4	711208	7450482
		0.5	5	708890	7450168
		0.5	5	710985	7450515
		0.5	5	710997	7450516
		0.5	5	711009	7450522
		0.5	5	711061	7450530
		0.5	5	711069	7450407
		0.5	5	711071	7450491
		0.5	5	711072	7450444
		0.5	5	711083	7450506
		0.5	5	711087	7450507
		0.5	5	711090	7450506
		0.5	5	711095	7450513
		0.5	5	711095	7451038
		0.5	5	711102	7450484
		0.5	5	711104	7450505
		0.5	5	711181	7450453
		0.5	5	711199	7450437
		0.5	5	711206	7450473
		0.5	5	711227	7450468
		0.5	5	711231	7450462
		0.5	5	711238	7450459
		0.5	5	711245	7450458
		0.5	5	711250	7450456
		0.5	5	711256	7450456
		0.5	5	711264	7450453
		0.5	5	711278	7450454
		0.5	5	711279	7450454
		0.5	5	711283	7450452
		0.5	5	711286	7450430
		0.5	5	711296	7450444
		0.5	5	711301	7450443
		0.5	5	711572	7450367

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
Eremophila sp. Hamersley Range (K. Walker KW 136) P1	A	0.5	5	711593	7450341
		0.5	5	712606	7450699
		0.5	6	710997	7450522
		0.5	6	711033	7450493
		0.5	6	711056	7450529
		0.5	6	711067	7450517
		0.5	6	711125	7450465
		0.5	6	711193	7450326
		0.5	6	711216	7450440
		0.5	6	711652	7450393
		0.5	7	710759	7450406
		0.5	7	711077	7450514
		0.5	7	711114	7450504
		0.5	8	710990	7450527
		0.5	8	711071	7450518
		0.5	8	711204	7450472
		0.5	9	710804	7450412
		0.5	9	710828	7450428
		0.5	9	710964	7450504
		0.5	10	708751	7450383
		0.5	10	708757	7450386
		0.5	10	708895	7450161
		0.5	10	710801	7450439
		0.5	10	711017	7450492
		0.5	10	711029	7450490
		0.5	10	711033	7450483
		0.5	10	711041	7450486
		0.5	10	711047	7450489
		0.5	10	711052	7450525
		0.5	10	711065	7450492
		0.5	10	711073	7450487
		0.5	10	711079	7450484
		0.5	10	711082	7450483
		0.5	10	711084	7450507
		0.5	10	711094	7450504
		0.5	10	711098	7450506
		0.5	10	711099	7450512
		0.5	10	711121	7450971
		0.5	10	711212	7450471
		0.5	10	711215	7450471
		0.5	10	711218	7450434

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
Eremophila sp. Hamersley Range (K. Walker KW 136) P1	A	0.5	10	711219	7450468
		0.5	10	711222	7450436
		0.5	10	711224	7450464
		0.5	10	711247	7450420
		0.5	12	711292	7450327
		0.5	12	711307	7450314
		0.5	12	711612	7450335
		0.5	12	711643	7450364
		0.5	15	710876	7450401
		0.5	15	710878	7450436
		0.5	15	711089	7450385
		0.5	15	711096	7450376
		0.5	20	711344	7450315
		0.5	22	711466	7450329
		0.5	24	711255	7450318
		0.5	24	711411	7450351
		0.5	25	711073	7450400
		0.5	30	708765	7450408
		0.5	32	711434	7450345
		0.5	50	711143	7450381
		0.5	55	711138	7450365
		0.5	55	711168	7450341
		1	1	710941	7450542
		1	1	711093	7451039
		1	5	711285	7450355
		1	5	711304	7450357
		1	9	711122	7450431
		1	11	711509	7450353
		1	12	710895	7450411
		1	15	711313	7450335
		1	20	711229	7450341
		2	20	711204	7450385
		4	6	711507	7450354
		6	55	711528	7450355
Eremophila sp. Hamersley Range (K. Walker KW 136) P1	E	-	1	716597	7450185
		-	1	716625	7449983
		-	1	716638	7449976
		-	2	716576	7450103
		-	2	716576	7450141
		-	2	716579	7450075
		-	2	716589	7450060

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
Eremophila sp. Hamersley Range (K. Walker KW 136) P1	E	-	2	716620	7450003
		-	3	716589	7450053
		-	3	716614	7450015
		-	3	716620	7449996
		-	3	716621	7450009
		-	4	716596	7450032
		-	4	716725	7450481
		-	6	716575	7449976
		-	6	716585	7450063
		-	6	716587	7450089
		-	6	716606	7450024
		-	7	716695	7450483
		-	10	716560	7449994
		-	10	716569	7449950
		-	10	716662	7450443
		-	12	716585	7450145
		-	14	716547	7450036
		-	15	716561	7450092
		-	18	716665	7450473
		-	21	716560	7450038
		-	25	716561	7450066
		-	25	716570	7450033
		-	25	716644	7450470
		-	27	716584	7450158
		-	33	716588	7450041
Eremophila sp. Hamersley Range (K. Walker KW 136) P1	H	-	1	710400	7450964
		-	1	711211	7451234
		-	1	711215	7451230
		-	1	711243	7451185
		-	1	711619	7451017
		-	1	711996	7450714
		-	1	712012	7450684
		-	2	711114	7451148
		-	2	711123	7451072
		-	2	712595	7450380
		-	3	712515	7450610
		-	5	711078	7451132
		-	5	711133	7451229
		-	5	711288	7451113
		-	6	710340	7451030
		-	6	711345	7451051

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
Eremophila sp. Hamersley Range (K. Walker KW 136) P1	H	-	6	712725	7450470
		-	7	711660	7450974
		-	8	711083	7451126
		-	8	711442	7451014
		-	10	711167	7451253
		-	12	710484	7451075
		-	15	710426	7451070
		-	20	711108	7450021
		-	20	711415	7451015
		-	20	712540	7450663
		-	50	711115	7450985
Eremophila sp. West Angelas (S. van Leeuwen 4068) P1	A	0.1	1	710070	7450580
		0.1	1	719527	7450347
		0.1	1	719872	7450384
		0.1	1	720532	7450448
		0.1	1	720630	7450489
		0.1	1	720647	7450455
		0.1	1	720794	7450561
		0.1	1	720805	7450428
		0.1	2	710064	7450581
		0.1	2	710107	7450457
		0.1	2	710250	7450519
		0.1	2	710422	7450564
		0.1	2	711430	7450340
		0.1	2	719457	7450395
		0.1	2	719462	7450380
		0.1	2	719563	7450341
		0.1	2	720489	7450483
		0.1	2	720529	7450446
		0.1	2	720556	7450490
		0.1	2	720557	7450455
		0.1	2	720582	7450458
		0.1	2	720601	7450484
		0.1	2	720606	7450491
		0.1	2	720658	7450480
		0.1	2	720915	7450594
		0.1	2	721244	7450658
		0.1	2	721254	7450619
		0.1	2	721266	7450677
		0.1	3	710066	7450578
		0.1	3	710071	7450549

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
Eremophila sp. West Angelas (S. van Leeuwen 4068) P1	A	0.1	3	710127	7450574
		0.1	3	710445	7450559
		0.1	3	720545	7450580
		0.1	3	720588	7450446
		0.1	3	720599	7450441
		0.1	3	720615	7450488
		0.1	3	720633	7450482
		0.1	3	720664	7450447
		0.1	3	720688	7450576
		0.1	3	720733	7450566
		0.1	3	720842	7450575
		0.1	3	720965	7450515
		0.1	4	710056	7450577
		0.1	4	710069	7450557
		0.1	4	710357	7450534
		0.1	4	710382	7450540
		0.1	4	720827	7450579
		0.1	4	721117	7450633
		0.1	5	710064	7450575
		0.1	5	710079	7450557
		0.1	5	710090	7450562
		0.1	5	710231	7450512
		0.1	5	710284	7450540
		0.1	5	710370	7450539
		0.1	5	720645	7450479
		0.1	6	710140	7450562
		0.1	6	710326	7450533
		0.1	6	710353	7450538
		0.1	6	720577	7450574
		0.1	6	720778	7450560
		0.1	7	710107	7450565
		0.1	7	720665	7450556
		0.1	8	710119	7450457
		0.1	8	710233	7450535
		0.1	8	710396	7450548
		0.1	9	710396	7450477
		0.1	9	710421	7450479
		0.1	9	710443	7450486
		0.1	10	710188	7450538
		0.1	12	710155	7450555
		0.1	12	710497	7450473

