biologic

Strategic Environmental Assessment

Short-range Endemic Invertebrate Review and Risk Assessment

BHP Billiton Iron Ore Pty Ltd

September 2015

Strategic Environmental Assessment

Short-range Endemic Invertebrate Review and Assessment

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EXECUTIVE SUMMARY

BHP Billiton Iron Ore is seeking a regional strategic environmental assessment, which includes proposed future mines and associated infrastructure developments in the Central Pilbara region.

Biologic Environmental Survey was commissioned by BHP Billiton Iron Ore to undertake a strategic environmental assessment for terrestrial short-range endemic invertebrates (SREs) within the Study Area.

This report provides an assessment of potential impacts on short-range endemic (SRE) invertebrate habitats arising from the Strategic Proposal. The assessment has been conducted in two phases, as outlined below, and consolidated into a single assessment.

The Phase 1 assessment focussed on investigating land system suitability for SRE habitats, within the context of regional SRE fauna sampling effort and current knowledge of SRE fauna distribution patterns.

The Phase 2 assessment consolidated the Phase 1 assessment with regional vegetation mapping (Onshore 2014) and regional vertebrate fauna habitat mapping (Biologic 2014) so as to produce:

- a detailed, consolidated map of the major SRE habitats across the SEA Study Area;
- an assessment of the suitability of the consolidated habitats for SRE fauna across the SEA Study Area; and
- an assessment of the relative importance and proportional area of each SRE habitat type across the Study Area, within each BHP Billiton Iron Ore Hub and with respect to the current Full Development Scenario (FDS) disturbance footprints.

This report provides guidance regarding the potential significance of the FDS, regionally and at the Operation Tenure scale, and potential priorities for future management.

Phase 1 assessment

A desktop review was undertaken of 62 survey or impact assessment reports across the 36 development projects located within the Study Area. The survey or impact assessment reports were compared with the combined WAM/ BHP Billiton Iron Ore database records. The survey effort undertaken throughout the Study Area included 22,906 SRE fauna collection records from combined database searches and 551 habitat assessment sites (from BHP Billiton Iron Ore database records only). The results of the database searches clearly illustrate the spatial extent of the SRE survey work that has been undertaken within the Study Area to date.

Within the Study Area a total of 144 SRE or potential SRE species have been recorded (from database searches), including mygalomorph spiders (59 species), selenopid spiders (13 species), scorpions (10 species), pseudoscorpions (13 species), snails (4 species), millipedes (35 species), and isopods (10 species). Assessment of regional distribution of species was not possible for all

SRE faunal groups due to incomplete and patchy survey data. However, the spatial extent of survey work in the Pilbara and the consistent collection of particular faunal groups (namely Camaenid snails, *Urodacus* scorpions, *Antichiropus* millipedes, and mygalomorph spiders) has provided some examples of regionalisation.

The desktop review highlighted the inconsistencies in the way in which the knowledge of SRE fauna, distributions and habitat requirements have been recorded in the Pilbara to date. The variability within the reports reviewed during this process illustrates the current lack of standardised reporting for SRE taxa and habitat types. Inconsistencies included, but were not limited to:

- Species nomenclature - species nomenclature varied between reports conducted by different consultants. Additionally some species previously thought to be SREs are no longer regarded as such as a result of progress with species identifications.
- Habitat descriptions - the description and classification of suitabile SRE habitats lacks consistency between reports, and even within some reports. This makes consistent identification of potential SRE habitats problematic.
- Biased sampling - most SRE surveys are associated with development proposals and therefore the location and timing of the survey effort is biased towards development areas within the Study Area.

Taking these constraints into consideration, a methodology was developed based on occurrence of potential SRE habitats and microhabitats and the respective connections with SRE fauna, and applied to the 74 Land systems within the Study Area. The extent of each land system, being the most finely scaled mappable habitat unit, is considered to indicate the maximum potential range of SRE habitats that occur within that particular land system; however, land systems are based on soils, vegetation type and geology and are not an adequate surrogate for SRE habitat or species distributions.

This approach provided a five-tiered, mappable suitability assessment that allowed SRE fauna, habitats and disturbance footprints to be overlaid and assessed with respect to potential impacts.

Twelve SRE habitats were identified through this process, based on the presence of microhabitats (relevant to SRE fauna) and the likelihood of SRE fauna occurring. Once ranked, deep gullies and gorges, and salt lakes were regarded as the most suitabile for SRE fauna.

Phase 2 assessment

The Phase 2 process was in three steps:

- the reconciliation of the 12 SRE habitat types derived during the Phase 1 assessment with the 17 vertebrate fauna habitats identified as part of the fauna habitat mapping process;

- the reconciliation of the 17 vertebrate fauna habitats with the 16 landforms and 47 broad floristic formations categorised within the vegetation mapping process; and
- consolidating this data into ten broad SRE habitat units.

The broad SRE habitat units were based on the polygons mapped in the fauna habitat and vegetation mapping reports, and were not always directly relatable to a single SRE habitat type. This has resulted in some of the habitat units containing more than one habitat type. Likewise, the extent to which a habitat unit accurately reflects the true extent of a habitat type has been taken into account when assessing the overall suitability.

Three SRE habitat units dominate the total mapped area; Groves and Drainage Foci (level 3: 46,648 ha), Boulders, Outcrops, Ridges and Breakaways (level 4: 45,498 ha) and Drainage foci and Swamp/ depressions (level 4: 25,024 ha), with the least common the Isolated sands (level 4: 62Ha).

The risk assessment showed a wide range of outcomes within the Operation Tenures, with some Operation Tenures containing up to eight of the ten SRE habitat units (MAC-PAC, Mudlark Well and South Flank) while at least one contained only three SRE habitat units (Caramulla). Two Operation Tenures had less than 25% of the area mapped (Roy Hill [10.5%] and Ministers North [23.5%]) and one (Rocklea) had no mapping at all. As such, assessments for these Operation Tenures were limited.

The assessment within this report is also limited with respect to providing a regional-scale assessment as the mapping was restricted to the areas where fauna and vegetation mapping has been conducted, which focused primarily on the Operation Tenures. As such, the Phase 1 assessment is still relevant at the regional scale, but the Phase 2 assessment provides greater detail within those projects Operation Tenures where fauna and vegetation mapping has occurred.

This assessment provides guidance regarding the potential significance of individual Operation Tenures and where the potential priorities for future management are.

Within this context of this assessment providing guidance for potential future priorities and management, 15 Operation Tenures were assessed as having at least one habitat as potentially a high priority for future management, with five of these determined based on Phase 1 mapping due to incomplete Phase 2 mapping. Of the remaining Operation Tenures, two were assessed as a low priority, but both have incomplete survey coverage within the FDS, and the third was assessed as a medium priority.

1 INTRODUCTION

BHP Billiton Iron Ore is seeking a regional strategic environmental assessment (Figure 1.1), which includes proposed future mines and associated infrastructure developments in the Central Pilbara region.

This report provides an assessment of potential impacts on short-range endemic (SRE) invertebrate habitats. The assessment has been conducted in two phases, as outlined below, and consolidated into a single assessment.

The Phase 1 assessment focussed on investigating land system suitability for SRE habitats, within the context of regional SRE fauna sampling effort and current knowledge of SRE fauna distribution patterns.

The Phase 2 assessment consolidated the Phase 1 assessment with regional vegetation mapping (Onshore 2014) and regional vertebrate fauna habitat mapping (Biologic 2014) so as to produce:

- a detailed, consolidated map of the major SRE habitats across the SEA Study Area;
- an assessment of the suitability of the consolidated habitats for SRE fauna across the SEA Study Area; and
- an assessment of the relative importance and proportional area of each SRE habitat type across the SEA Study Area, within each BHP Billiton Iron Ore Hub and with respect to the current Full Development Scenario (FDS) disturbance footprints.

This report provides guidance regarding the potential significance of the FDS, regionally and at the Operation Tenure scale, and potential priorities for future management.

1.1 Short-range Endemism

The Environmental Protection Authority (EPA) defines short-range endemics (SREs) as…" *terrestrial and freshwater invertebrates that have naturally small distributions of less than 10,000 km*^{2} (after Harvey 2002)"; however, within this distribution, the actual areas occupied by potential SREs may be small, discontinuous or fragmented.

Potential SRE taxa typically display ecological and life-history traits including:

- poor dispersal powers;
- habitat requirements and availability: confinement to discontinuous habitats;
- usually have highly seasonal activity patterns, many species only being active during cooler, wetter periods; and
- low levels of fecundity.

Many short- range endemics are considered to be relictual taxa (remnants of species that went extinct elsewhere) and are confined to certain habitats, and in some cases, single geographic areas (Main 1996). According to Main (1996) relictual species generally persist in habitats

characterised by permanent moisture and shade. Habitats that experience high rainfall and/or fog, whether induced by topography or coastal proximity, or areas associated with freshwater courses (e.g. swamps), caves, or microhabitats associated with southern slopes of hills and ranges, rocky outcrops, deep litter beds, or various combinations of these features (Main 1996, 1999).

The key groups that are likely to contain SRE fauna include the following: Gastropoda (snails, freshwater and terrestrial) (Johnson *et al*. 2004; Johnson 2012; Johnson *et al*. 2012); Oligochaeta (earthworms); Onychophora (velvet worms); Arachnida (mygalomorph spiders, pseudoscorpions, scorpion, selenopid spiders, mites) (Castalanelli *et al*. 2014; Crews and Harvey 2011; Harvey *et al*. 2012); Malacostraca (slaters, freshwater crayfish); and Diplopoda (millipedes) (Harvey 2002). SRE tendencies may also exist within many other more poorly known groups (e.g. opiliones, geophilomorph centipedes etc), and in other ecological settings (e.g. freshwater, subterranean, soil fauna) however this report does not cover these groups/ ecosystems.

In the context of this report the term 'short-range endemics' refers to Western Australian terrestrial invertebrates and includes:

- spiders and their relatives (scorpions, pseudoscorpions and others);
- millipedes;
- isopods; and
- land snails.

Short-range endemics are protected under the following Acts:

- *Environmental Protection Act 1986*; and
- *Wildlife Conservation Act 1950*.

Therefore, any development proposal that has the potential to impact on SRE taxa needs to be assessed under the Environmental Protection Act 1986. Some of the key threatening processes identified by the EPA (2009) for SRE fauna includes:

- clearing of native vegetation (habitat removal);
- changes to fire regimes;
- introduction and/or spread of weeds and soil pathogens;
- fragmentation and subdivision of habitats; and
- changes to surface hydrology.

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Pindanland
McLarty
PORT HEDLAND
Roebourne
SHAY GAP
MARBLE BAR
Main Line Rail
Chichester
Roy Hill
Fortescue
Munjina/
Upper Marillana
Marillana
Mindy
TOM PRICE
Tandanya
Yandi
Ministers North
Hamersley
Mining
Area C
Jinidi
Rocklea
Coondiner
South
Flank
Mudlark
Ophthalmia/ Prairie Downs
Newman
Gurinbiddy
Caramulla
NEWMAN
Jimblebar
Ashburton
Augustus
Trainor

Legend

- Regional Rail
- Regional Main Roads
- Regional Towns
- Karijini National Park
- BHPBIO Operation Tenure

IBRA subregion

- Ashburton
- Augustus
- Chichester
- Fortescue
- Hamersley
- McLarty
- Pindanland
- Roebourne
- Trainor

1:1,280,000

0 10 20 40 60 km

N

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BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 1.1: BHP Billiton Iron Ore Operation Tenure and IBRA subregions

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 14/01/2015. Size: A3

2 ENVIRONMENT

2.1 Biogeography

The majority of the Study Area falls within the Pilbara biogeographical region, with a small section within the Gascoyne Region as defined by the Interim Biogeographic Regionalisation of Australia (IBRA) (Thackway and Cresswell 1995).

The Pilbara bioregion is subdivided into four subregions: the Chichester, Fortescue Plains, Hamersley and Roebourne of which the Study Area covers each of these (Figure 2.1). The Gascoyne bioregion is subdivided into three subregions: the Ashburton, Carnegie and Augustus, with the Study Area covering a portion of the Augustus subregion (Figure 2.1).

The majority of the Study Area lies within the Hamersley subregion (Figure 2.1). The Hamersley subregion is a mountainous area of Proterozoic sedimentary ranges and plateaux, dissected by gorges (Kendrick 2001). The principal vegetation community comprises Mulga low woodland over bunch grasses in valley floors, while *Eucalyptus leucophloia* over *Triodia brizoides* is dominant on the ranges.

The Fortescue Plains subregion, comprises the next largest portion of the Study Area. This subregion contains the Fortescue Marsh, which is listed as a nationally important wetland (Environment Australia 2001). Outside the Fortescue Marsh, this subregion is characterised by River Red Gum (*E. camaldulensis*) woodlands fringing drainage lines and deeply incised gorge systems (Kendrick 2001).

Smaller proportions of the Study Area lie within the Chichester, Augustus and Roebourne subregions. The Chichester subregion lies within the northern section of the Pilbara Craton. It contains undulating Archaean granite and basalt plains and significant areas of basaltic ranges. The Plains support shrub steppe, which is characterised by *Acacia inaequilatera* over *Triodia wiseana* hummock grasslands. *Eucalyptus leucophloia* tree steppes occur on the ranges (Kendrick and McKenzie 2002).

Rugged low Proterozoic sedimentary and granite ranges divided by broad flat valleys characterise the Augustus subregion (Desmond *et al.* 2001). The Gascoyne River system is the main drainage for the subregion. The subregion contains extensive areas of alluvial valley-fill deposits. The shallow stony loams on the rises support Mulga woodland with areas of *Triodia* while the shallow earthy loams over hardpan on the plains are covered by Mulga parkland (Desmond *et al.* 2001).

The Roebourne subregion comprises Quaternary alluvial and Aeolian coastal and subcoastal plains. The plains are covered by a grass savannah of mixed bunch (*Aristida* spp., *Enneapogon* spp.), and hummock grasses (*Triodia* spp.) and dwarf shrubland of *Acacia stellaticeps* or *A. pyrifolia* and *A. inaequilatera*. *Triodia* hummock grasslands dominate the uplands. Ephemeral

drainage lines support *Eucalyptus victrix* or *Corymbia hamersleyana* woodlands (Kendrick and Stanley 2001).

2.2 Climate

The majority of the Study Area is within the Pilbara Region, which experiences high temperatures and low, irregular rainfall following tropical cyclones in summer. The majority of the rainfall occurs in summer, often linked with thunderstorms and occasional tropical cyclones. Average annual rainfall for the Pilbara is 290 mm, with January, February and March the wettest months. A minimum of one tropical cyclone moves through or along the coast of the region in a normal summer, supplying half the annual rainfall (McKenzie *et al.* 2009).

The climate of the Study Area was characterised into three climatic sub-types (Figure 2.2) following the Köppen classification system (Stern *et al*. 2001). This classification system uses native vegetation as an expression of climate, combining factors such as average annual temperatures and precipitation, monthly temperatures and precipitation, and the dominant seasonality of precipitation. The climatic groups and classes for the Study Area include:

Desert

- hot (persistently dry);
- hot (winter drought); and

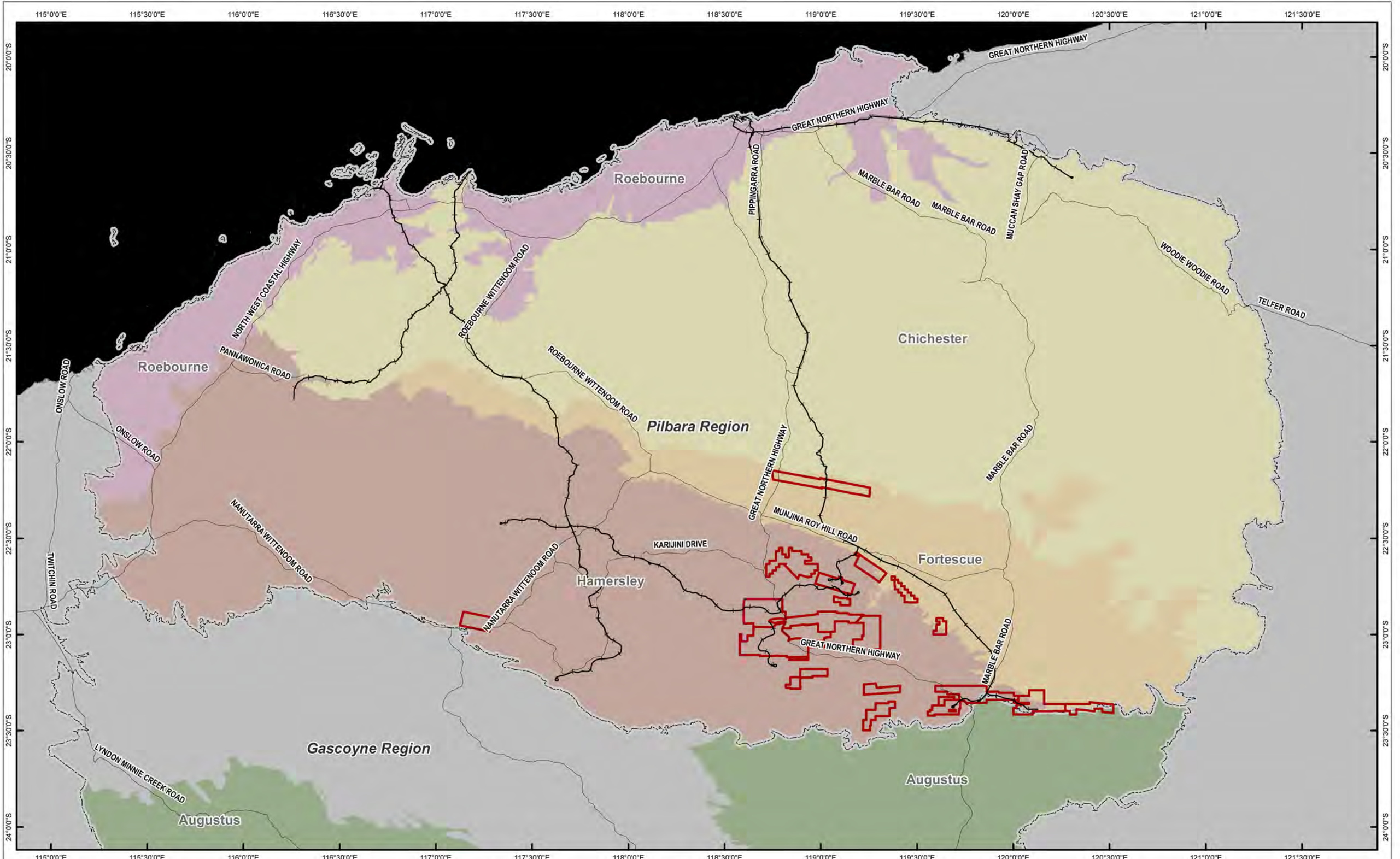
Grassland

- hot (persistently dry).

Due to the size of the Study Area, climatic conditions vary throughout. Three weather stations located throughout the Study Area provide an indication of temperature and rainfall patterns: Port Hedland post office; Wittenoom; and Newman (Figure 2.2). Average annual rainfall and average monthly maximum temperatures are shown in Table 1.1 (BoM 2013).

Table 2.1: Average weather conditions within the Study Area (BoM 2013).

Weather station location	Average annual rainfall (mm)	Average monthly temperature (°C)
Port Hedland post office	329.3 mm (max in Feb/March)	31.8°C (Nov-April)
Wittenoom	463.7 mm (max in Jan/Feb)	32.8°C (Nov-Feb)
Newman airport	310.2 mm (max in Feb)	31.4°C (Dec-Feb)



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0 20 40 60 80 100

Kilometers

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BHPBIO

SRE ASSESSMENT

STRATEGIC ASSESSMENT AREA

IBRA SUBREGIONS

FIGURE 2.1

Legend

- BHPBIO Operation Tenure
- Pilbara and Gascoyne Regions

IBRA Subregions

- Augustus
- Chichester
- Fortescue
- Hamersley
- Roebourne

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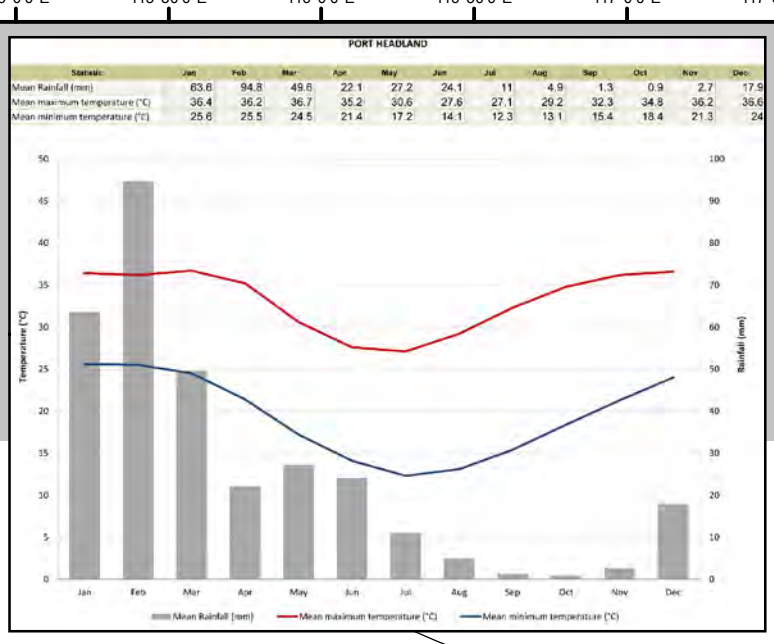

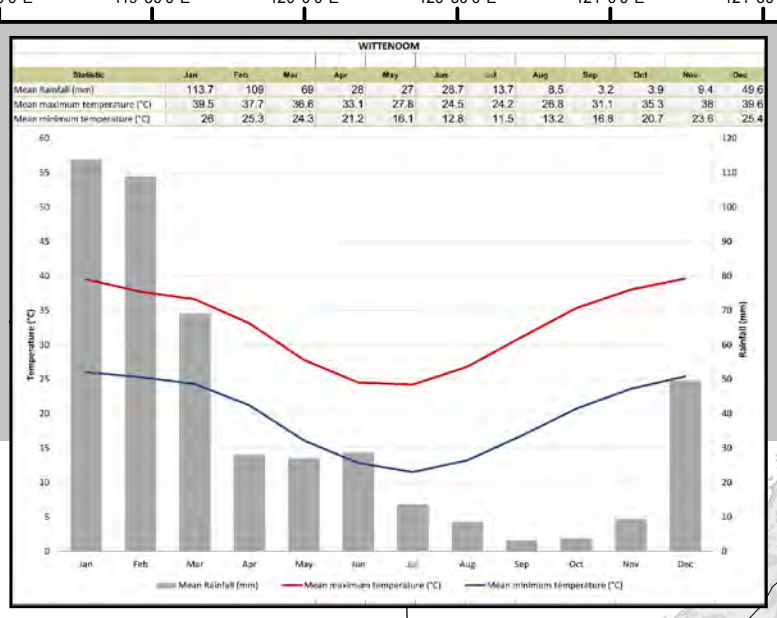

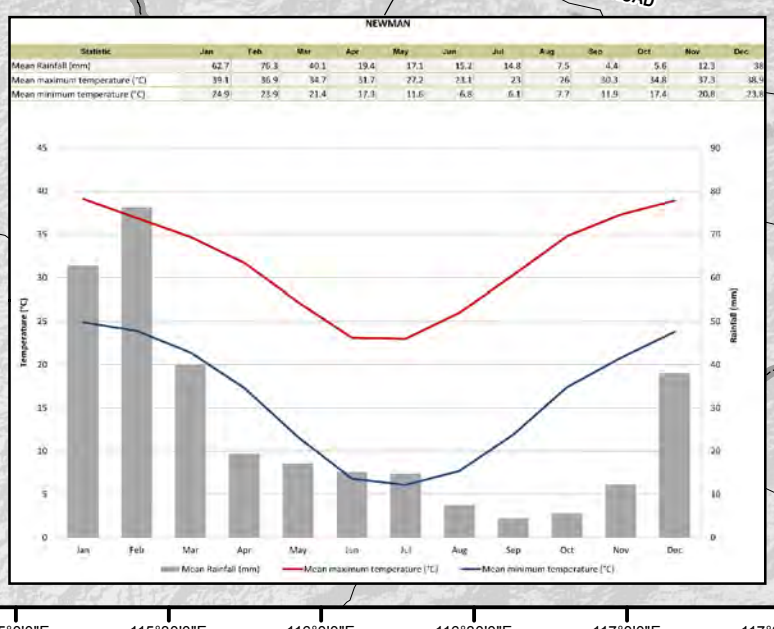

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BHPBIO
SRE ASSESSMENT
STRATEGIC ASSESSMENT AREA
CLIMATE MAPPING
FIGURE 2.2

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Kilometers
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Datum: GDA94
Projection: MGA Zone 50

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Legend

- IBRA Pilbara & Gascoyne
- BHPBIO Operation Tenure

Climate Classifications

- Desert, Hot, Persistently Dry
- Desert, Hot, Winter Drought
- Grassland, Hot, Persistently Dry
- Grassland, Hot, Summer Drought

2.3 Geology and Soils

Geology

The regional geology of the Study Area is dominated by the Archaean hard-rock landscapes of the Pilbara craton (Figure 2.3). The base rock of the northern regions of the Pilbara Craton is the most exposed and oldest Archaean granite and greenstone terrane in Australia (Griffin 1990). This granite-greenstone terrane was formed between 3,500 and 2,800 million years ago as a result of four major phases of complex deformation and associated metamorphism (Griffin 1990).

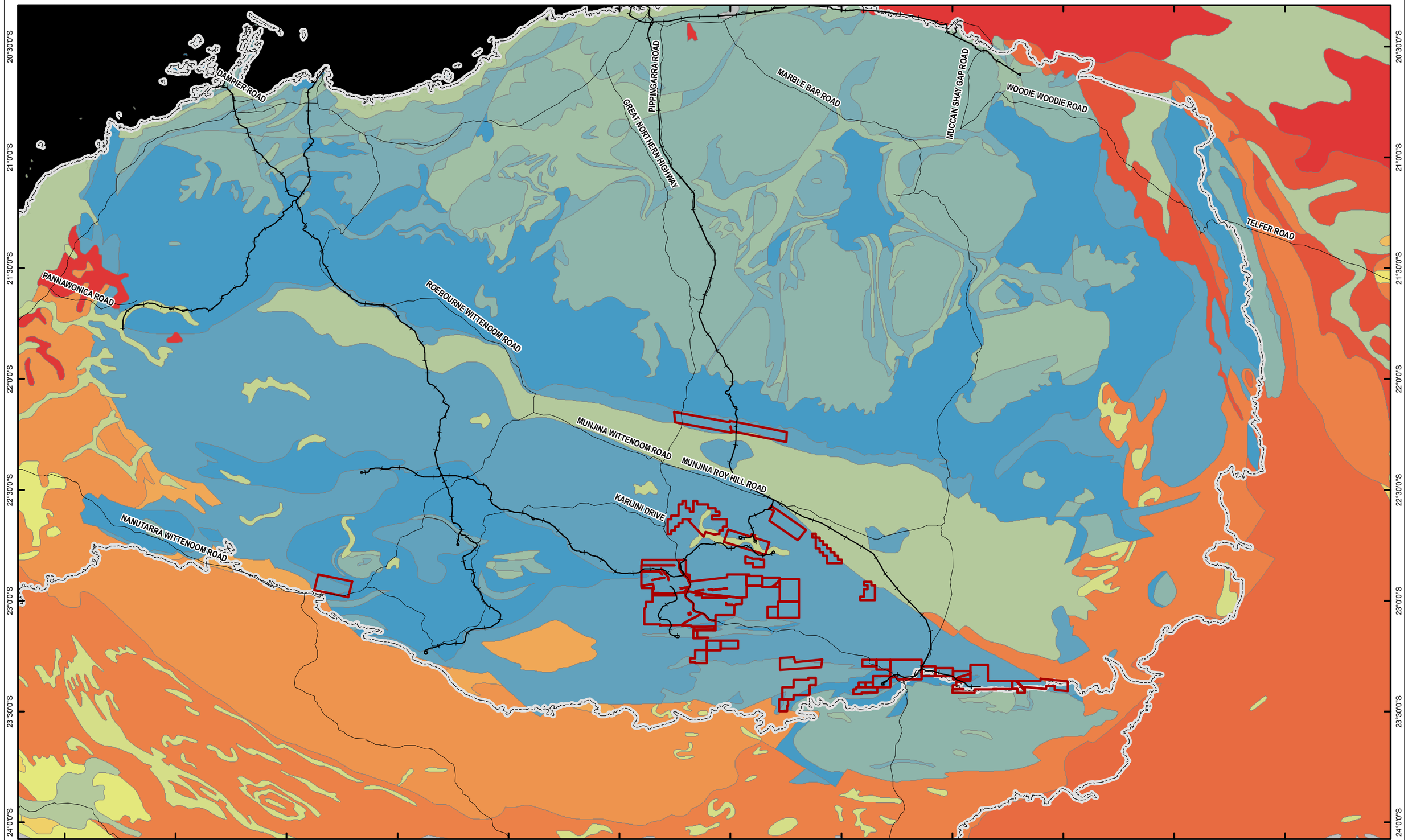
In the south, the base rock is overlain with rugged sedimentary strata, volcanic flows and lateritised caps (Archaean and Proterozoic) of the Hamersley Basin. This Basin is the younger (2,760 to 1,700 million years old) of the two major components of the Pilbara Craton, and forms a relatively undisturbed cover over the older granite-greenstone terrane (SL Johnson In: Van Vreeswyk *et al.* 2004). In the north of the Hamersley Basin are the Archaean basalt, shale, sandstone, conglomerate, tuff and carbonate formations of the Northwest and Northeast Pilbara Sub-basins. These rocks are collectively known as the Fortescue Group and, with a narrow strip of banded iron formation, they make up the Chichester Ranges (Tille 2006). To the south, the Hamersley Range has formed on the late Archaean-Palaeoproterozoic metamorphosed banded iron formations, shales, dolerite, carbonate, chert and rhyolite of the South Pilbara Sub-basin. These rocks belong to the Hamersley Group and make up part of the Ophthalmia Fold Belt. The Hamersley Basin in its entirety is also referred to as the Mount Bruce Supergroup and comprises the Turee Creek, Hamersley and Fortescue Groups (Powell and Horwitz 1994).

The Study Area south of the Hamersley Basin lies within the Ashburton Basin. The geology of the Ashburton Basin is characterized by Palaeoproterozoic sandstone, carbonate, basalt, shale and conglomerate (Tille 2006).

Small southern sections of the survey area fall within the Bangemall Proterozoic sedimentary basins and the Archaean granitic rocks of the Sylvania Inlier. A small section in the north of the Study Area falls within the Carnarvon sedimentary basin.

Soils

The soils of the Pilbara region are generally skeletal, shallow and stony with the colours reflecting the underlying parent material. Texturally, soils are stony loams, with clays and silts toward the bottom of the ranges (McKenzie *et al*. 2009). Soils are generally of low fertility and slightly acidic, except for clays associated with basalts, and alluvial and colluvial valley floors, which are more alkaline and fertile (McKenzie *et al*. 2009).



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Kilometers

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Datum: GDA94

BHPBIO

SRE ASSESSMENT

STRATEGIC ASSESSMENT AREA

GEOLOGY 2500K GENERALISED

FIGURE 2.3

SEE LEGEND SEPARATE SHEET

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Legend

IBRA Pilbara & Gascoyne

BHPBIO Operation Tenure

Geology 2500K Generalised

CODE, NARRATIVE, AGE

- AP_b:Basalt, dacite, and sandstone:Archaean
- AP_i:Iron-formation and shale:Archaean
- Ab:Metamorphosed basic and ultrabasic volcanic and intrusive rocks:Archaean
- Agn:Granite and Gneiss:Archaean
- Asf:Metamorphosed sedimentary and acid volcanic rocks:Archaean
- Cza:Alluvial, shoreline, and eolian deposits:Phanerozoic
- Czsl:Marine limestone, sandstone, and valley-fill deposits:Phanerozoic
- P-d:Basic and ultrabasic intrusive rocks:Proterozoic - Phanerozoic
- P_gn1:Granite and gneiss:Proterozoic
- P_gn2:Granite and gneiss:Proterozoic
- P_s1:Metasedimentary rocks:Proterozoic
- P_s2:Metasedimentary rocks:Proterozoic
- P_ss1:Sandstone and shale:Proterozoic
- P_ss2:Sandstone and shale:Proterozoic
- P_st1:Sandstone:Proterozoic
- P_st2:Sandstone:Proterozoic
- Ps:Marine and continental sedimentary rocks:Phanerozoic
- TRKs:Marine and continental sedimentary rocks:Phanerozoic

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0 20 40 60 80 100

Kilometers

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Datum: GDA94

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SRE ASSESSMENT

GEOLOGY 2500K

FIGURE 2.3

LEGEND

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Van Vreeswyk *et al.* (2004) identified 21 broad soil groups from the Pilbara and interpreted their occurrence according to the region's geomorphology. A general overview of the soils of the Pilbara is as follows.

More than a third of the Pilbara consists of rugged hills and ranges. The soils on the ranges are predominately stony with minor red shallow loams and some red shallow sands. Calcareous shallow loams are mostly common on basalt-based hills, whilst soils of the granitic terrain are mostly red shallow sands. Within the hill systems and valleys the soils are shallow red/brown non-cracking clays, which occur as isolated pockets of soil. Downslope from the ranges soils become deeper in the form of stony-surfaced, red loamy earths with some areas of deep red/brown non-cracking clay. The lowest landscape units (i.e. alluvial plains) have self-mulching cracking clays with areas of deep red/brown non-cracking clays or red deep loamy duplexes. The broad, gently sloping plains are composed of red sandy earths, red deep sands and red loamy earths (Van Vreeswyk *et al.* 2004).

Tille (2006) provided a hierarchy of soil-landscape mapping units of Western Australia's Rangelands and Arid Interior. The state has been divided into a number of the soil-landscape regions, provinces and zones. The updated maps and descriptions form part of Western Australia's contribution to the Australian Soil Resource Information System (ASRIS).

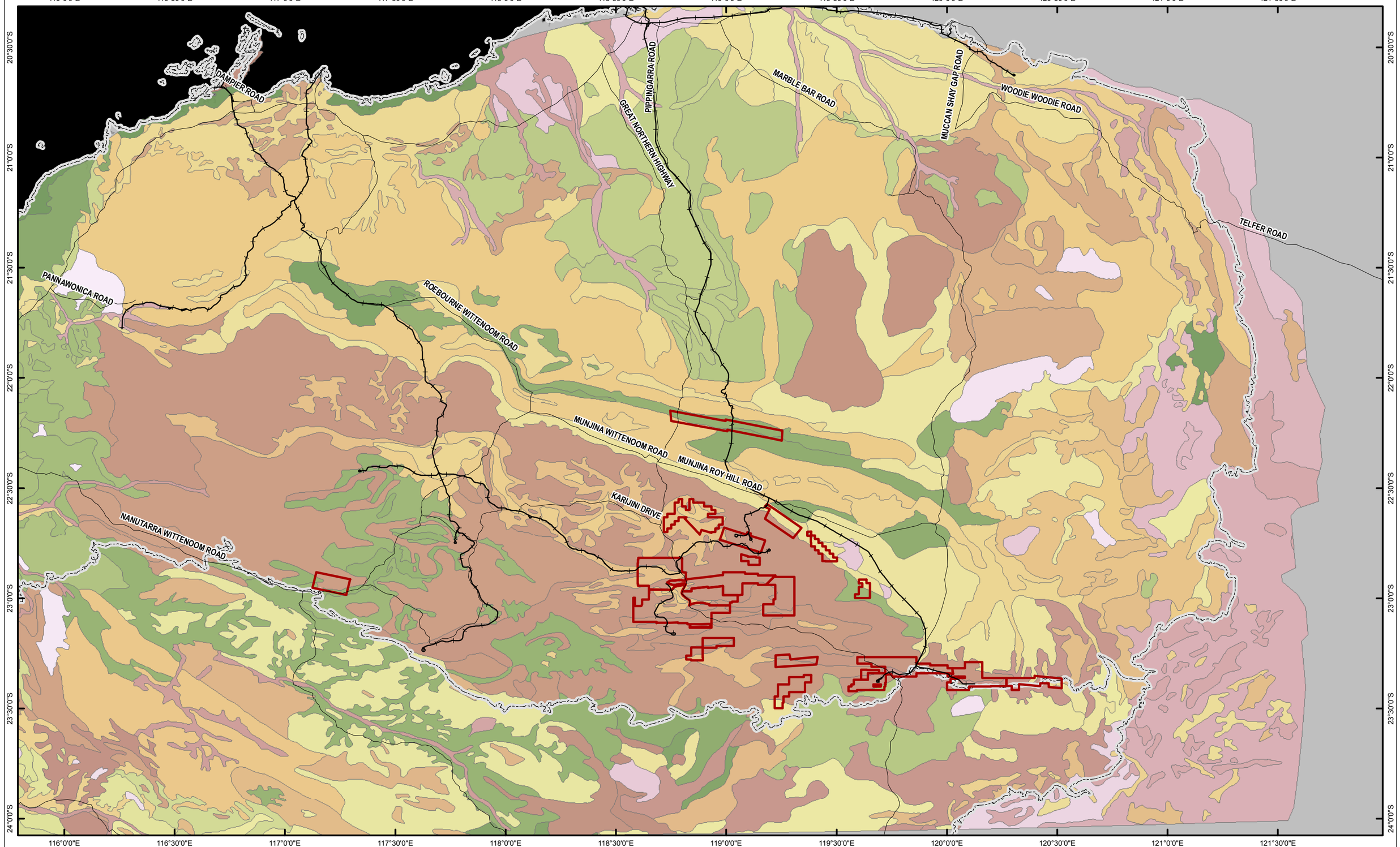
The Study Area contains nine soil-landscape zones, predominantly within the Fortescue Province and one within the Ashburton Province (Table 2.2; Figure 2.4). Tille (2006) describes the Fortescue Province as follows.