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
Eremophila sp. West Angelas (S. van Leeuwen 4068) P1	A	0.1	15	710082	7450550
		0.1	15	710473	7450482
		0.1	15	710484	7450473
		0.1	15	721138	7450617
		0.1	16	710196	7450542
		0.1	18	710152	7450560
		0.1	19	710098	7450560
		0.1	20	709998	7450505
		0.1	20	710140	7450468
		0.1	20	710311	7450421
		0.1	22	710303	7450433
		0.1	26	710274	7450431
		0.5	1	711157	7450426
		0.5	2	711044	7450570
		0.5	2	711074	7450554
		0.5	2	711224	7450506
		0.5	3	711143	7450520
		0.5	4	711089	7450551
		0.5	4	711237	7450404
		0.5	5	720239	7450683
		1	5	720588	7450488
		1	5	720613	7450488
Eremophila sp. West Angelas (S. van Leeuwen 4068) P1	H	-	5	710430	7450566
		-	10	710054	7450570
		-	10	710368	7450552
		-	10	710475	7450575
		-	10	710553	7450570
		-	10	711234	7450494
		-	10	711551	7450476
		-	10	711651	7450491
		-	10	719272	7450805
		-	10	719324	7450801
		-	20	710189	7450557
		-	20	711077	7450545
		-	20	711431	7450507
		-	20	711469	7450496
		-	20	719400	7450784
		-	20	719481	7450763
		-	30	719356	7450802
Goodenia lyrata P3	F	0.1	1	715444	7452887

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727) P3	C	-	10	706660	7446956
		-	20	706664	7446928
		-	50	706648	7446948
Grevillea saxicola P3	A	0.1	1	704284	7449935
		0.1	1	704539	7450222
		0.1	1	706995	7449945
		0.1	1	707050	7450013
		0.1	1	708186	7450952
		0.1	1	709515	7450289
		0.1	1	709540	7450249
		0.1	1	709591	7450249
		0.1	1	709604	7450223
		0.1	1	709690	7450274
		0.1	1	709723	7450254
		0.1	1	709777	7450405
		0.1	1	709778	7450301
		0.1	1	709780	7450421
		0.1	1	709790	7450423
		0.1	1	709794	7450331
		0.1	1	709810	7450297
		0.1	1	709810	7450423
		0.1	1	709812	7450304
		0.1	1	711771	7450210
		0.1	1	712152	7450234
		0.1	1	712396	7450189
		0.1	1	712654	7450339
		0.1	1	712926	7450187
		0.1	1	718857	7450184
		0.1	1	718890	7450186
		0.1	1	719567	7450337
		0.1	1	720006	7450398
		0.1	1	720115	7450411
		0.1	1	720203	7450416
		0.1	1	720343	7450501
		0.1	1	720355	7451567
		0.1	1	720514	7450459
		0.1	2	706987	7449932
		0.1	2	706994	7449974
		0.1	2	707017	7449982
		0.1	2	707830	7450509

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
		0.1	2	709641	7450234
		0.1	2	709770	7451436
		0.1	2	709789	7450380
		0.1	2	709813	7450363
		0.1	2	709842	7450534
		0.1	2	709866	7450546
		0.1	2	709903	7450562
		0.1	2	710002	7450572
		0.1	2	710004	7450588
		0.1	2	710011	7451142
		0.1	2	710046	7450567
		0.1	2	710370	7450431
		0.1	2	710863	7450415
		0.1	2	712215	7450238
		0.1	2	712596	7450323
		0.1	3	706949	7449861
		0.1	3	707011	7449944
		0.1	3	709839	7450562
		0.1	3	709859	7450520
		0.1	3	709870	7450508
Grevillea saxicola P3	A	0.1	3	710382	7450445
		0.1	3	711824	7450212
		0.1	3	712560	7450168
		0.1	3	712608	7450188
		0.1	3	712686	7450188
		0.1	3	712847	7450188
		0.1	3	716900	7450027
		0.1	4	707752	7450580
		0.1	4	707834	7450564
		0.1	4	708915	7450009
		0.1	4	709728	7451430
		0.1	4	709842	7450541
		0.1	4	709895	7450561
		0.1	4	710441	7450455
		0.1	4	711046	7450398
		0.1	4	712022	7450286
		0.1	4	712446	7450219
		0.1	4	712528	7450175
		0.1	4	712885	7450185
		0.1	4	717332	7449896
		0.1	5	709582	7450211

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
		0.1	5	709849	7451552
		0.1	5	710139	7450564
		0.1	5	710269	7450404
		0.1	5	711167	7450339
		0.1	5	711222	7450313
		0.1	5	712120	7450242
		0.1	5	712528	7450187
		0.1	5	718090	7450146
		0.1	6	707735	7450503
		0.1	6	711517	7450311
		0.1	6	711585	7450346
		0.1	6	712064	7450288
		0.1	6	712372	7450238
		0.1	6	712651	7450187
		0.1	6	712813	7450190
		0.1	6	718102	7450062
		0.1	7	708748	7449918
		0.1	7	711675	7450381
		0.1	7	711751	7450288
		0.1	7	711814	7450247
Grevillea saxicola P3	A	0.1	7	712252	7450248
		0.1	7	712266	7450240
		0.1	8	707910	7450407
		0.1	8	708015	7450360
		0.1	8	709577	7450268
		0.1	8	710164	7450441
		0.1	8	710235	7450514
		0.1	8	710241	7450421
		0.1	8	710271	7450514
		0.1	8	710357	7450463
		0.1	8	710418	7450538
		0.1	8	710454	7450480
		0.1	8	710522	7450459
		0.1	8	710847	7450418
		0.1	8	711709	7450242
		0.1	8	711847	7450247
		0.1	8	712090	7450261
		0.1	8	712632	7450356
		0.1	9	711864	7450286
		0.1	10	707811	7450441
		0.1	10	709610	7450260

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
		0.1	10	709626	7450215
		0.1	10	709653	7450266
		0.1	10	709891	7450469
		0.1	10	710574	7450416
		0.1	10	710621	7450457
		0.1	10	711240	7450314
		0.1	10	711322	7450308
		0.1	10	711437	7450341
		0.1	10	712625	7450385
		0.1	11	709998	7451230
		0.1	11	710802	7450430
		0.1	11	711106	7450371
		0.1	12	711599	7450346
		0.1	12	712296	7450262
		0.1	15	709730	7450297
		0.1	15	709766	7450303
		0.1	15	710041	7451204
		0.1	15	710700	7450450
		0.1	15	710752	7450446
		0.1	15	710760	7450436
Grevillea saxicola P3	A	0.1	15	712342	7450258
		0.1	16	711464	7450325
		0.1	20	709681	7450234
		0.1	20	709775	7450469
		0.1	20	709856	7450408
		0.1	20	710659	7450461
		0.1	22	718064	7450070
		0.1	40	709911	7450498
		0.5	1	709132	7449820
		0.5	1	710639	7450472
		0.5	1	710678	7450495
		0.5	1	710680	7450491
		0.5	1	710713	7450493
		0.5	1	710721	7450491
		0.5	1	710737	7450507
		0.5	1	710739	7450486
		0.5	1	710743	7450499
		0.5	1	710755	7450502
		0.5	1	710766	7450504
		0.5	1	710770	7450488
		0.5	1	710771	7450513

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
		0.5	1	710809	7450515
		0.5	1	710811	7450499
		0.5	1	710814	7450502
		0.5	1	710828	7450490
		0.5	1	710834	7450507
		0.5	1	710837	7450506
		0.5	1	710842	7450502
		0.5	1	710852	7450507
		0.5	1	710854	7450511
		0.5	1	710864	7450473
		0.5	1	710866	7450516
		0.5	1	710881	7450504
		0.5	1	710886	7450469
		0.5	1	710944	7450479
		0.5	1	710950	7450477
		0.5	1	710953	7450475
		0.5	1	710962	7450505
		0.5	1	710965	7450481
		0.5	1	710972	7450483
		0.5	1	710973	7450498
Grevillea saxicola P3	A	0.5	1	710977	7450523
		0.5	1	710979	7450483
		0.5	1	710981	7450500
		0.5	1	710985	7450500
		0.5	1	710992	7450528
		0.5	1	710998	7450483
		0.5	1	711009	7450479
		0.5	1	711013	7450484
		0.5	1	711016	7450534
		0.5	1	711027	7450529
		0.5	1	711033	7450493
		0.5	1	711034	7450482
		0.5	1	711041	7450526
		0.5	1	711052	7450530
		0.5	1	711061	7450499
		0.5	1	711080	7450484
		0.5	1	711083	7450505
		0.5	1	711088	7450541
		0.5	1	711099	7450508
		0.5	1	711102	7450521
		0.5	1	711109	7450480

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
		0.5	1	711115	7450503
		0.5	1	711116	7450526
		0.5	1	711124	7450463
		0.5	1	711139	7450500
		0.5	1	711144	7450504
		0.5	1	711177	7450484
		0.5	1	711188	7450481
		0.5	1	711191	7450443
		0.5	1	711199	7450483
		0.5	1	711200	7450484
		0.5	1	711215	7450402
		0.5	1	711221	7450466
		0.5	1	711235	7450459
		0.5	1	711240	7450428
		0.5	1	711256	7450456
		0.5	1	711264	7450431
		0.5	1	711265	7450452
		0.5	1	711292	7450447
		0.5	1	711308	7450434
		0.5	1	711816	7450179
Grevillea saxicola P3	A	0.5	1	711830	7450171
		0.5	2	708920	7450120
		0.5	2	710685	7450497
		0.5	2	710695	7450498
		0.5	2	710746	7450506
		0.5	2	710750	7450484
		0.5	2	710760	7450485
		0.5	2	710778	7450513
		0.5	2	710779	7450497
		0.5	2	710796	7450516
		0.5	2	710871	7450510
		0.5	2	710877	7450470
		0.5	2	710895	7450468
		0.5	2	710921	7450477
		0.5	2	710959	7450508
		0.5	2	710986	7450481
		0.5	2	710987	7450524
		0.5	2	711017	7450490
		0.5	2	711037	7450496
		0.5	2	711052	7450461
		0.5	2	711065	7450492

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
		0.5	2	711069	7450516
		0.5	2	711081	7450516
		0.5	2	711155	7450461
		0.5	2	711202	7450469
		0.5	2	711209	7450514
		0.5	2	711215	7450436
		0.5	2	711231	7450429
		0.5	2	711236	7450425
		0.5	2	711242	7450422
		0.5	2	711277	7450430
		0.5	2	711286	7450430
		0.5	2	711291	7450448
		0.5	2	711297	7450425
		0.5	2	711305	7450426
		0.5	2	720053	7451635
		0.5	2	720205	7451639
		0.5	3	706718	7449924
		0.5	3	708197	7450962
		0.5	3	710703	7450421
		0.5	3	710735	7450480
Grevillea saxicola P3	A	0.5	3	710745	7450482
		0.5	3	710866	7450402
		0.5	3	710961	7450480
		0.5	3	710989	7450477
		0.5	3	711037	7450484
		0.5	3	711199	7450475
		0.5	3	711225	7450464
		0.5	3	711247	7450421
		0.5	3	711249	7450348
		0.5	3	711259	7450422
		0.5	4	710610	7450512
		0.5	4	710870	7450505
		0.5	4	711070	7450406
		0.5	4	711496	7450365
		0.5	4	716882	7449912
		0.5	5	704277	7449927
		0.5	5	707053	7449685
		0.5	5	707420	7449731
		0.5	5	708905	7450171
		0.5	5	710665	7450426
		0.5	5	710976	7450464

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
		0.5	5	711073	7450490
		0.5	5	711103	7450505
		0.5	5	711213	7450354
		0.5	5	711391	7450379
		0.5	5	720936	7451241
		0.5	6	707818	7450448
		0.5	6	710723	7450418
		0.5	6	711316	7450337
		0.5	6	712441	7450200
		0.5	7	711787	7450143
		0.5	8	711460	7450393
		0.5	9	712271	7450229
		0.5	10	704444	7450230
		0.5	10	704567	7450194
		0.5	10	704606	7450183
		0.5	10	707289	7449915
		0.5	10	708189	7450940
		0.5	10	711170	7450369
		0.5	10	711233	7450350
		0.5	10	712465	7450511
Grevillea saxicola P3	A	0.5	13	708873	7450014
		0.5	13	711387	7450354
		0.5	20	704404	7450159
		0.5	20	704559	7450220
		0.5	20	710728	7450450
		1	1	709132	7449821
		1	1	712800	7450140
		1	1	713558	7450156
		1	1	719495	7450403
		1	1	719552	7450330
		1	2	709740	7450286
		1	2	709751	7450287
		1	2	709761	7450290
		1	2	709769	7450292
		1	2	709806	7450424
		1	2	709831	7450421
		1	2	709840	7450434
		1	2	709869	7450454
		1	2	709871	7450492
		1	2	709880	7450506
		1	2	709915	7450522

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
		1	2	719368	7450379
		1	2	719388	7450386
		1	2	719519	7450369
		1	2	719524	7450383
		1	2	720266	7450457
		1	2	720476	7450450
		1	3	709603	7450247
		1	3	709615	7450253
		1	3	709645	7450246
		1	3	709655	7450252
		1	3	709658	7450235
		1	3	709850	7450441
		1	3	709860	7450469
		1	3	709860	7450482
		1	3	709862	7450456
		1	3	709922	7450528
		1	3	709933	7450530
		1	3	709976	7450525
		1	3	709995	7450532
		1	3	710019	7450529
Grevillea saxicola P3	A	1	3	710054	7450529
		1	3	710066	7450538
		1	3	719367	7450361
		1	3	719394	7450395
		1	3	719414	7450399
		1	3	719485	7450388
		1	4	710844	7450417
		1	4	719468	7450383
		1	5	711127	7450430
		1	5	711803	7450277
		1	5	712853	7450169
		1	6	706982	7449964
		1	6	711552	7450356
		1	6	711570	7450364
		1	6	712052	7450266
		1	6	712332	7450237
		1	7	706981	7449874
		1	7	710768	7450409
		1	7	711604	7450394
		1	8	710943	7450454
		1	8	712001	7450280

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
Grevillea saxicola P3	A	1	9	712670	7450176
		1	11	712707	7450152
		2	1	707034	7449992
		2	2	719523	7450357
		2	3	720312	7450520
		2	3	720430	7450457
		2	3	720438	7450450
		2	4	711155	7450433
		2	8	709841	7450043
		2	10	710826	7450461
		2	10	710858	7450547
		2	11	711840	7450292
		2	11	711898	7450285
		3	1	709045	7449688
		3	1	709056	7449685
		3	1	710941	7450542
		3	3	719500	7450366
		3	3	719525	7450319
		3	3	720279	7450449
		3	3	720315	7450432
		3	5	719419	7450385
		3	10	710599	7450473
		3	14	709786	7451537
		4	3	720295	7450524
		5	8	719450	7450387
	C	-	1	707876	7450248
	E	-	1	713251	7450250
		-	1	713276	7450245
		-	1	713440	7450211
		-	1	713500	7450180
		-	1	713524	7450182
		-	1	713560	7450174
		-	1	713714	7450134
		-	1	713723	7450138
		-	1	713723	7450154
		-	1	713733	7450144
		-	1	713739	7450144
		-	1	713772	7450155
		-	1	713777	7450144
		-	1	713847	7450155
		-	1	713863	7450139

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
Grevillea saxicola P3	E	-	1	713879	7450132
		-	1	713921	7450071
		-	1	713923	7450089
		-	1	713937	7450085
		-	1	713954	7449977
		-	1	714181	7450366
		-	1	716805	7449981
		-	1	716813	7449993
		-	1	716861	7450058
		-	1	716896	7450115
		-	1	716899	7450138
		-	1	717301	7449903
		-	1	717350	7449916
		-	2	713780	7450134
		-	2	713785	7450488
		-	2	713906	7450090
		-	2	713911	7450100
		-	2	714111	7449956
		-	2	716758	7449952
		-	2	716879	7450091
		-	3	713437	7450225
		-	3	713790	7450143
		-	3	713821	7450178
		-	3	713912	7450079
		-	3	714132	7449952
		-	3	716849	7450020
		-	3	716867	7450079
		-	3	716882	7450052
		-	4	716778	7449968
		-	4	716827	7450002
		-	4	716837	7450008
		-	5	713578	7450177
		-	5	714152	7449980
		-	7	714014	7449972
		-	7	716869	7450047
		-	8	713966	7449972
		-	9	713896	7450082
		-	10	714087	7449952
		-	19	714057	7449956
	H	-	1	710904	7450566
		-	1	711121	7451040