"*Hills and ranges (with stony plains and some alluvial plains and sandplains) on the volcanic, granitic and sedimentary rocks of the Pilbara Craton. Stony soils with Red loamy earths and Red shallow loams (and some Red/brown non-cracking clays, Red deep sandy duplexes and Red deep sands)".*

Table 2.2: Soil-landscape zones included in the Study Area (Tille 2006)

Zone	Code	Characteristics
Fortescue Province		
Nullagine Hills Zone	280	Hills and ranges (with some stony plains) on volcanic and sedimentary rocks of the Pilbara Craton (including the Hamersley Basin). Stony soils with Red shallow loams and sands. Spinifex grasslands with kanji and snappy gum.
De Grey-Roebourne Lowlands Zone	281	Alluvial plains and sandplains (and some floodplains and stony plains) on alluvial and marine deposits over rocks of the northern Pilbara Craton. Red deep sandy duplexes with Red loamy earths and some Red/brown non- cracking clays, Cracking clays, Red sandy earths and Red deep loamy duplexes. Spinifex grasslands with kanji and tussock grasslands.
Chichester Ranges Zone	282	Hills and dissected plateaux (with some stony plains) on basalt and sedimentary rocks of the Hamersley Basin. Stony soils with some Red shallow loams and Hard cracking clays. Spinifex grasslands with kanji and snappy gum (and some tussock grasslands).
Abydos Plains and Hills Zone	283	Stony plains (with some hills) on granitic rocks of the Pilbara Craton (East Pilbara Terrane). Red deep sandy duplexes and Red shallow loams with Stony soils, Red sandy earths and Red loamy earths. Spinifex grasslands with kanji (and some tussock grasslands).
Fortescue Valley Zone	284	Alluvial plains, hardpan wash plains and sandplains (with stony plains, floodplains and some salt lakes) on alluvial deposits over sedimentary rocks of the Hamersley Basin. Red deep sands, Red loamy earths and Red/brown non-cracking clays with some Red shallow loams and Hard cracking clays. Mulga shrublands and spinifex grasslands with some tussock grasslands and halophytic shrublands.
Hamersley Plateaux Zone	285	Hills and dissected plateaux (with some stony plains and hardpan wash plains) on sedimentary and volcanic rocks of the Hamersley Basin (Ophthalmia Fold Belt). Stony soils with Red

Zone	Code	Characteristics
		shallow loams and some Red/brown non-cracking clays and Red loamy earths. Spinifex grasslands with snappy gum and kanji (and some mulga shrublands).
Jigalong Plains Zone	288	Alluvial plains, sandplains, hills and ranges (with floodplains and hardpan wash plains) on sedimentary rocks of the Manganese Group (with some basalt and granite). Red deep sands with Red/brown non-cracking clays, Red loamy earths, Red deep sandy and loamy duplexes, Stony soils and Red shallow loams. Mulga woodlands/shrublands with spinifex and tussock grasslands.
Harding Hills and Plains Zone	289	Hills and ranges with (stony plains and some alluvial and flood plains) on sedimentary, granitic and volcanic rocks of the northern Pilbara Craton. Stony soils with Red/brown non-cracking clays and Red shallow loams and some Hard cracking clays. Spinifex grasslands with kanji and snappy gum (and some tussock grasslands).
Ashburton Province		
Bulloo Plains and Hills Zone	290	Hardpan wash plains, stony plains, hills and ranges (with some sandplains) on sandstone and shale of parts of the Collier and Bresnahan Basins and granite of the Sylvania Inlier. Red shallow loams (often with hardpans), Red loamy earths, Stony soils and Red deep sands with some Red shallow sands. Mulga shrublands (with some spinifex grasslands).



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SRE ASSESSMENT

STRATEGIC ASSESSMENT AREA

CSIRO SOILS

FIGURE 2.4

See Legend Separate Sheet

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Legend

IBRA Pilbara & Gascoyne

BHPBIO Operation Tenure

CSIRO Soils

Mapping Unit / Description

AA11, Ranges of conglomerates

AA12, Ranges on conglomerate; extensive areas without soil cover and when present

AA16, Low ranges and steep hills on granites

AA7, Stony hills on granite--often with little soil cover: shallow stony sands (Uc5.11) are dominant but small areas of (Dr2.32) soils also occur. Occurs on sheet(s): 6

AA9, Stony hills on gneiss with frequent bare rock areas: shallow stony sands (Uc5.11) are dominant. Other soils include (Um5.41) as well as (Dr2.33 and Dr2.32). Occurs on sheet(s): 6

AB14, Upland sand plains with occasional dunes and minor inclusions of associated plains units: chief soils are red earthy sands (Uc5.21) with red sands (Uc5.11) and (Uc1) on the dunes; both (Gn) and (Um) soils of associated units occur. Occurs on sheet(s): 6

AB19, Extensive sandy plains: chief soils are red earthy sands (Uc5.21) with extensive areas of red earths (Gn2.12) and with some hard red soils (Dr) along creek lines. Similar to unit AB21 but without sandstone residuals. Occurs on sheet(s): 6

AB20, Isolated sand plains and dune fields: chief soils are red earthy sands (Uc5.21) with loose red sands (Uc1.23) on the dunes. Occurs on sheet(s): 6

AB21, Pindan country--gently undulating sand plain with a few small rocky sandstone residuals; no external drainage: chief soils are red earthy sands (Uc5.21)

AB39, Gently undulating plain dominated by longitudinal dunes of varying frequency; some exposures of ironstone gravels on low rises occur in the dune swales: chief soils are red earthy sands (Uc5.21) on dune slopes

AB41, Undulating areas on chert breccia with frequent rock outcrops; these areas are elevated above the main drainage-ways but are lower relatively than adjacent ranges: chief soils are shallow red earthy sands (Uc5.21). Occurs on sheet(s): 10

AB42, Upland sand plain associated with extensive areas of unit AB41: chief soils are red earthy sands (Uc5.21). Occurs on sheet(s): 10

AB43, Pediplains on granite with some granitic residuals

AB44, Plains with a variable

B27, Low terrace associated with main stream channels: chief soils are loose sands (Uc1.22) with some (Um5.11) soils on patches of calcrete (kunkar). Occurs on sheet(s): 6

BA17, Flat-topped but sometimes steep-sided hills with extensive areas of bare rock--sandstones and other sedimentary rocks

BB11, Flat-topped residuals capped by calcrete (kunkar) and opaline silica of the Oakover formation: chief soils are shallow alkaline loams (Um5.11) along with red earths (Gn2.12). Occurs on sheet(s): 6

BD1, Plains and levees

BD2, Terraces and levees flanking the main rivers: dominant soils are (Um5.2) but other soils of some importance are (Uc5.32) and (Gn2.13); while (Uc1.22) soils occur on the youngest terraces and there are limited areas of (Dr) soils. Occurs on sheet(s): 6

BE10, Plains with clay pans: earthy loams (Um5.3) are dominant along with areas of (Gn2.12) and (Uc5.21) soils on red-brown hardpan; and (Uf6.71) soils are associated with the clay pans. Occurs on sheet(s): 6

BE6, Extensive flat and gently sloping plains

BE9, Plains dominated by earthy loams (Um5.3) with red-brown hardpan at shallow depth: there are also large areas of (Uf6.71) and (Ug5.37) soils in lower situations. Narrow zones of (Um5.11) soils on calcrete (kunkar) are adjacent to many of the creek lines.

Bz15, Rocky hills and offshore islands of acid intrusive rock. Largely bare rock outcrop with pockets of shallow siliceous sands (Uc1.2) and loams (Um1). Occurs on sheet(s): 6

Fa10, Steep ranges comprising sandstones

Fa11, Stony hills with some steeply dissected pediments on sandstones

Fa12, Gently undulating plain with frequent low granite tors and coalescing pediplain: chief soils are earthy loams (Um5.51)

Fa13, Ranges of banded jaspilite and chert along with shales

Fa14, Steep hills and steeply dissected pediments on areas of banded jaspilite and chert along with shales

Fa15, Ranges of basalt along with shale

Fa16, Hills and steep dissected pediments in areas of basalt

Fa17, Ranges comprising basic intrusive rocks

Fa18, Low stony hills and steeply dissected pediments on areas of basic intrusive rocks

Fa19, Steep stony hills and ranges on metamorphosed basic and ultrabasic rocks

Fa28, Steep hills and low ranges associated with various rocks including dolomite and some chert breccia; exposures of rock are extensive and soils are shallow and stony: chief soils are shallow stony earthy loams (Um5.51). Other soils include shallow stony fo

Fa29, Steep stony hills and low ranges on highly folded quartzites

Fa30, Ranges on metamorphosed sandstones

Fa32, Low ranges and hills largely on metamorphics and granites but with some inclusions of sandstones and conglomerates; extensive areas of bare rock; transgressed by dunes in places and flanked by small plains: chief soils are probably shallow stony earthy l

Fa5, Ranges in areas of shales and greywacke along with some dolomites and volcanic rocks; there may be some narrow valley plains and steep dissected pediments: stony shallow earthy loams (Um5.51) are dominant but there are extensive areas without soil cover;

Fa6, Low ranges and stony hills often capped by red-brown hardpan and fringed by breakaways and dissected pediments; dominant soils are shallow stony earthy loams (Um5.51)

Fa8, Steep ranges comprising fine-grained sedimentary rocks along with basic dykes; extensive portions of this unit are without soil cover: chief soils are shallow stony earthy loams (Um5.51) on the steep slopes while shallow stony (Uc1.43) and (Uc5.11) soils

Fa9, Stony hills with some steeply dissected pediments on fine-grained sedimentary rocks and basic dykes; some small valley plains may occur: shallow stony earthy loams (Um5.51) dominate along with small areas of shallow stony (Uc1.43) soils on steeper slopes

Fb3, High-level valley plains set in extensive areas of unit Fa13. There are extensive areas of pisolitic limonite deposits: principal soils are deep earthy loams (Um5.52) along with small areas of (Gn2.12) soils. Occurs on sheet(s): 6

Fb8, Plains: chief soils are deep earthy loams (Um5.52) together with some areas of clay soils (Uf6.71) and (Ug5.37). Occurs on sheet(s): 10

Fy1, Steep ranges on dolomites and sandstones

Gf1, Steep ranges on basic lavas along with dolomites

Ja1, Extensive valley plains largely associated with the Fortescue River: chief soils are earthy clays (Uf6.71) along with some (Ug5.38)

Ja2, This unit occupies the central position within the high-level valley plains represented by unit Fb3: chief soils are earthy clays (Uf6.71) along with extensive areas of (Ug5.38) soils. Occurs on sheet(s): 6

Ja3, Gently undulating pediplains and alluvial plains associated with Permian sediments: chief soils are earthy clays (Uf6.71)

LAKE, Lake

Lb12, Valley flats along major drainage lines

Lh1, Coastal plains mainly beyond marine flooding influence: main soils are pedal calcareous earths (Gc2.22) with some associated highly calcareous earths (Gc1.12). On the seaward side are firstly samphire flats (Gc1.1) and then bare saline mud (Uf). Calcareo

MM16, Alluvial plains dominated by deep cracking clays (Ug5.38) along with some areas of (Uf6.71) soils

MM17, Alluvial plains with occasional stony residuals of basic and ultrabasic rocks: chief soils are deep cracking clays (Ug5.38) but extensive areas of (Dr2.33) and (Uf6.71) soils occur. (Uc5.32) and (Uc1.22) soils occur as narrow bands along stream channels.

MM18, This unit comprises a complex pattern of steep stony hills and valley plains along with some steep pediments. The hills are largely formed by metamorphosed basic and ultrabasic rocks as well as basic lavas

MM19, High-level gently undulating plain flanked by areas of basaltic ranges of unit Gfl: chief soils are cracking clays (Ug5.37). Areas of (Uf6.71) and (Dr2.33) soils occur also. Occurs on sheet(s): 6

MY1, Gently undulating plateau elements sometimes sharply incised by narrow valleys. The boundary of this unit is frequently formed by breakaways but it may at times merge beneath the adjacent plain. These areas are capped by the Robe pisolite iron ore format

MY4, Low lateritic residuals: chief soils are probably ironstone gravels in a red earth matrix (KS-Gn2.11

My53, Extensive plains dominated by neutral red earths (Gn2.12) with areas of acid and alkaline red earths (Gn2.11

My54, Broad very gently undulating plains with scattered rock outcrops occurring as mesas: chief soils are neutral and acid red earths (Gn2.12

My55, Gently sloping outwash plains generally flanking the northern face of the Hamersley Range; coarse surface gravels are extensive: chief soils are neutral red earths (Gn2.12) with some (Gn2.11) and (Dr2.33) soils. Occurs on sheet(s): 6

Mz23, Extensive flat and gently sloping plains with a scatter of surface gravels

Mz25, Plains associated with the Fortescue valley; there is a surface cover of stony gravels close to the ranges and hills: chief soils are acid red earths (Gn2.11) with some neutral red earths (Gn2.12); red-brown hardpan is absent. Associated are areas of cal

Mz36, Pediments with some steep hills on granites; granitic residuals; bosses and tors: chief soils are acid red earths (Gn2.11) overlying a red-brown hardpan. Other soils include (Uc5.11) and (Dr2.32). Occurs on sheet(s): 10

Oa11, Dissected stony pediments and hills occurring at foot of unit Gfl; some residuals of more resistant rocks occur as mesas. On deeply dissected areas lime is released from weathering of more basic rocks: chief soils are hard alkaline red soils (Dr2.13) and

Oc40, Alluvial plains

Oc48, Partly dissected pediments and breakaways capped by red-brown hardpan

Oc49, Partially dissected pediments with some low stony hills on fine-grained sedimentary rocks and basic dykes

Oc50, Dissected pediplain with occasional small steep stony hills frequently flanking areas of unit Fa5. Shales and greywackes along with some volcanics and dolomites form the country rock: hard alkaline red soils (Dr2.33) are dominant. Associated are areas of

Oc51, Gently undulating pediplain on granite with occasional low granite bosses and tors: hard alkaline red soils (Dr2.33) are dominant. (Dr2.32) soils also occur along with (Gn2.12) soils while (Um5.1) soils overlie calcrete (kunkar) zones adjacent to creeks.

Oc54, Partially dissected pediplains on gneiss. Low stony ridges associated with quartz dykes occur and there are minor occurrences of breakaways and mesas. Surface quartz gravels are extensive. Hard alkaline red soils (Dr2.33) are dominant along with (Dr2.32)

Oc55, Alluvial plains dominated by hard alkaline red soils (Dr2.33): narrow zones of (Um5.12) (Uc5.32)

Oc56, Plains dominated by hard alkaline red soils (Dr2.33) but with quite large areas of (Ug5.37) soils in lower situations. Other soils include (Um5.12)

Oc59, Foothill pediments with occasional rock outcrops and extensive stony gravel deposits: chief soils are hard alkaline red soils (Dr)

Oc61, Dissected pediments and steep residual hills with iron formations: chief soils are hard alkaline red soils

Oc62, Very gently undulating pediplain with low granite outcrops and tors; occasional basic dykes occur as low elongate ridges: chief soils are hard alkaline red soils (Dr2.33) and (Dr2.43) having coarse-textured A horizons up to 18 in. thick. Associated are o

Oc63, Pediplains on granite; more dissected than unit Oc62 and usually occurring as a zone flanking the main stream courses: chief soils are hard alkaline red soils (Dr2.33) and (Dr2.43). There are more areas of (Um5.11) soils on calcrete (kunkar) than in unit

Oc64, Low stony hills and dissected pediments on granite with occasional basic dykes: chief soils are hard

Oc65, Low stony hills and steeply dissected pediments in areas of fine-grained sandstone

Oc66, Gently undulating pediplains extending out from breakaways capped by Robe pisolite deposits and other related formations. There may be a few small flat-topped residuals rising above the pediplains: chief soils are hard alkaline red soils (Dr2.33). Small

Oc67, Plains: dominant soils are hard alkaline red soils (Dr2.33). Associated are extensive areas of (Um5.52) soils with (Ug5.38) soils in central landscape positions. Small areas of (Gn2.12) soils also occur as well as (Um5.11) on calcrete (kunkar). Occurs o

Oc68, Dissected stony pediments with some steep stony hills: chief soils are hard alkaline red soils (Dr2.33) but quite large areas of hard neutral red soils (Dr2.32) occur too. There are also significant areas of (Um5.5) soils. Occurs on sheet(s): 6

Oc69, Valley plains with occasional low flat-topped residuals that are often capped by iron ore formations but sometimes by calcrete (kunkar): hard alkaline red soils (Dr2.33) are dominant with some areas of (Dr2.32) soils. Significant areas of (Uf6.71) and (U

Oc70, Dissected pediments and low stony hills associated with cherts

Oc71, Outwash plains with much coarse surface gravel: chief soils are hard alkaline red soils (Dr2.33) but (Uf6.71)

Oc72, Plains dominated by hard alkaline red soils (Dr2.33) with some areas of (Gn2.12)

Oc73, Partially dissected pediments with some low stony hills. This unit usually flanks areas of unit Fa1O or unit Fa11: chief soils are hard alkaline red soils (Dr2.33) along with some areas of (Dr2.32) soils. Shallow stony (Uc5.11) soils occur on the steeper

Oc74, Dissected pediments with low stony hills as in unit Oc70

Oc75, Dissected pediments associated with dolomites and some chert breccias: chief soils are shallow and stony varieties of hard alkaline red soils (Dr2.33) along with some (Um5.51) soils. Occurs on sheet(s): 10

SV8, Salt flats

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SRE ASSESSMENT

CSIRO SOILS

FIGURE 2.4

LEGEND

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2.4 Land Systems

Land systems are units of the landscape incorporating soils, vegetation types and geology. The land systems within the Pilbara and Gascoyne bioregions have been described and mapped, and soil and vegetation condition assessed following Van Vreeswyk *et al.* (2004), and Payne *et al.* (1988), respectively

The Study Area covers 71 of the 102 land systems in the Pilbara bioregion and four of the 63 land systems in the Gascoyne bioregion (Figure 2.5). The Newman land system (Hills and ranges with spinifex grasslands) covers the greatest area (19.4%) within the Study Area with Boolgeeda (Stony plains with spinifex grasslands) and Rocklea (Hills and ranges with spinifex grasslands) covering the next greatest area land systems (8.7% and 8.4%, respectively) (Table 2.1).

Three land systems within the Study Area, including Horseflats, Marsh (Fortescue) and Wona, are considered to be Priority Ecological Communities (PEC) as identified by the DPaW (DPaW 2013).

The land systems of the Pilbara bioregion are grouped into 20 land types according to land units, soils, drainage patterns and vegetation. Nineteen of these land types occur within the Study Area (Table 2.1).

Table 2.3: Land Systems of the Study Area (Van Vreeswyk *et al*. 2004)

Land System	Land units and Vegetation	Area (ha)
Pilbara Bioregion		
1. Hills and ranges with spinifex grassland.		
Black	Linear ridges of dolerite or basalt supporting hard spinifex grasslands, with unvegetated boulder slopes and rock piles along summits.	51.5
Boolaloo	Granite hills, domes and tor fields and sandy plains with shrubby spinifex grasslands.	49577.2
Capricorn	Hills and ridges of sandstone and dolomite supporting shrubby hard and soft spinifex grasslands.	76585.2
Granitic	Rugged granitic hills supporting shrubby hard and soft spinifex grasslands.	43421.3
McKay	Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands.	153286.2

Land System	Land units and Vegetation	Area (ha)
Newman	Rugged jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.	1141628.5
Robertson	Hills and ranges of sedimentary rocks supporting hard spinifex grasslands.	14957.8
Rocklea	Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex (and occasionally soft spinifex) grasslands.	496528.7
Ruth	Hills and ridges of volcanic and other rocks supporting hard spinifex (occasionally soft spinifex) grasslands.	1910.8
Talga	Hills and ridges of greenstone and chert and stony plains supporting hard and soft spinifex grasslands.	41716.7
2. Hills and ranges with acacia shrublands		
Augustus	Rugged ranges, hills, ridges and plateaux supporting mulga shrublands and hard spinifex grasslands.	1514.7
Charley	Dolerite hills and ridges and restricted plains supporting mulga and cassia shrublands and spinifex grasslands.	5117.2
Marandoo	Basalt hills and restricted stony plains supporting grassy mulga shrublands.	176206.2
3. Plateaux, mesas and breakaways with spinifex grasslands		
Kumina	Duricrust plains and plateau remnants supporting hard spinifex grasslands.	1689.2
Oakover	Breakaways, mesas, plateaux and stony plains of calcrete supporting hard spinifex grasslands.	4414.5
Robe	Low limonite mesas and buttes supporting soft spinifex (and occasionally hard spinifex) grasslands.	31404.2
4. Plateaux, mesas and breakaways with acacia shrublands		

Land System	Land units and Vegetation	Area (ha)
Laterite	Laterite mesas and gravelly rises and plains supporting mulga shrublands.	6074.8
Table	Low calcrete plateaux, mesas and lower plains supporting mulga and cassia shrublands and minor spinifex grasslands.	20088.5
5. Dissected plains with spinifex grasslands		
Egerton	Dissected hardpan plains supporting mulga shrublands and hard spinifex hummock grasslands.	87032.3
Platform	Dissected slopes and raised plains supporting hard spinifex grasslands.	188829.5
6. Stony plains and hills with spinifex grasslands		
Adrian	Stony plains and low silcrete hills supporting hard spinifex grasslands.	16093.7
Bonney	Low rounded hills and undulating stony plains supporting soft spinifex grasslands.	121.4
Nirran	Undulating stony plains and hills supporting hard spinifex grasslands and mulga shrublands with soft spinifex.	30618.9
7. Stony plains and low hills with acacia shrublands		
Collier	Undulating stony uplands, low hills and ridges and stony plains supporting mulga shrublands.	17246.2
Prairie	Gently undulating stony plains and granite hills supporting acacia-eremophila-cassia shrublands and minor soft spinifex grasslands.	190141.1
8. Stony plains with spinifex grasslands		
Boolgeeda	Stony lower slopes and plains below hill systems supporting hard and soft spinifex grasslands and mulga shrublands.	511442.3
Macroy	Stony plains and occasional tor fields based on granite supporting hard and soft spinifex grasslands.	325086.3
Satirist	Stony plains and low rises supporting hard	3633.2

Land System	Land units and Vegetation	Area (ha)
	spinifex grasslands, and gilgai plains supporting tussock grasslands.	
9. Stony gilgai plains with tussock grasslands and spinifex grasslands		
White Springs	Stony gilgai plains supporting tussock grasslands and hard spinifex grasslands.	6401.4
Wona	Basalt upland gilgai plains supporting tussock grasslands and minor hard spinifex grasslands.	39108.4
10. Stony plains with acacia shrublands		
Dollar	Stony plains supporting acacia shrublands.	1380.6
Elimunna	Stony plains on basalt supporting sparse acacia and cassia shrublands and patchy tussock grasslands.	21921.7
Ford	Gently undulating shaly plains with isolated low hills supporting mulga shrublands.	8334.2
Paraburdoo	Basalt derived stony gilgai plains and stony plains supporting snakewood and mulga shrublands with spinifex and tussock grasses.	86341.2
Sylvania	Gritty surfaced plains and low rises on granite supporting acacia-eremophila-cassia shrublands.	107818.1
11. Sandplains with spinifex grasslands		
Divide	Sandplains and occasional dunes supporting shrubby hard spinifex grasslands.	296452.1
Uaroo	Broad sandy plains supporting shrubby hard and soft spinifex grasslands.	85642.7
12. Wash plains on hardpan with groved mulga shrublands (sometimes with spinifex understorey)		
Cadgie	Hardpan plains with thin sand cover and sandy banks supporting mulga shrublands with soft and hard spinifex.	47982.1
Fan	Washplains and gilgai plains supporting groved mulga shrublands and minor tussock grasslands.	148205.3

Land System	Land units and Vegetation	Area (ha)
Jamindie	Stony hardpan plains and rises supporting groved mulga shrublands, occasionally with spinifex understorey.	250960.3
Jurrawarrina	Hardpan plains and alluvial tracts supporting mulga shrublands with tussock and spinifex grasses.	49811.6
Nooingnin	Hardpan plains with very large groves supporting mulga shrublands.	77265.0
Pindering	Gravelly hardpan plains supporting groved mulga shrublands with hard and soft spinifex.	26317.5
Spearhole	Gently undulating hardpan plains supporting groved mulga shrublands and hard spinifex.	107710.2
Three Rivers	Hardpan plains and minor sandy banks supporting sparse mulga shrublands.	8511.3
Wannamunna	Hardpan plains and internal drainage tracts supporting mulga shrublands and woodlands (and occasionally eucalypt woodlands).	62648.1
Washplain	Hardpan plains supporting groved mulga shrublands.	45112.1
Zebra	Hardpan plains with large linear gravelly sand banks supporting acacia shrublands with soft and hard spinifex.	2644.1
13. Alluvial plains with soft spinifex grasslands		
Mallina	Sandy surfaced alluvial plains supporting soft spinifex (and occasionally hard spinifex) grasslands.	43242.5
Paradise	Alluvial plains supporting soft spinifex grasslands and tussock grasslands.	1121.2
Urandy	Stony plains, alluvial plains and drainage lines supporting shrubby soft spinifex grasslands.	43261.6
14. Alluvial plains with tussock grasslands or grassy shrublands		
Balfour	Shale, gravel and clay plains supporting eremophila-cassia shrublands, tussock grasslands, and halophytic shrublands.	2596.4

Land System	Land units and Vegetation	Area (ha)
Brockman	Alluvial plains with cracking clay soils supporting tussock grasslands.	32869.7
Horseflat	Gilgaied clay plains supporting tussock grasslands and minor grassy snakewood shrublands.	810.7
Turee	Stony alluvial plains with gilgaied and non-gilgaied surfaces supporting tussock grasslands and grassy shrublands.	58921.3
15. Alluvial plains with snakewood shrublands		
Christmas	Stony alluvial plains supporting snakewood and mulga shrublands with sparse tussock grasses.	23185.9
Cowra	Plains fringing the Marsh land system and supporting snakewood and mulga shrublands with some halophytic undershrubs.	20293.6
Hooley	Alluvial clay plains supporting a mosaic of snakewood shrublands and tussock grasslands.	31378.6
Marillana	Gravelly plains with large drainage foci and unchannelled drainage tracts supporting snakewood shrublands and grassy mulga shrublands.	41862.5
Narbung	Alluvial washplains with prominent internal drainage foci supporting snakewood and mulga shrublands with halophytic low shrubs.	15957.5
16. Alluvial plains with halophytic shrublands		
Cundelbar	Saline alluvial plains supporting halophytic shrublands.	2592.3
17. River plains with grassy woodlands and shrublands, and tussock grasslands		
Coolibah	Flood plains with weakly gilgaied clay soils supporting coolibah woodlands with tussock grass understorey.	88488.4
Fortescue	Alluvial plains and flood plains supporting patchy grassy woodlands and shrublands and	50417.1

Land System	Land units and Vegetation	Area (ha)
	tussock grasslands.	
Jigalong	Alluvial plains and flood plains supporting grassy shrublands and woodlands and halophytic shrublands.	5396.5
River	Active flood plains and major rivers supporting grassy eucalypt woodlands, tussock grasslands and soft spinifex grasslands.	89577.6
Yamerina	Flood plains and deltaic deposits supporting tussock grasslands, grassy woodlands and minor halophytic low shrublands.	30.9
18. Calcreted drainage plains with shrublands or spinifex grasslands		
Calcrete	Low calcrete platforms and plains supporting shrubby hard spinifex grasslands.	65428.9
Warri	Low calcrete platforms and plains supporting mulga and cassia shrublands.	25256.0
20. Salt lakes and fringing alluvial plains with halophytic shrublands		
Marsh	Lakebeds and flood plains subject to regular inundation, supporting samphire shrublands, salt water couch grasslands and halophytic shrublands.	97668.1
Outside Pilbara Bioregion		
Cheela	Degraded alluvial plains with sparse shrublands.	6.0
Ethel	Cobble plains with sparse mulga and other *Acacia* spp. shrublands.	2607.2
Kooline	Rough shale hills, saline drainage floors and broad braided creeks with sparse shrubs.	2647.7
Kunderong	Sandstone hills and outcrop plains covered in dwarf scrub, minor hardpan plains.	24110.4
Other mapped units		
Lake Bed	Salt lake floors	388.7
River channel/bed	River channels/ beds	1160.0

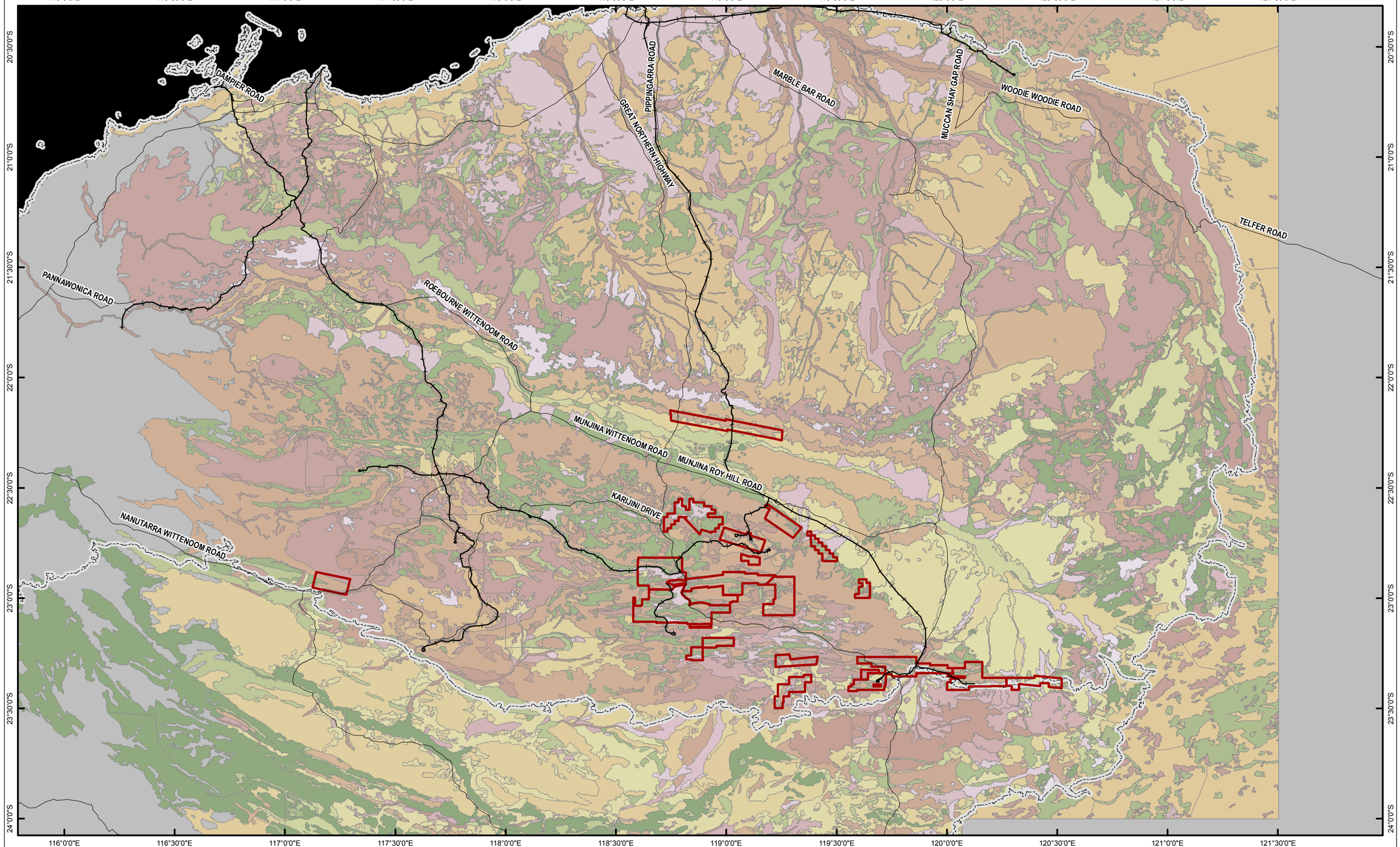

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Figure:	2.5	Date:	21/05/2015
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Kilometers

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BHPBIO

SRE ASSESSMENT

STRATEGIC ASSESSMENT AREA

LAND SYSTEMS

FIGURE 2.5

Legend

- IBRA Pilbara & Gascoyne
- BHPBIO Operation Tenure

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Legend

- IBRA Pilbara & Gascoyne
- BHPBIO Operation Tenure

Land Systems

- Adrian
- Ashburton
- Augustus
- Balfour
- Billygoat
- Black
- Bonney
- Boolaloo
- Boolgeeda
- Brockman
- Bryah
- Buckshot
- Cadgie
- Calcrete
- Callawa
- Capricorn
- Charley
- Cheela
- Cheerawarra
- Christmas
- Collier
- Coolibah
- Coongimah
- Cowra
- Cundelbar
- Disturbed Land
- Divide
- Dollar
- Edward
- Egerton
- Eighty Mile
- Elimunna
- Ethel
- Fan
- Ford
- Fortescue
- George
- Granitic
- Gregory
- Hooley
- Horseflat
- Jamindie
- Jigalong
- Jurrawarrina
- Kanjenjie
- Kooline
- Kumina
- Kunderong
- Kurubuka
- Lake Bed
- Laterite
- Little Sandy
- Littoral
- Lochinvar
- Macroy
- Mallina
- Marandoo
- Marillana
- Marsh
- McKay
- Mosquito
- Mulgul
- Nadarra
- Narbung
- Newman
- Nirran
- Nita
- Nooingnin
- Oakover
- Paraburdoo
- Paradise
- Paterson
- Pindering
- Platform
- Prairie
- Pullgarah
- Pyramid
- River
- River Channel
- Robe
- Robertson
- Rocklea
- Ruth
- Satirist
- Scoop
- Sherlock
- Spearhole
- Sylvania
- Table
- Talga
- Tallawuna
- Taylor
- Three Rivers
- Turee
- Uaroo
- Urandy
- Wannamunna
- Warri
- Washplain
- Weelarrana
- White Springs
- Wona
- Yamerina
- Zebra

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Figure:	2.3	Date:	19 Nov 2013
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SRE ASSESSMENT

LAND SYSTEMS

FIGURE 2.5

LEGEND

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2.5 Hydrology

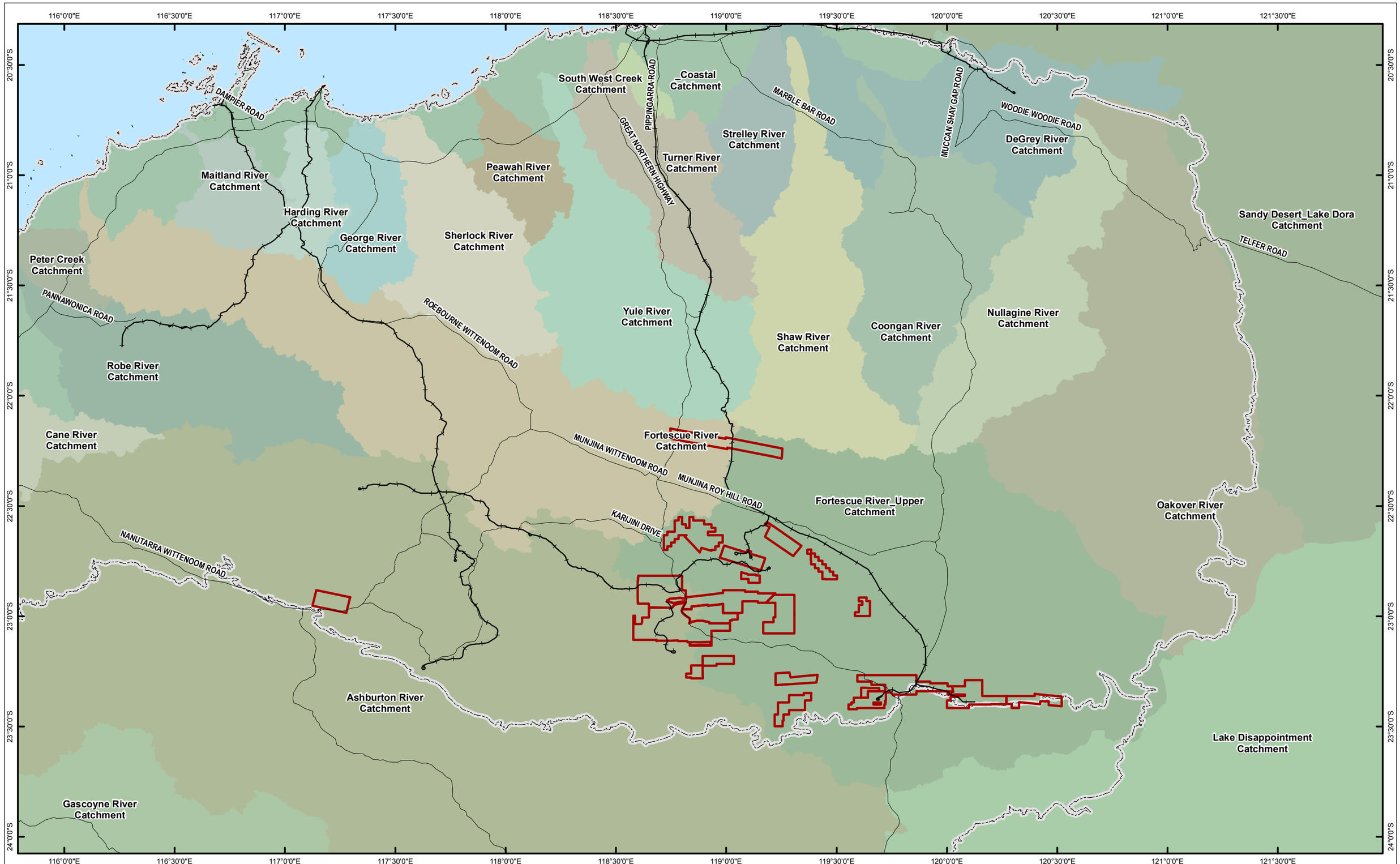
There are ten river catchments within the Study Area (Figure 2.6) with the Fortescue River Catchment dominating the area.

The Chichester Ranges form a major drainage divide through the centre of the Study Area. South of the divide the Fortescue River passes from south east to north west through the Study Area, containing the most prominent alluvial valley fill deposits in the State (Van Vreeswyk *et al.* 2004). North of the drainage divide, a number of significant rivers (Sherlock, Yule, Turner, Shaw and De Grey) discharge north to north west over the coastal flats toward the Indian Ocean (Van Vreeswyk *et al.* 2004).

The rivers in the Pilbara consist of broad sandy to gravelly channels that are dry for most of their length, even soon after floods. Stream flows are generally a direct response to rainfall and are highly seasonal and variable. The majority of the runoff occurs from January to March as a result of episodic cyclonic events. However, there are numerous permanent pools that are maintained by subsurface inflows and/or springs. Lower order creeks are prone to flash flooding, but retain water mostly in rock pools or against cliffs in small gorges (McKenzie *et al.* 2009). Springs are common in areas with porous or fractured geologies (e.g. calcrete, basalt, banded iron formations). Rivers have narrow, well drained floodplains for most of their length. The Fortescue Marsh and surrounds are the exception where broad claypans and clay flats exist. The Fortescue Marsh is the most prominent watercourse within the Study Area and is recognised as a wetland of national significance (ANCA 1996; Environment Australia 2001).

2.6 Land use

The land use of the Study Area is dominated by mining / exploration leases and pastoral leases, indicative of the Pilbara's primary industries of mining and agriculture. The Study Area also contains Karijini National Park in its entirety (including areas of future conservation estate) and sections of Woodstock/Abydos and Jigalong Aboriginal Reserves.



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Kilometers

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BHPBIO

SRE ASSESSMENT

STRATEGIC ASSESSMENT AREA

HYDROLOGICAL CATCHMENTS

FIGURE 2.6

Legend

- BHPBIO Operation Tenure
- IBRA Pilbara & Gascoyne

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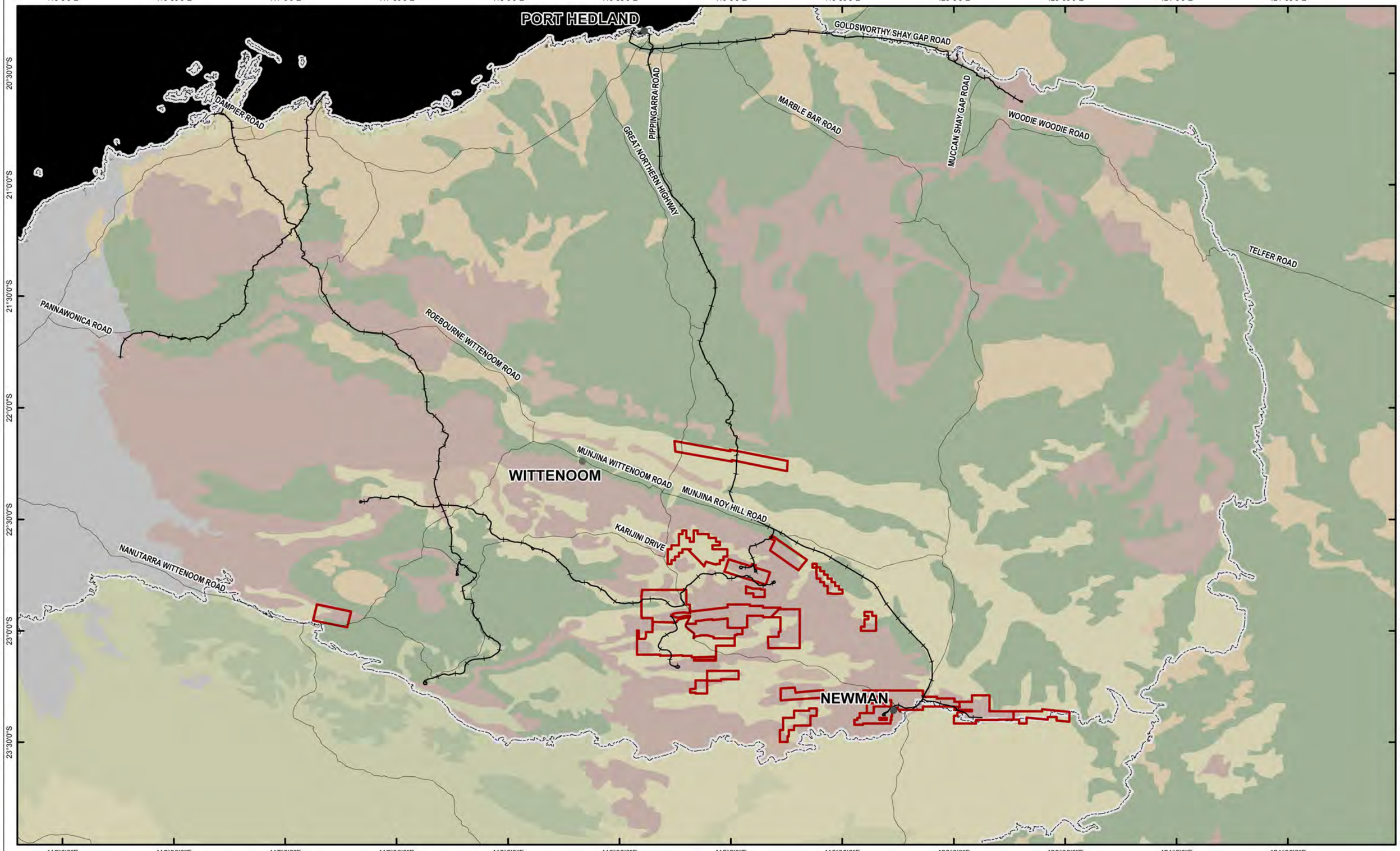
2.7 Vegetation

Beard (1975) classified the vegetation within the Study Area as being within the Eremaean Botanical Province. The section of the Study Area within the Pilbara Region (Fortescue Botanical District) encompasses the Abydos Plain, George Ranges, Chichester Plateau, Fortescue Valley and the Hamersley Plateau; and the Ashburton Valley and Kumarina Hills within the Gascoyne Region (Ashburton Botanical District) (Table 1.4; Figure 2.9).

Table 2.4: Vegetation systems within the Study Area (Beard 1975)

Region/ Subregion	Vegetation System (Beard 1975)	Description
Pilbara		
Hamersley	Hamersley Plateau	The principal vegetation community in the valley floors of this subregion comprise low Mulga woodland over bunch grasses, while *Eucalyptus leucophloia* over *Triodia brizoides* is dominant on the skeletal soils of the ranges (Kendrick, 2001b).
Fortescue Plains	Fortescue Valley	This subregion contains extensive salt marshes, Mulga-bunch grass and short grass communities on the eastern plains. River red gum (*Eucalyptus camaldulensis*) and Coolabah (*E. victrix*) woodlands with soft spinifex and Buffel grass (*Cenchrus ciliaris*) understorey occur along drainage lines and active floodplains. This subregion contains the northern limit of Mulga (*Acacia aneura;* the species formerly known as *A. aneura* is now split into several different species.) in the Pilbara.
Chichester	Abydos Plain	Shrub-steppe of *Acacia pyrifolia-Triodia pungens* association is the dominant community on granite where there is a general cover of hummock grasses with widely spaced shrubs. *Triodia pungens* is the most common species on deeper soils over granite, being replaced by *T. wiseana* var. *brevifolia* on stony ground, by *T. lanigera* on sandy soils and *T. longiceps* or *T. angusta* becoming dominant on calcrete.

Region/ Subregion	Vegetation System (Beard 1975)	Description
Chichester	Chichester Plateau	*Acacia pyrifolia-Triodia* shrub steppe is present on the hard alkaline red soils. This association is similar to that of the Abydos Plain. The shrub steppe changes to grass savannah (dominated by *Aristida latifolia*) on clay soils in the lower regions of the system. The southern flank of the Plateau leading to the Fortescue is chacterised by Mulga in valleys, lower slopes support Mulga with understorey of spinifex *T. pungens* and *Eucalyptus brevifolia-T. wiseana* steppe on upper slopes.
Chichester	George Ranges	Tree steppe cover the high, steep, rocky parts of the Ranges with shrub steppe in the valleys and lower slopes. *E. leucophloia* occurs occasionally within the tree steppe and hummock grasses a mixture of *Triodia pungens* and *T. brizoides* in the north. *T. brizoides* is replaced in the south with *T. wiseana* var. *brevifolia.* The shrub-steppe of *Acacia pyrifolia-Triodia pungens* association is similar to that of the Abydos Plain.
Gascoyne		
Augustus	Kumarina Hills	This subregion contains Mulga woodlands with *Triodia* on shallow stony loams on rises and Mulga parklands on shallow earthy loams over hardpan on the plains (Desmond *et al*., 2001).
Ashburton	Ashburton Valley	Low woodlands of Mulga/ snakewood occur on shallow earthy loams over hardpan on the plains, with mulga scrub and *Eremophila* shrublands on the shallow stony loams of the ranges. Low mixed shrublands occur on hills with other areas supporting large areas of *Triodia* (Kendrick 2001).



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BHPBIO
SRE ASSESSMENT
STRATEGIC ASSESSMENT AREA
BEARD'S VEGETATION SYSTEMS
FIGURE 2.7

Legend

- IBRA Pilbara & Gascoyne Regions
- BHPBIO Operation Tenure

Beards Vegetation Systems

- Acacia shrubland
- Acacia woodland
- Eucalyptus forest
- Eucalyptus woodland
- Melaleuca woodland
- Mixed shrubland
- Sedgeland
- Short-Bunch Grassland: Treeless
- Spinifex Grassland: Tree steppe

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3 METHODS

3.1 Focus taxa

Currently within Western Australia there are seven taxonomic groups that are used to assess the impact of a disturbance on SRE invertebrate taxa and habitats. This assessment follows that approach; the groups are listed below.

- Mygalomorph spiders (trapdoor spiders)
- Selenopid spiders
- Pseudoscorpions
- Scorpions
- Millipedes
- Terrestrial snails
- Isopods

3.2 Internal Expertise and External Consultation

The primary author for this report has the following relevant experience:

- 20 years working with terrestrial invertebrates in Western Australia;
- 12 years working with terrestrial invertebrates in the Pilbara region;
- 4 years working in a regulatory position with DPaW and the OEPA, assessing and providing scientific advice and guidance on SRE invertebrate surveys and impact assessments; and
- 4 years conducting SRE invertebrate surveys as a consultant throughout Western Australia, with a particular focus on the Pilbara.

External consultation during the assessment was restricted to SRE taxonomic experts that BHP Billiton Iron Ore and the OEPA recognise throughout the normal course of a SRE survey and assessment. In particular, the WA Museum was consulted primarily as the repository for the state's fauna survey data.

Experts consulted:

WA Museum

Dr Mark Harvey: WA Museum Curator of Terrestrial Invertebrates: World expert on pseudoscorpions, millipedes and selenopid spiders;

Dr Amber Beavis: WA Museum SRE expert;

Dr Mark Castellanelli: WA Museum expert on mygalomorph and araneomorph spiders;

Mr Corey Whisson: WA Museum expert on terrestrial snails; and

Mrs Cathy Carr: WA Museum expert on millipedes.

Non- WA Museum

Dr Erich Volschenk: Australian expert on scorpions; and

Dr Simon Judd: Australian expert on isopods.

3.3 Literature and database review

The Study Area used to search for literature and database records was a bounding box 450 km x 360 km, with the following coordinates:

NW –20.389; 116.725

SE –24.059; 120.836

Literature review

Many terrestrial invertebrate surveys have been conducted within the Study Area, with the overwhelming majority related directly to mining and resource projects. A list of all projects in the Study Area that have been assessed, or are currently being assessed by the EPA, was compiled from publicly available information. This provided a list of projects that may have had terrestrial invertebrate surveys conducted. The WAM databases were also investigated to identify projects that may have been overlooked, or were not included in the OEPA list.

All survey reports related to BHP Billiton Iron Ore projects were accessible, as were most surveys for non-BHP Billiton Iron Ore projects that have been assessed by the OEPA. It is highly likely that there are survey reports that were not accessible, particularly for projects that had not been assessed by the OEPA at ther time of conducting this review.

SRE survey or SRE assessment reports from projects currently operating or proposed within the Study Area were reviewed. These reports extended to projects beyond the list provided by the OEPA. Information from these reports regarding SRE findings and environments where they were located (i.e. gullies, drainage lines) was recorded and summarised. It should be noted that the information recorded in regard to the habitat conditions in which the SRE species were recorded is incomplete and does not follow a standardised format.

Database review

At the time that this data were compiled (May 2013), the decision was made by the primary author and BHP Billiton Iron Ore that the WA Museum databases would be the primary focus, as this is the state's repository for invertebrate fauna data. This data was supplemented by the BHP Billiton Iron Ore SRE database, which contains all SRE data from BHP Billiton Iron Ore projects once submitted by consultants (and is usually consistent with the WA Museum data), and further data from two Australian experts on scorpions and isopods; Dr Erich Volschenk and Dr Simon Judd

respectively (the latter of these was only a small subset of the database as the entire dataset was not available). Any SRE data not found within these datasets would have likely required a great deal of work to align with the taxonomic designations within the WA Museum, Volshenk and Judd databases, and the resources (time and budget) were not available at the time.

The data received from these sources included morphological and molecular species designations, and both were treated equally where available.

Short-range endemic taxa

Information on the SRE fauna and habitats within the Study Area was compiled using information gathered from the following sources:

Table 3.1: Databases searched and parameters used

Source	Database	Parameters
Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC, 2013, now Department of Environment; DoE)	Protected Matters Search Tool. *Accessed 7 May 2013.*	Polygon coordinates -19.44581,114.14483 -19.44581,121.1651 -24.0464,121.1651 -24.0464,114.14483
Department of Parks and Wildlife (DPaW 2013)	NatureMap. *Accessed 8 May 2013*	IBRA subregions
Western Australian Museum (WAM 2013)	Museum records. *Received 30 May 2013*	Study Area
Australian Government	Atlas of Living Australia (ALA). *Accessed 7 May 2013*	Study Area
BHP Billiton Iron Ore	SRE Fauna database. *Received 13 May 2013*	Study Area

All database records were filtered to those within the Study Area, either during the search or through a separate mapping process afterwards. The databases were also cross-compared to remove any duplicate records.

Where taxonomically similar records from both the WAM and the BHP Billiton Iron Ore databases appeared at the same location (as indicated by cross checking co-ordinates), further clarification was sought from the WAM taxonomists to confirm whether the BHP Billiton Iron Ore record was, in fact, a duplicate. In many cases, the WAM voucher number or field collection number of the records could also be directly compared to indicate duplicates, without the need for advice from the WAM. Where duplicate records were confirmed as above, the WAM record was kept and the BHP Billiton Iron Ore record (usually superseded) was omitted.

The Protected Matters (DoE), NatureMap (DPaW) and ALA databases were all further filtered to taxonomic groups that are considered likely to include SRE species.

The BHP Billiton Iron Ore database included all SRE fauna records that have been submitted by its consultants.

Two outputs from the WAM databases were received; firstly an unfiltered data set that contained all Arachnida records within the Study Area, and secondly, a filtered SRE fauna database, including Arachnida, Gastropoda and Myriapoda.

The locations of records from the unfiltered Arachnida database were used to indicate the approximate extent of terrestrial invertebrate surveys that may have collected invertebrate SRE fauna throughout the Study Area. The aim was to provide an approximation of the survey effort for terrestrial SRE invertebrate fauna throughout the Study Area, without showing incidental records from surveys focused on other fauna groups (such as subterranean fauna surveys or parasite surveys) or singleton opportunistic records which did not result from a dedicated terrestrial invertebrate survey. Based on the information within multiple fields in the WAM data, all subterranean and aquatic invertebrate fauna records were removed, as well as any records that were clearly collected during studies of non-target fauna (e.g. parasite surveys), and opportunistic singleton collections. It should be noted that the remaining data was only used to indicate the approximate survey effort for SRE fauna and did not contribute to the species list, which was compiled from the filtered WAM SRE dataset. The remaining collection records were predominantly sourced by fauna consultants from targeted terrestrial SRE invertebrate surveys or dry pitfall trapping during vertebrate fauna surveys, as well as records from State Government fauna surveys. It was acknowledged that this method of estimating survey effort for SRE fauna throughout the Study Area is an underestimate, as the real survey effort would contain a vastly greater number of sites where no fauna were collected, or where the results were perhaps not vouchered at the WAM.

The WAM SRE data were filtered by the WA Museum using a spatial filter, which calculates the known area for each species and determines if a species' known distribution is less than the nominal limits for an SRE species i.e. <10,000km^2 (Harvey 2002, EPA 2009). As such, the data received includes all species of Arachnida, Gastropoda and Myriapoda that have a currently

known distribution of less than 10 000km^2. Within these records, all species of *Antichiropus* millipedes are regarded as confirmed SRE and all other species are regarded as potential SRE (Mark Castellanelli pers comm). The scorpion and mollusc data underwent further scrutiny by respective experts (Erich Volschenk and Corey Whisson) who provided a SRE status on each individual species, and removed those regarded as not SRE.

The SRE categories used by taxonomists at the WAM rely on a high degree of taxonomic certainty at the species or equivalent morphospecies level. The majority of SRE fauna are collected as new or undescribed species, therefore the WAM allocates a morphospecies code (e.g. 'MYG#' for mygalomorph spiders, or 'PSE#' for pseudoscorpions) to indicate taxa that are highly likely to belong to a distinct, undescribed species (based on morphology or DNA evidence). Only named species and these undescribed 'valid' morphospecies are included in the data sets used for the assessment. At any given time, there would be a great number of additional specimens within the WAM records that are not able to be verified as SRE species because they are not been able to be identified to species or equivalent morphospecies level. This would include, for example; juvenile specimens, specimens of inappropriate sex (usually female arachnids), damaged specimens, and/ or specimens that have not been genetically sequenced. All such records were necessarily excluded from the assessment.

SRE Categories used by the WAM

The SRE status categories used in this report follow the WAM (2013) categorisation for SRE invertebrates (Table 3.4, Appendices 3 and 4). This system is based upon the 10,000 km^2 range criterion proposed by Harvey (2002), and uses three broad categories to deal with varying levels of taxonomic certainty that may apply to any given taxon (Table 3.4).

Potential SRE status is sub-categorised by what is currently known about the species in question; *i.e.* whether there are B) habitat indicators, C) morphology indicators, D) molecular evidence, or E) a weight of general knowledge and experience with the group that suggests a reasonable likelihood that the species could be SRE. In terms of SRE likelihood, the more evidence that exists under sub categories B, C, D, and E, the greater the likelihood that further investigation will confirm that the species is a SRE.

Table 3.2: SRE categorisation used by WAM taxonomists (Appendices 3 and 4).

	Taxonomic Certainty	Taxonomic Uncertainty
Distribution <10,000 km^2	**Confirmed SRE** • A known distribution of < 10,000 km^2. • The taxonomy is well known. • The group is well represented in collections and/ or via comprehensive sampling.	**Potential SRE** • Patchy sampling has resulted in incomplete knowledge of geographic distribution. • Incomplete taxonomic knowledge. • The group is not well represented

	Taxonomic Certainty	Taxonomic Uncertainty
		in collections. • Category applies where there are significant knowledge gaps. **SRE Sub-categories may apply:** A) Data Deficient B) Habitat Indicators C) Morphology Indicators D) Molecular Evidence E) Research & Expertise
Distribution >10,000 km^2	**Widespread (not SRE)** • A known distribution of > 10,000 km^2. • The taxonomy is well known. • The group is well represented in collections and/ or via comprehensive sampling.	

However, the WAM category A) 'data deficient' is different; this category indicates that the current taxonomic data or specimen collection records are insufficient to adequately assess the SRE status of the species in question. The current assessment considers `data deficient` taxa to be unable to be assessed as Potential SRE species at the current time, owing to a lack of taxonomic information or geographical context.

Threatened communities

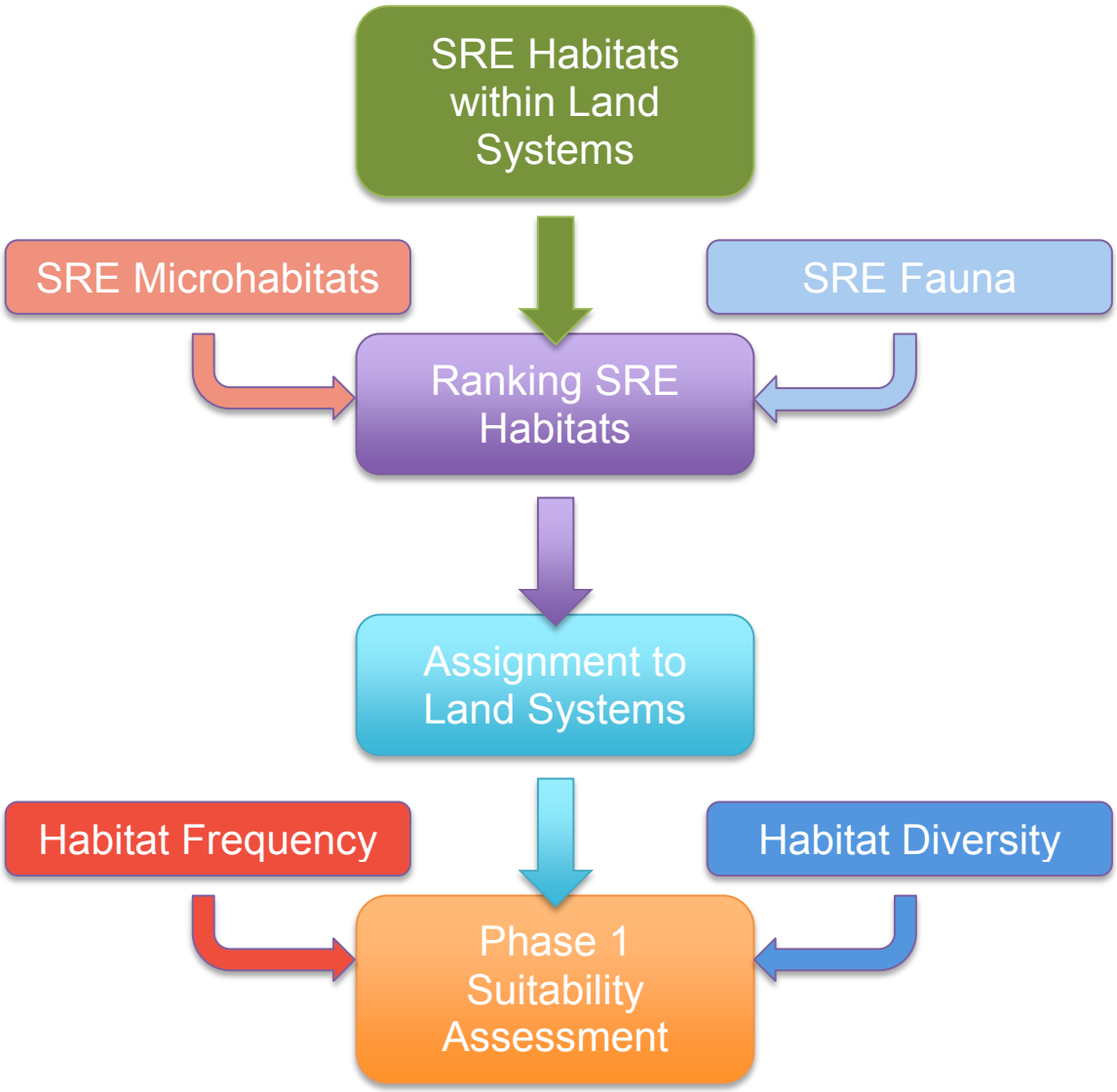
Information on the presence of Threatened and Priority Ecological Communities (TECs/ PECs) within the Study Area was provided by Department of Parks and Wildlife (DEC March 2013, Version 18).

Any TECs and PECs occurring within the Study Area were assessed for likelihood of supporting SREs by examining faunal data collected from within them and available habitat information.

3.4 Phase 1 SRE Suitability Assessment

The Phase 1 SRE suitability assessment was divided into four steps, with three spatial levels; land systems, habitats and microhabitats. The flowchart below (Figure 3.1) summarises the steps used to derive the Phase 1 suitability assessment and then each step is described in detail further below, ordered and named in reference to the flowchart.

Figure 3.1: Flowchart of Phase 1 assessment methodology.



SRE Habitats within Land Systems

The land units within each land system, as described in van Vreeswyk (2004), were assessed for habitats that are congruent with the current understandings of SRE habitats in the Pilbara region. The table below shows a complete land system description with the parts relevant to SRE habitats in bold. These descriptive elements were then compiled and used to identify SRE habitat types found throughout the land systems of the Study Area.

As part of this process, the land systems were also assessed for SRE dispersal habitats. SRE dispersal habitats are not the same as SRE habitats, although they do share some microhabitat

characteristics. SRE habitats are permanent refuges for SRE fauna, while SRE dispersal habitats provide temporary/ semi-permanent corridors for movement of some SRE fauna between SRE habitats. They are included in this report to illustrate the influence of some land units on the dispersal of some SRE fauna.

As undertaken for SRE habitats, an assssment of the potential SRE dispersal land units within each land system across the Pilbara bioregion, was undertaken. With this, the focus was on land units that contained vegetation descriptions of habitats that had a minimum density of moderately close tall shrubland or woodland and occur over a wide area; i.e. appear to have a high level of connectivity. This broad type of vegetation has been chosen as it is more likely to contain protective microhabitats that would allow SRE fauna to disperse more easily; i.e. heavy vegetation, leaf litter and woody debris. Within the assessment, the dispersal habitats were treated as more suitable than the non-SRE habitat but less suitable than the Low suitability habitats.

Table 3.3: An example of a complete land system description, highlighting which aspects are relevant to SRE habitats (bold).

Newman Land System. Rugged jaspilite plateaux, chert, siltstone, shale, dolomite and minor acid volcanics.

Unit	Area (%)	Land unit	Soil	Vegetation
1	70%	Plateaux, ridges, mountains and hills – **mountain tracts, plateaux and strike ridges, relief up to 400 m**; level or rounded **plateaux summits and mountain crests, ridges and indented escarpments with vertical upper cliff faces** and moderately inclined to very steep upper scree slopes; surface mantles of abundant to very abundant pebbles, cobbles and stones of ironstone, jaspilite, chert and other rocks. **Also outcrop of parent rock.**	Stony soils (203), red shallow loams (522) and some red shallow sands (423).	Hummock grasslands of *Triodia wiseana*, *T. brizoides*, *T. plurinervata* (hard spinifex) with very scattered to scattered shrubs and trees including *Acacia* and Senna spp., *Grevillea wickhamii* (Wickham's grevillea), *Eucalyptus leucophloia* (snappy gum) and other eucalypts. Occasionally hummock grass is *Triodia biflora* (soft spinifex).
2	20%	Lower slopes – gently inclined concave slopes mostly less than 400 m in extent with mantles of very abundant pebbles and cobbles of ironstone and other rocks.	Stony soils (203) on upper margins with red loamy earths (544) on lower margins.	Similar to unit 1.
3	5%	Stony plains – gently undulating lower plains and interfluves up to 500 m in extent with mantles of abundant to very abundant pebbles of ironstone.	Stony soils (203), red shallow loams (522) and some red shallow sands (423).	Hummock grasslands of *Triodia wiseana*, *T.* spp. (hard spinifex) with isolated to very scattered shrubs of *Acacia* and *Senna* spp. and

Unit	Area (%)	Land unit	Soil	Vegetation
				occasional eucalypt trees. Occasionally hummock grasslands of *Triodia pungens* (soft spinifex).
4	5%	Narrow drainage floors with channels – almost level floors up to 400 m wide but usually much less in valleys, mantles of abundant pebbles of ironstone and other rocks; channels up to 200 m wide with cobble bedloads.	Red shallow loams (522), red loamy earths (544). Channels with river bed soils (705).	Smaller floors support hummock grassland of *Triodia pungens* with very scattered shrubs. **Larger floors and channels support tall shrublands/woodlands of Acacia spp. and *Eucalyptus victrix* (coolibah)** with tussock grass or hummock grass understoreys.

Ranked Habitats

The next step involved ranking the SRE habitats derived from the land system descriptions based on the likelihood species from the broad SRE taxonomic groups will be present and the likelihood the habitat will support a restricted species. This was done based on the microhabitats likely to be present at each SRE habitat and our understanding of how this influences the occurrence of fauna from the broad SRE taxonomic groups.

A list of microhabitats that are regarded as most likely to influence the presence of SRE fauna in the Pilbara was produced, and assigned to each SRE habitat.

Each of the seven SRE fauna groups (as listed in Section 3.1) was given a likelihood rating for each habitat type, based on the presence of microhabitats (5 = Highly Likely to 1 = Highly Unlikley):

- **Fauna likelihood:** the likelihood that species of this fauna group will occur within this habitat.
- **SRE likelihood:** if species of this fauna group do occur, the likelihood that the habitat will support a SRE species.

Each habitat was given an overall likelihood score (likelihood that it will support a SRE species) that was calculated by summing the Fauna likelihood and SRE likelihood scores of the fauna groups that are Likely to be present (>3 Fauna likelihood score). These were then averaged so as to remove any bias towards habitats with more than one fauna group. Once the overall likelihood score was calculated, the habitats were ranked with the top 15% (between 8.5 and 10) regarded as having a High likelihood, the next 15% (between 7 and 8.4) as Medium likelihood and the bottom 20% (between 5 and 7) as Low likelihood. A likelihood score below 5 indicates any fauna likely to be present is highly unlikely to be restricted.

An example is provided below. Only three fauna groups are regarded as likely to be present, land snails, pseudoscorpions and isopods. As such, the Fauna and SRE likelihodd scores are summed of only those three and the average calculated, which in this example is 7.

Table 3.4: An example of how the overall likelihood score is calculated.

SRE Fauna	Important microhabitats	Fauna likelihood	SRE likelihood	Sum (>3 Fauna likelihood)	Overall likelihood score
Shallow Gullies: LL, V, R					
Trapdoor spiders	LL, V	3	3		
Urodacidae	LL, V, R	3	2		
Millipedes	LL, V	3	2		
Land snails	LL, V	4	2	6	
Pseudoscorpions	LL, V, R	5	2	7	
Isopods	LL, V, R	5	3	8	
Selenopid spiders	R, V	3	2		**7.0**

Assignment to Land Systems

Each of the SRE habitats was then assigned to each land system, along with the overall likelihood ranking of Low, Medium or High, based on the land system descriptions.

Along with the likelihood ranking, a frequency rating of Low, Medium or High was assigned to each SRE habitat within each land system. This frequency rating was aimed at taking into account the likely frequency of each SRE habitat within a land system, so as to reduce the influence of SRE habitats that are found infrequently. The rating is partly based on the percentage area of the associated Land Unit within each land system (as can be seen within Table 3.3 in the 2nd column), and any text within the land system description that may provide some direct insight into frequency of a habitat. An example is shown below. Within this land system, the Area % of Unit 1 (Plateaux, ridges, mountains and hills) is 70%; which primarily comprises Gullies and Ridges (and can be regarded as High frequency), while Outcrops are mentioned as a secondary feature (Medium frequency).

Table 3.5: An example of how habitat frequency has been assessed.

Unit	Area (%)	Land unit
1	70%	Plateaux, ridges, mountains and hills – **mountain tracts, plateaux and strike ridges, relief up to 400 m**; level or rounded **plateaux summits and mountain crests, ridges and indented escarpments with vertical upper cliff faces** and moderately inclined to very steep upper scree slopes; surface mantles of abundant to very abundant pebbles, cobbles and stones of ironstone, jaspilite, chert and other rocks. **Also outcrop of parent rock.**

Phase 1 Suitability Assessment

The final step in the Phase 1 suitability assessment involved combining the habitat likelihood ranking and the frequency rating into a table for each land system. Once this was compiled, each land system was given a suitability rating based on the habitat likelihood ranking of the habitats present, the frequency with which that habitat is likely to occur and the number (diversity) of SRE habitats present, to provide input on habitat diversity into the assessment. The suitability ratings are shown below, followed by an example in Table

Rating 1: Low/ No Suitability: These land systems do not appear to have any SRE habitats present, but may still contain SRE dispersal habitats.

Rating 2: Low/ Med Suitability: These land systems contain 1 or 2 SRE habitats, of which at least one is a Low likelihood habitat and the other may be a Medium likelihood, but in Low frequency.

Rating 3: Med Suitability: These land systems contain 2 or more SRE habitats; either a high diversity of Low frequency Medium likelihood habitats or a low diversity of Medium frequency Medium likelihood habitats.

Rating 4: Med/ High Suitability: These land systems contain 2 or more SRE habitats; either a high diversity of Medium frequency Medium likelihood habitats or a low diversity of High frequency Medium likelihood habitats.

Rating 5: High Suitability: All of these land systems contain at least one High likelihood SRE habitat.

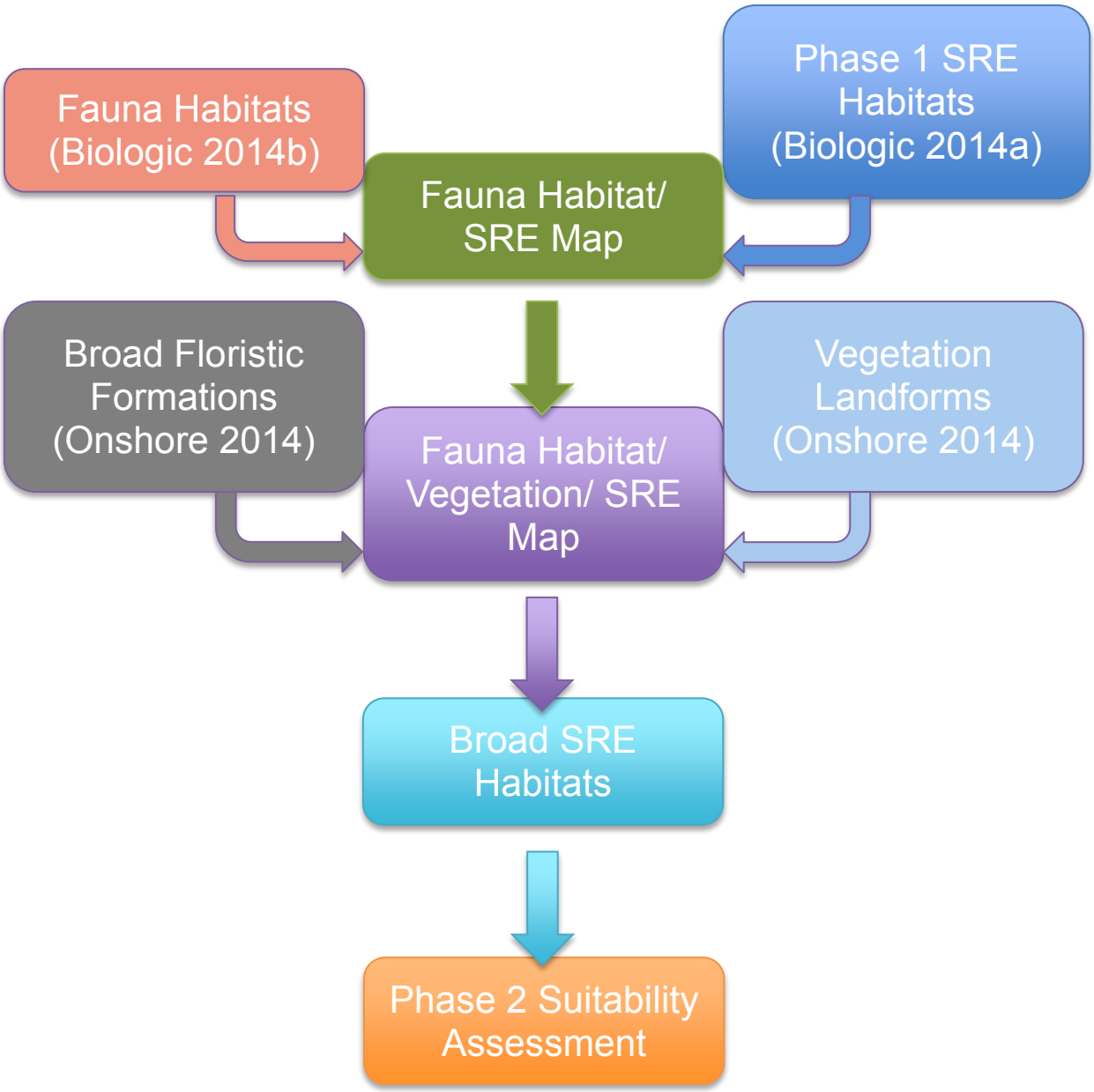
Table 3.6: An example showing how the Boolaloo land system has been determined as having a Med/ High suitability (4) .

Land system	SRE habitat								Suitability rating
	Shallow gullies		Boulders		Outcrops		Isolated sand		
	Hab	Freq	Hab	Freq	Hab	Freq	Hab	Freq	
Boolaloo	Low	Med	Med	Med	Med	Med	Med	Low	4

3.5 Phase 2 SRE Suitability Assessment

The Phase 2 SRE suitability assessment was divided into five steps, with three input layers; the Phase 1 SRE habitats, the consolidated fauna habitat mapping (Biologic 2014b) and the consolidated vegetation mapping (Onshore 2014). The flowchart below (Fiure 3.2) summarises the steps used to derive the Phase 2 suitability assessment and then each step is described in detail further below, ordered and named in reference to the flowchart (Figure 3.2).

Figure 3.2: Flowchart of Phase 2 assessment methodology.



Fauna Habitat/ SRE Map

The first step comprised the reconciliation of the SRE habitat types derived during the Phase 1 assessment (Biologic 2014a) with the 17 vertebrate fauna habitats identified by Biologic (2014b). This included determining which fauna habitats align with which SRE habitats and providing

discussion on the potential protection and isolation provided by each habitat type, and the presence of microhabitats that influence the likelihood of SRE fauna.

Protection, within the context of SRE habitats and fauna in the Pilbara, can be defined as the level of physical protection from solar exposure and disturbances. The former influencing temperature variation at ground level, with a particular emphasis on minimising extreme temperatures, which plays a direct role in maintaining cool, moist environments, which influences fauna and vegetation presence, and fauna activity. Protection from disturbance is associated with providing protection from processes that can directly threaten individual fauna, or that can alter or remove certain habitat characteristics associated with providing protection from solar exposure. The most common disturbances include fire, flood and invasive species, particularly cattle and weeds.

Isolation, within the context of SRE habitats and fauna in the Pilbara, can be defined as the distance between two sites that share similar protective habitat characteristics, relative to the ecological requirements of the fauna, taking into account the lack of these protective habitat characteristics in the intervening landscape. The lack of protective habitat characteristics in the adjacent landscape can play a major role in limiting the dispersal of some fauna, thereby influencing the capacity for a species to move to other habitats that share the same protective habitat characteristics, but are disconnected from the original habitat. The term connectivity is also used regularly within the framework of isolation; however, this is usually within the context of the connectivity of microhabitats and it's influence on species' distributions and dispersal.

Neither of these terms are easily quantified, and their influence with each respective fauna habitat is based on current knowledge and experience in the Pilbara.

This information was then used to provide a comment on the overall likelihood that SRE fauna would be present, and to apply a SRE habitat suitability ranking (1 = low to 5 = high), based on Biologic (2014a).

Fauna Habitat/ Vegetation/ SRE Map

The second step reconciled the vertebrate fauna habitat mapping with the vegetation mapping (Onshore 2014). There was some congruence between the polygons in both data sets; however, the habitat characterisation of the mapped polygons was variable between the two data sets. This difference in characterisation was due to the variation in context between the two mapping exercises; the first taking into account fauna requirements and the second flora.

Onshore (2014) classified the vegetation data into 16 landforms, which were broadly congruent with vertebrate fauna habitats. Through this broad connection, the Onshore landforms were categorised with respect to their suitability for SRE habitats.

The third step comprised identifying which of the Onshore (2014) landforms contained vegetation associations likely to be suitable for SRE fauna.

Each vegetation association was categorised in Onshore (2014) according to broad floristic formations, which comprise the dominant vegetation taxon (e.g. *Triodia*, *Acacia*, *Eucalyptus*), its height (e.g. low, high), its density (e.g. closed, open) and its structure (e.g. hummock grassland, forest, woodland). Sixty one of these broad floristic formations were described by Onshore. For the current assessment, the height component of the vegetation was excluded as it is considered less relevant to SRE fauna habitats and this allowed the number of different formations to be simplified to 47.

The broad floristic formations regarded as suitable as SRE habitats were mapped based on the landforms (Onshore) they corresponded with. In some cases, this included open or simple landforms such as plains or hill slopes, which are not considered suitable for SRE fauna in their own right, but which may be suitable where they provide adequate shelter and complex microhabitats in leaf litter and woody debris. This step broadened the scope of the mapping beyond assessment of landform characteristics only, and ensured that suitable, vegetation- based SRE habitats would be incorporated regardless of (and in combination with) landform based SRE habitats.