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
Grevillea saxicola P3	H	-	1	711234	7450494
		-	1	711288	7451113
		-	1	712423	7450673
		-	1	712551	7450514
		-	1	712554	7450183
		-	1	712569	7450705
		-	1	712643	7450213
		-	1	712847	7450229
		-	1	717299	7449904
		-	1	717354	7449903
		-	1	718080	7450212
		-	1	718088	7450131
		-	1	718135	7450086
		-	1	718138	7449987
		-	1	718170	7450008
		-	1	719408	7450712
		-	1	719440	7450643
		-	2	711956	7450361
		-	2	712463	7450450
		-	2	712468	7451024
		-	2	712589	7450579
		-	2	712595	7450380
		-	2	717280	7449881
		-	2	718035	7449925
		-	2	718064	7449951
		-	3	712464	7450533
		-	3	712466	7451142
		-	3	712521	7450871
		-	3	712764	7450461
		-	4	711574	7451100
		-	4	712257	7450590
		-	5	710956	7450557
		-	5	717977	7449901
		-	5	718559	7451083
		-	10	712725	7450470
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2	A	0.1	1	699261	7444531
		0.1	1	699972	7444780
		0.1	1	709677	7450288
		0.1	1	712488	7450677
		0.1	2	700020	7444806
		0.1	2	709660	7450261

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2	A	0.1	3	699256	7444523
		0.1	3	699270	7444529
		0.1	3	699950	7444776
		0.1	3	712005	7450792
		0.1	3	712047	7450702
		0.1	4	699280	7444534
		0.1	4	699986	7444785
		0.1	4	710131	7450460
		0.1	4	712079	7450674
		0.1	5	700113	7444797
		0.1	5	712218	7450633
		0.1	6	712067	7450676
		0.1	6	712839	7450677
		0.1	6	713113	7450559
		0.1	7	712124	7450666
		0.1	7	712530	7450711
		0.1	9	712052	7450674
		0.1	10	700086	7444796
		0.1	10	700233	7444837
		0.1	10	700393	7444895
		0.1	10	712915	7450629
		0.1	13	711984	7450805
		0.1	14	712545	7450701
		0.1	15	700307	7444839
		0.1	15	712953	7450589
		0.1	15	713076	7450557
		0.1	18	712008	7450762
		0.1	18	712023	7450757
		0.1	22	713056	7450564
		0.1	25	713027	7450587
		0.1	30	700840	7445124
		0.1	31	713095	7450575
		0.5	10	700066	7444859
		2	15	709682	7450274
		2	15	709684	7450273
	C	-	15	716581	7449974
	E	-	15	716581	7449974
	H	-	1	712545	7450684
		-	3	712438	7450673
		-	5	712154	7450654
		-	5	712341	7450641

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708) P2	H	-	8	712095	7450677
		-	10	712272	7450647
		-	10	712631	7450733
		-	10	712891	7450628
		-	20	712958	7450600
Lepidium catapycnon P4	A	1	50	711042	7450545
		0.5	20	713413	7450293
		1	70	715517	7450688
		0.1	9	715800	7450997
		1	50	715834	7450952
		1	60	715855	7450952
		1	100	715857	7450952
		1	80	715886	7450947
		1	80	715907	7450945
		0.1	2	715909	7450997
		1	80	715939	7450941
		1	40	715961	7450940
		1	120	716026	7450944
		1	30	716049	7450997
		1	100	716058	7450948
		1	120	716080	7450951
		1	80	716103	7450955
		1	40	716123	7450951
		0.1	10	716142	7451067
		1	80	716147	7450948
		1	60	716166	7450944
		1	40	716196	7450960
		1	60	716261	7450926
		1	80	716281	7450920
		1	100	716301	7450906
		0.5	1	716314	7450888
		1	100	716314	7450886
		0.5	50	716352	7450884
		0.5	25	716362	7450934
		-	20	716362	7450871
		0.1	10	716447	7450878
		0.5	40	716455	7450940
		1	50	716490	7450882
		1	50	716523	7450883
		0.5	25	716571	7450895

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
		1	50	716580	7450861
		0.5	2	719176	7450368
		0.5	50	719195	7450369
		0.1	5	719211	7450407
		0.1	5	719214	7450409
		0.5	20	719231	7450382
		0.5	20	719242	7450402
		0.1	5	719246	7450368
		0.1	5	719249	7450383
		0.5	5	719396	7450477
		0.5	20	719427	7450440
		0.5	20	719464	7450442
		0.1	1	719484	7450384
		0.5	30	719513	7450468
		0.5	20	719523	7450446
		0.5	10	719565	7450465
		0.1	10	719585	7450296
		0.1	10	719592	7450324
		0.1	10	719613	7450330
		0.5	20	719620	7450477
Lepidium catapycnon P4	A	0.1	10	719623	7450329
		0.1	25	719636	7450487
		0.5	5	719680	7450415
		0.1	4	719698	7450474
		3	20	719767	7450382
		3	20	719775	7450392
		0.1	5	719828	7450383
		0.1	5	719832	7450386
		0.5	5	719845	7450413
		0.1	4	719854	7450415
		0.1	5	719877	7450400
		0.1	5	719879	7450398
		0.5	5	719922	7450436
		0.1	5	719923	7450424
		0.5	5	719949	7450436
		0.5	5	719949	7450445
		0.5	40	719983	7450455
		1	10	719985	7450453
		1	10	720012	7450435
		0.1	2	720020	7450398
		1	10	720044	7450455

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
		1	10	720088	7450448
		0.1	2	720096	7450418
		0.5	5	720114	7451848
		1	20	720116	7450455
		0.1	2	720130	7450405
		0.1	25	720130	7450526
		1	10	720148	7450403
		1	15	720151	7450401
		3	15	720171	7450404
		1	10	720175	7450411
		0.5	20	720201	7450890
		0.5	20	720212	7450836
		0.5	30	720221	7450859
		0.5	5	720225	7450525
		0.5	5	720226	7450527
		0.5	20	720227	7450607
		0.5	20	720238	7450799
		0.5	20	720251	7450688
		0.5	1	720253	7450549
		0.5	20	720253	7450630
Lepidium catapycnon P4	A	0.1	3	720285	7450563
		0.5	20	720309	7450583
		5	100	720340	7450406
		0.1	1	720355	7451567
		2	30	720361	7450413
		0.5	20	720376	7450557
		0.5	20	720379	7450647
		0.5	10	720387	7450563
		1	10	720392	7450415
		0.1	1	720393	7450560
		1	10	720422	7450437
		1	10	720423	7450441
		0.5	50	720429	7450562
		1	10	720432	7450460
		1	10	720448	7450441
		0.1	100	720452	7450612
		0.1	35	720456	7450548
		3	500	720464	7450570
		1	10	720473	7450457
		0.5	50	720480	7450556
		0.1	100	720495	7450560

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
Lepidium catapycnon P4	A	0.5	100	720508	7450568
		2	20	720517	7450495
		0.1	15	720520	7450573
		0.1	5	720549	7450464
		0.1	5	720569	7450470
		0.5	100	720585	7451690
		2	20	720621	7450469
		2	20	720625	7450467
		0.1	30	720633	7450529
		2	20	720633	7450467
		1	10	720647	7450499
		0.5	30	720652	7450978
		0.1	30	720766	7450526
		1	10	720775	7450498
		0.1	50	720848	7450404
		3	50	720864	7450518
		0.1	30	720868	7450552
		0.1	50	720926	7450441
		0.5	5	720936	7451232
		1	10	720965	7450492
		0.1	1	720995	7451577
		0.1	50	721009	7450449
		0.1	2	721023	7450581
		1	10	721078	7450542
		0.5	100	721151	7451859
		0.5	100	721185	7451866
		1	10	721203	7450542
		1	10	721327	7450693
	B	-	40	715941	7451107
	B	-	40	716133	7451133
	D	-	4	715482	7450699
		-	1	715491	7450693
		-	5	715497	7450690
		-	12	715506	7450692
		-	4	715510	7450690
		-	1	715511	7450665
		-	7	715511	7450691
		-	6	715514	7450689
		-	1	715515	7450657
		-	91	715532	7450669
	E	-	7	715772	7450944