Broad SRE Habitats

The polygon layers resulting from each of the two steps described above were compiled into a single dataset and reclassified according to the SRE habitat types (as defined in Biologic (2014a)). The resulting polygons represent broad SRE habitat units based on similar landform, drainage and vegetation characteristics. Each of the broad SRE habitat units features a varying number of potential SRE habitat types that are all related to the range of habitat characteristrics found within the broader unit (for example, within the Boulders, Outcrops, Ridges and Breakaways habitat unit, there would be expected to be a number of potential SRE habitats such as boulder piles, ridges, breakaways and rocky outcrops).

Phase 2 SRE Suitability Assessment

In the final step of the Phase 2 SRE suitability assessment, each Broad SRE Habitat was assessed for it's suitability for SRE habitats based on the suitability ratings given to the landforms present within each, as defined in the earlier consolidation of data during Phase 2.

3.6 Risk Assessment

SRE Habitats

The risk assessment focuses on two scales of potential impact; the regional scale and the local scale. The regional scale takes into account the entirety of the BHP Billiton Iron Ore and third party disturbance footprints within the Study Area, and is focused on the Phase 1 suitability assessment. The local scale assesses each individual BHP Billiton Iron Ore Operation Tenure, and the associated FDS, and uses the Phase 2 suitability assessment, where available, and the Phase 1 suitability assessment where the Phase 2 assessment is not available.

The regional risk assessment looks at the extent of risk of impact through comparing each land system occurring within BHP Billiton Iron Ore's FDS with the total area of each land system within the Study Area. The SRE suitability rating associated with each land system is then taken into account when determining the possible significance of the impact.

The local scale risk assessment looks at the extent of risk of impact through comparing each SRE habitat (and land system where mapping is not available) occurring within each of BHP Billiton Iron Ore's FDSs (within each Operation Tenure) with the total area of each SRE habitat (or land system) within the Study Area. The SRE suitability rating associated with each SRE habitat (or land system) is then taken into account when determining the possible significance of the FDS impact.

3.7 Limitations

There are a number of limitations associated with the Phase 1 and Phase 2 assessment using the data available at the time. These limitations are discussed below.

Data (fauna)

Taxonomic uncertainty

The taxonomy of SRE species in the Pilbara region is incomplete, with significant knowledge gaps remaining, for example, in the description of new species, in the relationships of genera and higher taxonomic levels, and in the characterisation of SRE status, which is also dependent on species distribution data and ecological data. Many taxonomic groups including most arachnids, require mature male specimens for morphological identifications at the species level; therefore, when female or juvenile specimens are collected identifications cannot be confirmed based on morphology alone. This will often lead to either uncertainty in the survey results or to molecular work being undertaken. While molecular studies (i.e. DNA analysis) can often provide a clear delineation of species-level identifications, they are mostly undertaken on an ad-hoc basis, testing a limited sub-sample of individuals against a limited reference data set (due to the cost and

availability of sequences), which results in a partial data set, with numerous knowledge gaps remaining.

Distribution data gaps

Many terrestrial invertebrate species in the Pilbara are only known from a handful of locations, centred around areas where intensive surveys have been undertaken. Some of these occurrence patterns may be attributed to limited species distributions or the extent of potential habitats, but it is generally difficult to discount the effects of sampling discrepancies. These sampling discrepancies are exacerbated by different levels of experience in survey personnel, different survey methodologies and different/ sub-optimal survey timing. As knowledge of SRE taxa has progressed over recent years, more groups are becoming collected as a regular part of SRE surveys (e.g. selenopid spiders, isopods); therefore, collection records for these groups are comparatively less rare.

As the majority of terrestrial invertebrate surveys in the region have been conducted as part of impact assessments for mining/ resource development projects, combined with limited opportunities to conduct regional sampling outside of the particular mining tenement targeted for development, this has had the effect of focussing the sampling (and therefore the species records) within mining tenements proposed for development. Due to the tendency for iron ore bearing geologies to occur within certain land systems, this has also meant that certain land systems have received the majority of survey effort, whereas others have received little to no attention at all, making it difficult to test any assumptions as to the likelihood of SRE fauna or habitats occurring.

The quality of the SRE fauna data, both from survey reports and WAM records, is variable and lacks consistency across the Study Area, having been subject to the sampling artefacts mentioned above, as well as uneven vouchering, and incomplete or erroneous collection records. The WAM data are only as reliable as the persons submitting it to the WAM, as there is limited scope for subsequent quality control or validation once it has been submitted. The quality of the species data may also be influenced by inconsistent taxonomy or variable interpretations of taxonomy and SRE status between different taxonomists. Additionally, not all survey reports for projects within the Study Area were available for review.

The greatest difficulty that the current state of data represents is the ability to confidently determine a species true distribution, which underpins the basic tenet of SRE surveys and assessments. The degree to which we can use the current data for determining species distributions will be discussed further in the desktop review.

Lack of ecological/ biological knowledge of species

There is a poor ecological and biological understanding of SRE fauna at all taxonomic levels, but particularly at the species level, which limits our ability to understand their potential to be dispersal

limited or restricted to particular habitats. How a species feeds, reproduces and disperses are integral to understanding habitat requirements and, ultimately, understanding the potential for geographic restriction and/ or habitat specialisation.

To date there has been little consistency in the collection methods used in surveys or in the description of ecological characteristics relevant to SRE fauna; therefore, it is difficult to determine links between fauna and habitat requirements. For example, some methods of collection rely on fauna activity (pitfall trapping) and, as such, there is a limited connection between the fauna and the habitat. Despite this, the habitat specialisations of some fauna are better established than others, due to what is known of higher taxonomic levels (e.g. Selenopid spiders are specialised to rocky habitats, whereas most burrowing mygalomorph spiders are reliant on deeper soil profiles).

Data (habitats)

Habitat data are not routinely collected as part of terrestrial invertebrate surveys, and when it is collected, there are few applicable standards. This has resulted in the majority of fauna survey data having limited contextual information, with respect to habitat requirements for recorded species. Where habitat information is recorded, it is usually limited to a single habitat definition, with little microhabitat detail. There is also little consistency in the naming and characterisation of habitats and microhabitats, with names changing between consultancies, and between or even within individual reports.

GIS data

All GIS layers that are currently publicly available, covering the Pilbara region, are at very low resolutions. This makes it very difficult to conduct any habitat mapping over large areas, particularly when SRE habitats are often very small and relictual.

There are also a low number of government weather stations in the Pilbara, which makes climate mapping inaccurate. This is exacerbated by the sporadic nature of rainfall in the Pilbara, where small distances on the ground can be subjected to large differences in rainfall.

Land systems

Land systems are very broad characterisations of land units incorporating soils, vegetation types and geology. Therefore land systems can provide an indication of the extent of areas within the Study Area that contain similar landscape characteristics that may vary in their ability to support SRE species (such as deep gullies and gorges within the Newman land system). However, at a finer scale, land systems are divided into land units, which are more directly associated with habitats and microhabitat characteristics relevant to SRE fauna. Many different types of land units (i.e. habitats) are present within each land system; therefore, the total extent of the land system is not considered to be a homogeneous habitat for SRE species, nor is it considered to be uniformly suitabile for SRE species. Unfortunately, the individual land units within each land system are not

mapped, so determining the potential occurrence of habitats within land systems requires a high degree of subjectivity.

In the Phase 1 suitability assessment, the extent of each land system, being the most finely-scaled mappable habitat unit, is considered to indicate the maximum potential range of SRE habitats that occur within that particular land system. However, the extent of land systems is not considered to be a suitable surrogate for the extent of particular SRE habitats, which can be much more restricted or discontinuous within a land system (e.g. gullies on individual mountains within the Newman land system), or which can occur across several different land systems as soils or geology change (e.g. Mulga groves following drainage lines within the Jamindie and Boolgeeda land systems).

Phase 1 SRE suitability assessment

The SRE suitability assessment is influenced by a number of the factors mentioned above but also has a number of elements that are based on “best available knowledge”. This has provided an assessment that will continue to evolve as our knowledge improves.

The SRE suitability assessment required subjectivity in assessing numerous aspects such as:

- Fauna likelihood;
- SRE fauna likelihood;
- Habitat occurrence (likely occurrence and frequency);
- Habitat significance; and
- Congruence between habitats and land units.

These limitations have been taken into account during the assessment of potential SRE species distributions throughout the Study Area. Certain land systems or project areas within the Study Area have been surveyed more thoroughly than others and therefore the level of confidence in the assessment of these areas is higher.

The outcomes of this assessment are based on knowledge and experience of SRE fauna in the Pilbara in the context of the likelihoods and suitability associated with the currently available data.

The potential risk of a particular BHP Billiton Iron Ore or Third Party project area impacting suitabile SRE habitat was then assessed based on the suitability assessment.

Phase 2 SRE suitability assessment

This assessment is largely influenced by the limitations of each of the individual data sets, as discussed in Section 3.5 of this document. There are also a number of elements that are based on “best available knowledge”, particularly with respect to the true extent of SRE habitats on the ground. While the SRE habitat units used within this assessment were more fine-scaled than the land system mapping used in the Phase 1 assessment, the degree to which they accurately reflect

the occurrence of SRE habitat types on the ground varies between the habitat units and the SRE habitat types in question (which can vary in size and extent themselves). In this report we refer to this as congruence, and it is discussed below.

The level of congruence between the broad SRE habitat units and the true SRE habitats that occur within them varies for each habitat unit, and are herein regarded as either low, medium or high (Figure 3.3).

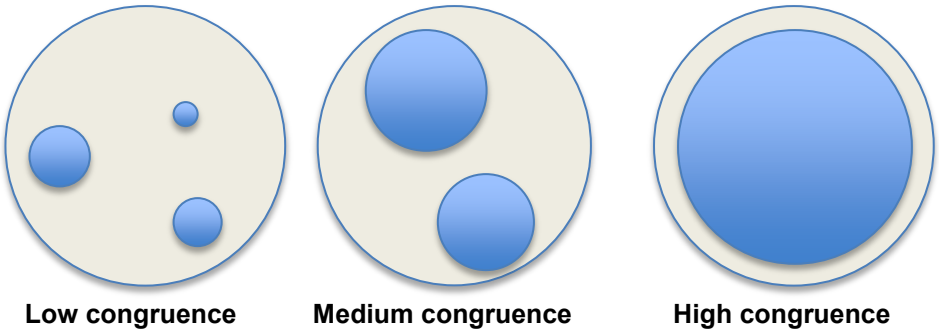


Figure 3.3: Levels of congruence. The beige circle represents the broad SRE habitat unit (as mapped) and the blue circles represent the SRE habitats within.

Low congruence indicates the extent of the SRE habitats (blue circles) is likely to be much smaller than the extent of the broad SRE habitat unit (beige circle). A high congruence indicates that the broad SRE habitat unit (as mapped) is likely to be an accurate reflection of the extent of the relative SRE habitat.

This concept is discussed directly within the risk assessment section of this report to provide some context about the accuracy of the risk assessment relative to a particular SRE habitat.

Potential Priorities for Future Management

Part of the Risk Assessment included producing a table outlining a level of potential priority for future management for each of the Operation Tenures. This was produced taking into account the following:

- Percentage of the FDS that has been mapped;
- If any SRE fauna has been recorded in the local area;
- Current SRE survey coverage;
- SRE habitats known within the local area;
- Estimate of level of impact of the FDS (Low, Medium or High); and
- Factors that may influence the likelihood of SRE fauna occurring within each respective SRE habitat:
    - Suitability rating;
    - Level of congruence;

- Estimated level of potential isolation; and
- Estimated level of connectivity of the SRE habitat beyond the impact.

Based on these factors, a rating of Low to High was given for each SRE habitat within each Operation Tenure. An explanation is also provided detailing the reasoning behind the level given.

Concluding Statement on Limitations

The subjective ratings and estimates found throughout both the Phase 1 and Phase 2 assessments were conducted after consultation with relevant experts (as noted in Section 3.2), and will be subject to change as our knowledge of SRE habitats and fauna improve, but with respect to the primary focus of this assessment, it is fit for purpose.

4 RESULTS

4.1 Database and literature search results

Literature results

Sixty two SRE survey or Impact Assessment reports were sourced and reviewed during the literature review. A summary of the information within these reports is tabled in Appendix A, including records of potential SRE or confirmed SRE species within the Study Area, a summary of the suitabile SRE habitats, and other contextual details of the sampling effort undertaken.

Cross comparison of the SRE fauna results from the 62 reports reviewed and the combined WAM/ BHP Billiton Iron Ore database records (to the best of our ability, within the constraints of the data, refer section 3.4.1) showed that the database records for the most part encompassed the faunal results from the literature. In consideration of the inconsistencies in the way SRE habitats were identified and classified within the various reports (refer section 3.4.2), the habitat data from the literature could not be mapped or assessed at a meaningful level. For this reason, the SRE habitat results from the literature searches have not been included further below.

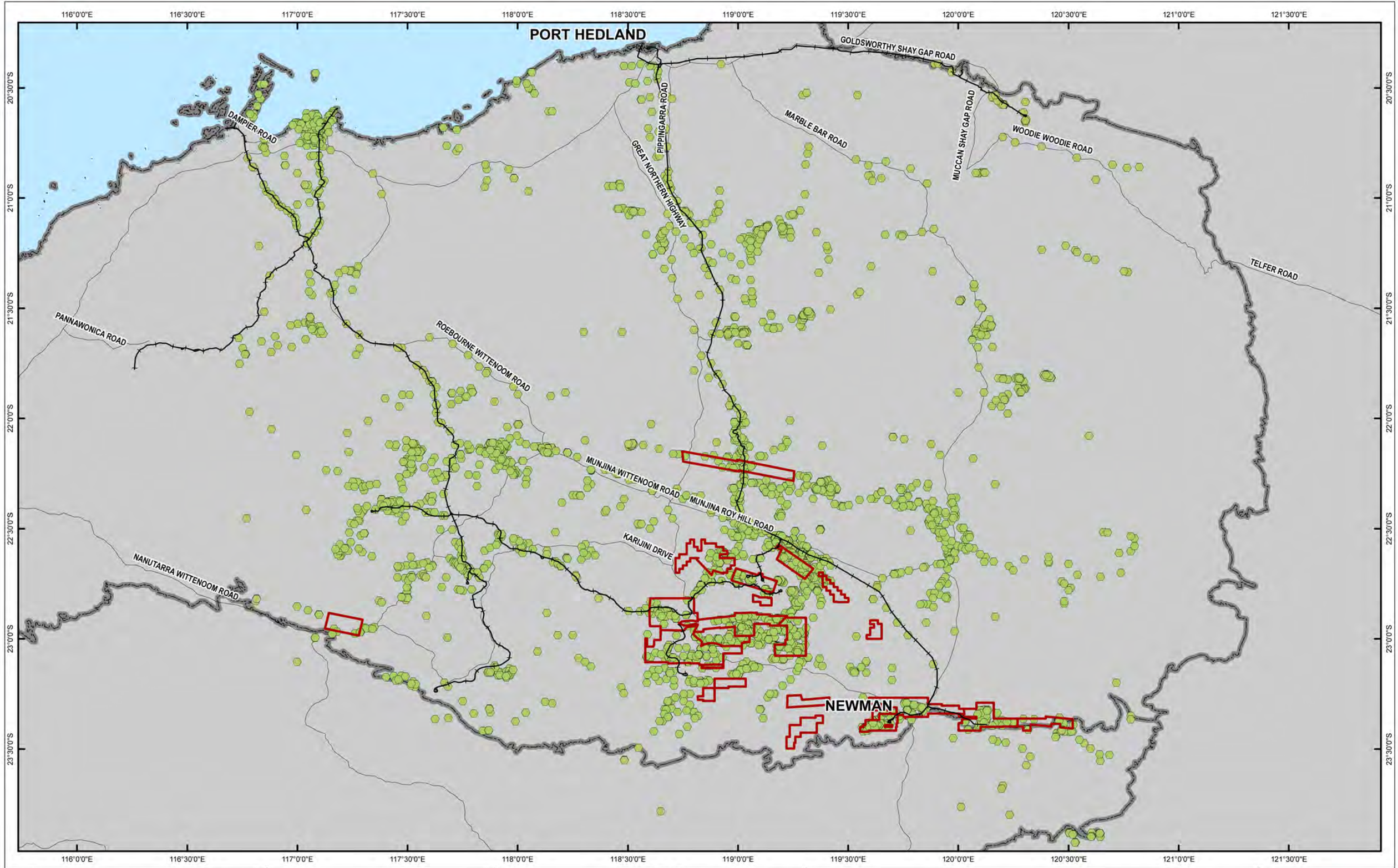
Survey effort

At the time of this report, 36 major mining development projects (or activities associated with mining projects) were proposed or operating within the Study Area. Appendix A outlines the number and location of SRE surveys that have been undertaken throughout the Study Area, according to major project name. The results of the database searches further illustrate the spatial extent of the SRE survey work that has been undertaken within the Study Area to date.

The survey effort undertaken throughout the Study Area included 22,906 terrestrial invertebrate fauna collection records from combined database searches (Figure 4.1) and 551 habitat assessment sites (from BHP Billiton Iron Ore database records only) (Figure 4.2).

SRE Fauna results (database searches)

A total of 144 SRE or potential SRE species have been recorded (from database searches) within the Study Area, including mygalomorph spiders (59 species), selenopid spiders (13 species), scorpions (10 species), pseudoscorpions (13 species), snails (4 species), millipedes (35 species), and isopods (10 species) (see Appendix B for species list). Figure 4.3 shows the distribution of the records (at each higher taxonomic level) throughout the Study Area.



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BHPBIO

SRE ASSESSMENT

STRATEGIC ASSESSMENT AREA

TERRESTRIAL INVERTEBRATE SURVEY DATA

FIGURE 4.1

Legend

- Terrestrial Invertebrate Survey Data
- BHPBIO Operation Tenure
- IBRA Pilbara & Gascoyne regions

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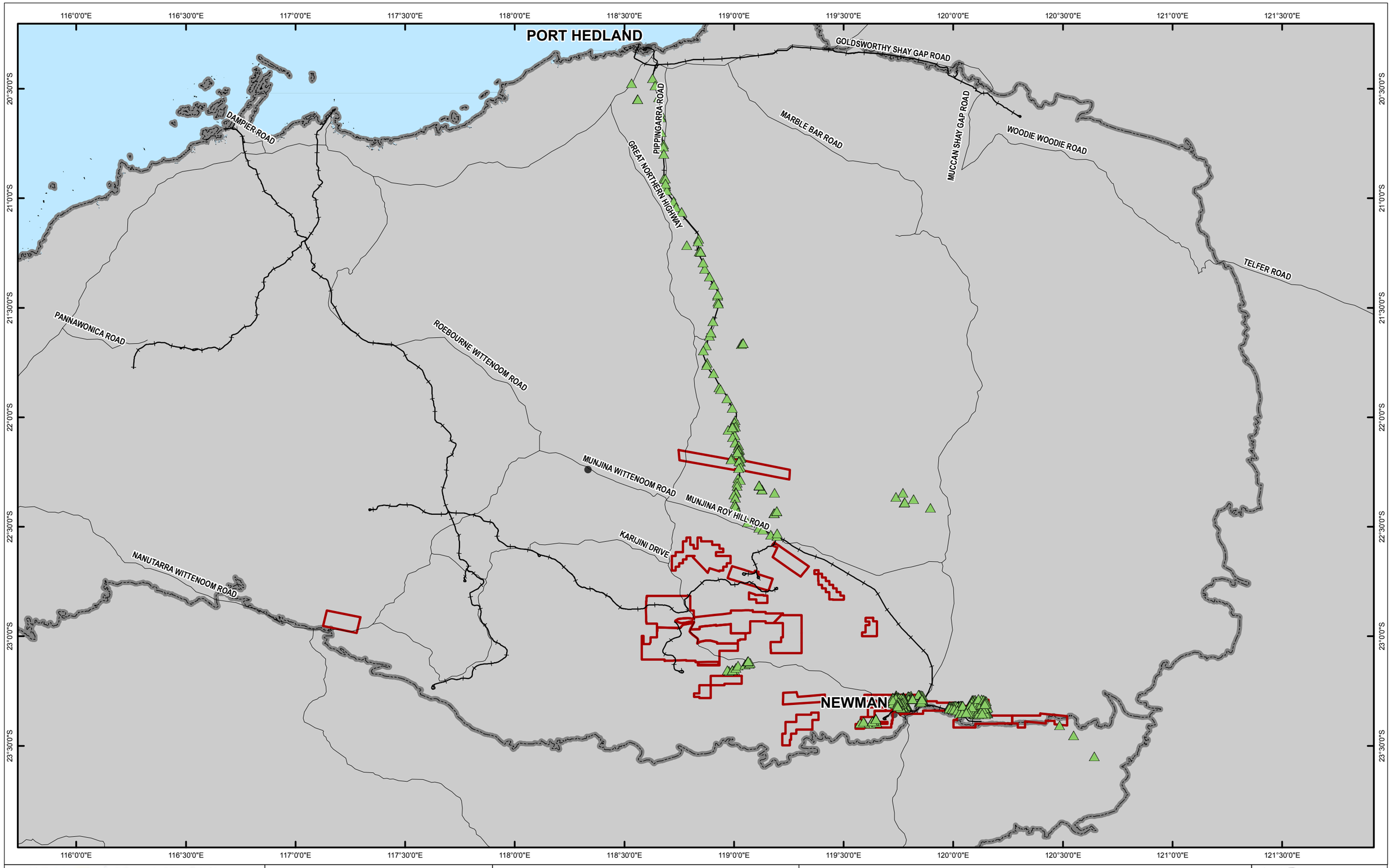

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SRE ASSESSMENT

STRATEGIC ASSESSMENT AREA

TERRESTRIAL INVERTEBRATE HABITAT DATA

FIGURE 4.2

Legend

- Terrestrial Invertebrate Habitat Data
- BHPBIO Operation Tenure
- IBRA Pilbara & Gascoyne regions

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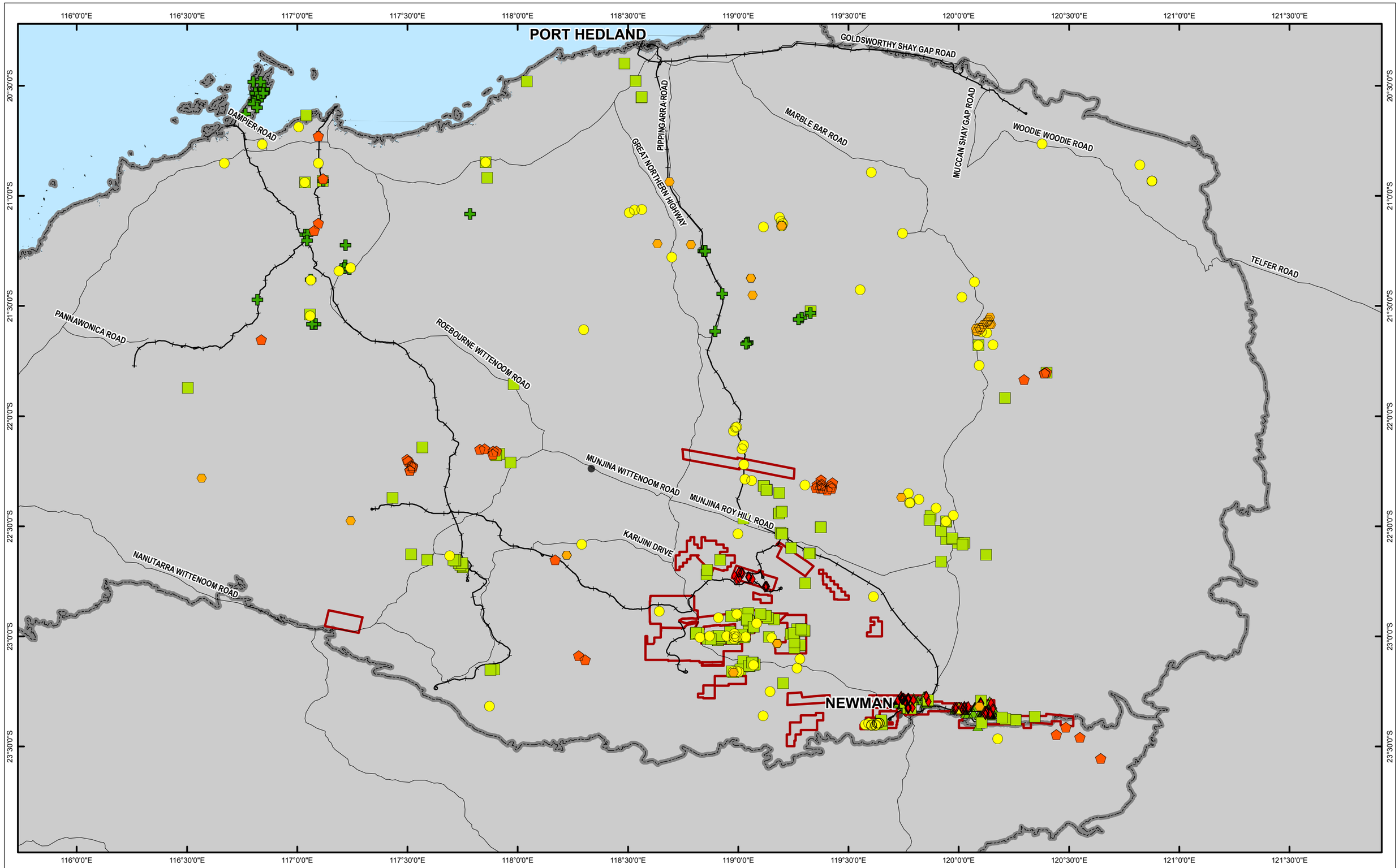

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BHPBIO

SRE ASSESSMENT

STRATEGIC ASSESSMENT AREA

ALL POTENTIAL AND KNOWN SRE TAXA

FIGURE 4.3

Legend

- IBRA Pilbara & Gascoyne
- BHPBIO Operation Tenure
- Camaenidae
- Isopoda
- Mygalomorphae
- Myriapoda
- Pseudoscorpiones
- Scorpiones
- Selenopidae

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Threatened and Priority Ecological Communities

Within the Study Area there are two Threatened Ecological Communities (TEC) as identified by the Department of Parks and Wildlife (DPaW - previously Environment and Conservation) (Ethel Gorge and Themeda grasslands) and 16 Priority Ecological Communities.

The Ethel Gorge TEC (*Ethel Gorge aquifer stygobiont community*) is listed as Endangered (B ii)[1]. The Themeda grasslands TEC is described as "*Themeda grasslands on cracking clays (Hamersley Station, Pilbara). Grassland plains dominated by the perennial Themeda (kangaroo grass) and many annual herbs and grasses*" and is classified as Vulnerable (A) under WA criteria[2]. However, neither of these TECs specifically refer to terrestrial SRE fauna communities or habitat that is likely to support terrestrial SRE fauna, therefore they are not a subject of this assessment.

Other ecological communities that do not necessarily meet the survey criteria for TEC listing, or that are not adequately defined as TECs, are added to the Priority Ecological Community (PEC) list (DPaW). Thirteen PECs occur within the Study Area (Appendix C); however, only 7 of these are considered to have potential to support SRE fauna or suitabile SRE habitats (Table 4.1 and Figure 4.4). The Fortescue Marsh, Weeli Wolli Spring and Coolibah-lignum flats are the most likely PECs that support significant SRE habitat.

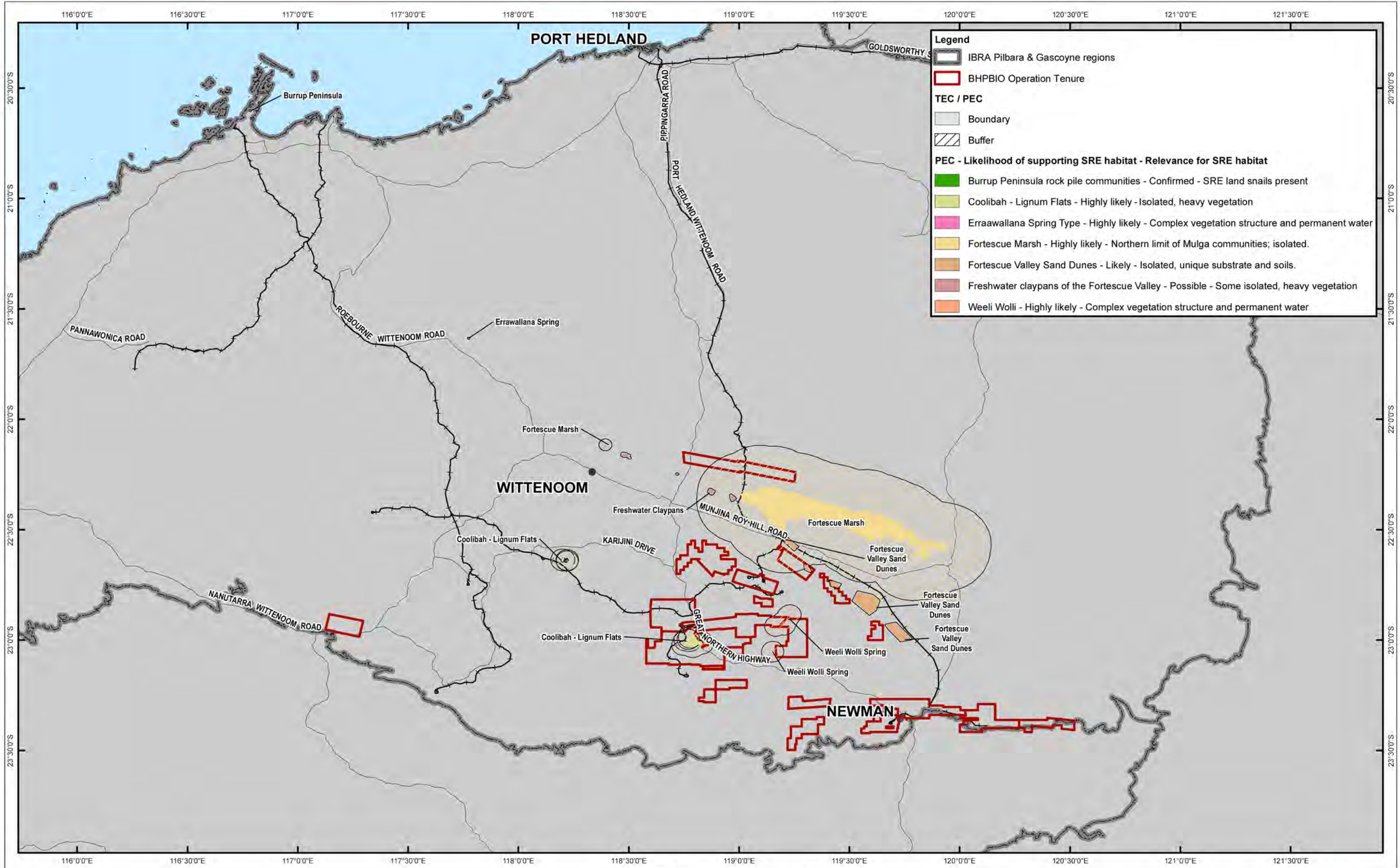
[1] An ecological community will be listed as Endangered when it has been adequately surveyed and is not Critically Endangered but is facing a very high risk of total destruction in the near future. For this community the listing has been determined as its B) Current distribution is limited, **and** 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.

[2] 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 ecological community (as classified A) exists largely as modified occurrences that are likely to be capable of being substantially restored or rehabilitated.

Table 4.1: Priority Ecological Communities located within the Study Area that are relevant to SRE fauna and habitats.

# PEC	Priority Ecological Community	Community description	SRE Suitability	Relevance for SRE habitat
2	Weeli Wolli Spring Community	The spring and creekline are noted for their relatively high diversity of stygofauna and this is probably attributed to the large-scale calcrete and alluvial aquifer system associated with the creek.	Highly likely	Complex vegetation structure, permanent water
4	Burrup Peninsula rock pile communities	Comprise a mixture of Pilbara and Kimberley species, communities are different from those of the Hamersley and Chichester Ranges. Short-range endemic land snails.	Confirmed	SRE land snails present
16	Freshwater claypans of the Fortescue Valley	Important for waterbirds, invertebrates and some poorly collected plants. *Eriachne* spp., *Eragrostis* spp. grasslands. Unique community, has few Coolabah.	Possible	Some isolated, heavy vegetation
17	Fortescue Marsh (Marsh land system)	Regarded as the largest ephemeral wetland in the Pilbara. It is a highly diverse ecosystem with fringing mulga woodlands (on the northern side), samphire shrublands and groundwater dependent riparian ecosystems. It is an arid wetland utilized by waterbirds and supports a rich diversity of restricted aquatic and terrestrial invertebrates.	Highly likely	Northern limit of Mulga woodland communities; isolated

# PEC	Priority Ecological Community	Community description	SRE Suitability	Relevance for SRE habitat
20	Coolibah-lignum flats	Coolibah and mulga (*Acacia aneura*) woodland over lignum and tussock grasses on clay plains (Coondewanna Flats and Wanna Munna Flats). Coolibah woodlands over lignum (*Muehlenbeckia florulenta*) over swamp wandiree. Coolibah woodland over lignum and silky browntop (*Eulalia aurea*).	Highly likely	Isolated drainage focus, dense vegetation
25	Fortescue Valley Sand Dunes	These red linear sand dune communities lie on the Divide land system at the junction of the Hamersley Range and Fortescue Valley, between Weeli Wolli Creek and the low hills to the west. A small number are vegetated with *Acacia dictyophleba* scattered tall shrubs over *Crotalaria cunninghamii*, *Trichodesma zeylanicum* var. *grandiflorum* open shrubland. They are regionally rare, small and fragile and highly susceptible to threatening processes.	Likely	Isolated, unique substrate and soils.
28	Errawallana Spring	Geologically distinct. Sherlock River system. Permanent spring-fed creek. Has atypical invertebrate community.	Highly likely	Complex vegetation structure, permanent water



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SRE ASSESSMENT

STRATEGIC ASSESSMENT AREA

PEC'S ACROSS THE ASSESSMENT AREA

FIGURE 4.4

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4.2 Phase 1 SRE suitability assessment

SRE Habitats within Land Systems

The Study Area covers 71 of the 102 land systems in the Pilbara bioregion and four of the 63 land systems in the Gascoyne bioregion.

Land system assessment for SRE habitats

Table 4.2 shows the results of the assessment of each land system (grouped according to land type) across the Study Area. The SRE land unit column shows which land units contain habitat descriptions congruent with potential SRE habitat and the SRE habitat description column outlines this descriptive text. The final column contains the percentage area that Van Vreeswyck *et al.* (2004) and Payne *et al.* (1988) states the particular land unit occupies within the given land system.

It is important to note that the entirety of a land system may not be suitable for supporting SRE's; however, as land units are not currently mapped in the Study Area, land systems are used to provide an indication of areas that contain potential SRE habitat.

Table 4.2: Relevant land units and descriptions, and proportions of suitable SRE habitat within each land system across the Study Area.

Land system	SRE land unit	SRE habitat description	Area % of LS
Land type 1: Hills and ranges with spinifex grasslands			
Black	Ridges	Ridges with linear crests and summits up to 90 m, with very steep upper slopes	80
Boolaloo	Hill, tor heaps and hill slopes	Boulder strewn slopes, bare domes and tor heaps	70
	Sandy plains	Between hills and tor heaps; red deep sands	10
Capricorn	Ridges, hills and upper slopes	Rocky summits…with moderately inclined to very steep upper slopes…frequent exposures of bedrock	70
Granitic	Hills, ridges, domes and uppers slopes	Hill crests and ridge summits with….outcrop of granitic rocks; tor heaps and bare rounded dome surfaces of exposed rock….to steep upper slope	40
	Drainage foci	Isolated foci…receiving run-on from bare domes and hills…close tall shrublands of *Acacia tumida* or other acacias	<1
McKay	Hills, ridges and plateaux remnants	Rounded hill and ridge crests…inclined plateaux remnants….to very steep upper slopes…..also rock outcrop	60
	Breakaways	Indurated mesa caps of ironstone or laterite with vertical breakaway faces up to 15 m high….	2
Newman	Plateaux, ridges, mountains and hills	Mountain tracts, plateaux and strike ridges, relief up to 400 m…plateaux summits and mountain crests, ridges and indented escarpments with vertical upper cliff faces…also outcrop of parent rock	70
Robertson	Hill crests and plateaux surfaces	Surface mantles of ….pebbles, cobbles, stones and boulders of sedimentary rock, also much rock outcrop.	20
	Upper hillslopes	Occasional near vertical cliff faces below crests….frequent rock outcrop	25

Land system	SRE land unit	SRE habitat description	Area % of LS
Rocklea	Hills, ridges, plateaux and upper slopes	Crests and plateaux surfaces…to very steep, sometimes benched, upper slopes….also much outcrop of basalt	65
Ruth	Hills, ridges and upper slopes	Moderately inclined to steep convex and concave upper slopes…also outcrop of parent rock	75
	Sandplains	Restricted patches…between hills…red deep sands and red sandy earths	5
Talga	Hills and ridges	Moderately inclined to very steep, sometimes benched, upper slopes….outcrops of parent rock	50
Land type 2: Hills and ranges with acacia shrublands			
Augustus	Ranges, hills, ridges and rocky uplands	Gently rounded summits, near vertical escarpments	65
Charley	Hills and ridges	Rounded stony summits and crests, steep upper slopes	60
Marandoo	Hills, ridges and upper slopes	Rounded hill crests and ridge summits with moderately inclined to steep upper slopes….also rock outcrop	50
Ashburton River Catchment Land Systems			
Kooline	Shale hills and ridges	Dense colluvial mantles and steeply dipping shale outcrop	60
	Quartz ridges	Up to 50 m high and 1 km long by 0.5 km wide, steep rocky slopes	1
Kunderong	Low rounded hill, large ridges	Some large ridges to 150 m or more…gently rounded hill crests, stony convex slopes with prominent structural benching…locally greater, sandstone outcrop	26
	Hardpan plains with groves	Up to 2 km wide and 4 km long….subject to sheet flow	10
	Flow areas with groves	Drainage zones associated with outcrop plains	1
Land type 3: Plateaux, mesas and breakaways with spinifex grasslands			
Kumina	Low rises	Rounded rises….to 10 m…also ironstone rock outcrop	90
Oakover	Plateaux and mesa tops with breakaways	Inclined plateaux surfaces with highly dissected margins, almost vertical breakaway escarpments of duricrust….also calcrete outcrop	40
Robe	Low plateaux, mesas and buttes	Inclined crests, near vertical breakaway faces, up to 10 m high….outcrops of limonite	60
Land type 4: Plateaux, mesas and breakaways with acacia shrublands			
Laterite	Mesas and low hills	Nearly level mesa tops or rounded crests, vertical breakaway faces up to 3-4 m	30
Table	Calcrete mesas, low plateaux and hills	Level plateaux tops	50
	Drainage foci	On unit 1 (see above) about 0.5 m below adjacent surfaces…self-mulching cracking clays	1
Land type 5: Dissected plains with spinifex grasslands			
Egerton	Dissected slopes	Slopes….sometimes steep in upper parts with small breakaway faces up to 3 m high	75
Platform	None		
Land type 6: Stony plains and hills with spinifex grasslands			
Adrian	None		
Bonney	Hills	Rounded hills…also rock outcrop	26
Nirran	Low ridges and rounded hills	Ridges and hills….also rock outcrop	15
Land type 7: Stony plains and low hills with acacia shrublands			
Collier	Low hills and ridges	Hill crests with steep convex and concave upper slopes….outcrop…isolated ridges….with stony slopes	30
Prairie	Hills	Low hills with rounded and boulder strewn crests….and outcrops of granite	26

Land system	SRE land unit	SRE habitat description	Area % of LS
	Dolerite ridges	Low (up to 5 m high) ridges up to 50 m wide usually 100-500 m long but occasionally several kilometres	2
Land type 8: Stony plains with spinifex grasslands			
Boolgeeda	Groves	Small (up to 20 m long) arcuate drainage foci occurring infrequently on lower and upper plains.	1
Macroy	Low hills and ridges	Isolated hills and tor heaps….ridges…, moderately inclined to very steep slopes, surface mantles of….and boulders of granite, quartz and other rocks.	5
	Calcrete plains	Level plains restricted to 300-400 m in extent….also calcrete outcrop.	3
Satirist	Calcrete plains	Level plains 200-300 m in extent….also calcrete outcrop.	5
Land type 9: Stony gilgai plains with tussock grasslands and spinifex grasslands			
White Springs	None		
Wona	None		
Land type 10: Stony plains with acacia shrublands			
Dollar	Drainage foci	Discrete, variable shaped foci on stony plains, commonly 50-200 m in extent, receiving run-on from adjacent surfaces	8
	Swamp and depressions	Up to 500 m in extent, moundy or gilgai relief…*Eucalyptus victrix* (coolibah) woodlands	<1
Elimunna	Groves	Discrete drainage foci (up to 50 m long to 5-15 m wide)	1
Ford	Residual hardpan plains	Minor areas of hardpan plain…with dissected margins and breakaways up to 3 m high	2
Paraburdoo	Low basalt hills and ridges	Up to 1 km long with rounded crests….and rock outcrops of basalt	2
	Groves	Level drainage foci mostly 20-40 m in extent	2
Sylvania	Low rises and tors	Occasional tor heaps of granite with relief to 20 m….and outcrop of granite	5
	Hardpan plains and small groves	Occasional small groves (up to 200 m long by 30 m wide) on plains and receiving run-on from plains	18
Ashburton River Catchment Land Systems			
Ethel	None		
Land type 11: Sandplains with spinifex grasslands			
Divide	Sand dunes	Linear dunes up to 15 m high with moderately inclined slopes, hummocky crests and loose surfaces	1
Uaroo	None		
Land type 12: Wash plains on hardpan with groved mulga shrublands (sometimes with spinifex understory)			
Cadgie	Groves	Arcuate drainage foci occurring on hardpan plains	1
Fan	Groves	Drainage foci occurring as prominent bands on loamy plains and washplains	15
	Drainage foci	Depressions and irregular foci…. often with gilgai relief	1
Jamindie	Low ridges and hills	Ridges and hills…some rock outcrop	5
	Groves	Accurate drainage foci…on hardpan plains	15
	Sandy banks	Banks up to 0.5 m high, mostly less than 100 m long and 10 to 20 m wide….Red deep sands….shrublands with *A. aneura* and other *Acacias*	2
Jurrawarrina	Groves and drainage foci	Foci as bands…on stony and hardpan plains, and drainage tracts…. frequently with gilgai microrelief	22
Nooingnin	Groves	Bands of dense vegetation on hardpan plains	10

Land system	SRE land unit	SRE habitat description	Area % of LS
	Sandy banks	Banks up to 0.5 m high and 100 m wide, linear or reticulate up to 2 km long….Red deep sands and red sandy earths…tall shrublands of *A. aneura* and other *Acacias*	10
Pindering	Groves	Linear or arcuate drainage foci	8
Spearhole	Groves	Groves or arcuate bands on hardpan plains	15
Three Rivers	Sandy banks	Up to 1 m high and 1 km long by 20 m wide occurring on hardpan plains	15
	Groves	Drainage foci on hardpan plains…receiving run-on from adjacent surfaces	2
Wannamunna	Groves	Arcuate drainage foci….on hardpan plains….receiving run-on from adjacent plains; often with gilgai microrelief	15
Washplain	Groves	Drainage foci….on alluvial hardpan plains and drainage tracts	15
Zebra	Groves	Drainage foci…receiving run-on from adjacent hardpan plains	3
	Sandy banks and sand sheets	…also patches of sand sheet up to 1 km in extent	33
Land type 13: Alluvial plains with soft spinifex grasslands			
Mallina	Stony rises and low hills	Occasional isolated stony rises or low hills….abundant stony surface mantles and rock outcrop	<1
Paradise	None		
Urandy	None		
Land type 14: Alluvial plains with tussock grasslands or grassy shrublands			
Balfour	None		
Brockman	Groves	Drainage foci on hardpan plains…..gilgai microrelief	1
	Swamps	Slight depressions…within gilgai plains	1
Horseflat	None		
Turee	Groves and drainage foci	…on hardpan plains and stony plains, receiving run-on from adjacent surfaces	1
Ashburton River Catchment Land Systems			
Cheela	None		
Land type 15: Alluvial plains with snakewood shrublands/acacia shrublands			
Christmas	Groves and drainage foci	Groves…and diffuse foci…receiving run-on from adjacent plains….gilgai microrelief	20
Cowra	Groves	Drainage foci…on stony and alluvial plains…sometimes with microrelief	2
Hooley	None		
Marillana	Drainage foci	Level foci as shallow, circular or irregularly shaped depressions…. receiving run-on from adjacent plains and drainage tracts; gilgai microrelief	12
	Groves	Arcuate foci….on gravelly plains and drainage tracts….receiving run-on from adjacent surfaces	1
Narbung	Drainage foci	Circular, oval or irregularly shaped foci and groves…. receiving run-on from adjacent plains	4
Land type 16: Alluvial plains with halophytic shrublands			
Cundelbar	Groves	Drainage foci….on gravelly plains and saline alluvial plains, receiving run-on from adjacent surfaces	3
Land type 17: River plains with grassy woodlands and shrublands, and tussock grasslands			
Coolibah	Depressions and drainage foci	Low lying depressions and drainage foci…within flood plains and alluvial plains	10
Fortescue	Groves	Drainage foci occurring on hardpan plains	1
Jigalong	Drainage foci	Discrete drainage foci, groves and pans…within alluvial	3

Land system	SRE land unit	SRE habitat description	Area % of LS
		plains, occasionally with weakly gilgaied microrelief	
River	None		
Yamerina	Swampy depressions	Level internal drainage foci, roughly circular or oval in shape	2
Land type 18: Calcreted drainage plains with shrublands or spinifex grasslands			
Calcrete	Drainage foci	Small depressions and minor sink holes on calcrete platforms. Foci and swamps….within calcrete and sandy plains, sometimes with gilgai microrelief	1
Warri	Drainage foci and sinkholes	Oval or elongated foci on calcrete tables	2
Land type 20: Salt lakes and fringing alluvial plains with halophytic shrublands			
Marsh	Channels and water holes	Very occasional large waterholes up to 300 m wide and 3 km long	<1
Weelarrana	Salt lake beds	Level, bare saline surfaces extending for 3-4 km	25

Land system assessment for SRE dispersal habitats

Three land types were regarded as not suitabile for SRE dispersal habitats; land types 16, 18 and 20, as they did not contain land units that meet the criteria set out in Section 3.4.

Table 4.3: Relevant land units and descriptions, and proportions of SRE dispersal habitats within each land system across the Study Area.

Land system	SRE dispersal land unit	SRE dispersal habitat description	Area % of LS
Land type 1: Hills and ranges with spinifex grasslands			
Black	None		
Boolaloo	Narrow drainage floors and channels	Larger channels have fringing woodlands of eucalypts and melaleuca	2
Capricorn	None		
Granitic	Narrow drainage floors and channels	Larger floors with channels support moderately close to close tall shrublands/woodlands with *Acacia, Eucalyptus* and *Melaleuca* spp.	5
McKay	None		
Newman	Narrow drainage floors with channels	Larger floors and channels support tall shrublands/woodlands *of Acacia* spp. and *Eucalyptus victrix* (coolibah)	5
Robertson	Narrow drainage floors and channels	Moderately close tall shrublands/low woodlands of *Acacia* spp.	5
Rocklea	None		
Ruth	None		
Talga	None		
Land type 2: Hills and ranges with acacia shrublands			
Augustus	Channels and creeks	Fringing woodlands of *Acacia coriacea* (river jam), *A. citrinoviridis* and *Eucalyptus camaldulensis* (red river gum)	3
Charley	Drainage floors and channels	Moderately close tall shrublands of *A. aneura* and other *Acacias*	3
Marandoo (	Drainage floors and channels	Moderately close woodlands of *A. aneura*…. Also grassy eucalypt woodlands along creeks	10
Ashburton Land Systems			

Land system	SRE dispersal land unit	SRE dispersal habitat description	Area % of LS
Kooline	Flow zones with braided channels	Tall shrubland of *Acacia wanyu* and *A. kempeana*	10
Kunderong	Channels and creeklines	Fringing woodland of *Eucalyptus camaldulensis* or tall shrubland of *Acacia aneura*, *A. pruinocarpa* or *A. tetragonophylla*	1
Land type 3: Plateaux, mesas and breakaways with spinifex grasslands			
Kumina	None		
Oakover	Drainage lines	Larger floors with channels support *Acacia* or Eucalypt tall shrublands/woodlands	10
Robe	Drainage floors and channels	Also moderately close eucalypt or *Acacia* woodlands/tall shrublands	5
Land type 4: Plateaux, mesas and breakaways with acacia shrublands			
Laterite	Drainage floors with braided creeklines	Moderately close tall shrublands/woodlands of *Acacia aneura* and other *Acacias*	10
Table	Channels and creeklines	Close fringing tall shrublands/woodlands of *Acacia aneura* and other *Acacia* spp.	4
Land type 5: Dissected plains with spinifex grasslands			
Egerton	Drainage floors and channels	Moderately close woodlands/tall shrublands of *A. aneura* with other shrubs	9
Platform	Drainage floors	Scattered to close tall shrublands/woodlands with *Acacia citrinoviridis* (black mulga), *A. tumida* (pindan wattle) and other *Acacias*	15
Land type 6: Stony plains and hills with spinifex grasslands			
Adrian	None		
Bonney	None		
Nirran	Narrow drainage floors and creeklines	Moderately close tall shrublands/woodlands with *Acacia citrinoviridis* (black mulga), *A. aneura*	8
Land type 7: Stony plains and low hills with acacia shrublands			
Collier	Channels and banks	Moderately close woodlands/tall shrublands of *A. aneura, A. kempeana* (witchetty bush) and other *Acacia* spp.	5
Prairie	Creeklines and channels	Close fringing low woodlands or tall shrublands with *Eucalyptus victrix* (coolibah), *Acacia* spp.	4
Land type 8: Stony plains with spinifex grasslands			
Boolgeeda	Narrow drainage floors and channels	Scattered to close tall shrublands or woodlands of *A. aneura, A. atkinsiana, Corymbia hamersleyana* (Hamersey bloodwood)	10
Macroy	Drainage floors and channels	Channels have fringing grassy woodlands with *Eucalyptus camaldulensis* (river red gum) and *Acacia coriacea* (river jam)	12
Satirist	Drainage tracts and minor channels	Larger channels may have fringing grassy woodlands with *Eucalyptus victrix* (coolibah)	5
Land type 9: Stony gilgai plains with tussock grasslands and spinifex grasslands			
White Springs	Drainage lines	Moderately close tall shrubland of *Acacia* spp	1
Wona	Drainage lines	Scattered to moderately close tall shrublands of *Acacia xiphophylla* or other *Acacias*	5
Land type 10: Stony plains with acacia shrublands			
Dollar	Braided channels	Moderately close tall shrublands including *Acacia wanyu* and numerous other *Acacia* spp.	3
Elimunna	None		
Ford	Saline drainage floors with braided	Braided channels with moderately close to close fringing tall shrublands with *A. aneura, A. coriacea* (river jam), *A.*	15

Land system	SRE dispersal land unit	SRE dispersal habitat description	Area % of LS
	channels	*sclerosperma* (limestone wattle) and *A. citrinoviridis* (black mulga)	
Paraburdoo	Braided creeklines and channels	Moderately close tall shrublands/woodlands of *Acacia citrinoviridis* (black mulga) and other *Acacia* spp., *E camaldulensis* (river red gum)	3
Sylvania	Drainage tracts	Moderately close tall shrublands of *Acacia aneura* and other acacias	10
Ashburton Land Systems			
Ethel	Braided channels	Dense tall shrubland of various *Acacia* spp.	
Land type 11: Sandplains with spinifex grasslands			
Divide	Tracts receiving run-on	Scattered to close tall shrublands of *A. aneura, A. kempeana* (witchetty bush)	3
Uaroo	None		
Land type 12: Wash plains on hardpan with groved mulga shrublands (sometimes with spinifex understory)			
Cadgie	None		
Fan	None		
Jamindie	None		
Jurrawarrina	Channels	Moderately close fringing tall shrublands/woodlands with *A. aneura,* other acacias and eucalypts	1
Nooingnin	Narrow drainage zones	Close low woodlands of *A. aneura* and other *Acacia* spp.	2
Pindering	None		
Spearhole	None		
Three Rivers	None		
Wannamunna	Internal drainage plains	Moderately close to closed woodlands of *Acacia aneura* and *Eucalyptus victrix*	20
Washplain	Tracts receiving more concentrated through flow	Moderately close to closed woodlands or tall shrublands of *Acacia aneura*	14
Zebra	None		
Land type 13: Alluvial plains with soft spinifex grasslands			
Mallina	Drainage tracts, river terraces, banks and channels	Also fringing grassy woodlands of *Eucalyptus camaldulensis* (river red gum), *E. victrix* (coolibah) along channels	2
Paradise	None		
Urandy	None		
Land type 14: Alluvial plains with tussock grasslands or grassy shrublands			
Balfour	Drainage tracts and creeklines	Moderately close to close *Acacia aneura* tall shrublands with other *Acacias*	10
Brockman	Narrow drainage tracts and channels	Larger creeklines with fringing woodlands of *Eucalyptus camaldulensis* (river red gum), *E. victrix* (coolibah), *Acacia coriacea* (river jam) and *A. citrinoviridis* (black mulga)	3
Horseflat	Channels and minor river terraces	Fringing woodlands with *Eucalyptus camaldulensis* (river red gum), *E. victrix* (coolibah) and *Acacia coriacea* (river jam)	<1
Turee	Channeled drainage tracts	Larger tracts with channels support tall shrublands or low woodlands with *Acacia coriacea* (river jam), other *Acacias*, *Eucalyptus victrix* (coolibah)	10
Ashburton Land Systems			
Cheela	None		

Land system	SRE dispersal land unit	SRE dispersal habitat description	Area % of LS
Land type 15: Alluvial plains with snakewood shrublands/acacia shrublands			
Christmas	None		
Cowra	None		
Hooley	Drainage tracts	…or tall moderately close shrublands/woodlands with *Acacia aneura, A. xiphophylla*, *A. coriaceae* (river jam), *Eucalyptus victrix* (coolibah)	10
Marillana	Drainage tracts	Scattered to close tall shrublands or woodlands of *Acacia aneura*	22
Narbung	None		
Land type 16: Alluvial plains with halophytic shrublands			
Cundelbar	None		
Land type 17: River plains with grassy woodlands and shrublands, and tussock grasslands			
Coolibah	Flood plains	Moderately close woodlands of *Eucalyptus victrix* (coolibah) or *Acacia distans*	50
	Channel, bank and minor river terrace	Moderately close or close fringing woodlands of *Eucalyptus victrix, E. camaldulensis* and *Acacia* spp.	2
Fortescue	Channels	Fringing woodlands with *Eucalyptus camaldulensis* (river red gum), *E. victrix* (coolibah), *Acacia coriaceae* (river jam) and *A. citrinoviridis*	3
Jigalong	Major and minor channels	Close fringing woodlands and tall shrublands often dominated by *Acacia citrinoviridis*. Also *Acacia coriaceae*, *Eucalyptus camaldulensis* (river red gum) and *E. victrix* (coolibah)	3
River	Minor and major channels	Banks with close or closed fringing woodlands with *Eucalyptus camaldulensis* (river red gum), *E. victrix* (coolibah), *Melaleuca argentea* (cadjeput), *M. glomerata, Sesbania formosa* (white dragon tree), *Acacia coriaceae* (river jam)	20
Yamerina	Channels	Margins and banks support fringing woodlands with *Eucalyptus camaldulensis* (river red gum), *E. victrix* (coolibah) and *Melaleuca* spp. (paper bark)	2
Land type 18: Calcreted drainage plains with shrublands or spinifex grasslands			
Calcrete	None		
Warri	None		
Land type 20: Salt lakes and fringing alluvial plains with halophytic shrublands			
Marsh	None		
Weelarrana	None		

Derived SRE habitats

From the land systems and land unit descriptions, twelve SRE habitat types were derived. Table 4.4 outlines the description of each SRE habitat type and SRE dispersal habitat type and the number of land systems in which they each occur (occurrence).

Table 4.4: SRE habitat types and its occurrence within land systems

Habitat	Code	Land unit description	Occurrence (No. of land systems)
Gullies and gorges	Gu	Mesas, plateaux, mountains and hills where dissected by drainage; relief above 80 m	10
Shallow gullies	SGu	As above, but relief between 25 m and 80 m	15
Ridges	Ri	Steep upper slopes to vertical cliff faces	19
Boulders	Bo	Boulders and tor heaps	5
Breakaways	Br	Vertical breakaway faces	6
Outcrops	Ou	Outcropping, bare domes, plateaux remnants and areas of exposed rock	24
Isolated sands	IS	Areas of isolated deep sands, often between uplands	4
Groves	Gr	Isolated areas of denser, taller vegetation, sometimes associated with drainage foci	23
Drainage foci	DF	Small, disjunct areas which receive run-on from adjacent surfaces, resulting in denser, taller vegetation	27
Swamp and depressions	Sw	Areas of moisture retention associated with soil changes, sometimes associated with drainage foci	5
Salt lakes	SL	Saline floors, periodically inundated	1
Waterholes	Wa	Isolated waterholes	1
SRE dispersal habitat		Moderately close tall shrubland or woodland, as a minimum density, and appear to be widespread	45

Ranking Habitats

As described in Section 3.4, ranking the SRE habitats involved the incorporation of SRE microhabitat information and SRE fauna likelihood.

Microhabitats

Five microhabitat types were identified as being most important for the presence of SRE fauna in the Pilbara;

- leaf litter, including humus and organic topsoil;
- heavy vegetation, including bark, logs and debris;
- rocky microhabitats, cracked and loose rock material;
- deep soils, particularly non-skeletal; and
- microrelief; small, ground-level variations in elevation.

Each of the twelve habitat types (as outlined in Table 4.4) comprises an assortment of microhabitats, which influence the presence of SRE fauna. Table 4.5 shows each habitat type and the most common microhabitats associated with them. It must be noted that this is focussing on just the common microhabitats, and there are many exceptions.

Table 4.5: Microhabitat association with habitat types

SRE Habitat	Land units	Common Microhabitats
Deep gullies and gorges	Mesas, plateaux, mountains and hills where dissected by drainage; relief greater than 80 m	Leaf Litter Heavy Vegetation Cracked/ Loose Rock
Shallow gullies	As above, relief between 25 and 80 m	Leaf Litter Heavy Vegetation Cracked/ Loose Rock
Ridges	Steep upper slopes to vertical cliff faces	Cracked/ Loose Rock
Boulders	Boulders and tor heaps	Cracked/ Loose Rock
Breakaways	Vertical breakaway faces	Cracked/ Loose Rock
Outcrops	Outcropping, bare domes, plateaux remnants and areas of exposed rock	Cracked/ Loose Rock
Isolated sands	Areas of isolated deep sands, usually between hills	Deep Soils
Groves	Isolated areas of denser, taller vegetation, sometimes associated with drainage foci	Leaf Litter Heavy Vegetation Deep Soils
Drainage foci	Small, disjunct areas which receive run-on from adjacent surfaces, resulting in denser, taller vegetation	Leaf Litter Heavy Vegetation Deep Soils
Swamp and depressions	Areas of moisture retention associated with soil changes, sometimes associated with drainage foci	Vegetation Deep Soils Microrelief
Salt lake	Saline floors, periodically inundated	Deep Soils
Waterholes	Isolated waterholes	Leaf Litter Heavy Vegetation Deep Soils

SRE Habitat	Land units	Common Microhabitats
SRE Dispersal Habitat	**Land units**	**Common Microhabitats**
Drainage lines / creeklines / channels	Habitats with a minimum density of moderately close tall shrubland or woodland and a high level of connectivity	Leaf Litter Heavy Vegetation Deep Soils

SRE Fauna Likelihoods

Each of the seven SRE fauna groups (as listed in Table 4.7) were given a likelihood rating for each habitat type;

- **Fauna likelihood:** the likelihood that species of this fauna group will occur within this habitat.
- **SRE likelihood:** if species of this fauna group do occur, the likelihood that the habitat will support a SRE species.

These ratings are listed in Table 4.7, and are based on current knowledge and experience in the Pilbara.

Likelihood

5 Highly likely

4 Likely

3 Possible

2 Unlikely

1 Highly unlikely

Table 4.6 lists each of the 12 SRE habitats derived from the land systems. Each SRE habitat contains microhabitats, which are listed along with each of the SRE faunal groups, which, in turn, have the microhabitats listed that are important for that particular faunal group. The likelihood scores reflect the availability of important microhabitats and the potential for habitat restriction. Only fauna that are likely to be present (Fauna likelihood >3) are included in the calculation (as shaded).

Table 4.6: The likelihood of SRE fauna presence, and the influence of microhabitats at each SRE habitat. The shading indicates the faunal groups that were used in the calculation, as they are the ones likely to be present.

SRE Fauna	Important microhabitats	Fauna likelihood	SRE likelihood	Sum (>3 Fauna likelihood only)	Average likelihood
Deep Gullies and Gorges: LL, V, R					
Trapdoor spiders	LL, V	4	5	9	
Urodacidae	LL, V, R	4	5	9	
Millipedes	LL, V	4	4	8	
Land snails	LL, V	4	4	8	
Pseudoscorpions	LL, V, R	5	4	9	
Isopods	LL, V, R	5	4	9	
Selenopid spiders	R, V	5	4	9	**8.7**
Shallow Gullies: LL, V, R					
Trapdoor spiders	LL, V	3	3		
Urodacidae	LL, V, R	3	2		
Millipedes	LL, V	3	2		
Land snails	LL, V	4	2	6	
Pseudoscorpions	LL, V, R	5	2	7	
Isopods	LL, V, R	5	3	8	
Selenopid spiders	R, V	3	2		**7.0**
Ridges: R					
Trapdoor spiders		3	3		
Urodacidae	R	4	4	8	
Millipedes		3	3		
Land snails		3	2		
Pseudoscorpions	R	5	3	8	
Isopods	R	5	3	8	
Selenopid spiders	R	5	3	8	**8.0**
Boulders: R					
Trapdoor spiders		2	2		
Urodacidae		3	2		
Millipedes		3	4		
Land snails		4	4	8	
Pseudoscorpions	R	5	3	8	
Isopods	R	5	4	9	
Selenopid spiders	R	4	4	8	**8.3**
Breakaways: R					
Trapdoor spiders		2	2		
Urodacidae		3	2		
Millipedes		3	4		
Land snails		3	3		

SRE Fauna	Important microhabitats	Fauna likelihood	SRE likelihood	Sum (>3 Fauna likelihood only)	Average likelihood
Pseudoscorpions	R	5	3	8	
Isopods	R	5	3	8	
Selenopid spiders	R	4	3	7	**7.7**
Outcrops: R					
Trapdoor spiders		3	2		
Urodacidae		3	3		
Millipedes		3	4		
Land snails		3	3		
Pseudoscorpions	R	5	3	8	
Isopods	R	5	3	8	
Selenopid spiders	R	4	3	7	**7.7**
Isolated sands: DS					
Trapdoor spiders	DS	4	4	8	
Urodacidae	DS	4	4	8	
Millipedes		2	2		
Land snails		2	3		
Pseudoscorpions		2	3		
Isopods		3	3		
Selenopid spiders		1	1		**8.0**
Groves: LL, V, DS					
Trapdoor spiders	LL, DS	5	4	9	
Urodacidae	LL, DS	5	3	8	
Millipedes	LL, V	4	4	8	
Land snails	LL, V	5	3	8	
Pseudoscorpions	LL, V	5	3	8	
Isopods	LL, V	5	3	8	
Selenopid spiders	V	3	3		**8.2**
Drainage foci: LL, V, DS					
Trapdoor spiders	LL, DS	4	3	7	
Urodacidae	LL, DS	4	3	7	
Millipedes	LL, V	4	4	8	
Land snails	LL, V	5	3	8	
Pseudoscorpions	LL, V	5	3	8	
Isopods	LL, V	5	3	8	
Selenopid spiders	V	3	3		**7.7**
Swamp and depressions: V, DS, MR					
Trapdoor spiders	DS	3	3		
Urodacidae	DS	2	2		
Millipedes	V	3	2		
Land snails	V, MR	4	3	7	
Pseudoscorpions	V	3	3		

SRE Fauna	Important microhabitats	Fauna likelihood	SRE likelihood	Sum (>3 Fauna likelihood only)	Average likelihood
Isopods	V	3	3		
Selenopid spiders	V	3	4		**7.0**
Salt lakes: DS					
Trapdoor spiders	DS	4	4	8	
Urodacidae	DS	4	4	8	
Millipedes		2	4		
Land snails		3	4		
Pseudoscorpions		2	3		
Isopods		2	4		
Selenopid spiders		2	4		**8.0**
Waterholes: LL, V, DS					
Trapdoor spiders	LL, DS	3	4		
Urodacidae	LL, DS	3	3		
Millipedes	LL, V	4	4	8	
Land snails	LL, V	5	4	9	
Pseudoscorpions	LL, V	4	3	7	
Isopods	LL, V	5	3	8	
Selenopid spiders	V	3	3		**8.0**

Habitat Ranking

The average likelihood scores (as shown in Table 4.6) were used to determine which SRE habitats were most likely to contain restricted species (Table 4.7).

Table 4.7: Likelihood of habitat supporting SRE species.

Habitats	Average likelihood score	Likelihood ranking
Deep Gullies and Gorges	8.7	High
Boulders	8.3	Medium
Groves	8.2	Medium
Ridges	8.0	Medium
Isolated sands	8.0	Medium
Salt lakes	8.0	Medium
Waterholes	8.0	Medium
Drainage foci	7.7	Medium
Breakaways	7.7	Medium
Outcrops	7.7	Medium
Swamps and depressions	7.0	Low
Shallow Gullies	7.0	Low

Assignment to Land Systems

As described in Section 3.4, assigning a suitability rating to each land system involved the assignment of SRE habitats to each land system, along with their respective likelihood rankings, and determining the likely frequency of each SRE habitat within each land system. This information, along with the level of diversity, was used to derive a suitability rating, as shown in the final column of Table 4.8.

Phase 1 Suitability Assessment

Table 4.8 shows each land system with SRE habitats present, the likely frequency of those habitats and the SRE suitability rating, as detailed below:

Rating 1: Low/ No Suitability: These land systems do not appear to have any SRE habitats present, but may still contain SRE dispersal habitats.

Rating 2: Low/ Med Suitability: These land systems contain 1 or 2 SRE habitats, of which at least one is a Low significance habitat and the other may be a Medium significance, but in Low frequency.

Rating 3: Med Suitability: These land systems contain 2 or more SRE habitats; either a high diversity of Low frequency Medium significance habitats or a low diversity of Medium frequency Medium significance habitats.

Rating 4: Med/ High Suitability: These land systems contain 2 or more SRE habitats; either a high diversity of Medium frequency Medium habitats or a low diversity of High frequency Medium habitats.

Rating 5: High Suitability: All of these land systems contain at least one High significant SRE habitat.

Table 4.8: SRE Suitability assessment table for all land systems in the Study Area

Land system	SRE habitat																								Suitability rating
	Gullies		Shallow gullies		Ridges		Boulders		Breakaways		Outcrops		Isolated sand		Groves		Drainage		Swamp		Salt lake		Water holes		
	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	
Adrian																									1
Augustus	High	High			Med	High																			5
Balfour																									1
Black	High	Med			Med	High																			5
Bonney			Low	Med							Med	Low													2
Boolaloo			Low	Med			Med	Med			Med	Med	Med	Low											4
Boolgeeda															Med	Low	Med	Low							3
Brockman															Med	Low	Med	Low	Low	Low					3
Cadgie															Med	Low	Med	Low							2
Calcrete																	Med	Low	Low	Low					2
Capricorn	High	Med			Med	Med					Med	Med													5
Charley			Low	Med	Med	Med																			3
Cheela																									1
Christmas															Med	High	Med	High							4
Collier			Low	Med	Med	Med					Med	Med													3
Coolibah																	Med	Med	Low	Med					3
Cowra															Med	Low	Med	Low							2
Cundelbar															Med	Low	Med	Low							2
Divide													Med	Low											2

Land system	SRE habitat																								Suitability rating
	Gullies		Shallow gullies		Ridges		Boulders		Breakaways		Outcrops		Isolated sand		Groves		Drainage		Swamp		Salt lake		Water holes		
	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	
Dollar																	Med	Med	Low	Low					3
Egerton			Low	High					Med	Med															3
Elimunna															Med	Low	Med	Low							2
Ethel																									1
Fan															Med	Med	Med	Med	Low	Low					3
Ford			Low	Low					Med	Low															2
Fortescue															Med	Low	Med	Low							2
Granitic			Low	High	Med	Med	Med	Med			Med	Med					Med	Low							4
Hooley																									1
Horseflat																									1
Jamindie					Med	Low					Med	Low	Med	Low	Med	Med	Med	Med							3
Jigalong															Med	Low	Med	Low							2
Jurrawarrina															Med	High	Med	High							4
Kooline			Low	Med	Med	Low					Med	Med													3
Kumina											Med	Low													2
Kunderong			Low	Low	Med	Low					Med	Med			Med	Low									3
Laterite			Low	Low	Med	Med			Med	Med															3
Macroy			Low	Low	Med	Low	Med	Low			Med	Med													3
Mallina											Med	Low													2
Marandoo	High	Med			Med	High					Med	Med													5
Marillana															Med	Low	Med	Med							3

Land system	SRE habitat																								Suitability rating
	Gullies		Shallow gullies		Ridges		Boulders		Breakaways		Outcrops		Isolated sand		Groves		Drainage		Swamp		Salt lake		Water holes		
	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	
Marsh																							Med	Low	2
McKay	High	Med			Med	High			Med	Low	Med	Med													5
Narbung																	Med	Low							2
Newman	High	High			Med	High					Med	Med													5
Nirran			Low	Low							Med	Low													2
Nooingnin													Med	Med	Med	Med									3
Oakover	High	Med			Med	High			Med	Med	Med	Med													5
Paraburdoo											Med	Low			Med	Low	Med	Low							3
Paradise																									1
Pindering															Med	Med									3
Platform																									1
Prairie			Low	Low	Med	Low	Med	Low			Med	Low													3
River																									1
Robe	High	Med			Med	High			Med	Med	Med	Med													5
Robertson			Low	High	Med	Med	Med	Med			Med	Med													4
Rocklea	High	Med			Med	Med					Med	Med													5
Ruth			Low	Med	Med	Med					Med	Med	Med	Med											4
Satirist											Med	Low													2
Spearhole															Med	High									3
Sylvania							Med	Low			Med	Low			Med	Med									3
Table	High	Low			Med	High											Med	Low							5

Land system	SRE habitat																								Suitability rating
	Gullies		Shallow gullies		Ridges		Boulders		Breakaways		Outcrops		Isolated sand		Groves		Drainage		Swamp		Salt lake		Water holes		
	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	Sig	Freq	
Talga			Low	High	Med	High					Med	Med													3
Three Rivers													Med	Low	Med	Low	Med	Low							3
Turee															Med	Low	Med	Low							2
Uaroo																									1
Urandy																									1
Wannamunna															Med	Med	Med	Med							3
Warri																	Med	Low							2
Washplain															Med	Med	Med	Med							3
Weelarrana																					Med	Med			3
White Springs																									1
Wona																									1
Yamerina																	Med	Low	Low	Low					2
Zebra													Med	High	Med	Low	Med	Low							4

Figure 4.5 shows the Phase 1 SRE suitability mapping across the Study Area. Of the seventy four land systems in the Study Area, eleven were regarded as having High SRE suitability, seven as having Medium/ High, twenty four as having Medium, eighteen as Low/ Medium and thirteen as having Low SRE suitability. Below is a brief summary of each rating and the habitats they contain.

High (5) SRE suitability land systems

All but one High suitability land system was associated with Deep Gullies and Gorges.

Medium/ High (4) SRE suitability land systems

These land systems primarily comprise slope type habitats; Shallow Gullies, Ridges, Boulders and Outcrops, with some Groves, Drainage Foci and Isolated Sands.

Medium (3) SRE suitability land systems

These land systems have an even spread of most habitats, particularly Shallow Gullies, Ridges, Outcrops, Isolated Sands, Groves and Drainage Foci. The majority of the Swamp habitats are also in this category, along with the Salt lake habitat.

Low/ Medium (2) SRE suitability land systems

This category is dominated by land systems with Shallow Gullies, Outcrops, Groves and Drainage Foci in Low frequencies.

Low (1) SRE suitability land systems

There are no SRE habitats expected in these land systems, but more than half still contained SRE dispersal habitats.

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7400000

PORT HEDLAND
SHAY GAP
MARBLE BAR
Main Line Rail (Northern section)
Main Line Rail (Central section)
Roy Hill
Main Line Rail (Marsh section)
Munjina/ Upper Marillana
TOM PRICE
Rocklea
Tandanya
Yandi
Marillana
Mindy
Ministers North
Mining Area C
Jinidi
Coondiner
South Flank
Mudlark
Ophthalmia/ Prairie Downs
Newman
Gurinbiddy
Caramulla
Jimblebar

Legend

- Regional Towns
- Consolidated SRE Habitat Mapping Area and BHPBIO Operation Tenure

Land System SRE Suitability

- Not Assessed
- Disturbed Land
- 1 - Low
- 2 - Low / Medium
- 3 - Medium
- 4 - Medium / High
- 5 - High

1:1,280,000

0 10 20 40 60 km

N

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Strategic Assessment of SRE Invertebrates

Fig. 4.5: Overall Land System SRE Suitability and boundary of Consolidated SRE Habitat mapping

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 28/05/2015. Size: A3

4.3 Phase 2 SRE Suitability Assessment

Fauna Habitat/ SRE Map

Each of the 17 vertebrate fauna habitats (Biologic 2014b: Figure 4.6) were investigated for their suitability for SRE habitat types, as described in Biologic (2014a). Of the 17 fauna habitats, eight were regarded as likely to contain SRE habitats, one likely to contain SRE dispersal habitats and nine regarded as unlikely to contain habitats suitable for SRE fauna (Table 4.9).

Of the 12 SRE habitat types (Biologic 2014a) considered, two appear highly unlikely to occur within the Study Area; salt lakes and waterholes, as the former is only found within the Weelarrana land system and the latter is found within the Marsh land system, neither of which occurs within the Study Area.

Below is the description of each fauna habitat (taken from Biologic 2014b) that is considered suitable for at least one SRE or dispersal habitat. These are further outlined in Table 4.9, which discusses the suitability with SRE habitats and fauna.

Granite domes and boulders (tors)

This habitat occurs where the surrounding rock/ soil material has eroded, exposing large domes and boulders. Boulder piles and exfoliating rock on the granite domes provide highly suitable crevices and cracks for rocky habitat specialist SRE fauna to inhabit. Vegetation is generally sparse through these areas due to the lack of soil availability, although isolated patches of highly suitable leaf litter microhabitats can occur under fig trees and shrubs that grow amongst the rock piles.

They are almost always surrounded by sand plains, and are therefore highly isolated at the landscape scale.

Mulga

This habitat includes woodlands and other ecosystems in which Mulga (formerly *Acacia aneura,* now recognized as multiple species) is dominant, either as the principal *Acacia* shrub species or mixed with others. It consists of disintegrating groves on stony soils with spinifex understorey.

This habitat type is grouped with other habitat occurring on the plains; however, it is noted that small groves of Mulga can occur on ridgelines.

Sand dune

This habitat comprises sand ridges of loose sand supporting similar vegetation species to the surrounding sandplain, dominated by *Triodia* spp. grasslands and areas of *Acacia* spp. shrubland occurring in the Study Area immediately south of the Fortescue Marsh.

Gorge/ gully

Gorges and gullies are rugged, steep-sided valleys incised into mountainous terrains. Gorges tend to be deeply incised, with vertical cliff faces, while gullies are more open (but not as open as shallow gullies; see Minor drainage lines). Caves and rock pools are most often encountered in this habitat type. The vegetation can be dense and complex in areas of soil deposition or sparse and simple where erosion has removed the topsoil or the substrate comprises mainly rocks and scree.

Minor drainage line

This habitat type is located within the shallow gullies and depressions, generally through the Crest/ slope habitat. The vegetation is dominated by *Acacia* low shrubland, with a sparse understorey often consisting solely of tussock grassland of introduced Buffel Grass **Cenchrus ciliaris*. The substrate can be sandy in places but generally consists of a skeletal loam gravel or stone.

Drainage area

This habitat type is characterised by *Eucalyptus xerothermica* and *Corymbia hamersleyana* woodland over broad-leafed *Acacia* shrubland on sandy loam soils sometimes with exposed rocky areas. These areas can have high vegetation density, complexity and diversity. They tend to occur on accretional or depositional areas and often have deeper and richer soils than other fauna habitats. Understorey grasses tend to be dominated by tussock grasses rather than spinifex, or introduced Buffel Grass **Cenchrus ciliaris*.

Major drainage line

Major Drainage Lines comprise mature River Red Gums, Coolibahs and stands of Silver Cadjeput over river pools. Open, sandy or gravelly riverbeds characterise this habitat type. In ungrazed areas, the vegetation adjacent to the main channel or channels is denser, taller and more diverse than adjacent terrain and can include reedbeds around pools.

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7600000
7500000
7400000

PORT HEDLAND
MARBLE BAR
Roebourne
Chichester
Hamersley
Ashburton
Fortescue
Trainor
Augustus

Main Line Rail (Northern section)
Main Line Rail (Central section)
Main Line Rail (Marsh section)

Roy Hill
Munjina/ Upper Marillana
Marillana
Tandanya
Yandi
Mindy
Mining Area C
Ministers North
South Flank
Jinidi
Mudlark
Coondiner
Gurinbiddy
Ophthalmia/ Prairie Downs
Newman
Caramulla
Jimblebar

Legend

- Regional Towns
- Consolidated SRE Habitat Mapping Area and BHPBIO Operation Tenure

Consolidated Fauna Habitat Type

- Artificial NQ Habitat
- Disturbed
- Cleared
- Boulders
- Granite Domes
- Calcrete Area
- Crest / Slope
- Gilgai
- Gorge / Gully
- Hardpan
- Mulga
- Fortescue Marsh Samphire
- Drainage Area
- Drainage Line
- Major Drainage Line
- Minor Drainage Line
- Sand Dune
- Sand Plain
- Sandy / Stony Plain
- Stony Plain

Please note: the Rocklea Operation Tenure is not shown as there is no mapping in that area.