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
		-	1	715798	7450874
		-	1	715826	7450892
		-	40	715826	7450916
		-	67	715827	7450932
		-	20	715829	7450932
		-	100	715831	7450899
		-	120	715831	7450921
		-	13	715832	7450757
		-	52	715832	7450926
		-	13	715834	7450934
		-	25	715835	7450940
		-	6	715838	7450934
		-	1	715839	7450896
		-	60	715842	7450919
		-	78	715842	7450953
		-	14	715846	7450893
		-	20	715846	7450901
		-	82	715846	7450908
		-	41	715847	7450920
		-	57	715847	7450938
Lepidium catapycnon P4	E	-	41	715849	7450956
		-	8	715854	7450904
		-	165	715854	7450939
		-	44	715855	7450922
		-	31	715856	7450953
		-	15	715860	7450903
		-	68	715860	7450909
		-	16	715861	7450946
		-	120	715861	7450926
		-	43	715863	7450935
		-	1	715866	7450959
		-	1	715867	7450905
		-	5	715869	7450893
		-	46	715869	7450913
		-	13	715873	7450879
		-	9	715874	7450898
		-	7	715878	7450918
		-	44	715878	7450883
		-	3	715880	7450872
		-	10	715883	7450936
		-	7	715886	7450950

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
		-	120	715887	7450880
		-	18	715891	7450899
		-	7	715892	7450911
		-	5	715902	7450879
		-	100	715903	7450920
		-	4	715908	7450881
		-	18	715908	7450906
		-	16	715910	7450875
		-	50	715911	7450951
		-	6	715912	7450863
		-	45	715912	7450980
		-	10	715916	7450901
		-	52	715916	7450863
		-	100	715916	7450929
		-	19	715918	7450965
		-	67	715919	7450918
		-	5	715923	7450862
		-	4	715925	7450974
		-	57	715925	7450891
		-	45	715927	7450883
Lepidium catapycnon P4	E	-	6	715933	7450954
		-	116	715933	7450931
		-	31	715935	7450907
		-	85	715938	7450873
		-	24	715943	7450927
		-	40	715943	7450898
		-	22	715944	7450915
		-	7	715946	7450947
		-	24	715947	7450841
		-	35	715947	7450848
		-	22	715955	7450852
		-	37	715955	7450878
		-	3	715959	7450854
		-	27	715959	7450937
		-	8	715961	7450920
		-	1	715969	7450771
		-	1	715999	7450778
		-	1	716001	7450957
		-	24	716009	7450923
		-	5	716021	7450925
		-	35	716023	7450964

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
		-	125	716025	7450908
		-	78	716031	7450938
		-	160	716044	7450900
		-	45	716046	7450970
		-	41	716049	7450880
		-	135	716053	7450920
		-	36	716057	7450942
		-	79	716072	7450880
		-	174	716078	7450957
		-	160	716079	7450931
		-	62	716089	7450972
		-	106	716090	7450951
		-	75	716093	7450932
		-	46	716101	7450919
		-	18	716112	7450914
		-	134	716120	7450958
		-	12	716124	7450914
		-	85	716124	7450962
		-	91	716141	7450917
		-	2	716146	7450866
Lepidium catapycnon P4	E	-	75	716147	7450960
		-	43	716149	7450950
		-	152	716161	7450910
		-	15	716165	7450950
		-	120	716166	7450944
		-	49	716176	7450931
		-	148	716184	7450901
		-	75	716188	7450939
		-	140	716191	7450924
		-	1	716205	7450957
		-	25	716209	7450904
		-	26	716220	7450845
		-	42	716291	7450899
		-	6	716336	7450869
		-	35	716455	7450840
		-	46	716497	7450879
		-	13	716509	7450880
		-	16	716557	7450885
		-	20	716560	7450877
		-	60	716562	7450967
		-	18	716571	7450886

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
Lepidium catapycnon P4	E	-	254	716585	7450879
		-	7	716597	7450854
		-	96	716597	7450840
		-	15	716604	7450932
		-	6	716607	7450868
		-	21	716617	7450863
		-	8	716620	7450857
		-	11	716669	7450871
		-	203	716685	7450857
		-	6	716835	7450898
		-	3	716952	7450947
		-	16	716975	7450943
		-	10	716976	7450967
		-	23	716991	7450935
		-	1	716999	7450966
		-	53	717017	7450996
		-	32	717026	7451017
		-	4	717146	7451053
		-	44	717236	7451030
	H	-	10	712521	7450871
		-	1	718746	7450041
		-	1	718771	7450109
		-	1	718797	7450125
		-	1	718847	7450159
		-	5	718904	7450163
		-	1	719081	7450239
		-	1	719209	7450399
		-	3	719410	7450644
		-	10	719420	7450649
		-	5	719440	7450643
		-	10	719476	7450648
		-	5	719572	7450926
		-	10	719642	7450926
		-	5	719667	7450879
	J	-	1	715942	7451107
Ptilotus mollis P4	A	0.1	1	716314	7450888
		0.1	2	710026	7451202
		0.1	2	710028	7451216
		0.1	2	716348	7450850
		0.1	3	710030	7451195
		0.1	4	716365	7450840

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
Ptilotus mollis P4	A	0.1	11	716350	7450888
		0.1	12	710014	7451155
		0.5	1	711060	7450500
		0.5	6	710665	7450611
		0.5	6	710690	7450612
	E	-	1	716685	7450857
		-	2	716527	7450856
		-	2	716585	7450879
		-	2	716848	7450763
		-	2	716952	7450947
		-	2	716955	7450854
		-	2	716955	7450929
		-	3	716617	7450863
		-	3	716880	7450831
		-	3	716990	7450918
		-	4	716916	7450844
		-	5	716989	7450872
		-	6	716709	7450802
		-	6	716961	7450911
		-	7	716719	7450766
		-	7	716747	7450735
		-	7	716991	7450944
		-	9	716597	7450854
		-	11	716884	7450892
		-	11	716985	7450898
		-	12	716835	7450898
		-	14	716597	7450840
		-	14	716789	7450735
		-	18	716818	7450751
		-	20	716975	7450943
		-	25	716999	7450966
		-	28	716869	7450857
	H	-	1	718161	7451081
		-	1	719093	7450517
		-	1	719420	7450649
		-	2	710714	7450635
		-	3	719124	7450494
		-	8	719410	7450644
		-	10	710674	7450606
		-	10	712187	7451180
		-	20	709954	7450630

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
Ptilotus mollis P4	H	-	20	712465	7451142
		-	30	711539	7451107
	I	-	50	701756	7443276
Rhagodia sp. Hamersley (M. Trudgen 17794) P3	A	0.1	1	698882	7446756
		0.1	1	698918	7446755
		0.1	1	698933	7446767
		0.1	1	699050	7446218
		0.1	1	699079	7446169
		0.1	1	699142	7446754
		0.1	1	699187	7446156
		0.1	1	699216	7446699
		0.1	1	699280	7446221
		0.1	1	700255	7446956
		0.1	1	706354	7446733
		0.1	1	706367	7446611
		0.1	1	706373	7446819
		0.1	1	706374	7446518
		0.1	1	706447	7446669
		0.1	1	706457	7446593
		0.1	1	706499	7446707
		0.1	1	708140	7448403
		0.1	1	708175	7448431
		0.1	1	709549	7450286
		0.1	1	709667	7450268
		0.1	1	709681	7450240
		0.1	1	709683	7450274
		0.1	1	709694	7450283
		0.1	1	709730	7450251
		0.1	1	709749	7450309
		0.1	1	709771	7450399
		0.1	1	709863	7450571
		0.1	1	709871	7450491
		0.1	1	710005	7450579
		0.1	1	710666	7450528
		0.1	1	711160	7450347
		0.1	1	711315	7450332
		0.1	1	711343	7450314
		0.1	2	699134	7446228
		0.1	2	699230	7446210
		0.1	2	699269	7446260
		0.1	2	706355	7446565

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
Rhagodia sp. Hamersley (M. Trudgen 17794) P3	A	0.1	2	706430	7446784
		0.1	2	706431	7446789
		0.1	2	709697	7450250
		0.1	3	699031	7446175
		0.1	3	699383	7446337
		0.1	3	706330	7446785
		0.1	3	706376	7446829
		0.1	3	706412	7446790
		0.1	3	707818	7450448
		0.1	3	708029	7450331
		0.1	3	711060	7450377
		0.1	4	699200	7446206
		0.5	1	699258	7446703
	G	0.5	1	701072	7446511
		0.5	1	701447	7445501
		0.5	1	701496	7445998
		0.5	1	701584	7446234
		0.5	1	706263	7446392
		0.5	2	703455	7446430
Triodia sp. Mt Ella (M.E. Trudgen 12739) P3	A	0.1	2	717464	7449882
		0.1	20	718161	7450162
		0.5	30	716998	7450255
		0.5	50	717487	7449880
		1	20	718203	7451112
		1	50	716891	7450100
		1	100	717049	7450268
		20	300	718093	7450092
		25	200	716984	7450220
		25	400	718085	7450116
		25	400	718093	7450193
		25	400	718114	7450216
		35	300	718148	7450267
		35	300	718168	7450238
		35	400	718089	7450122
		35	400	718101	7450173
		5	20	718980	7450183
		5	150	717529	7449873
	C	-	10	716946	7450138
	E	-	10	716946	7450138
	H	-	10	719036	7450892
		-	15	717661	7450706

Species	Project	Cover (%)	Abundance	Easting (mE)	Northing (mN)
Triodia sp. Mt Ella (M.E. Trudgen 12739) P3	H	-	20	717616	7450700
		-	20	718206	7451107
		-	20	719297	7450800
		-	20	719324	7450801
		-	40	718141	7450890
		-	50	717507	7450099
		-	100	717739	7449887
		-	100	717800	7449890
		-	100	718035	7449925
		-	100	718064	7449951
		-	100	718113	7450112
		-	100	719356	7450802
		-	100	719400	7450784

[1] - Project	Source
A	Greater Hope Downs – Flora and Vegetation survey (current survey)
B	Hope Downs proposed rail SO-06-01466 (Pilbara Iron 2006)
C	Hope Downs Rail Corridor (Juna Downs Section) Vegetation and Flora Survey (Biota Environmental Sciences 2006)
D	Rare Flora Survey for Dales Gorge Target Drilling (Rio Tinto 2012)
E	Flora and Vegetation Survey at Hope Downs 1 (Rio Tinto 2013)
F	Baby Hope Downs Flora and Vegetation Survey (Biota Environmental Sciences 2014)
G	Hope Downs 2 AR-13-11444 and Bakers East SO-13-11013 Biological Assessment (Astron Environmental Services 2014)
H	Systematic Flora Survey at Hope Downs 1 Bedded Hilltop Drilling AR-15-13090 (Rio Tinto 2015)
I	Rio Tinto flora database - Newman Highway (No Report Observation) (Rio Tinto Iron Ore 2018)
J	Threatened and Priority Flora Database (TPFL) (Department of Biodiversity, Conservation, and Attractions 2019a)
K	Western Australian Herbarium Database (Department of Biodiversity, Conservation, and Attractions 2019b)

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Astron Environmental Services 2014, *Hope Downs 2 AR-13-11444 and Bakers East SO-13-11013 Biological Assessment*, unpublished report to Rio Tinto Iron Ore.

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Rio Tinto Iron Ore 2018, 'Flora Database Records', Digital dataset supplied by Rio Tinto.

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Appendix O: Introduced Flora Species (Weed) Locations and Descriptions

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Survey Area

Introduced Flora Species - Recorded by Astron

- **Aerva javanica*
- **Argemone ochroleuca*
- **Bidens bipinnata*
- **Cenchrus ciliaris*
- **Cenchrus setiger*
- **Chloris virgata*
- **Citrullus colocynthis*
- **Conyza bonariensis*
- **Cynodon dactylon*
- **Datura leichhardtii* subsp. *leichhardtii*
- **Euphorbia hirta*
- **Flaveria trinervia*
- **Lactuca serriola*
- **Malvastrum americanum*
- **Melinis repens*
- **Rumex vesicarius*
- **Setaria verticillata*
- **Sigesbeckia orientalis*
- **Sisymbrium orientale*
- **Solanum nigrum*
- **Sonchus oleraceus*
- **Tribulus terrestris*
- **Tridax procumbens*
- **Vachellia farnesiana*

Introduced Flora Species - Previous

- **Bidens bipinnata*
- **Brassica tournefortii*
- **Cenchrus ciliaris*
- **Cenchrus setiger*
- **Chloris virgata*
- **Datura leichhardtii* subsp. *leichhardtii*
- **Flaveria trinervia*
- **Malvastrum americanum*
- **Rumex vesicarius*
- **Setaria verticillata*
- **Sigesbeckia orientalis*
- **Sonchus oleraceus*
- **Vachellia farnesiana*

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Rio Tinto

Hope Downs 2 Proposal – Flora and Vegetation Survey

Figure O.1: Introduced flora species (weed) locations

Scale: 1:80,000 at A3

Coordinate System: GDA 1994 MGA Zone 50

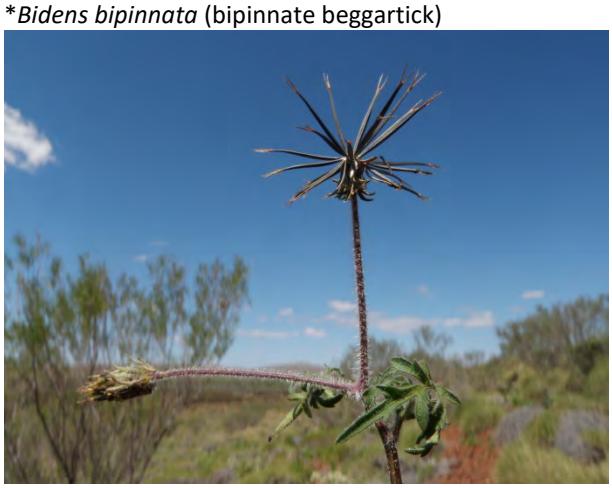
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Author: B. Eckermann | Drawn: C. Dyde | Date: 07-11-2019 | Figure Ref: 14292A-19-BIDR-3RevB_191107_Weeds_FigO1

Table O.1: Weed species recorded in the survey area.

Species	Description[1]	Habitat[1]
**Bidens bipinnata* (bipinnate beggartick) 	Erect annual, herb, 0.1 m to 0.9(-1.5) m high. Flowers yellow, March to September.	Alluvium, clay, loam over sandstone, limestone. Along rivers and creeks, coastal areas, rocky hillsides.
**Brassica tournefortii* (Mediterranean turnip)[2] 	Annual, herb, 0.1 m to 0.6 m high. Flowers yellow-cream-white, June to November.	Sandy soils. Aggressive weed of disturbed ground, roadsides, cultivation and seaside.
**Cenchrus ciliaris* (buffel grass) 	Tufted or sometimes stoloniferous perennial, grass-like or herb, 0.2 m to 1.5 m high. Flowers purple, February to October.	White, red or brown sand, stony red loam, black cracking clay.

Species	Description[1]	Habitat[1]
**Cenchrus setiger* (birdwood grass) 	Erect, tussocky, stoloniferous perennial, herb or grass-like, to 0.5 m high. Flowers cream-purple, April to May.	Brown sands, red loam, pindan soils. Sand dunes, plains, rangelands, stony hillsides, floodplains.
**Chloris virgata* (feathertop rhodes grass) 	Annual, grass-like or herb, (0.15-)0.23-0.45(-0.95) m high. Flowers green-purple, April to May or September.	Clay, sand. Sand dunes.
**Conyza bonariensis* (flaxleaf fleabane) 	Erect annual, herb, 0.15 m to 1.5 m high. Flowers white, January to December.	Variety of soils. Weed of cultivation, waste places and roadsides.

Species	Description[1]	Habitat[1]
**Cynodon dactylon* (Couch) 	Rhizomatous (or stoloniferous), prostrate perennial, grass-like or herb, 0.05 m to 0.3 m high. Flower green-purple, June to November or February.	Sand, loam, clay.
**Datura leichhardtii* subsp. *leichhardtii* (Native Thornapple) 	Stout annual, herb, 0.2 m to 1 m high. Flowers white, January to October.	Alluvium. Along watercourses.
**Flaveria trinervia* (speedy weed) 	Erect annual shrub. Flowers yellow, May to July.	Sandy flat, along watercourses.

Species	Description[1]	Habitat[1]
**Lactuca serriola* (prickly lettuce) 	Erect annual or biennial, herb, 0.4 m to 2 m high. Flowers yellow, October to December or January to February.	Roadsides, gardens, cultivated fields, disturbed sites.
**Malvastrum americanum* (spiked malvastrum) 	Erect perennial, herb or shrub, 0.5 m to 1.3 m high. Flowers yellow-orange, April to July.	Orange/red/yellow sands, gritty alluvial sand, black/brown clay, alluvial cracking clays, limestone, calcrete. Stony ridges and hillsides, floodplains, along drainage lines.
**Rumex vesicarius* (ruby dock)[2] 	Erect, stout, fleshy, hollow-stemmed annual, herb, 0.2 m to 1 m high. Flowers red-pink, July to September.	Sandy alluvial soils, gravelly ironstone soils. Along roadsides, in disturbed areas.