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Strategic Assessment of SRE Invertebrates

Fig. 4.6: Consolidated fauna habitat mapping (Biologic 2014b)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 14/01/2015. Size: A3

Table 4.9 SRE suitability and likelihood based on vertebrate fauna habitat landforms (from Biologic 2014b)

Landform (Biologic 2014b)	SRE suitability	SRE habitat	SRE notes	SRE likelihood	Microhabitat
Gorge / gully	5	Yes	High protection and isolation	Specialist spp in isolated patches possible, but high disturbance	Very rocky, dense, complex vegetation, sometimes soils
Granite domes	5	Yes	High protection and isolation	High likelihood of protection, isolation and low disturbance	Very rocky
Boulders	5	Yes	High protection and isolation	High likelihood of protection, isolation and low disturbance	Very rocky
Crest / slope	4	Yes	High protection and some isolation	Contains ridges, outcrops and breakaways, but likely connectivity within a single system	Very rocky, some vegetation patches
Drainage area	4	Yes	High protection and some isolation	Contains dense vegetation habitats, but likely connectivity via dispersal habitats	Dense, complex vegetation, deep soils
Mulga	3	Yes	High protection but low isolation	Some isolated patches and specialist spp	Dense vegetation, deep soils
Minor drainage line	3	Yes	Moderate protection and some isolation	High in landscape and associated with small ridges and shallow gullies, but mainly low shrubland. Some protection (rock, litter, debris) but some connectivity and disturbance	Rocky habitats with minor vegetation. Some dispersal potential.
Sand dune	4	Yes	Low protection but high isolation	Potential for restricted/specialist spp	Deep, loose soils, very different to surrounding environment
Major drainage line	2	Dispersal	High protection but low isolation	High protection (litter, debris and deep soils) but high connectivity and disturbance	Dispersal habitat. Dense vegetation, deep soils
Calcrete area	1	No	Low protection but some isolation	Specialist spp in isolated patches possible	Low, homogenous vegetation. Some microrelief
Gilgai	1	No	Low protection but some isolation	Specialist spp in isolated patches possible, but high disturbance	Low, homogenous vegetation, some microrelief. No rocks
Fortescue marsh samphire	1	No	Low protection but some isolation	Specialist spp in isolated patches possible, but high disturbance	Low, homogenous vegetation, waterlogged soils. No rocks

Landform (Biologic 2014b)	SRE suitability	SRE habitat	SRE notes	SRE likelihood	Microhabitat
Sand plain	1	No	Low protection and low isolation	Specialist spp unlikely. Very widespread habitats with limited specialisation.	No complexity in vegetation or rocky habitats
Stony plain	1	No	Low protection and low isolation	Specialist spp unlikely. Very widespread habitats with limited specialisation.	No complexity in vegetation or rocky habitats
Hardpan	1	No	Low protection and low isolation	Specialist spp unlikely. Very widespread habitats with limited specialisation. Some disturbance	No complexity in vegetation or rocky habitats
Sandy / stony plain	1	No	Low protection and low isolation	Specialist spp unlikely. Very widespread habitats with limited specialisation.	No complexity in vegetation or rocky habitats
Drainage line	1	No	Low protection but low isolation	Limited protection (little to no dense vegetation), high connectivity and disturbance	Dispersal habitat during flooding. Limited vegetation, some soils
Artificial/ disturbed	1	No	No SRE value	No SRE value. Highly disturbed.	No SRE value

Vegetation/ Fauna Habitat/ SRE Map

Each of the 16 landform types identified by Onshore (2014) (Figure 2.7) were investigated for their congruence with the vertebrate fauna habitats and their suitability as SRE habitats. Likewise, the 47 broad floristic formations were also investigated for their suitability as SRE habitats (Table 4.10) (Figure 2.8).

Seven of the landforms were regarded as likely to contain SRE habitats, one was likely to contain SRE dispersal habitats and eight were regarded as unlikely to contain habitats suitable for SRE fauna. Of the 47 broad floristic formations investigated, seven were regarded as likely to contain SRE habitats, of which five were within the Flood plain landform. All seven formations were forest and woodlands, both open and closed (Table 4.11).

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PORT HEDLAND

Roebourne

Chichester

Hamersley

Ashburton

Fortescue

Trainor

Augustus

MARBLE BA

Main Line Rail
(Northern section)

Main Line Rail
(Central section)

Main Line Rail
(Marsh section)

Roy Hill

Munjina/
Upper Marillana

Marillana

Tandanya

Yandi

Mindy

Mining
Area C

Ministers North

South
Flank

Jinidi

Mudlark

Coondiner

Gurinbiddy

Ophthalmia/ Prairie Downs

Newman

Caramulla

Jimblebar

Legend

- Regional Towns
- Consolidated SRE Habitat Mapping Area and BHPBIO Operation Tenure

Consolidated vegetation mapping (Onshore 2014)

Landform Units

- CALCRETE PLAINS
- DISTURBED
- FLOOD PLAINS
- FOOTSLOPES
- GILGAI PLAINS
- GORGES AND GULLIES
- GRANITE OUTCROPS AND ROCK PILES
- HILL CRESTS AND UPPER HILL SLOPES
- HILL SLOPES AND LOW UNDULATING HILLS
- MAJOR DRAINAGE LINES
- MEDIUM DRAINAGE LINES
- MINOR DRAINAGE LINES
- SALINE FLATS AND MARSH
- SAND DUNES
- SAND PLAINS
- STONY PLAINS

Please note: the Rocklea Operation Tenure is not shown as there is no mapping in that area.

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0 5 10 20 30 40 50 km

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 4.7: Consolidated mapping of landform/ vegetation units (Onshore 2014)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 28/05/2015. Size: A3

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PORT HEDLAND

Roebourne

Chichester

Hamersley

Fortescue

Ashburton

Main Line Rail (Northern section)

Main Line Rail (Central section)

Main Line Rail (Marsh section)

Roy Hill

Munjina/ Upper Marillana

Marillana

Tandanya

Yandi

Mindy

Mining Area C

Ministers North

South Flank

Jinidi

Mudlark

Coondiner

Gurinbiddy

Ophthalmia/ Prairie Downs

Newman

Caramulla

Jimblebar

Augustus

Legend

- Regional Towns
- Consolidated SRE Habitat Mapping Area and BHPBIO Operation Tenure

Consolidated vegetation mapping (Onshore 2014)

Broad Floristic Formation

- *Cenchrus Closed Tussock Grassland
- *Cenchrus Open Tussock Grassland
- *Cenchrus Scattered Tussock Grasses
- *Cenchrus Tussock Grassland
- Acacia Closed Forest
- Acacia High Open Shrubland
- Acacia High Shrubland
- Acacia Low Closed Woodland
- Acacia Low Open Forest
- Acacia Low Open Heath
- Acacia Low Open Woodland
- Acacia Low Woodland
- Acacia Open Forest
- Acacia Open Heath
- Acacia Open Scrub
- Acacia Open Shrubland
- Acacia Shrubland
- Aristida Open Tussock Grassland
- Astrebla Tussock Grassland
- Callitris Low Open Forest
- Chrysopogon Open Tussock Grassland
- Corymbia Low Open Woodland
- Corymbia Low Woodland
- Disturbed
- Dysphania Herbs
- Enneapogon Open Tussock Grassland
- Enneapogon Tussock Grassland
- Eragrostis Tussock Grassland
- Eremophila Low Open Shrubland
- Eriachne Open Tussock Grassland
- Eriachne Tussock Grassland
- Eucalyptus Low Open Forest
- Eucalyptus Low Open Woodland
- Eucalyptus Low Woodland
- Eucalyptus Open Forest
- Eucalyptus Woodland
- Eulalia Open Tussock Grassland
- Eulalia Tussock Grassland
- Frankenia Low Open Shrubland
- Glinus Herbs
- Maireana Low Open Shrubland
- Melaleuca High Open Forest
- Melaleuca Open Forest
- Mosaic: Acacia Low Open Woodland/ Acacia Low Woodland
- Mosaic: Acacia Low Open Woodland/ Triodia Closed Hummock Grassland
- Mosaic: Triodia Hummock Grassland
- Mosaic: Triodia Hummock Grassland/ Acacia High Open Shrubland
- Mosaic: Triodia Open Hummock Grassland/ Triodia Hummock Grassland
- Petalostylis Shrubland
- Pluchea Low Shrubland
- Senna Low Open Shrubland
- Sida Very Open Herbs
- Tecticornia Low Open Heath
- Themeda Closed Tussock Grassland
- Themeda Open Tussock Grassland
- Themeda Tussock Grassland
- Triodia Closed Hummock Grassland
- Triodia Hummock Grassland
- Triodia Open Hummock Grassland
- Typha Sedges

Please note: the Rocklea Operation Tenure is not shown as there is no mapping in that area.

1:1,000,000

0 5 10 20 30 40 50 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 4.8: Consolidated mapping of broad floristic formations (Onshore 2014)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 28/05/2015. Size: A3

Table 4.10: Presence of each SRE habitat type (Biologic 2014a) within each landform (as described by Biologic 2014b and Onshore 2014).

Landforms	Broad floristic formations	Source	SRE habitat types (Biologic 2014a)										
			Deep gullies/ gorges	Ridges	Boulders	Breakaways	Outcrops	Shallow gullies	Drainage foci	Groves	Swamps/ depressions	Isolated sands	Dispersal
Gorges/ gullies		Biologic 2014b	X										
Gorges/ gullies		Onshore 2014	X										
Hill slopes and low undulating hills	Open forest	Onshore 2014		X	X	X							
Hill crests and upper hill slopes		Onshore 2014		X		X	X						
Boulders		Biologic 2014b			X								
Granite outcrops and rock piles		Biologic 2014b			X		X						
Granite domes		Onshore 2014					X						
Hill slopes and low undulating hills	Woodland (Closed and Open)	Onshore 2014					X			X			
Minor drainage line		Biologic 2014b						X	X				
Mulga		Biologic 2014b							X	X			
Flood plains	Forest (Closed and Open)	Onshore 2014							X	X			
Flood plains	Woodland (Closed and Open)	Onshore 2014							X	X			
Drainage area		Biologic 2014b							X		X		

Landforms	Broad floristic formations	Source	SRE habitat types (Biologic 2014a)										
			Deep gullies/ gorges	Ridges	Boulders	Breakaways	Outcrops	Shallow gullies	Drainage foci	Groves	Swamps/ depressions	Isolated sands	Dispersal
Sand dune		Onshore 2014										X	
Sand dune		Biologic 2014b										X	
Medium drainage line		Onshore 2014									X		X
Major drainage line		Onshore 2014											X
Major drainage line		Biologic 2014b											X

Table 4.11: Landforms present within each broad floristic formation (Onshore 2014)

Broad floristic formation		Dominant Landforms (60-100%)	Common (30-60%)	Uncommon (0-30%)
**Cenchrus*	Closed Grassland	Flood plains		
**Cenchrus*	Grassland	Major drainage and Flood plains		
**Cenchrus*	Open Grassland	Gilgai plains		Stony plains and Major drainage
Acacia	Closed Forest	Flood plains		
Acacia	Closed Woodland	Flood plains and Major drainage		
Acacia	Open Forest	Stony plains and Flood plains	Gorges/ gullies and Sand plains	Hilllopes and Major drainage
Acacia	Open Heath	Minor drainage		Flood plains, Hillslopes and Sand plains
Acacia	Open Scrub	Minor drainage and Stony plains,		Medium drainage
Acacia	Open Shrubland	Hill slopes, Low hills, Flood plains and Gilgai plains		Granite outcrops, Stony plains and Sand plains
Acacia	Open Woodland	Flood plains		
Acacia	Shrubland	Minor drainage	Major drainage, Flood plains, Hill slopes and Low hills	
Acacia	Woodland	Gorges/ gullies	Hillslopes and Flood plains	Stony plains
Aristida	Open Grassland	Flood plains		
Astrebla	Grassland	Stony plains		
Callitris	Open Forest	Gorge/ gullies		

Broad floristic formation		Dominant Landforms (60-100%)	Common (30-60%)	Uncommon (0-30%)
Chrysopogon	Open Grassland	Flood plains		
Corymbia	Open Woodland	Minor drainage, Sand plains and Stony plains		
Corymbia	Woodland	Gorges/ gullies		Flood plains and Major drainage
Disturbed	Disturbed	Disturbed		
Dysphania	Herbs	Stony plains		
Enneapogon	Grassland	Hill slopes		
Enneapogon	Open Grassland	Calcrete plains		
Eragrostis	Grassland	Gilgai plains		
Eremophila	Open Shrubland	Flood plains		
Eriachne	Grassland	Flood plains	Minor drainage	Medium drainage and Gilgai plains
Eriachne	Open Grassland	Minor drainage		
Eucalyptus	Open Forest	Major drainage		
Eucalyptus	Open Woodland	Medium drainage		
Eucalyptus	Woodland	Medium drainage		Major drainage
Eulalia	Grassland	Flood plains		
Eulalia	Open Grassland	Minor drainage		
Frankenia	Open Shrubland	Saline flats		
Glinus	Herbs	Medium drainage		

Broad floristic formation		Dominant Landforms (60-100%)	Common (30-60%)	Uncommon (0-30%)
Maireana	Open Shrubland	Flood plains		
Melaleuca	Open Forest	Major drainage		
Petalostylis	Shrubland	Minor drainage		
Pluchea	Shrubland	Flood plains		
Senna	Open Shrubland	Sand plains		
Sida	Open Herbs	Gilgai plains		
Tecticornia	Open Heath	Saline flats		
Themeda	Closed Grassland	Medium drainage		Flood plains
Themeda	Grassland	Gorges/gullies	Flood plains	Major drainage, Medium drainage, Minor drainage
Themeda	Open Grassland	Medium drainage		
Triodia	Closed Grassland	Hill crests		Flood plains and Sand plains
Triodia	Grassland	Footslopes, Hill slopes and Hill crest	Stony plains and Sand dunes	Medium drainage, Minor drainage, Flood plains, Sand plains, Calcrete plains, and Gorge/ gullies
Triodia	Open Grassland	Stony plains	Hill slopes and Hill crest	Sand plains, Medium drainage, Minor drainage, Gorge/ gullies, Flood plains and Granite outcrops
Typha	Sedges	Major drainage		

Broad SRE Habitats

Congruence/ Accuracy

As discussed in Section 3.4, the polygons used for this map were not always directly relatable to a single SRE habitat type, as the source polygons from the vegetation and vertebrate fauna mapping often contained multiple potential SRE habitat types. Nevertheless, the data were grouped into 10 broad SRE habitat units based on the SRE habitat types that are likely to be present (Table 4.12; Figure 4.9).

The high congruence broad SRE habitat units are:

- Deep gullies/ gorges;
- Boulders and Outcrops; and
- Isolated sands.

The medium congruence broad SRE habitat units are:

- Boulders, Outcrops, Ridges and Breakaways, in part;
- Shallow gullies and Drainage foci, in part;
- Groves and Drainage foci;
- Drainage foci and Swamp/ depressions, in part;
- Dispersal and Swamp/ depressions, in part; and
- Dispersal habitats.

The low congruence broad SRE habitat units are:

- Boulders, Outcrops, Ridges and Breakaways, in part;
- Groves and Outcrops;
- Shallow gullies and Drainage foci, in part;
- Drainage foci and Swamp/ depressions, in part; and
- Dispersal and Swamp/ depressions, in part.

Table 4.12: Habitat types, SRE suitability, congruence and mapped area.

SRE Habitat unit	SRE suitability	Congruence	Total mapped area (ha)	% of total mapped area
Groves and Drainage Foci	3	Medium	46648	10.9
Boulders, Outcrops, Ridges and Breakaways	4	Medium/ Low	45498	10.6
Drainage foci and Swamp/ depressions	4	Medium/ Low	31390	7.3
Shallow gullies and Drainage foci	3	Medium/ Low	10925	2.6
Dispersal habitats	2	Medium	9320	2.2
Deep gullies/ gorges	5	High	9065	2.1

SRE Habitat unit	SRE suitability	Congruence	Total mapped area (ha)	% of total mapped area
Dispersal habitats and Swamp/ depressions	3	Medium/ Low	2187	0.5
Groves and Outcrops	4	Low	715	0.2
Boulders and Outcrops	5	High	634	0.1
Isolated sands	4	High	62	<0.1
Non-SRE Habitat	1	Low	271797	63.5

Phase 2 SRE Suitability Assessment

The final SRE suitability map represents the areas within the mapped Study Area that can be regarded as either low, medium or high suitability for SRE habitats, and thus SRE fauna. Any areas not shown have either not been assessed (due to a lack of vegetation and fauna mapping) or are regarded as not suitable for SRE habitats and fauna. These areas are clearly outlined in the figures.

SRE suitability is ranked from 1 (no SRE habitat suitable for SRE fauna) to 5 (highly likely to be suitable for SRE fauna). Only broad SRE habitats ranked from 3 to 5 are regarded as suitable for SRE fauna, but the figures also include Dispersal habitats (ranking 2), which do contain SRE microhabitats but are not regarded as SRE habitats due to the high level of continuity. These are included due to the presence of SRE microhabitats and their importance for adjacent SRE habitats.

The most suitable broad SRE habitat units are the Deep gullies/ gorges, and Boulders and Outcrops. Both these units contain landforms that are often isolated, and the mapping for both is regarded as highly congruent with the true extent of the habitats. The Deep gullies/ gorges are a common habitat unit (9065 ha) while the Boulders and Outcrops are not common (634 ha).

The next most suitable broad SRE habitat units (rating 4) are the Boulders, Outcrops, Ridges and Breakaways, Drainage foci and Swamp/ depressions, Groves and Outcrops, and Isolated sands. The Isolated sands are the only habitat unit at this rating level that is highly congruent, but it is also very uncommon (62 ha: <0.1%). The first two habitat units are Medium/ Low congruence (some of the SRE habitats are Medium congruence and some are Low congruence) and are two of the most common habitat units (45498 ha: 10.6% and 31390 ha: 7.3% respectively), while Groves and Outcrops are Low congruence and uncommon (715 ha: 0.2%).

Three habitat units are regarded as rating 3 suitability; Groves and Drainage Foci, Shallow gullies and Drainage foci, and Dispersal habitats and Swamp/ depressions. The former habitat unit is the most common of th mapped units, covering 46648 ha (10.9%), and is

Medium congruence. The other two are both Medium/ Low congruence and cover 10925 ha (2.6%) and 2187 ha (0.5%) respectively.

Dispersal habitats (rating 2) cover 9320 ha (2.2%) and the non-SRE habitats cover 271797 ha, almost 64% of the mapped area.

Table 4.13: SRE suitability and habitat types.

Landforms	SRE habitat units (as mapped)	SRE suitability	SRE habitat types (Biologic 2014a)										
			Deep gullies/ gorges	Ridges	Boulders	Breakaways	Outcrops	Shallow gullies	Drainage foci	Groves	Swamps/ depressions	Isolated sands	Dispersal
Gorges/ gullies	Deep gullies/ gorges	5	X										
Gorges/ gullies	Deep gullies/ gorges		X										
Hill slopes and low undulating hills	Boulders, Outcrops, Ridges and Breakaways	4		X	X	X							
Hill crests and upper hill slopes	Boulders, Outcrops, Ridges and Breakaways			X		X	X						
Boulders	Boulders and Outcrops	5			X								
Granite outcrops and rock piles	Boulders and Outcrops				X		X						
Granite domes	Boulders and Outcrops						X						
Hill slopes and low undulating hills	Groves and Outcrops	4					X			X			
Minor drainage line	Shallow gullies and Drainage foci	3						X	X				
Mulga	Groves and Drainage foci	3							X	X			
Flood plains	Groves and Drainage foci								X	X			
Flood plains	Groves and Drainage foci								X	X			
Drainage area	Drainage foci and	4							X		X		

Landforms	SRE habitat units (as mapped)	SRE suitability	SRE habitat types (Biologic 2014a)										
			Deep gullies/ gorges	Ridges	Boulders	Breakaways	Outcrops	Shallow gullies	Drainage foci	Groves	Swamps/ depressions	Isolated sands	Dispersal
	Swamp/ depressions												
Sand dune	Isolated sands	4										X	
Sand dune	Isolated sands											X	
Medium drainage line	Dispersal and Swamp/ depressions	3									X		X
Major drainage line	Dispersal habitats	2											X
Major drainage line	Dispersal habitats												X

PORT HEDLAND

Main Line Rail
(Northern section)

Main Line Rail
(Central section)

Roy Hill

Main Line Rail
(Marsh section)

Munjina/
Upper Marillana

Yandi

Marillana

Mindy

Tandanya

Ministers
North

Mining Area C

South
Flank

Jinidi

Mudlark

Coondiner

Gurinbiddy

Ophthalmia/ Prairie Downs

Newman

Caramulla

Jimblebar

SHAY GAP

MARBLE
BAR

TOM
PRICE

Rocklea

1:680,000
0 5 10 20 30 40 50
km

1:320,000
0 2.5 5 10 15
km

N

biologic

Legend

- Regional Towns
- Regional Highway
- Regional Rail
- Consolidated SRE Habitat Study Area and BHPBIO Operation Tenure

Consolidated SRE Habitats

- Boulders and Outcrops
- Boulders, Outcrops, Ridges and Breakaways
- Deep gullies/ gorges
- Dispersal habitats
- Dispersal habitats and Swamps/ depressions
- Drainage foci and Swamps/ depressions
- Groves and Drainage foci
- Groves and Outcrops
- Isolated sands
- Non-SRE Habitat
- Shallow gullies and Drainage foci
- Area not assessed

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 4.9: Consolidated SRE Habitat units within the Study Area

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Created 26/05/2015. Size: A0

5 RISK ASSESSMENT

5.1 Pilbara IBRA Region (Phase 1)

Table 5.1 identifies the total area (in hectares) of each land system that occurs within the BHP Billiton Iron Ore FDS and other third party project areas, in comparison with the wider extent of the land system throughout the Pilbara IBRA Region. Table 5.2 shows in greater detail the area (in hectares) and proportionate area of each land system within each BHP Billiton Iron Ore Operation Tenure.

Figure 5.1 shows the suitability rating of the land systems throughout the Pilbara IBRA region, and the location of BHP Billiton Iron Ore FDS and other third party project areas. The majority of these Hubs/ project areas occur within land systems that have been identified as having high SRE suitability, or occur across both high and medium suitability areas (Figure 5.1). No project is located completely within low suitability land systems.

Table 5.1: The total area and % of each land system for the BHPBIO FDS, 3rd party projects and all projects combined, as compared to the total area for the Pilbara IBRA region.

Land Systems	SRE suitability	BHPBIO FDS		3rd party projects		All projects		Total
		Area (ha)	Area (%)	Area (ha)	Area (%)	Area (ha)	Area (%)	Area (ha)
Adrian	1	68	0.3			68	0.3	24509
Augustus	5							1072468
Balfour	1							148479
Black	5							17023
Bonney	2							75498
Boolaloo	4	39				39		158798
Boolgeeda	3	25662	2.9	8100	0.9	33762	3.8	882929
Brockman	3	581	0.8			581	0.8	73777
Cadgie	2	114	0.2			114	0.2	74586
Calcrete	2	1193	0.7	245	0.1	1437	0.9	164003
Capricorn	5	11		176		187		688642
Charley	3							98238
Cheela	1							19121
Christmas	4	285	1.2	2		287	1.2	23186
Collier	3							98614
Coolibah	3							101035
Cowra	2	22	0.1	119	0.6	141	0.7	20294
Cundelbar	2							3720
Divide	2	1600	0.3	2539	0.4	4139	0.7	611946
Dollar	3							22481
Egerton	3	708	0.2			708	0.2	305931
Elimunna	2	1537	2.3			1537	2.3	65656
Ethel	1			39		39		88867
Fan	3	882	0.6	4590	3.1	5471	3.7	148205
Ford	2							77883
Fortescue	2	103	0.2	281	0.6	385	0.8	50417
Granitic	4	35				35		406218
Hooley	1							59081

Land Systems	SRE suitability	BHPBIO FDS		3rd party projects		All projects		Total
		Area (ha)	Area (%)	Area (ha)	Area (%)	Area (ha)	Area (%)	Area (ha)
Horseflat	1							189193
Jamindie	3	4718	1.1	15563	3.6	20281	4.7	436024
Jigalong	2							71485
Jurrawarrina	4			4		4		66475
Kooline	3							668787
Kumina	2							9669
Kunderong	3							171195
Macroy	3	1300	0.1			1300	0.1	1328524
Marsh	2	11				11		97668
McKay	5	3778	0.9	934	0.2	4711	1.2	408328
Narbung	2							15958
Newman	5	56546	3.2	20848	1.2	77395	4.3	1793772
Nirran	2							30720
Nooingnin	3	134	0.1			134	0.1	169225
Paradise	1							148278
Pindering	3	1874	4.8	286	0.7	2160	5.6	38757
Platform	1	4717	2.0	2012	0.9	6729	2.9	230746
River	1	1797	0.4	1091	0.2	2888	0.6	503490
River Channel	1							15244
Robe	5	2082	2.7	630	0.8	2712	3.5	76958
Robertson	4							272044
Rocklea	5	1973	0.1	444		2417	0.1	2751157
Ruth	4							157137
Satirist	2							43484
Spearhole	3	1187	0.7	1295	0.8	2482	1.5	164631
Sylvania	3	214	0.2	930	0.9	1144	1.1	107818
Table	5	8		83	0.1	92	0.1	129587
Talga	3							212619
Three Rivers	3							9109
Turee	2	43		3633	3.9	3675	4.0	92741
Uaroo	1	265				265		709472
Urandy	1	598	0.7	3955	4.4	4554	5.1	90130
Wannamunna	3	6205	9.9	356	0.6	6562	10.5	62648
Warri	2							60285
Washplain	3	542	0.6	89	0.1	631	0.7	91809
White Springs	1							26563
Wona	1	63				63		180118
Yamerina	2							85433
Zebra	4	660	1.8			660	1.8	37550
Total		**124516**	**0.5**	**68320**	**0.3**	**192835**	**0.8**	**23123557**

600000 650000 700000 750000 800000 850000

7700000 7650000 7600000 7550000 7500000 7450000 7400000

Main Line Rail (Northern section)

MARBLE BAR

Main Line Rail (Central section)

Roy Hill

Main Line Rail (Marsh section)

Munjina/ Upper Marillana

Yandi

Marillana

Mindy

Tandanya

Ministers North

Mining Area C

Jinidi

Coondiner

South Flank

Mudlark

Gurinbiddy

Newman

Ophthalmia/ Prairie Downs

NEWMAN

Caramulla

Jimblebar

Legend

- Regional Towns
- Full Development Scenario
- Phase 2 Assessment Boundary
- Third Party Development

Land System SRE Suitability

- Not Assessed
- Disturbed Land
- 1 - Low
- 2 - Low / Medium
- 3 - Medium
- 4 - Medium / High
- 5 - High

Consolidated SRE Habitats Suitability

- 1 - Non-SRE
- 2 - Low/ Medium
- 3 - Medium
- 4 - Medium/High
- 5 - High

INSET 1:1,000,000

Rocklea

7480000 7470000 7460000 7450000

490000 500000 510000 520000 530000 540000 550000

1:1,000,000

0 5 10 20 30 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.1: Suitability assessment of all BHPBIO operation tenures and third party project footprints

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

Table 5.2: The area of each land system within each BHPBIO FDS.

Land Systems	SRE Suitability	Caramulla	Coondiner	Gurinbiddy	Jimblebar	Jinidi	Marillana	Mindy	Mining Area C	Ministers North	Mudlark	Munjina/Upper Marillana	Newman	Ophthalmia/Prairie	Rail	Rocklea	Roy Hill	South Flank	Tandanya	Yandi
Adrian	1														68					
Augustus	5																			
Balfour	1																			
Black	5																			
Bonney	2																			
Boolaloo	4														39					
Boolgeeda	3		1096	1494	1601	783	1402	2357	3221		4160	1384	1589	79	962	7		1280	4246	8
Brockman	3											581								
Cadgie	2	114																		
Calcrete	2								115			1058			20					
Capricorn	5														11					
Charley	3																			

Land Systems	SRE Suitability	Caramulla	Coondiner	Gurinbiddy	Jimblebar	Jinidi	Marillana	Mindy	Mining Area C	Ministers North	Mudlark	Munjina/Upper Marillana	Newman	Ophthalmia/Prairie	Rail	Rocklea	Roy Hill	South Flank	Tandanya	Yandi
Cheela	1																			
Christmas	4														89		196			
Collier	3																			
Coolibah	3																			
Cowra	2														22					
Cundelbar	2																			
Divide	2	471			468			366							294					
Dollar	3																			
Egerton	3					57					64		23	564						
Elimunna	2												1382		154					
Ethel	1																			
Fan	3		317					5							633					
Ford	2																			
Fortescue	2														103					

Land Systems	SRE Suitability	Caramulla	Coondiner	Gurinbiddy	Jimblebar	Jinidi	Marillana	Mindy	Mining Area C	Ministers North	Mudlark	Munjina/Upper Marillana	Newman	Ophthalmia/Prairie	Rail	Rocklea	Roy Hill	South Flank	Tandanya	Yandi
Granitic	4														35					
Hooley	1																			
Horseflat	1																			
Jamindie	3	184			929						7				97		3501			
Jigalong	2																			
Jurrawarrina	4																			
Kooline	3																			
Kumina	2																			
Kunderong	3																			
Laterite	3																			
Macroy	3														1300					
Mallina	2														42					
Marandoo	5																			
Marillana	3														30					

Land Systems	SRE Suitability	Caramulla	Coondiner	Gurinbiddy	Jimblebar	Jinidi	Marillana	Mindy	Mining Area C	Ministers North	Mudlark	Munjina/Upper Marillana	Newman	Ophthalmia/Prairie	Rail	Rocklea	Roy Hill	South Flank	Tandanya	Yandi
Marsh	2														11					
McKay	5	99			882	115						204	154		230		329			1765
Narbung	2																			
Newman	5	26	1112	2696	3249	3165	4648	1507	6455	1933	5214	2	7330	1159	568	3931	4682	4864	3958	45
Nirran	2																			
Nooingnin	3													134						
Oakover	5					336									41					
Paraburdoo	3																			
Paradise	1																			
Pindering	3											913			76			885		
Platform	1			442		1686			332		96	40	22	711	315			349	724	
Prairie	3																			
River	1	38	454				241	256	0				583		152					72
River Channel	1																			

Land Systems	SRE Suitability	Caramulla	Coondiner	Gurinbiddy	Jimblebar	Jinidi	Marillana	Mindy	Mining Area C	Ministers North	Mudlark	Munjina/Upper Marillana	Newman	Ophthalmia/Prairie	Rail	Rocklea	Roy Hill	South Flank	Tandanya	Yandi
Robe	5		61												88					1935
Robertson	4																			
Rocklea	5								2		74		933	636	67	260				
Ruth	4																			
Satirist	2																			
Spearhole	3			454										613					120	
Sylvania	3				214															
Table	5													8						
Talga	3																			
Three Rivers	3																			
Turee	2													43						
Uaroo	1														265					
Urandy	1						2	532							132					
Wannamunna	3			452					503		823	2275	115	125	130			23	1759	

Land Systems	SRE Suitability	Caramulla	Coondiner	Gurinbiddy	Jimblebar	Jinidi	Marillana	Mindy	Mining Area C	Ministers North	Mudlark	Munjina/Upper Marillana	Newman	Ophthalmia/Prairie	Rail	Rocklea	Roy Hill	South Flank	Tandanya	Yandi
Warri	2																			
Washplain	3	192			143								198		9					
White Springs	1																			
Wona	1														63					
Yamerina	2																			
Zebra	4	424			236															
Grand Total		**1549**	**3041**	**5538**	**8015**	**6143**	**6293**	**5024**	**10629**	**1933**	**10437**	**6457**	**14394**	**4073**	**6046**	**4198**	**8707**	**7401**	**10807**	**3981**

SRE species recorded in suitability rating areas

The majority (511 records, or 66% of the total number of records) of SRE species records occur within high suitability (Suitability rating 5) land systems. Land systems with a medium Suitability rating (rating 3) contained the second highest (17%) number of SRE records (Table 5.3). The numbers of SRE records in the low suitability areas and outside of suitability areas was an order of magnitude lower than in the high and medium suitability areas, although this was also true of the medium-high suitability areas (rating 4).

Table 5.3: Number of records of SRE species within each of the five SRE suitability categories.

SRE Taxon	1	2	3	4	5	Outside suitability areas	Total
Camaenidae	10	1	10	13	21	5	**60**
Isopoda	2	3	11	0	253	0	**269**
Mygalomorphae	22	26	71	2	70	6	**197**
Myriapoda	3	2	23	7	61	3	**99**
Pseudoscorpiones	0	0	9	1	18	0	**28**
Scorpiones	5	1	14	0	15	4	**39**
Selenopidae	4	0	11	1	88	16	**120**
Grand Total	**46**	**33**	**149**	**24**	**526**	**25**	**812**

Table 5.4 shows the SRE species richness (i.e. number of species) that occurs within land systems of each of the five Suitability ratings. The various faunal groups differed in occurrence within each of the suitability rating areas, for example selenopid spiders, isopods and to a lesser degree camaenid snails showed the greatest species richness within areas rated a suitability category of 5, while the majority of other groups (e.g. mygalomorph spiders, myriapods, pseudoscorpions) had high species richness between categories 3 and 5. The highest overall species richness was recorded in land systems with a Suitability rating of 5; however the next two highest numbers of species were recorded from Suitability rating 3 and 1, largely as a result of the richness of mygalomorph spiders in these types of land systems.

Table 5.4: SRE species richness occurring within each of the five SRE suitability categories.

SRE Taxon	1	2	3	4	5	Outside suitability areas	Total
Camaenidae	2	1	1	2	4	1	**4**
Isopoda	2	2	5	0	9	0	**10**
Mygalomorphae	15	10	32	2	26	4	**59**
Myriapoda	3	2	18	6	23	2	**35**
Pseudoscorpiones	0	0	6	1	6	0	**13**
Scorpiones	3	1	5	0	6	2	**10**
Selenopidae	2	0	2	1	10	2	**13**
Grand Total	**27**	**16**	**69**	**12**	**84**	**11**	**144**

Table 5.5 and 5.6 show the SRE species present within each of the BHP Billiton Iron Ore Operation Tenures and Third Party project areas, in relation to the relevant land system Suitability ratings and the wider known occurrence of the species in question. A total of 60 SRE species have been detected within the BHP Billiton Iron Ore Operation Tenures (Table 5.5), compared to 13 SRE species recorded within Third Party project areas (Table 5.6). This result is more likely to be an artefact of sampling intensity rather than a lower capacity of the Third Party Project areas to support SRE fauna, as many of these areas occurred on land systems of high SRE suitability. None of the SRE species recorded in third party project areas were recorded within the BHP Billiton Iron Ore Operation Tenures (Table 5.4).

Table 5.5: SRE species recorded in Third Party project areas.

Higher Taxon	Species	Newman (5)	Jamindie (3)	Boolgeeda (3)	Fortescue (2)	Marsh (2)	Platform (1)	Within BHPBIO Operation Tenures (# records)	Outside BHPBIO/ 3rd party Operation Tenures (# records)
Cloudbreak									
Scorpion	*Urodacus* `cloudbreak`		2					No	Yes (8)
Davidsons Creek									
Scorpion	*Urodacus* `Davidson Creek`				1			No	Yes (3)
Koodaideri Iron Ore Project									
Myriapoda	*Antichiropus `DIP029`*	1						No	No
Marandoo									
Scorpion	*Lychas `marandoo 1`*	1						No	Yes (2)
Marillana Iron Ore Project									
Mygalomorphae	*Swolnpes `MYG234`*					1		No	Yes (1)
Pilbara Iron Ore and Inf. Project- Christmas Creek									
Myriapoda	*Antichiropus `DIP031`*	1	2	1				No	Yes (1)
Pseudoscorpion	*Synsphyronus `PSE006`*		1					No	No
Roy Hill Iron Ore Project									
Myriapoda	*Antichiropus `DIP004`*		1					No	No
Mygalomorphae	*Idiommata `MYG128`*		1					No	Yes (1)
	Missulena `MYG252-DNA`		1					No	Yes (5)
Solomon Iron Ore Project									
Mygalomorphae	*Kwonkan `MYG169`*						1	No	No
Scorpion	*Lychas `kings`*						1	No	Yes (2)
	Urodacus `hamersley black`						1	No	Yes (11)
Total	**13 species**	**4**	**7**	**1**	**1**	**1**	**3**		

Table 5.6: SRE species recorded in BHP Billiton Iron Ore Operation Tenures

Higher Taxon	Species	Robe (5)	Rocklea (5)	McKay (5)	Newman (5)	Sylvania (3)	Wanna-munna (3)	Washplain (3)	Boolgeeda (3)	Egerton (3)	Jamindie (3)	Pindering (3)	Elimunna (2)	River (1)	Divide (2)	Platform (1)	Inside: outside disturbance footprint	Recorded in other BHPBIO Operation Tenures	Recorded Outside BHPBIO Operation Tenures
Roy Hill																			
Myriapoda	*Antichiropus sp.*				1												Outside	No	Yes (1)
Marillana																			
None recorded																	-		
Yandi																			
Mygalomorphae	*Aurecocrypta* 'MYG246'								1								Outside	No	Yes (1)
Selenopidae	*Karaops* ARA001-DNA			15													Outside	No	No
	Karaops ARA002-DNA	1		1													Outside	No	No
Ministers North																			
No survey																	-		
Mindy																			
None recorded																	-		
Coondiner																			
No survey																	-		
Tandanya																			
Myriapoda	*Antichiropus* 'DIP047'												1				Outside	No	No
Mudlark																			
Selenopidae	*Karaops* 'sp. indet. (juv.)'				8				3								Outside	No	Yes (23)
	Karaops 'sp. nov. Newman'				2												Outside	No	No
Mining Area C																			
Mygalomorphae	*Aname* 'MYG104'								1								Outside	No	Yes (1)
	Aganippe 'MYG083'								1								Inside	No	Yes (1)
	Aname 'MYG195'				13												Both (4:9)	Yes (9)	No
	Chenistonia 'MYG088'				2												Inside	No	No

Higher Taxon	Species	Robe (5)	Rocklea (5)	McKay (5)	Newman (5)	Sylvania (3)	Wanna-munna (3)	Washplain (3)	Boolgeeda (3)	Egerton (3)	Jamindie (3)	Pindering (3)	Elimunna (2)	River (1)	Divide (2)	Platform (1)	Inside: outside disturbance footprint	Recorded in other BHPBIO Operation Tenures	Recorded Outside BHPBIO Operation Tenures
Mining Area C cont.																			
	Missulena 'sp. nov. Newman'				3												Inside	No	No
	Missulena langlandsi				3												Inside	No	Yes (2)
	Teyl 'MYG027'				1												Inside	No	Yes (1)
	Yilgarnia 'MYG197'				1				2								Outside	Yes (2)	No
Myriapoda	*Antichiropus* 'DIP006'				1												Inside	No	No
	Antichiropus 'sp. juv. ' Jinidi				1												Outside	No	Yes (5)
Selenopidae	*Karaops* 'sp. nov. Area C'				1												Outside	No	No
South Flank																			
Mygalomorphae	*Aganippe 'sp. sigillate'*								6								Inside	No	No
	Aname 'MYG195'				8							1					Both (6:3)	Yes (13)	No
	Aname 'Hooded'				2		2		2								Both (3:3)	No	No
	Aname 'Sock'				5		1		7			1					Both (12:2)	No	No
	Aname 'Spray'								1								Inside	No	No
	Yilgarnia 'MYG197'				2												Both (1:1)	Yes (2)	No
Myriapoda	*Antichiropus* 'Area C sp. 2'											1					Outside	No	No
	Antichiropus 'DIP007'				6		1										Both (3:4)	No	No

Higher Taxon	Species	Robe (5)	Rocklea (5)	McKay (5)	Newman (5)	Sylvania (3)	Wanna-munna (3)	Washplain (3)	Boolgeeda (3)	Egerton (3)	Jamindie (3)	Pindering (3)	Elimunna (2)	River (1)	Divide (2)	Platform (1)	Inside: outside disturbance footprint	Recorded in other BHPBIO Operation Tenures	Recorded Outside BHPBIO Operation Tenures
Jinidi																			
Mygalomorphae	*Aname* 'MYG098'															2	Inside	Yes (2)	No
	Conothele 'MYG002'								1								Inside	No	No
	Missulena faulderi				2											1	Outside	No	No
	Yilgarnia 'MYG033'				5											2	Both (2:5)	No	Yes (1)
Pseudoscorpion	*Troglochernes* 'PSE072'									2							Outside	No	No
Gurinbiddy																			
No survey																	-		
Ophthalmia/ Prairie Downs																			
No survey																	-		
Newman																			
Mygalomorphae	*Aname* `MYG098`				1				1								Both (1:1)	Yes (2)	No
	Aname `MYG205`								1				2				Inside	No	No
	Aname `MYG206`								1				2				Inside	No	No
	Aurecocrypta 'MYG315'				1												Outside	No	No

Higher Taxon	Species	Robe (5)	Rocklea (5)	McKay (5)	Newman (5)	Sylvania (3)	Wanna-munna (3)	Washplain (3)	Boolgeeda (3)	Egerton (3)	Jamindie (3)	Pindering (3)	Elimunna (2)	River (1)	Divide (2)	Platform (1)	Inside: outside disturbance footprint	Recorded in other BHPBIO Operation Tenures	Recorded Outside BHPBIO Operation Tenures
Newman cont.																			
	Cethegus 'MYG299'				4				2								Outside	No	No
	Conothele 'MYG385'				1												Outside	No	No
Selenopidae	*Karaops* 'ARA003-DNA'				10												Both (2:8)	Yes (5)	No
	Karaops 'ARA005-DNA'		2		29												Outside	No	No
Myriapoda	*Antichiropus* `DIP014`				5												Both (3:2)	No	No
	Antichiropus `DIP015`				1				1								Both (1:1)	No	No
	Antichiropus `OB35_1`				7												Both (4:3)	No	No
	Antichiropus `OB35_2`				2												Outside	No	No
	Antichiropus `sp. juv.`				1				1								Inside	No	No
Isopoda	*Buddelundia* '10NM'				20				1								Both (5:16)	Yes (28)	No
	Buddelundia '16NM'		6		83												Both (1:88)	No	No
	Buddelundia '49'		2		29				3				2	1			Both (11:26)	Yes (32)	No
	Buddelundia '78'		2		43				2								Outside	No	No
	Buddelundia '79'				1								1	1			Both (1:2)	No	No
	Buddelundia '80'				1												Outside	No	No

Higher Taxon	Species	Robe (5)	Rocklea (5)	McKay (5)	Newman (5)	Sylvania (3)	Wanna-munna (3)	Washplain (3)	Boolgeeda (3)	Egerton (3)	Jamindie (3)	Pindering (3)	Elimunna (2)	River (1)	Divide (2)	Platform (1)	Inside: outside disturbance footprint	Recorded in other BHPBIO Operation Tenures	Recorded Outside BHPBIO Operation Tenures
Newman cont.																			
	Buddelundiinae 'OB24'		1		3				1								Outside	No	No
Jimblebar																			
Mygalomorphae	*Aganippe* 'MYG085'								1								Outside	No	Yes (9)
	Aganippe 'sp. MYG384-DNA'								1								Outside	No	No
	Aname aragog				1												Outside	No	No
	Missulena occatoria-group				2	1											Outside	No	No
	Buddelundia '10NM'			10	18												Both (7:21)	Yes (21)	No
Isopoda	*Buddelundia* '36NM'				3												Outside	No	No
	Buddelundia '49'			5	24			1	1								Both (7:25)	Yes (37)	No
	Buddelundia sp. nov.										1						Outside	No	No
	Buddelundiinae 'WN'				2												Outside	No	No
Selenopidae	*Karaops* 'ARA003-DNA'				5												Both (4:1)	Yes (10)	No
	Karaops 'ARA004-DNA'				10												Outside	No	No
Pseudoscorpion	*Xenolpium* 'PSE079'				1												Inside	No	No

Higher Taxon	Species	Robe (5)	Rocklea (5)	McKay (5)	Newman (5)	Sylvania (3)	Wanna-munna (3)	Washplain (3)	Boolgeeda (3)	Egerton (3)	Jamindie (3)	Pindering (3)	Elimunna (2)	River (1)	Divide (2)	Platform (1)	Inside: outside disturbance footprint	Recorded in other BHPBIO Operation Tenures	Recorded Outside BHPBIO Operation Tenures
Caramulla																			
Mygalomorphae	*Synothele* 'MYG116'														1		Outside	No	No
	Kwonkan 'MYG094'														1		Outside	No	No
Rocklea																			
No survey																	-		
Total		**1**	**13**	**23**	**375**	**1**	**4**	**1**	**49**	**2**	**1**	**3**	**8**	**2**	**2**	**5**			

SRE habitat units

The most common SRE habitat unit within the FDS, not including non-SRE habiitats, were the Boulders, Outcrops, Ridges and Breakaways (level 4: 13,123 ha), which accounts for 28.8% of the mapped extent of this unit. The habitat unit with the greatest proportion within the FDS is the Groves and Outcrops, with 49.1%, although this is a less common unit, only covering 715Ha of the mapped area.

Of the most suitable habitat units (level 5), 27.2% of the Deep gullies/ gorges and 1.6% of the Boulders and Outcrops are within the FDS footprint. Of the level 4 habitat units, Groves and Outcrops (49.1%), Boulders, Outcrops, Ridges and Breakaways (28.8%), Drainage foci and Swamp/ depressions (27.2%) and Isolated sands (16.1%) are also present within the FDS.

The estimated percentages of remaining SRE habitat (extent beyond the FDS) are as follows; Boulders and Outcrops (98.4% remaining), Dispersal habitats and Swamp/ depressions (90.1% remaining), Dispersal habitats (85.2% remaining), Isolated sands (83.9% remaining), Groves and Drainage Foci (76.9% remaining), Deep gullies/ gorges (72.8% remaining), Drainage foci and Swamp/ depressions (72.8% remaining), Shallow gullies and Drainage foci (71.5% remaining), Boulders, Outcrops, Ridges and Breakaways (71.5% remaining) and Groves and Outcrops (50.9% remaining).

The above estimates of remaining SRE habitat units need to be taken within the context of their regional extent, so as to allow localised isolation to be taken into account. The next section, which discusses each Operation Tenure individually, will provide some of this context.

Table 5.7: The extent of all mapped habitat units (SRE and non SRE) within and outside the FDS.

SRE Habitat unit	SRE suitability	Total mapped area (ha)	Total inside of FDS* (ha)	% inside of FDS	Overall area outside of FDS* (ha)	% of overall area outside of FDS
Groves and Drainage Foci	3	46648	10744	23.0%	35904	77.0%
Boulders, Outcrops, Ridges and Breakaways	4	45498	13132	28.9%	32366	71.1%
Drainage foci and Swamp/ depressions	4	31390	8556	27.3%	22835	72.7%
Shallow gullies and Drainage foci	3	10925	3137	28.7%	7788	71.3%
Dispersal habitats	2	9320	1331	14.3%	7989	85.7%
Deep gullies/ gorges	5	9065	2488	27.4%	6577	72.6%
Dispersal habitats and Swamp/ depressions	3	2187	214	9.8%	1973	90.2%
Groves and Outcrops	4	715	349	48.8%	366	51.2%
Boulders and Outcrops	5	634	10	1.6%	623	98.4%
Isolated sands	4	62	10	15.7%	52	84.3%
Non-SRE Habitat	1	271797	66082	24.3%	205715	75.7%

Table 5.8: The extent of each mapped habitat units (SRE and non SRE) for each respective Operation Tenure. The area for each habitat unit within each respective FDS footprint is also given as a percentage of the total area of that habitat within that particular Operation Tenure.

Operation Tenures	Area of FDS (ha)	% of FDS mapped	Boulders and Outcrops	Deep gullies/ gorges	Boulders, Outcrops, Ridges and Breakaways	Drainage foci and Swamps/ depressions	Groves and Outcrops	Isolated sands	Dispersal habitats and Swamps/ depressions	Groves and Drainage foci	Shallow gullies and Drainage foci	Dispersal habitats	Non-SRE Habitat
		SRE Suitability	5	5	4	4	4	4	3	3	3	2	1
Rail Line	6046	87.5	10	56	147	155			21	415	111	85	4291
Caramulla	1549	100				353				182		58	956
Coondiner	3041	100		133	19	912					89	114	1775
Gurinbiddy	5538	100		135	1611	164			0.0	1042	84		2503
Jimblebar	8015	66.5		3.6	240	496			0.2	561	102	8.2	3922
Jinidi	6143	100		86	1227	1589			0.2	336	258	6.3	2640
Marillana	6293	100		107	1861	0.0		7.9		28	400	210	3680
Mindy	5024	100		20		457		1.9	0.01		94	144	4306
Mining Area C	10629	100		299	650	682			13	185	316		8484
Ministers North	1933	27.6				18			0.0		18		497
Mudlark	10437	100		547	1910	413				911	347	48	6263
Munjina/Upper Marillana	6457	100				1244			81	2782	19	91	2239
Newman	14394	88.7		205	2161	755			31	876	264	192	8281

Operation Tenures	Area of FDS (ha)	% of FDS mapped	Boulders and Outcrops	Deep gullies/ gorges	Boulders, Outcrops, Ridges and Breakaways	Drainage foci and Swamps/ depressions	Groves and Outcrops	Isolated sands	Dispersal habitats and Swamps/ depressions	Groves and Drainage foci	Shallow gullies and Drainage foci	Dispersal habitats	Non-SRE Habitat
Ophthalmia/Prairie	4073	84.7		6.4	256	137			0.1	1586	89	11	1365
Rocklea	4198	0											
Roy Hill	8707	10.9			276				67	115		17	474
South Flank	7401	100		666	130	529	349		0.2	352	651	19	4706
Tandanya	10807	100		201	2099	499			0.0	1253	279	106	6369
Yandi	3981	98.0		23	535	112			0.1	6.6	4.8	208	3010
Outside FDS	22998891		623	6577	32377	22876	366	52	1974	36019	7798	8002	206035
Grand Total	**23123557**		**634**	**9065**	**45498**	**31390**	**715**	**62**	**2187**	**46648**	**10925**	**9320**	**271797**

Table 5.9: Potential priority for future management of each SRE habitat within the FDS of each Operation Tenure, assuming sufficient survey coverage.

% FDS Mapped [1]	SRE fauna within Operation Tenure [2]	Current survey coverage in FDS [3]	SRE habitat within FDS [4] (suitability)	Potential level of impact within FDS [5]	Factors increasing likelihood of SRE species occurring				Potential Priority for Future Management [10]	Explanatory notes
					Med/ High (4/5) Suitability [6]	High Congruence [7]	Mod/ High Isolation [8]	Low Connectivity beyond FDS [9]		
Caramulla										
100%	Yes	1-40%	Drainage foci and Swamp/ depressions (4)	Med	X				Low	All SRE habitats present extend well beyond the FDS and have limited isolation potential.
			Groves and Drainage foci (3)	Med					Low	
			Dispersal habitats (2)	Med					Low	
			Unmapped area	N/A					Low	
Coondiner										
100%	No	0%	Deep gullies/ gorges (5)	High	X	X	X		High	The extensive Deep gullies/ gorges habitat, while continuous beyond the FDS, is still likely to record restricted fauna due to the high likelihood of isolated habitats. The Shallow gullies and Drainage foci habitat unit also appears to have limited extent beyond the FDS but the low suitability and congruence reduce the likelihood. The remaining SRE habitats extend beyond the FDS and have limited isolation potential.
			Boulders, Outcrops, Ridges and Breakaways (4)	High	X				Low	
			Drainage foci and Swamp/ depressions (4)	High	X				Low	
			Shallow gullies and Drainage foci (3)	High				X	Med	
			Dispersal habitats (2)	High					Low	
			Unmapped area	N/A					Low	
Gurinbiddy										
100%	No	1-40%	Deep gullies/ gorges (5)	High	X	X	X	X	High	The Deep gullies/ gorges habitat in the western section appears to be heavily impacted by the FDS, and the remaining habitat is likely to contain isolated habitats. The remaining SRE habitats extend beyond the FDS and have limited isolation potential.
			Boulders, Outcrops, Ridges and Breakaways (4)	High	X				Low	
			Drainage foci and Swamp/ depressions (4)	High	X				Low	
			Dispersal habitats and Swamp/ depressions (3)	Low					Low	
			Groves and Drainage foci (3)	High					Low	
			Shallow gullies and Drainage foci (3)	High					Low	
			Unmapped area	N/A					Low	
Jimblebar										
66.5%	Yes	60-80%	Deep gullies/ gorges (5)	High	X	X	X		Med	The Deep gullies/ gorges habitat in the north western section appears to be moderately impacted by the FDS, and the remaining habitat is likely to contain isolated habitats. The remaining SRE habitats extend beyond the FDS and have limited isolation potential. The remaining 18% of the Operation Tenure that is unmapped, which is impacted by the FDS, comprises some Phase 1 Level 5 suitability habitat, and therefore likely to contain High suitability habitat.
			Boulders, Outcrops, Ridges and Breakaways (4)	High	X				Low	
			Drainage foci and Swamp/ depressions (4)	High	X				Low	
			Dispersal habitats and Swamp/ depressions (3)	High					Low	
			Groves and Drainage foci (3)	High					Low	
			Shallow gullies and Drainage foci (3)	High					Low	
			Dispersal habitats (2)	Low					Low	
			Unmapped area	N/A					High	

% FDS Mapped [1]	SRE fauna within Operation Tenure [2]	Current survey coverage in FDS [3]	SRE habitat within FDS [4] (suitability)	Potential level of impact within FDS [5]	Factors increasing likelihood of SRE species occurring				Potential Priority for Future Management [10]	Explanatory notes
					Med/ High (4/5) Suitability [6]	High Congruence [7]	Mod/ High Isolation [8]	Low Connectivity beyond FDS [9]		
Jinidi										
100%	Yes	40-60%	Deep gullies/ gorges (5)	Low	X	X	X	X	High	The Deep gullies/ gorges habitat in the north western section appears to be heavily impacted by the FDS, and the remaining habitat is likely to contain isolated habitats. The remaining SRE habitats extend beyond the FDS and have limited isolation potential.
			Boulders, Outcrops, Ridges and Breakaways (4)	Med	X				Low	
			Drainage foci and Swamp/ depressions (4)	High	X				Low	
			Dispersal habitats and Swamp/ depressions (3)	Med					Low	
			Groves and Drainage foci (3)	High					Low	
			Shallow gullies and Drainage foci (3)	High					Low	
			Dispersal habitats (2)	Low					Low	
			Unmapped area	N/A					Low	
Marillana										
100%	No	1-40%	Deep gullies/ gorges (5)	Med	X	X	X		Med	The Isolated sands are heavily impacted and the Deep gullies/ gorges habitat in the south eastern section appears to be moderately impacted by the FDS, and the remaining Deep gullies/ gorge habitat is likely to contain isolated habitats. The remaining SRE habitats extend beyond the FDS and have limited isolation potential.
			Boulders, Outcrops, Ridges and Breakaways (4)	High	X				Low	
			Drainage foci and Swamp/ depressions (4)	Low	X				Low	
			Isolated sands (4)	High	X	X	X	X	High	
			Groves and Drainage foci (3)	High					Low	
			Shallow gullies and Drainage foci (3)	High					Low	
			Dispersal habitats (2)	High					Low	
			Unmapped area	N/A					Low	
Mindy										
100%	No	1-40%	Deep gullies/ gorges (5)	High	X	X	X	X	High	The Isolated sands and the Deep gullies/ gorges habitat are heavily impacted throughout the Operation Tenure. The remaining SRE habitats extend beyond the FDS and have limited isolation potential.
			Drainage foci and Swamp/ depressions (4)	High	X				Low	
			Isolated sands (4)	High	X	X	X	X	High	
			Dispersal habitats and Swamp/ depressions (3)	High					Low	
			Shallow gullies and Drainage foci (3)	High				X	Low	
			Dispersal habitats (2)	High					Low	
			Unmapped area	N/A					Low	
Mining Area C										
100%	Yes	40-60%	Deep gullies/ gorges (5)	Med	X	X	X	X	High	The Deep gullies/ gorges habitat in the eastern section appears to be heavily impacted by the FDS, and the remaining habitat is likely to contain isolated habitats. The remaining SRE habitats extend beyond the FDS and have limited isolation potential.
			Boulders, Outcrops, Ridges and Breakaways (4)	High	X				Low	
			Drainage foci and Swamp/ depressions (4)	Med	X				Low	
			Groves and Outcrops (4)	None	X				Low	
			Dispersal habitats and Swamp/ depressions (3)	Low					Low	

% FDS Mapped [1]	SRE fauna within Operation Tenure [2]	Current survey coverage in FDS [3]	SRE habitat within FDS [4] (suitability)	Potential level of impact within FDS [5]	Factors increasing likelihood of SRE species occurring				Potential Priority for Future Management [10]	Explanatory notes
					Med/ High (4/5) Suitability [6]	High Congruence [7]	Mod/ High Isolation [8]	Low Connectivity beyond FDS [9]		
			Groves and Drainage foci (3)	Med					Low	
			Shallow gullies and Drainage foci (3)	Med					Low	
			Dispersal habitats (2)	None					None	
			Unmapped area	N/A					Low	
Ministers North										
27.6%	No	0%	Drainage foci and Swamp/ depressions (4)	None	X				None	Only 24% of this Operation Tenure is mapped with the remaining 76% comprising Phase 1 Level 5 suitability. As such, there is a high likelihood that this Operation Tenure will contain High suitability habitat.
			Dispersal habitats and Swamp/ depressions (3)	High					Low	
			Shallow gullies and Drainage foci (3)	High					Low	
			Dispersal habitats (2)	High					Low	
			Unmapped area	N/A					High	
Mudlark Well										
100%	Yes	1-40%	Deep gullies/ gorges (5)	Med	X	X	X	X	High	The Deep gullies/ gorges habitat in the northern and southern sections appears to be heavily impacted by the FDS, and the remaining habitat is likely to contain isolated habitats. The remaining SRE habitats extend beyond the FDS and have limited isolation potential.
			Boulders, Outcrops, Ridges and Breakaways (4)	Med	X				Low	
			Drainage foci and Swamp/ depressions (4)	Low	X				Low	
			Groves and Outcrops (4)	Med	X				Low	
			Dispersal habitats and Swamp/ depressions (3)	Low					Low	
			Groves and Drainage foci (3)	Low					Low	
			Shallow gullies and Drainage foci (3)	Med					Low	
			Dispersal habitats (2)	Low					Low	
			Unmapped area	N/A					Low	
Munjina/ Upper Marillana										
100%	Yes	1-40%	Deep gullies/ gorges (5)	None	X	X	X		None	The most suitable SRE habitat in this Operation Tenure (Level 4: Drainage foci and Swamp/ depressions) is extensive beyond the FDS and highly likely to occur well beyond the Operation Tenure boundary.
			Boulders, Outcrops, Ridges and Breakaways (4)	None	X				None	
			Drainage foci and Swamp/ depressions (4)	High	X				Low	
			Dispersal habitats and Swamp/ depressions (3)	Med					Low	
			Groves and Drainage foci (3)	High					Low	
			Shallow gullies and Drainage foci (3)	Low					Low	
			Dispersal habitats (2)	Med					Low	
			Unmapped area	N/A					N/A	
Newman										
88.7%	Yes	40-60%	Deep gullies/ gorges (5)	High	X	X	X	X	High	The Deep gullies/ gorges habitat in the northern and south western sections appears to be heavily impacted by the FDS, and the remaining habitat is likely to contain isolated habitats. The Boulders, Outcrops, Ridges and Breakaways in the
			Boulders, Outcrops, Ridges and Breakaways (4)	High	X			X	Med	

% FDS Mapped [1]	SRE fauna within Operation Tenure [2]	Current survey coverage in FDS [3]	SRE habitat within FDS [4] (suitability)	Potential level of impact within FDS [5]	Factors increasing likelihood of SRE species occurring				Potential Priority for Future Management [10]	Explanatory notes
					Med/ High (4/5) Suitability [6]	High Congruence [7]	Mod/ High Isolation [8]	Low Connectivity beyond FDS [9]		
			Drainage foci and Swamp/ depressions (4)	Med	X				Low	south western section is also moderately impacted. The remaining mapped SRE habitats extend beyond the FDS and have limited isolation potential. The remaining 21% of the Operation Tenure that is unmapped, which is impacted by the FDS, is primarily Phase 1 Level 5 suitability habitat, and therefore likely to contain High suitability habitat.
			Dispersal habitats and Swamp/ depressions (3)	High					Low	
			Groves and Drainage foci (3)	High					Low	
			Shallow gullies and Drainage foci (3)	Med					Low	
			Dispersal habitats (2)	Med					Low	
			Unmapped area	N/A					High	
Ophthalmia/Prairie Downs										
84.7%	No	0%	Deep gullies/ gorges (5)	Med	X	X	X		Med	The Deep gullies/ gorges habitat appears to be lightly impacted by the FDS. The remaining mapped SRE habitats extend beyond the FDS and have limited isolation potential. The remaining 25% of the Operation Tenure that is unmapped, which is impacted by the FDS, is primarily Phase 1 Level 5 suitability habitat, and therefore likely to contain High suitability habitat.
			Boulders, Outcrops, Ridges and Breakaways (4)	High	X				Low	
			Drainage foci and Swamp/ depressions (4)	Med	X				Low	
			Dispersal habitats and Swamp/ depressions (3)	Med					Low	
			Groves and Drainage foci (3)	Med					Low	
			Shallow gullies and Drainage foci (3)	Med					Low	
			Dispersal habitats (2)	Low					Low	
			Unmapped area	N/A					High	
Rocklea										
0%	No	1-40%	N/A	N/A	N/A	N/A	N/A	N/A	N/A	No mapping or survey work has been undertaken in this Operation Tenure and the FDS primarily impacts on Phase 1 Level 5 suitability. As such, there is a high likelihood that this Operation Tenure will contain High suitability habitat.
			Unmapped area	N/A					High	
Roy Hill										
10.9%	Yes	1-40%	Deep gullies/ gorges (5)	Med	X	X	X		Med	Only 10% of this Operation Tenure is mapped with the remaining 90% comprising approximately equal parts Phase 1 Level 5 and Level 3 suitability. As such, there is a high likelihood that this Operation Tenure will contain High suitability habitat.
			Boulders, Outcrops, Ridges and Breakaways (4)	Med	X				Low	
			Dispersal habitats and Swamp/ depressions (3)	High					Low	
			Groves and Drainage foci (3)	High					Low	
			Dispersal habitats (2)	High					Low	
			Unmapped area	N/A					High	
South Flank										
100%	Yes	40-60%	Deep gullies/ gorges (5)	High	X	X	X		High	The Deep gullies/ gorges habitat in the central section appears to be heavily impacted by the FDS, and the remaining habitat is likely to contain isolated habitats. The remaining SRE habitats extend beyond the FDS and have limited isolation potential.
			Boulders, Outcrops, Ridges and Breakaways (4)	Med	X				Low	
			Drainage foci and Swamp/ depressions (4)	High	X				Low	
			Groves and Outcrops (4)	High	X				Low	
			Dispersal habitats and Swamp/ depressions (3)	High					Low	
			Groves and Drainage foci (3)	High					Low	

% FDS Mapped [1]	SRE fauna within Operation Tenure [2]	Current survey coverage in FDS [3]	SRE habitat within FDS [4] (suitability)	Potential level of impact within FDS [5]	Factors increasing likelihood of SRE species occurring				Potential Priority for Future Management [10]	Explanatory notes
					Med/ High (4/5) Suitability [6]	High Congruence [7]	Mod/ High Isolation [8]	Low Connectivity beyond FDS [9]		
			Shallow gullies and Drainage foci (3)	High					Low	
			Dispersal habitats (2)	High					Low	
			Unmapped area	N/A					N/A	
Tandanya										
100%	Yes	1-40%	Deep gullies/ gorges (5)	High	X	X	X	X	High	The Deep gullies/ gorges habitat in the northern sections appears to be heavily impacted by the FDS, and the remaining habitat is likely to contain isolated habitats. The Boulders, Outcrops, Ridges and Breakaways in the northern section is also moderately impacted. The remaining mapped SRE habitats extend beyond the FDS and have limited isolation potential.
			Boulders, Outcrops, Ridges and Breakaways (4)	High	X			X	Med	
			Drainage foci and Swamp/ depressions (4)	High	X				Low	
			Dispersal habitats and Swamp/ depressions (3)	Low					Low	
			Groves and Drainage foci (3)	Med					Low	
			Shallow gullies and Drainage foci (3)	High					Low	
			Dispersal habitats (2)	High					Low	
			Unmapped area	N/A					Low	
Yandi										
98%	Yes	>80%	Deep gullies/ gorges (5)	High	X	X	X		Med	The small amount of Deep gullies/ gorges habitat in the western and eastern sections appears to be moderately impacted by the FDS, and the remaining habitat is likely to contain isolated habitats. The remaining SRE habitats extend beyond the FDS and have limited isolation potential.
			Boulders, Outcrops, Ridges and Breakaways (4)	Low	X				Low	
			Drainage foci and Swamp/ depressions (4)	Med	X				Low	
			Dispersal habitats and Swamp/ depressions (3)	Med					Low	
			Groves and Drainage foci (3)	Med					Low	
			Shallow gullies and Drainage foci (3)	Low					Low	
			Dispersal habitats (2)	High					Low	
			Unmapped area	N/A					Low	

[1] This is the % of the Operation Tenure that has been mapped within Phase 2.

[2] This includes Potential SRE fauna, i.e. fauna that may be SRE but current knowledge does not allow 100% certainty.

[3] This is an approximate % of how much of the FDS has been surveyed for SRE fauna.

[4] These are the SRE habitats, as defined in Phase 2, that occur within each Operation Tenure. This includes the areas that are unmapped. Where the mapping has not been completed within a Operation Tenure, this is likely to be an underrepresentation of what SRE habitats are present, as set out in the limitations for the Phase 1 suitability assessment.

[5] This is an approximate level of the potential impact, at the Operation Tenure level, given the % of each SRE habitat within the FDS.

Factors increasing the likelihood of SRE species occurring within the FDS

- [6] This indicates which of the SRE habitats are regarded as most suitable for SRE fauna, and does not vary between Operation Tenures.
- [7] This indicates which of the SRE habitats are regarded as congruent with the mapping, and does not vary between Operation Tenures. (refer to Section 4.3.1 for a full explanation of congruence)
- [8] This indicates the likelihood of isolated habitats or sites within each SRE habitat type, and does not vary between Operation Tenures.
- [9] This indicates whether the SRE habitat is likely to be isolated within the FDS due to a possible low level of connectivity with the same or similar habitats outside the FDS.

[10] This gives an indication of the potential priority level for each SRE habitat, taking into account the factors mentioned above and within the context of the % of mapping that has been completed. Where mapping is not complete, Phase 1 suitability is taken into account.

5.2 BHP Billiton Iron Ore Operation Tenure

Each description below discusses the extent of mapping within each Operation Tenure, and the presence and significance of SRE habitat units with respect to the Study Area and the FDS with respect to each Operation Tenure.

Refer Figures 5.1.1 to 5.20.3 for maps of SRE survey effort, SRE habitat assessment effort, SRE records, land systems, Conolidated SRE habitats (Phase 2) and SRE Suitability at each BHP Billiton Iron Ore Operation Tenure.

Main Rail Line: Northern section (Figures 5.1.1, 5.1.2 and 5.1.3) and Southern section (Figures 5.2.1, 5.2.2 and 5.2.3)

The Main Rail Line has been mapped to 1 km either side of the line itself; however, the FDS is less than 100 m. As such, the Main Rail Line disturbance is discussed with respect to the presence of the broad SRE habitat units in the immediate vicinity, rather than within the area of disturbance.

Both the 'northern' and 'southern' sections of the rail line (north of the Roy Hill Operation Tenure) run through similar habitats; therefore, they are discussed collectively, as follows.

Five broad SRE habitat units are mapped within the vicinity of the Main Rail Line; Boulders and Outcrops (level 5), Boulders, Outcrops, Ridges and Breakaways (level 4), Groves and Drainage Foci (level 3), Dispersal habitats and Swamp/ depressions (level 3), and Dispersal habitats (level 2). Of these, the Boulders and Outcrops habitat unit is the most significant as this is one of the few habitat units with a high congruence to the mapped unit, contains highly suitable SRE habitats (level 5), and the rail line is the only mapped section which contains this habitat unit. The Boulders, Ridges, Outcrops and Breakaways habitat unit is also significant due to its high suitability for SRE fauna (level 4), although it is a less congruent unit that is common throughout the rest of the Study Area.

The remainder of the habitat units are tied closely to the drainage lines running through the northern Pilbara, which have high connectivity beyond the vicinity of the rail line.

640000 650000 660000 670000 680000 690000 700000

7750000 7740000 7730000 7720000 7710000 7700000 7690000 7680000 7670000 7660000

PORT HEDLAND

Legend

- Regional Towns

Full Development Scenario

- Rail
- SRE Sampling sites
- SRE Habitat sites

Mygalomorphae

- Aganippe `MYG084`
- Aname `MYG208`
- Aname `MYG209`
- Aname `boodarie`

Selenopidae

- Karaops `sp. indet. (juv.)`
- Karaops `sp. nov. Mount Dove`
- Karaops `wodgina`

Pseudoscorpiones

- Sundochernes `PSE021`

Polydesmida

- Antichiropus `DIP033`

1:280,000

0 2 4 8 12 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.1.1: Locations of sampling, habitat assessment sites and SRE faunal records of the Main rail line (northern section)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

640000 650000 660000 670000 680000 690000 700000

7750000 7740000 7730000 7720000 7710000 7700000 7690000 7680000 7670000 7660000

PORT HEDLAND

Littoral
Cheerawarra
Yamerina
Paradise
Macroy
Mallina
River Channel
Granitic
Calcrete
Horseflat
Robe
Satirist
Oakover
Uaroo
River
Boolaloo
Ruth
Black
Talga
Platform
Rocklea

Legend

- Regional Towns

Full Development Scenario

- Rail

Consolidated SRE Habitats

- Boulders and Outcrops
- Boulders, Outcrops, Ridges and Breakaways
- Dispersal habitats
- Dispersal habitats and Swamps/ depressions
- Groves and Drainage foci
- Non-SRE Habitat

Land Systems

- Black
- Boolaloo
- Boolgeeda
- Calcrete
- Capricorn
- Cheerawarra
- Granitic
- Gregory
- Horseflat
- Littoral
- Macroy
- Mallina
- Oakover
- Paradise
- Platform
- River
- River Channel
- Robe
- Rocklea
- Ruth
- Satirist
- Talga
- Uaroo
- Yamerina

1:280,000

0 2 4 8 12 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.1.2: Land Systems and consolidated SRE habitats of the Main rail line (northern section)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

640000 650000 660000 670000 680000 690000 700000

7750000 7740000 7730000 7720000 7710000 7700000 7690000 7680000 7670000 7660000

PORT HEDLAND

Legend

Regional Towns

Full Development Scenario

Rail

Consolidated SRE Habitats Suitability

1 - Non-SRE
2 - Low/ Medium
3 - Medium
4 - Medium/High
5 - High

Land System SRE Suitability

Not Assessed
1 - Low
2 - Low / Medium
3 - Medium
4 - Medium / High
5 - High

1:280,000

0 2 4 8 12 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.1.3: SRE suitability of Land Systems and consolidated SRE habitats of the Main rail line (northern section)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

660000 670000 680000 690000 700000 710000 720000 730000

7660000 7650000 7640000 7630000 7620000 7610000 7600000 7590000 7580000 7570000

Legend

Full Development Scenario

- Rail
- SRE Sampling sites
- SRE Habitat sites

Selenopidae

- Karaops `sp. indet. (juv.)`
- Karaops `wodgina`

Pseudoscorpiones

- Feaella `PSE007 tealei`
- Feaella `PSE017`
- Oratemnus `PSE018`
- Synsphyronus `PSE008`
- Synsphyronus `PSE012`

Camaenidae

- Quistrachia turneri

Polydesmida

- Antichiropus `DIP005`

1:280,000

0 2 4 8 12 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.2.1: Locations of sampling, habitat assessment sites and SRE faunal records of the Main rail line (central section)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

660000 670000 680000 690000 700000 710000 720000 730000

7660000 7650000 7640000 7630000 7620000 7610000 7600000 7590000 7580000 7570000

Uaroo
Boolgeeda
Capricorn
Robe
Black
Boolaloo
Platform
Talga
Macroy
White Springs
River
Granitic
Rocklea

Legend

Full Development Scenario

- Rail

Consolidated SRE Habitats

- Boulders and Outcrops
- Boulders, Outcrops, Ridges and Breakaways
- Dispersal habitats
- Dispersal habitats and Swamps/ depressions
- Groves and Drainage foci
- Non-SRE Habitat

Land Systems

- Black
- Bonney
- Boolaloo
- Boolgeeda
- Capricorn
- Granitic
- Macroy
- McKay
- Oakover
- Platform
- River
- Robe
- Rocklea
- Talga
- Uaroo
- White Springs
- Wona

1:280,000

0 2 4 8 12 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.2.2: Land Systems and consolidated SRE habitats of the Main rail line (central section)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

660000 670000 680000 690000 700000 710000 720000 730000

7660000 7650000 7640000 7630000 7620000 7610000 7600000 7590000 7580000 7570000

Legend

Full Development Scenario

- Rail

Consolidated SRE Habitats Suitability

- 1 - Non-SRE
- 2 - Low/ Medium
- 3 - Medium
- 4 - Medium/High
- 5 - High

Land System SRE Suitability

- 1 - Low
- 2 - Low / Medium
- 3 - Medium
- 4 - Medium / High
- 5 - High

1:280,000

0 2 4 8 12 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.2.3: SRE suitability of Land Systems and consolidated SRE habitats of the Main rail line (central section)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

Roy Hill FDS (Figures 5.3.1, 5.3.2 and 5.3.3)

Phase 1

The Roy Hill FDS predominantly runs along the high suitability Newman land system. The remainder covers sections of the Jamindie (Suitability rating 3), McKay (rating 5) and Christmas (rating 4) land systems.

Terrestrial invertebrate survey sites are located within as well as to the north and south of the FDS. Within the FDS, survey sites are located within the Newman and Jamindie land systems, both inside and outside the FDS.

SRE species have also been recorded surrounding the FDS within the McKay (two records of millipede) and Rocklea (one millipede recorded) Land systems to the north of the Hub and the Christmas (Suitability rating 4 - two records of millipede) and Marsh (Suitability rating 2 - three trapdoor spider records) land systems to the south of the FDS.

Considering the limited survey effort within the FDS and presence of SRE species in the immediate vicinity, it is likely that additional SRE species may be present in the FDS, particularly within the Newman land system, if suitable habitats (deep gullies and gorges, ridges, vertical faces and plateaux) are present.

Phase 2

Vegetation and vertebrate fauna habitat mapping has not been completed for the majority of the Roy Hill FDS and, as such, much of the Phase 1 assessment needs to be taken into account to provide an assessment. Only 11% of the 8,707 ha FDS has been mapped.

Of the 2,754 ha that has been mapped, four SRE habitat units are present; Boulders, Outcrops, Ridges and Breakaways (level 4; 276 ha within), Groves and Drainage foci (level 3; 115 ha within), Dispersal habitats and Swamps/ depressions (level 3; 67 ha within), and Dispersal habitats (level 2; 17 ha within).

This Operation Tenure contains some areas of potentially high priority for future management, namely within the Phase 1 Level 5 suitability mapping. Within this mapping unit there is a high likelihood that there will be high suitability habitats, with a high level of isolation, particularly Deep gullies/ gorges.

680000 690000 700000 710000 720000 730000

7580000 7570000 7560000 7550000 7540000 7530000 7520000 7510000

Mulga Downs

Legend

Full Development Scenario

- Rail
- Roy Hill
- Third Party Development
- SRE Sampling sites
- SRE Habitat sites

Mygalomorphae

- Aganippe `MYG086`
- Aganippe `MYG233`
- Aname `MYG104`
- Anidiops `MYG083`
- Swolnpes `MYG234`

Polydesmida

- Antichiropus `DIP012`
- Antichiropus `cloudbreak `
- Antichiropus `indet.`

1:200,000

0 1.5 3 6 9 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.3.1: Locations of sampling, habitat assessment sites and SRE faunal records of Roy Hill and the Main rail line (marsh section)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

680000 690000 700000 710000 720000 730000

7580000 7570000 7560000 7550000 7540000 7530000 7520000 7510000

White Springs
Macroy
Granitic
Talga
Rocklea
Wona
Robe
McKay
Capricorn
Jamindie
Christmas
Jurrawarrina
Coolibah
Brockman
Lake Bed
Adrian
Marsh
Calcrete
Cowra
Marillana
Divide
Fortescue

Legend

Full Development Scenario
- Rail
- Roy Hill
- Third Party Development

Consolidated SRE Habitats
- Boulders and Outcrops
- Boulders, Outcrops, Ridges and Breakaways
- Deep gullies/ gorges
- Dispersal habitats
- Dispersal habitats and Swamps/ depressions
- Groves and Drainage foci
- Non-SRE Habitat

Land Systems
- Adrian
- Boolgeeda
- Brockman
- Calcrete
- Capricorn
- Christmas
- Coolibah
- Cowra
- Divide
- Fortescue
- Granitic
- Jamindie
- Jurrawarrina
- Lake Bed
- Macroy
- Marillana
- Marsh
- McKay
- Newman
- Platform
- River
- Robe
- Rocklea
- Talga
- White Springs
- Wona

1:200,000

0 1.5 3 6 9 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.3.2: Land Systems and consolidated SRE habitats of Roy Hill and the Main rail line (marsh section)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

680000 690000 700000 710000 720000 730000

7580000 7570000 7560000 7550000 7540000 7530000 7520000 7510000

Legend

Full Development Scenario

- Rail
- Roy Hill
- Third Party Development

Consolidated SRE Habitats Suitability

- 1 - Non-SRE
- 2 - Low/ Medium
- 3 - Medium
- 4 - Medium/High
- 5 - High

Land System SRE Suitability

- Not Assessed
- 1 - Low
- 2 - Low / Medium
- 3 - Medium
- 4 - Medium / High
- 5 - High

1:200,000

0 1.5 3 6 9 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.3.3: SRE suitability of Land Systems and consolidated SRE habitats of Roy Hill and the Main rail line (central section)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

Marillana FDS (Figures 5.4.1, 5.4.2 and 5.4.3)

Phase 1

The majority of the Marillana FDS lies within the Newman land system (SRE Suitability rating 5), with small areas extending into the Boolgeeda (rating 3) and River (rating 1) land systems. The majority of the FDS is within the high suitability Newman land system.