Species	Description[1]	Habitat[1]
**Setaria verticillata* (whorled pigeon grass) 	Loosely tufted annual, grass-like or herb, 0.1 m to 1.3 m high. Flowers December or January to June.	Sand, clay, loam.
**Sigesbeckia orientalis* (Indian weed) 	Erect, slender annual, herb, 0.15 m to 1 m high. Flowers yellow, January to December.	Loamy soils over limestone or granite. Rocky gullies, limestone ranges, creek beds.
**Solanum nigrum* (black berry nightshade) 	Erect perennial, herb or shrub (short-lived), 0.3 m to 1 m high. Flowers white, January to December.	Dampland, along drainage line. Plain, hillslope, disturbed ground. Sand.

Species	Description[1]	Habitat[1]
**Sonchus oleraceus* (common sowthistle) 	Erect annual, herb, to 1.5 m high. Flowers yellow, January to December.	Variety of soils. Weed of waste places and disturbed ground.
**Vachellia farnesiana* (mimosa bush) 	Erect, spreading, thicket-forming, thorny tree or shrub, to 4 m high, bark dark grey, rough; leaves pinnate. Flowers yellow, June to August.	Stony sandy, clay or loam soils, gravel. Low-lying areas, river and creek banks, disturbed sites.

[1] – Florabase (Western Australian Herbarium 1998-2018).
[2] – Species not observed in current survey, but previously recorded within survey area. For project presence see Table O.2.

Table O.2: Locations of weed species recorded in the survey area (GDA94, Zone 50).

Species	Project[1]	Cover (%)	Abundance	Easting (mE)	Northing (mN)
**Bidens bipinnata*	A	-	5	696277	7445914
		-	30	696146	7445827
		-	40	696203	7445876
		-	40	706632	7446526
		-	100	695902	7445622
		-	100	696050	7445765
		-	100	696106	7445823
		-	100	696238	7445896
		-	100	696357	7445945
		-	200	695972	7445757
		-	500	695939	7445767
		0.1	1	697944	7446259
		0.1	1	702535	7446647
		0.1	1	707275	7445867
		0.1	1	708078	7448129
		0.1	3	719037	7456581
		0.1	5	705856	7446600
		0.1	6	714648	7452107
		0.1	6	718877	7456696
		0.1	10	695980	7446338
		0.1	10	702109	7442804
		0.1	10	706225	7446529
		0.1	10	709878	7450531
		0.1	10	709884	7450523
		0.1	10	710818	7450419
		0.1	10	718990	7456473
		0.1	10	720359	7450413
		0.1	15	706289	7443704
		0.1	15	718441	7454793
		0.1	20	702928	7449192
		0.1	20	706225	7446529
		0.1	20	709903	7450533
		0.1	20	710498	7450464
		0.1	20	710638	7450490
		0.1	25	718681	7456938
		0.1	30	710423	7450450
		0.1	30	711147	7450387
		0.1	30	719281	7454646

Species	Project[1]	Cover (%)	Abundance	Easting (mE)	Northing (mN)
		0.1	40	702774	7449267
		0.1	50	706457	7446593
		0.1	50	708156	7448359
		0.1	50	710685	7450451
		0.1	70	715647	7452359
		0.1	80	705243	7446960
		0.1	80	710941	7450542
		0.1	80	715969	7451699
		0.1	100	695845	7445441
		0.1	100	701678	7445609
		0.1	200	705143	7448941
		0.1	200	706244	7448788
		0.1	200	706322	7446735
		0.1	200	706377	7446614
		0.1	200	709045	7449688
		0.1	200	711311	7450316
		0.1	200	720355	7451567
		0.1	500	695611	7445317
		0.1	500	695767	7445375
**Bidens bipinnata*	A	0.1	500	695836	7445469
		0.1	500	698423	7446984
		0.1	500	701397	7446256
		0.1	500	701475	7446130
		0.1	500	707974	7448449
		0.1	500	708028	7450324
		0.1	700	711417	7450351
		0.1	1000	695501	7445232
		0.1	1000	695777	7445423
		0.1	1000	695807	7445430
		0.1	1000	704680	7446950
		0.1	1500	707818	7450448
		0.1	2000	696750	7446185
		0.1	2000	710669	7450451
		0.5	1	706588	7450157
		0.5	10	701610	7445967
		0.5	10	701612	7445972
		0.5	10	701620	7445957
		0.5	20	701623	7445913
		0.5	20	701624	7445924

Species	Project[1]	Cover (%)	Abundance	Easting (mE)	Northing (mN)
**Bidens bipinnata*	A	0.5	20	702842	7449232
		0.5	20	702926	7449161
		0.5	20	702926	7449205
		0.5	20	702933	7449174
		0.5	20	702940	7449196
		0.5	20	704495	7449030
		0.5	20	704530	7449018
		0.5	25	703521	7448903
		0.5	35	706655	7448969
		0.5	50	703522	7448905
		0.5	50	703552	7448913
		0.5	100	716039	7451579
		0.5	120	706213	7446504
		0.5	250	699269	7446266
		0.5	250	716014	7451622
		0.5	500	695631	7445372
		0.5	500	701652	7445711
		1	40	706292	7443062
		1	300	710667	7450425
		1	500	695433	7445209
		1	2000	700255	7446956
		1	5000	695530	7445282
		1	5000	701608	7445751
		2	300	696381	7445980
		2	300	696539	7445989
		2	300	696568	7445945
		2	300	696607	7445979
		2	300	696620	7446049
		2	300	696659	7446022
		2	300	696671	7446097
		2	300	696675	7446135
		3	1000	696428	7445960
	B	-	1	698722	7445491
		-	1	698744	7445573
		-	1	698761	7446051
		-	1	698786	7446046
		-	1	698849	7445186
		-	1	698850	7445174
		-	1	706133	7444097

Species	Project[1]	Cover (%)	Abundance	Easting (mE)	Northing (mN)
**Bidens bipinnata*	B	-	1	706147	7443993
		-	1	706155	7443871
		-	1	706167	7444334
		-	1	706177	7444269
		-	1	706178	7444184
		-	1	706189	7444235
		-	1	706197	7449222
		-	1	706248	7449320
		-	1	706294	7449027
		-	1	707358	7443287
		-	1	717557	7455709
		-	1	717644	7455754
		-	1	717698	7455808
		-	1	717917	7455363
		-	1	717956	7455447
		-	50	717653	7455606
	C	-	1	698744	7445573
		-	1	706189	7444235
		-	1	707358	7443287
	D	0.5	4	705727	7446535
		0.5	6	700888	7446474
		0.5	10	701594	7446130
		0.5	10	705948	7446543
		0.5	10	706651	7446512
		0.5	15	705783	7446530
		0.5	15	705830	7446488
		0.5	20	706021	7446546
		0.5	20	706218	7446536
		0.5	50	701719	7445623
		0.5	50	705750	7446519
	E	-	1	717354	7449903
	H	-	1	716084	7453270
		-	800	717271	7454170
		0.1	100	715444	7452890
		2	3	715444	7452890
**Brassica tournefortii*	B	-	1	706177	7444269
		-	1	706557	7444961
**Cenchrus ciliaris*	A	0.1	1	706044	7445212
		0.1	2	701532	7445507

Species	Project[1]	Cover (%)	Abundance	Easting (mE)	Northing (mN)
		0.1	6	701608	7445751
		0.1	10	700010	7444534
		0.5	20	699998	7444557
		0.5	20	699999	7444577
		0.5	20	700018	7444600
		0.5	20	700035	7444642
		0.5	25	707048	7445427
		0.5	80	706738	7445287
		1	20	704027	7444307
		1	20	704044	7444321
		1	20	704055	7444338
		1	20	705695	7445252
		1	20	705713	7445292
		1	20	706292	7443062
		1	20	706325	7443186
		1	20	706348	7443251
		1	20	706356	7443204
		1	20	706361	7443223
		1	20	706364	7443232
**Cenchrus ciliaris*	A	1	100	701490	7443878
		1	200	706640	7445126
		1	250	706416	7444693
		15	750	706392	7443534
		18	1000	706206	7445142
		2	80	706934	7445418
		2	100	706330	7443227
		2	100	706343	7443189
		2	200	706802	7445327
		2	200	706860	7445394
		2	250	706763	7445254
		2	300	701536	7445502
		25	2000	706197	7443827
		3	50	707275	7445867
		35	250	707021	7445409
		4	300	702109	7442804
		5	100	707246	7445760
		5	200	706874	7445360
		5	300	702620	7443049
		5	300	702748	7443218

Species	Project[1]	Cover (%)	Abundance	Easting (mE)	Northing (mN)
**Cenchrus ciliaris*	A	5	300	703061	7443351
		5	300	703085	7443406
		5	600	701347	7443766
		5	600	702682	7443102
		5	600	703167	7443479
		8	80	703034	7443326
		8	200	697184	7446846
		8	200	702814	7443254
		8	300	703189	7443487
		8	1000	706556	7444767
	B	-	1	706147	7443993
		-	1	706155	7443871
		-	1	706167	7444334
		-	1	706177	7444242
		-	1	706178	7444184
		-	1	706557	7444978
	H	-	1	710267	7452510
		-	10	716180	7452550
**Cenchrus setiger*	A	0.1	1	707275	7445867
		0.1	3	701609	7445832
		0.1	5	695875	7445464
		0.1	15	701534	7445512
		0.1	15	702660	7443054
		0.1	20	702726	7443180
		0.5	15	706949	7445404
		1	5	702677	7443148
		1	50	706837	7445329
		10	200	706587	7445030
		2	75	706294	7443088
		2	100	707247	7445761
		3	50	706295	7443697
		3	150	706722	7445204
		5	50	706292	7443062
		6	150	706297	7443339
		8	250	706347	7443425
	B	-	1	706148	7443922
		-	1	706248	7444433
**Chloris virgata*	A	0.1	1	695980	7446338
		0.5	1	696428	7445960

Species	Project[1]	Cover (%)	Abundance	Easting (mE)	Northing (mN)
**Chloris virgata*	H	-	1	715444	7452890
**Conyza bonariensis*	A	0.1	1	707275	7445867
**Cynodon dactylon*	A	0.1	5	700255	7446956
**Datura leichhardtii* subsp. *leichhardtii*	A	0.1	1	700255	7446956
		0.1	1	706695	7446818
		0.1	20	701676	7445632
**Flaveria trinervia*	A	0.1	1	706292	7443062
		0.1	1	707275	7445867
		0.1	2	720355	7451567
		0.1	3	695617	7445362
		0.1	5	702109	7442804
		0.1	20	701676	7445642
		0.1	20	702787	7443238
		0.1	25	701608	7445751
		0.1	30	700255	7446956
		0.5	5	706390	7442961
**Lactuca serriola*	A	0.1	2	707099	7449419
	I	-	1	717740	7458320
		-	1	718512	7458435
**Malvastrum americanum*	A	0.1	1	695311	7446872
		0.1	1	706457	7446593
		0.1	2	696656	7446022
		0.1	2	718301	7455179
		0.1	2	718335	7455098
		0.1	2	718529	7454873
		0.1	3	701491	7445451
		0.1	3	715924	7452452
		0.1	4	705973	7445811
		0.1	4	707275	7445867
		0.1	5	696428	7445960
		0.1	5	701754	7445482
		0.1	5	706459	7446548
		0.1	5	714648	7452107
		0.1	8	700255	7446956
		0.1	8	701678	7445610
		0.1	10	718990	7456473
		0.1	12	718877	7456696
		0.1	15	701608	7445751
		0.1	15	708156	7448359

Species	Project[1]	Cover (%)	Abundance	Easting (mE)	Northing (mN)
**Malvastrum americanum*	A	0.1	30	701941	7444507
		0.1	100	696838	7446379
		0.5	1	696307	7445921
		0.5	1	696307	7445923
		0.5	5	701610	7445967
		0.5	5	701617	7445892
		0.5	10	696307	7445925
		0.5	50	701485	7446089
		1	60	705729	7445302
	D	0.5	1	703455	7446430
		0.5	2	701821	7445415
		0.5	8	701918	7445413
		0.5	8	706386	7446577
		0.5	10	706325	7446602
		0.5	15	701675	7445632
	H	-	10	716180	7452550
		-	50	714645	7452850
		0.1	100	715444	7452890
**Rumex vesicarius*	E	-	5	719408	7450712
	H	0.1	1	715444	7452890
	I	-	1	717557	7458342
		-	1	717605	7458489
		-	1	717717	7459236
		-	1	717904	7459380
		-	1	717945	7459461
		-	1	718036	7459461
		-	1	718066	7459477
		-	1	718067	7459429
		-	1	718076	7459447
		-	1	718094	7459415
		-	1	718762	7459204
**Setaria verticillata*	A	0.1	1	705973	7445811
		0.1	5	696428	7445960
		0.1	10	707293	7445637
		0.1	50	720355	7451567
	B	-	1	698722	7445491
**Sigesbeckia orientalis*	A	0.1	1	706292	7443062
	B	-	1	706167	7444334
	E	-	1	717354	7449903

Species	Project[1]	Cover (%)	Abundance	Easting (mE)	Northing (mN)
**Sigesbeckia orientalis*	E	-	5	718338	7450204
**Solanum nigrum*	G	1	3	706762	7449301
		1	5	706873	7449533
**Sonchus oleraceus*	A	0.1	1	701628	7445795
		0.1	2	695509	7445249
		0.1	12	695989	7445449
		0.1	15	701608	7445751
		0.1	30	695640	7445347
		0.5	1	701625	7445750
	B	-	1	697799	7445291
		-	1	706121	7444064
		-	1	706147	7443993
		-	1	706155	7443871
		-	1	706156	7444070
		-	1	706167	7444334
		-	1	706177	7444269
		-	1	706178	7444184
		-	1	706248	7444433
		-	1	706343	7444556
		-	1	706557	7444978
	C	-	1	703816	7444021
	F	1	10	707272	7448910
		1	15	707229	7448920
		1	15	707278	7448930
		1	20	707226	7448930
	J	-	1	703816	7444021
**Vachellia farnesiana*	A	-	3	696049	7445786
		-	3	696159	7445885
		-	10	695902	7445622
		-	10	696146	7445827
		-	10	696296	7445922
		-	20	695972	7445757
		-	30	696050	7445765
		-	40	696236	7445888
		0.1	1	696340	7445967
		0.1	1	696351	7445975
		0.1	1	696591	7445975
		0.1	1	696653	7446020
		0.1	1	705797	7445560

Species	Project[1]	Cover (%)	Abundance	Easting (mE)	Northing (mN)
**Vachellia farnesiana*	A	0.1	1	706951	7445404
		0.1	1	715700	7452385
		0.1	2	695749	7445407
		0.1	2	696614	7445999
		0.1	2	696671	7446095
		0.1	2	706145	7443976
		0.1	2	706161	7444287
		0.1	2	706428	7446730
		0.1	3	706317	7444514
		0.1	4	696655	7446104
		0.1	4	696681	7446139
		0.1	4	706638	7445087
		0.1	5	695776	7445370
		0.1	5	706721	7445221
		0.1	6	706783	7445278
		0.1	7	702727	7443183
		0.1	7	707275	7445867
		0.1	10	696428	7445960
		0.1	12	706206	7445142
		0.1	20	696773	7446200
		0.5	1	701676	7445632
		0.5	2	696306	7445953
		0.5	2	707247	7445758
		0.5	2	707288	7445857
		0.5	3	695818	7445471
		0.5	4	696309	7445930
		0.5	15	696304	7445920
		1	2	695587	7445348
		1	3	696616	7446068
		1	8	695875	7445478
		10	10	695682	7445394
		2	5	706397	7444685
	B	-	1	707283	7445745
	C	-	1	707283	7445745

[1] - Project	Source
A	Greater Hope Downs – Flora and Vegetation survey (current survey)
B	Hope Downs Rail Corridor (Juna Downs Section) Vegetation and Flora Survey (Biota Environmental Sciences 2006)
C	Flora and Vegetation of the Hope Downs 2 Area (Mattiske Consulting 2010)
D	Hope Downs 2 and Bakers East Flora & Fauna Assessment (Astron Environmental Services 2014)
E	Systematic Flora Survey at Hope Downs 1 Bedded Hilltop Drilling AR-15-13090 (Rio Tinto 2015)
F	Weed Control Program - Inland Operations, Hope Downs 1 - 2016 Annual Summary Report (Astron Environmental Services 2016)
G	Weed Control Program – Inland Operations, Hope Downs 1 – 2017 Annual Summary Report (Astron Environmental Services 2018)
H	Baby Hope Downs Flora and Vegetation Survey (Biota Environmental Sciences 2014)
I	Weed Control Program – Inland Operations – Brockman 2 and Hope Downs 1 (Astron Environmental Services 2015)
J	Flora and Vegetation of the Hope Downs 2 Area (Mattiske Consulting 2010)

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