Terrestrial invertebrate surveys have been undertaken across the project area, with approximately half within the FDS. No SRE species have been recorded within the FDS.

Survey sites are also located in the land systems immediately to the north and east of the FDS. These surveys identified SRE species (trapdoor spiders) within the Boolgeeda and Fan land systems (both land systems rating 3).

As the Newman land system has a high suitability for supporting SRE species it is likely that SRE species may be present within the Marillana FDS within suitable habitat (deep gullies and gorges and ridges and vertical faces and plateaux).

Phase 2

The Marillana FDS covers 6,293 ha, of which 100% is mapped.

This FDS is dominated by rocky SRE habitat units, particularly Deep gullies/ gorges (level 5; 107 ha within the FDS footprint), Boulders, Outcrops, Ridges and Breakaways (level 4; 1,861 within), and Shallow gullies and Drainage foci (level 3; 400 ha within).

Another significant SRE habitat unit is a small portion (8 ha within) of Isolated sands (level 4) in the eastern section of the FDS. The extent to which this habitat unit extends beyond the FDS is unclear; although there are further occurrences of this habitat unit to the north which may be connected with the same habitat units within the FDS, although the current level of mapping does not cover the area between the two occurrences.

The remaining habitat units within the Marillana FDS are drainage-based, with Dispersal habitats (within the River land system) dominating the eastern corner of the FDS (level 2; 210 ha within), alongside small occurrences of Groves and Drainage foci (level 3; 28 ha within), and Drainage foci and Swamp/ depressions (level 4; <0.01 ha within).

This FDS contains one habitat regarded as a high priority (Isolated sands) and one a medium priority (Deep gullies/ gorges) for future management. Both these habitats have high suitability and congruence, with 99% of the Isolated sands in the Operation Tenure potentially impacted by the FDS.

720000 730000 740000 750000

7500000

7490000

Legend

Full Development Scenario

- Marillana
- Third Party Development
- SRE Sampling sites
- SRE Habitat sites

Mygalomorphae

- Aganippe `MYG085`
- Aname `armigera gp female`
- Swolnpes `MYG234`

1:100,000

0 0.75 1.5 3 4.5 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.4.1: Locations of sampling, habitat assessment sites and SRE faunal records of Marillana

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

720000 730000 740000 750000

7500000

7490000

Boolgeeda

Turee

Marillana

Fortescue

Fan

River

Platform

Urandy

Newman

Divide

Robe

Rocklea

Disturbed Land

Legend

Full Development Scenario

- Marillana
- Third Party Development

Land Systems

- Boolgeeda
- Disturbed Land
- Divide
- Fan
- Fortescue
- Marillana
- McKay
- Newman
- Platform
- River
- Robe
- Rocklea
- Turee
- Urandy

Consolidated SRE Habitats

- Boulders, Outcrops, Ridges and Breakaways
- Deep gullies/ gorges
- Shallow gullies and Drainage foci
- Dispersal habitats
- Dispersal habitats and Swamps/ depressions
- Drainage foci and Swamps/ depressions
- Groves and Drainage foci
- Isolated sands
- Non-SRE Habitat

1:100,000

N

0 0.75 1.5 3 4.5 km

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.4.2: Land Systems and consolidated SRE habitats of Marillana

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

720000 730000 740000 750000

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7490000

Legend

Full Development Scenario
- Marillana
- Third Party Development

Land System SRE Suitability
- Disturbed Land
- 1 - Low
- 2 - Low / Medium
- 3 - Medium
- 5 - High

Consolidated SRE Habitats Suitability
- 1 - Non-SRE
- 2 - Low/ Medium
- 3 - Medium
- 4 - Medium/High
- 5 - High

1:100,000

0 0.75 1.5 3 4.5 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.4.3: SRE suitability of Land Systems and consolidated SRE habitats of Marillana

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

Mindy Project FDS (Figures 5.4.1, 5.4.2 and 5.4.3)

Phase 1

The majority of the Mindy FDS covers the Boolgeeda (rating 3) and Newman (rating 5) land systems, with small sections within the Divide (rating 2), Urandy and River land systems (both land systems with a Suitability rating of 1).

Four terrestrial survey sites are located within the FDS in the Urandy (rating 1) and Boolgeeda (rating 3) land systems (Figure 5.12), however no SRE species were recorded (Figure 5.13). Survey sites are located to the east and west of the FDS with two records of SRE species in low and medium suitability land systems.

It is likely that SRE species may be present within the sections of the Mindy FDS within the Newman land system, if suitable habitat (deep gullies and gorges and ridges and vertical faces and plateaux) is present.

Phase 2

The Mindy FDS covers 5,024 ha, of which 100% has been mapped.

The dominant habitat units are associated with drainage areas, with Drainage foci and Swamp/ depressions (level 4; 457 ha within) in the south of the FDS, directly associated with Dispersal habitat (level 2; 144 ha within).

The other significant habitat units are the Deep gullies/ gorges (level 5; 20 ha within), and a small patch of Isolated sands (level 4; 2 ha within) in the central portion of the FDS. Shallow gullies and Drainage foci (level 3; 94 ha within) also occur, and a small area of Dispersal habitat and Swamp/ depressions (level 3; 0.01 ha within).

This FDS contains two habitats regarded as a high priority (Deep gullies/ gorges and Isolated sands) for future management. Both these habitats have high suitability and congruence, and appear to have low connectivity beyond the FDS.

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760000

7490000

7480000

7470000

Legend

Full Development Scenario

- Mindy
- Third Party Development
- SRE Sampling sites

Mygalomorphae

- Aganippe `MYG085`

1:80,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.5.1: Locations of sampling, habitat assessment sites and SRE faunal records of Mindy

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

740000

750000

760000

7490000

7480000

7470000

Fortescue

River

Fan

Marillana

Urandy

Boolgeeda

Divide

Newman

Robe

Legend

Full Development Scenario

- Mindy
- Third Party Development

Consolidated SRE Habitats

- Boulders, Outcrops, Ridges and Breakaways
- Deep gullies/ gorges
- Dispersal habitats
- Dispersal habitats and Swamps/ depressions
- Drainage foci and Swamps/ depressions
- Groves and Drainage foci
- Groves and Outcrops
- Isolated sands
- Non-SRE Habitat
- Shallow gullies and Drainage foci

Land Systems

- Boolgeeda
- Divide
- Fan
- Fortescue
- Marillana
- Newman
- River
- Robe
- Urandy

1:80,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.5.2: Land Systems and consolidated SRE habitats of Mindy

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

740000

750000

760000

7490000

7480000

7470000

Legend

Full Development Scenario

- Mindy
- Third Party Development

Land System SRE Suitability

- 1 - Low
- 2 - Low / Medium
- 3 - Medium
- 5 - High

Consolidated SRE Habitats Suitability

- 1 - Non-SRE
- 2 - Low/ Medium
- 3 - Medium
- 4 - Medium/High
- 5 - High

1:80,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.5.3: SRE suitability of Land Systems and consolidated SRE habitats of Mindy

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

Yandi FDS (Figures 5.5.1, 5.5.2 and 5.5.3)

Phase 1

The Yandi FDS covers the high suitability (rating 5) land systems of Newman, Robe, McKay and Rocklea.

Terrestrial invertebrate surveys, and habitat assessments, have been conducted within and surrounding the FDS.

Two SRE species of selenopid spiders have been recorded adjacent to the FDS.

It is likely that further SRE species may be present within the FDS, particularly within the deep gullies and gorges, as well as ridges, vertical faces and plateaux, outcrops and bare domes of the Robe, Newman and McKay land systems.

Phase 2

The Yandi FDS covers 3,981 ha, of which 98% is mapped.

This FDS is dominated by one habitat unit; Boulders, Outcrops, Ridges and Breakaways (level 4; 535 ha within), while Drainage foci and Swamps/ depressions also feature prominently (level 3; 112 ha within).

The other highly suitable SRE habitat units are small occurrences of Deep gullies/ gorges (level 5; 23 ha within), while less suitable SRE habitat units also occur; Shallow gullies and Drainage foci (level 3; 5 ha within), Groves and Drainage foci (level 3; 7 ha within) and Dispersal habitats and Swamp/ depressions (level 3; 0.1 ha within). Dispersal habitats (largely associated with Marillana Creek) also run throughout the FDS.

This FDS contains one habitat regarded as a medium priority for future management; the small amount of Deep gullies/ gorges in the western and eastern sections. This level is largely due to the high suitability, congruence and isolation, but the smaller level of potential impact from the FDS has reduced the priority level to medium.

700000

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Legend

Full Development Scenario

- Yandi
- Third Party Development
- SRE Sampling sites
- SRE Habitat sites

Selenopidae

- Karaops ARA001-DNA
- Karaops ARA002-DNA

Mygalomorphae

- Aurecocrypta `MYG246`

1:80,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.6.1: Locations of sampling, habitat assessment sites and SRE faunal records of Yandi

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

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710000

720000

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7480000

Boolgeeda

Platform

Calcrete

Robe

Rocklea

Oakover

Disturbed Land

McKay

River

Newman

Legend

Full Development Scenario
- Yandi
- Third Party Development

Land Systems
- Boolgeeda
- Calcrete
- Disturbed Land
- McKay
- Newman
- Oakover
- Platform
- River
- Robe
- Rocklea

Consolidated SRE Habitats
- Boulders, Outcrops, Ridges and Breakaways
- Deep gullies/ gorges
- Shallow gullies and Drainage foci
- Dispersal habitats
- Dispersal habitats and Swamps/ depressions
- Drainage foci and Swamps/ depressions
- Groves and Drainage foci
- Non-SRE Habitat

1:80,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.6.2: Land Systems and consolidated SRE habitats of Yandi

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

700000

710000

720000

7490000

7480000

Legend

Full Development Scenario

- Yandi
- Third Party Development

Land System SRE Suitability

- Disturbed Land
- 1 - Low
- 2 - Low / Medium
- 3 - Medium
- 5 - High

Consolidated SRE Habitats Suitability

- 1 - Non-SRE
- 2 - Low/ Medium
- 3 - Medium
- 4 - Medium/High
- 5 - High

1:80,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.6.3: SRE suitability of Land Systems and consolidated SRE habitats of Yandi

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

Munjina/ Upper Marillana FDS (Figures 5.5.1, 5.5.2 and 5.5.3)

Phase 1

The Munjina/ Upper Marillana FDS covers land systems rated as medium suitability (rating 3) for supporting SRE species (Boolgeeda, Wannamunna and Pindering), with small areas of the highly suitabile Newman and McKay land systems.

Survey sites in the area are predominantly located in the Wannamunna and Boolgeeda land systems, but are outside the FDS.

One trapdoor spider was recorded in the FDS, within the Boolgeeda land system

SRE species may also be present in suitable habitat (groves and drainage foci) within the medium suitability land systems of the FDS.

Phase 2

The Munjina/ Upper Marillana FDS covers 6,457 ha, of which 100% is mapped.

The FDS is dominated by Groves and Drainage foci (level 3; 2,782 ha) and Drainage foci and Swamp/ depressions (level 4; 1,244 ha within). The other SRE habitats present are Dispersal habitats and Swamp/ depressions (level 3; 81 ha within), Shallow gullies and Drainage foci (level 3; 19 ha within) and Disperal Habitats (level 2; 91 ha within).

All the habitats found within the FDS are regarded as low priority for future management; however, this should be viewed within the context of the lack of survey coverage within the FDS (between 1 and 40% coverage).

680000 690000 700000 710000

7500000

7490000

Legend

Full Development Scenario

- Munjina/ Upper Marillana
- Third Party Development
- SRE Sampling sites
- SRE Habitat sites

Selenopidae

- Karaops ARA001-DNA
- Karaops ARA002-DNA

Mygalomorphae

- Aurecocrypta `MYG246`
- Idiommata `MYG247`

Polydesmida

- Antichiropus `DIP029`

1:100,000

N

0 0.75 1.5 3 4.5 km

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.7.1: Locations of sampling, habitat assessment sites and SRE faunal records of Munjina/ Upper Marillana

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

680000 690000 700000 710000

7500000

7490000

Platform

Wannamunna

Newman

Brockman

Boolgeeda

Pindering

Calcrete

Oakover

Robe

McKay

Legend

Full Development Scenario

- Munjina/ Upper Marillana
- Third Party Development

Land Systems

- Boolgeeda
- Brockman
- Calcrete
- McKay
- Newman
- Oakover
- Pindering
- Platform
- Robe
- Wannamunna

Consolidated SRE Habitats

- Boulders, Outcrops, Ridges and Breakaways
- Deep gullies/ gorges
- Shallow gullies and Drainage foci
- Dispersal habitats
- Dispersal habitats and Swamps/ depressions
- Drainage foci and Swamps/ depressions
- Groves and Drainage foci
- Non-SRE Habitat

1:100,000

0 0.75 1.5 3 4.5 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.7.2: Land Systems and consolidated SRE habitats of Munjina/ Upper Marillana

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

680000 690000 700000 710000

7500000

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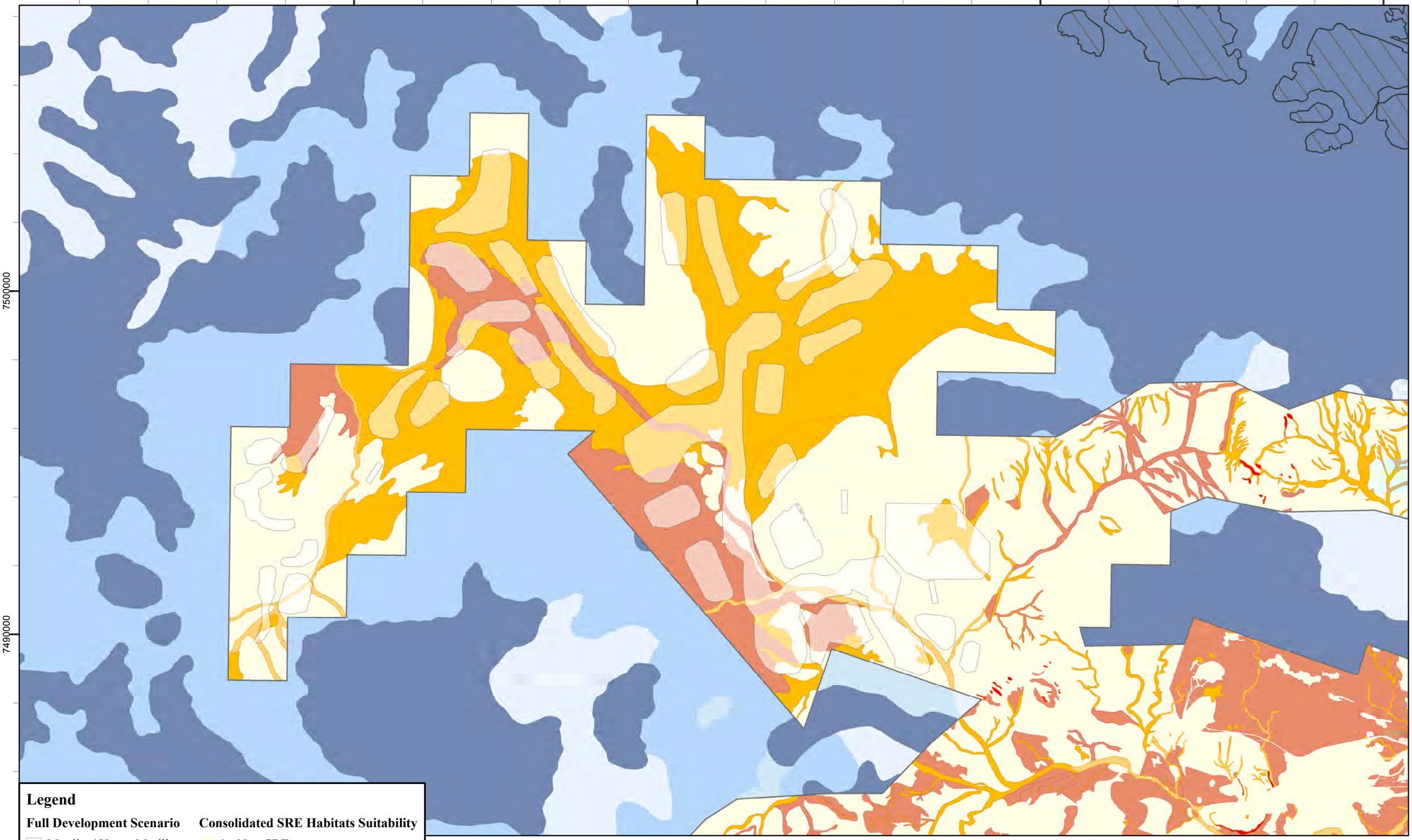

Legend

Full Development Scenario

- Munjina/ Upper Marillana
- Third Party Development

Land System SRE Suitability

- 1 - Low
- 2 - Low / Medium
- 3 - Medium
- 5 - High

Consolidated SRE Habitats Suitability

- 1 - Non-SRE
- 2 - Low/ Medium
- 3 - Medium
- 4 - Medium/High
- 5 - High

1:100,000

0 0.75 1.5 3 4.5 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.7.3: SRE suitability of Land Systems and consolidated SRE habitats of Munjina/ Upper Marillana

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

Tandanya FDS (Figures 5.6.1, 5.6.2 and 5.6.3)

Phase 1

Newman, Rocklea, Boolgeeda, Wannamunna, Spearhole, Elimunna and Platform land systems occur throughout the Tandanya FDS. The Newman and Rocklea land systems are considered high suitability (rating 5) for SRE species. The Boolgeeda, Wannamunna and Spearhole land systems are considered medium suitability (rating 3) for SRE species.

Terrestrial invertebrate surveys have been undertaken throughout the FDS. The majority of the sites were located within the Wannamunna (rating 3) land system. One SRE species (millipede) has been recorded within the low SRE suitability Elimunna land system (rating 2, bordering the high suitability land system of Rocklea), but outside the FDS. This could be a potential singleton record.

It is likely that additional SRE species may be present within the Tandanya FDS, particularly within the deep gullies and gorges as well as ridges, vertical faces and plateaux, outcrops and bare domes of the Newman land system as this system is common within the FDS. Additionally, SRE species have been recorded in surrounding FDS within the Newman and Boolgeeda land systems (South Flank, Mudlark Well and MAC).

Phase 2

The Tandanya FDS covers 10,807 ha, of which 100% is mapped.

Boulders, Outcrops, Ridges and Breakaways (level 4; 2,099 ha within), and Groves and Drainage Foci (level 3; 1,253 ha within) dominate the FDS.

The other SRE habitat units present are Deep gullies/ gorges (level 5; 201 ha within), Drainage foci and Swamp/ depressions (level 4; 499 ha within), Shallow gullies and Drainage foci (level 3; 279 ha within), and a small portion of Dispersal habitats and Swamp/ depressions (level 3; <0.01 ha within).

This FDS contains one area of high (Deep gullies/ gorges) and one of medium (Boulders, Outcrops, Ridges and Breakaways) priority for future management. The Deep gullies/ gorges in the northern section appear to be potentially heavily impacted by the FDS, while the Boulders, Outcrops, Ridges and Breakaways in the same area appear to be potentially moderately impacted.

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670000
680000
690000
7470000
7460000

Legend

Full Development Scenario

- Tandanya
- SRE Sampling sites

Mygalomorphae

- Aganippe `sp. sigillate`
- Aname 'Sock'
- Aname `Hooded`

Polydesmida

- Antichiropus `DIP007`
- Antichiropus `DIP047`

1:100,000

0 0.75 1.5 3 4.5 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.8.1: Locations of sampling, habitat assessment sites and SRE faunal records of Tandanya

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

660000
670000
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7460000
Calcrete
Wannamunna
Boolgeeda
Spearhole
Paraburdoo
McKay
Rocklea
Elimunna
Platform
Newman

Legend

Full Development Scenario
- Tandanya

Land Systems
- Boolgeeda
- Calcrete
- Elimunna
- McKay
- Newman
- Paraburdoo
- Platform
- Rocklea
- Spearhole
- Wannamunna

Consolidated SRE Habitats
- Boulders, Outcrops, Ridges and Breakaways
- Deep gullies/ gorges
- Shallow gullies and Drainage foci
- Dispersal habitats
- Dispersal habitats and Swamps/ depressions
- Drainage foci and Swamps/ depressions
- Groves and Drainage foci
- Groves and Outcrops
- Non-SRE Habitat

1:100,000

N

0 0.75 1.5 3 4.5 km

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.8.2: Land Systems and consolidated SRE habitats of Tandanya

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

660000 670000 680000 690000

7470000

7460000

Legend

Full Development Scenario

- Tandanya

Land System SRE Suitability

- 1 - Low
- 2 - Low / Medium
- 3 - Medium
- 5 - High

Consolidated SRE Habitats Suitability

- 1 - Non-SRE
- 2 - Low/ Medium
- 3 - Medium
- 4 - Medium/High
- 5 - High

1:100,000

0 0.75 1.5 3 4.5 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.8.3: SRE suitability of Land Systems and consolidated SRE habitats of Tandanya

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

Mudlark Well FDS (Figures 5.7.1, 5.7.2 and 5.7.3)

Phase 1

The Mudlark FDS overlies four land systems: Newman, Boolgeeda, Wannamunna and Platform, with the medium SRE suitability Boolgeeda and Wannamunna land systems dominating.

The majority of the survey sites in the area were located within the Boolgeeda and Wannamunna land systems, but generally outside the FDS. No SRE species were recorded in the FDS.

The Newman land system covers a significant portion of this FDS and is likely that SRE species may be present, particularly within deep gullies and gorges as well as ridges, vertical faces and plateaux. However, the majority of the FDS is within the Boolgeeda land system.

Although the Boolgeeda land system has been categorized as a medium suitability (rating 3) for supporting SRE species, previous surveys within the vicinity of the FDS (within South Flank and MAC) have reported the occurrence of SRE species within this land system. Therefore it is likely that additional SRE species may be present within this FDS (focusing on suitable habitats within the Newman and Boolgeeda land systems).

Phase 2

The Mudlark Well FDS covers 10,437 ha, of which 100% is mapped.

Deep gullies/ gorges habitat unit (level 5; 547 ha within), Boulders, Outcrops, Ridges and Breakaways (level 4; 1,910 ha within), Drainage foci and Swamp/ depressions (level 4; 413 ha within), Shallow gullies and Drainage foci (level 3; 347 ha within), and Groves and Drainage Foci (level 3; 911 ha within). Dispersal Habitats are also present (level 2; 48 ha).

This FDS contains one habitat (Deep gullies/ gorges) regarded as a high priority for future management, due to the potentially high impact of the FDS on the habitat, particularly in the northern and southern sections.

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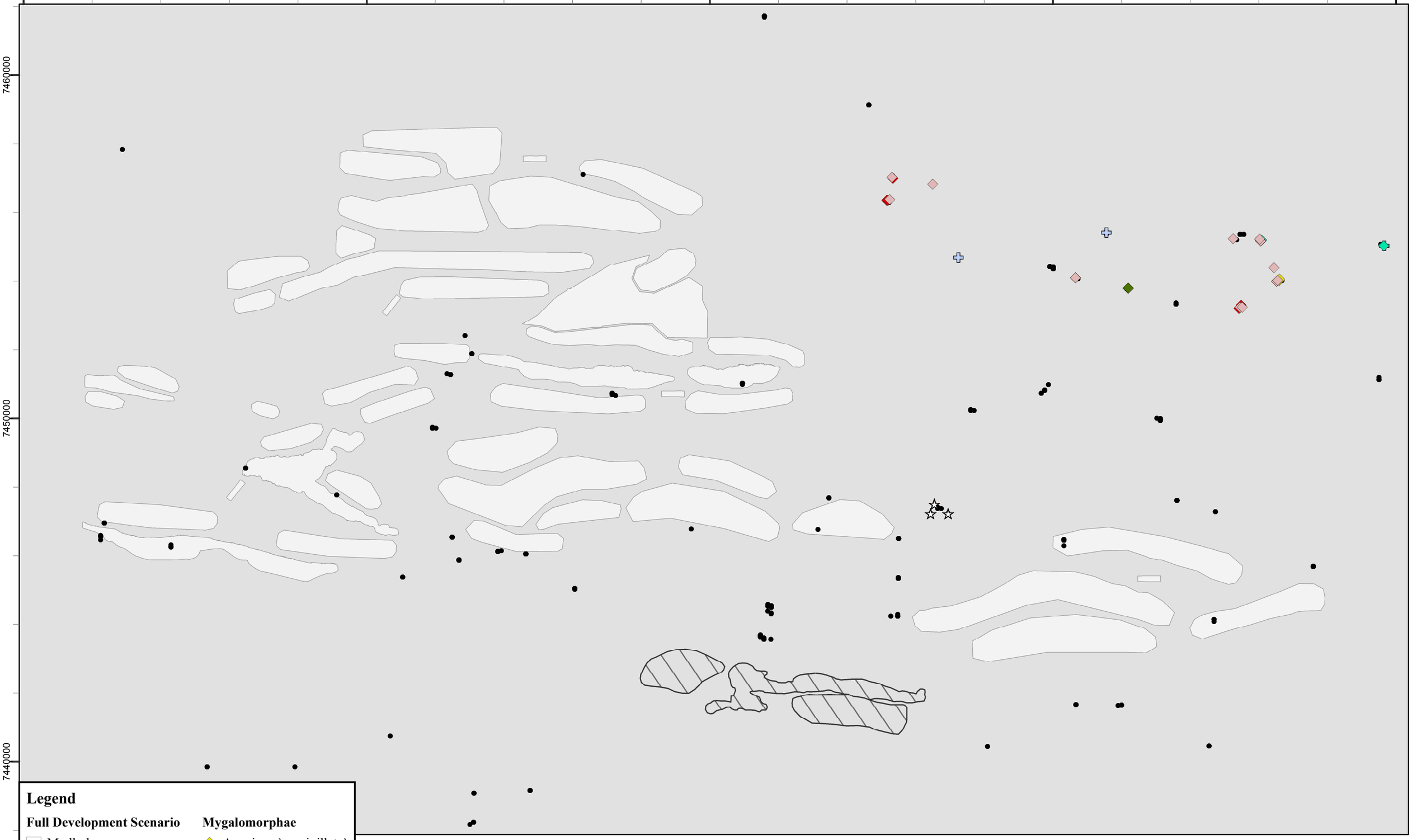
7460000

7450000

7440000



Legend

Full Development Scenario
- Mudlark
- Third Party Development
- SRE Sampling sites

Selenopidae
- Karaops `sp. indet. (juv.)`
- Karaops `sp. nov. Newman`

Mygalomorphae
- Aganippe `sp. sigillate`
- Aname 'Sock'
- Aname 'Spray'
- Aname `Hooded`
- Aname `MYG195`

Polydesmida
- Antichiropus `DIP007`

1:100,000

0 0.75 1.5 3 4.5 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.9.1: Locations of sampling, habitat assessment sites and SRE faunal records of Mudlark

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

660000 670000 680000 690000 700000

7460000

7450000

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Newman

Wannamunna

Pindering

Boolgeeda

Jamindie

Egerton

Rocklea

Legend

Full Development Scenario
- Mudlark
- Third Party Development

Land Systems
- Boolgeeda
- Egerton
- Elimunna
- Jamindie
- Newman
- Pindering
- Platform
- Rocklea
- Wannamunna

Consolidated SRE Habitats
- Boulders, Outcrops, Ridges and Breakaways
- Deep gullies/ gorges
- Shallow gullies and Drainage foci
- Dispersal habitats
- Dispersal habitats and Swamps/ depressions
- Drainage foci and Swamps/ depressions
- Groves and Drainage foci
- Groves and Outcrops
- Non-SRE Habitat

1:100,000

N

0 0.75 1.5 3 4.5 km

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.9.2: Land Systems and consolidated SRE habitats of Mudlark

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

660000 670000 680000 690000 700000

7460000

7450000

7440000

Legend

Full Development Scenario

- Mudlark
- Third Party Development

Land System SRE Suitability

- 1 - Low
- 2 - Low / Medium
- 3 - Medium
- 5 - High

Consolidated SRE Habitats Suitability

- 1 - Non-SRE
- 2 - Low/ Medium
- 3 - Medium
- 4 - Medium/High
- 5 - High

1:100,000

0 0.75 1.5 3 4.5 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.9.3: SRE suitability of Land Systems and consolidated SRE habitats of Mudlark

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

Mining Area C FDS (Figures 5.8.1, 5.8.2 and 5.8.3)

Phase 1

The Mining Area C FDS is dominated by three land systems; Newman (rating 5), Boolgeeda (rating 3) and Platform (rating 1).

Terrestrial invertebrate survey sites are located within and surrounding the FDS with a concentration of survey effort within the Newman land system. Six survey sites within the Boolgeeda land system supported trapdoor spiders, including within the FDS. Millipedes were recorded at two sites within the Newman land system, both inside the FDS.

Two of the trapdoor spider species (*Aname 'MYG195'* and *Yilgarnia 'MYG027'*) were also recorded at sites within the South Flank Project area. Four trapdoor spider species and a millipede were not recorded in any other FDS, however, they were located in areas outside of these. Three species of spider (*Chenistonia 'MYG088 female'*, *Chenistonia 'MYG088'* and *Missulena 'sp. nov. Newman'*) and one millipede species (*Antichiropus 'DIP006'*) were only found within the FDS. Two of the spiders (*Chenistonia 'MYG088 female'* and *Chenistonia 'MYG088'*) and the millipede (*Antichiropus 'DIP006'*) were singletons.

Given the large area of SRE suitabile land systems (particularly the Newman land system) within this FDS and the occurrence of SRE species both within and surrounding (South Flank and Tandanya Hubs) the Mining Area C FDS, it is likely that additional SRE species may be present in appropriate habitats (such as deep gullies and gorges as well as ridges, vertical faces and plateaux). within this FDS.

Phase 2

The Mining Area C FDS covers 10,629 ha, of which 100% is mapped.

This FDS is dominated by four SRE habitat units; Deep gullies/ gorges (level 5; 299 ha within), Drainage foci and Swamp/ depressions (level 4; 682 ha within), Boulders, Outcrops, Ridges and Breakaways (level 4; 650 ha within), and Shallow gullies and Drainage foci (level 3; 316 ha within).

The other SRE habitat units present within the FDS are Groves and Drainage foci (level 3; 185 ha within), and Dispersal habitats and Swamps/ depressions (level 3; 13 ha within).

This FDS contains one habitat (Deep gullies/ gorges) regarded as a high priority for future management, with areas of this habitat in the eastern section potentially heavily impacted by the FDS.

680000

690000

700000

7460000

Legend

Full Development Scenario

- Mining Area C
- SRE Sampling sites

Mygalomorphae

- Aganippe `sp. sigillate`
- Aname 'Sock'
- Aname 'Spray'
- Aname `Hooded`
- Aname `MYG195`
- Chenistonia `MYG088`

Polydesmida

- Antichiropus `Area C sp. 2`
- Antichiropus `DIP006`
- Antichiropus `DIP007`
- Antichiropus `indet.`

1:70,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.10.1: Locations of sampling, habitat assessment sites and SRE faunal records of Mining Area C (western part)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

700000

710000

720000

7460000

Legend

Full Development Scenario
- Mining Area C
- Third Party Development
- SRE Sampling sites

Selenopidae
- Karaops `sp. nov. Area C`

Pseudoscorpiones
- Troglochernes `PSE072`

Mygalomorphae
- Aganippe `MYG083`
- Aname 'Sock'
- Aname `MYG104`
- Aname `MYG195`
- Chenistonia `MYG088`
- Missulena `sp. nov. Newman`
- Missulena langlandsi
- Synothele `MYG055`
- Teyl `MYG027`
- Yilgarnia `MYG197`

Polydesmida
- Antichiropus `Area C sp. 2`
- Antichiropus `DIP007`
- Antichiropus `indet.`

1:70,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.10.2: Locations of sampling, habitat assessment sites and SRE faunal records of Mining Area C (eastern part)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

680000 685000 690000 695000 700000 705000

7465000

7460000

7455000

Boolgeeda

Newman

Wannamunna

Pindering

Platform

Legend

Full Development Scenario

- Mining Area C

Land Systems

- Boolgeeda
- Newman
- Pindering
- Platform
- Wannamunna

Consolidated SRE Habitats

- Boulders, Outcrops, Ridges and Breakaways
- Deep gullies/ gorges
- Shallow gullies and Drainage foci
- Dispersal habitats
- Dispersal habitats and Swamps/ depressions
- Drainage foci and Swamps/ depressions
- Groves and Drainage foci
- Groves and Outcrops
- Non-SRE Habitat

1:70,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.10.3: Land Systems and consolidated SRE habitats of Mining Area C (western part)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

700000

710000

720000

7460000

Robe

Rocklea

Boolgeeda

River

Oakover

Calcrete

Pindering

Newman

Egerton

Platform

Legend

Full Development Scenario
- Mining Area C
- Third Party Development

Land Systems
- Boolgeeda
- Calcrete
- Egerton
- Newman
- Oakover
- Pindering
- Platform
- River
- Robe
- Rocklea

Consolidated SRE Habitats
- Boulders, Outcrops, Ridges and Breakaways
- Deep gullies/ gorges
- Shallow gullies and Drainage foci
- Dispersal habitats
- Dispersal habitats and Swamps/ depressions
- Drainage foci and Swamps/ depressions
- Groves and Drainage foci
- Non-SRE Habitat

1:70,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.10.4: Land Systems and consolidated SRE habitats of Mining Area C (eastern part)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

680000 685000 690000 695000 700000 705000

7465000

7460000

7455000

Legend

Full Development Scenario

Mining Area C

Land System SRE Suitability

1 - Low

3 - Medium

5 - High

Consolidated SRE Habitats Suitability

1 - Non-SRE

2 - Low/ Medium

3 - Medium

4 - Medium/High

5 - High

1:70,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.10.5: SRE suitability of Land Systems and consolidated SRE habitats of Mining Area C (western part)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

700000 705000 710000 715000 720000 725000

7465000

7460000

7455000

Legend

Full Development Scenario

- Mining Area C
- Third Party Development

Land System SRE Suitability

- 1 - Low
- 2 - Low / Medium
- 3 - Medium
- 5 - High

Consolidated SRE Habitats Suitability

- 1 - Non-SRE
- 2 - Low/ Medium
- 3 - Medium
- 4 - Medium/High
- 5 - High

1:70,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.10.6: SRE suitability of Land Systems and consolidated SRE habitats of Mining Area C (eastern part)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

South Flank FDS (Figures 5.9.1, 5.9.2 and 5.9.3)

Phase 1

The majority of the South Flank FDS lies within the Newman land system, which is categorized as highly suitabile for SREs. Other land systems within the FDS include Boolgeeda, Wannamunna, Pindering and Platform.

Terrestrial invertebrate surveys have been undertaken within the FDS in all of the five land systems. A total of forty-six SRE individuals (2 x millipede and 6 x trapdoor spider species) were recorded within and adjacent to the South Flank FDS (predominantly within the Newman land system). Of the trapdoor spiders recorded, two species were also located within the Mining Area C area.

Two SRE species, both trapdoor spider species (*Aganippe 'sp. sigillate'* and *Aname 'Spray'*) were only recorded inside the FDS. These two species were not recorded at any other BHP Billiton Iron Ore or 3rd party project site. Of these, one trapdoor spider (*Aname 'Spray'*) was only recorded from one site within the South Flank FDS and is likely to be a singleton.

With the Newman land system dominating this FDS and the record of SRE species presence inside the FDS, it is likely that SRE species may be present within suitable SRE habitats of the Newman and Boolgeeda land systems at the South Flank FDS.

Phase 2

The South Flank FDS covers 7,401 ha, of which 100% has been mapped.

This FDS comprises eight SRE habitat units, with five of these occurring at similar spatial extents; Deep gullies/gorges (level 5; 666 ha within), Boulders, Outcrops, Ridges and Breakaways (level 4; 130 ha within), Drainage foci and Swamp/ depressions (level 4; 529 ha within), Groves and Outcrops (level 4; 349 ha within), Groves and Drainage Foci (level 3; 352 ha within), and Shallow gullies and Drainage foci (level 3; 651 ha within). There is also a small portion of Dispersal and Swamp/ depressions (level 3; 0.2 ha within).

One habitat (Deep gullies/ gorges) within this FDS is regarded as a high priority for future management with the FDS potentially impacting heavily on this habitat in the central section.

690000

700000

710000

7460000

7450000

Legend

Full Development Scenario
- South Flank
- Third Party Development
- SRE Sampling sites

Selenopidae
- Karaops `sp. indet. (juv.)`
- Karaops `sp. nov. Newman`

Mygalomorphae
- Aganippe `MYG083`
- Aganippe `sp. sigillate`
- Aname 'Sock'
- Aname 'Spray'
- Aname `Hooded`
- Aname `MYG104`
- Aname `MYG195`
- Missulena `sp. nov. Newman`
- Missulena langlandsi
- Teyl `MYG027`
- Yilgarnia `MYG197`

Polydesmida
- Antichiropus `Area C sp. 2`
- Antichiropus `DIP007`
- Antichiropus `indet.`

1:80,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.11.1: Locations of sampling, habitat assessment sites and SRE faunal records of South Flank

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

690000

700000

710000

7460000

7450000

Wannamunna

River

Newman

Pindering

Platform

Boolgeeda

McKay

Rocklea

Legend

Full Development Scenario
- South Flank
- Third Party Development

Land Systems
- Boolgeeda
- McKay
- Newman
- Pindering
- Platform
- River
- Rocklea
- Wannamunna

Consolidated SRE Habitats
- Boulders, Outcrops, Ridges and Breakaways
- Deep gullies/ gorges
- Shallow gullies and Drainage foci
- Dispersal habitats
- Dispersal habitats and Swamps/ depressions
- Drainage foci and Swamps/ depressions
- Groves and Drainage foci
- Groves and Outcrops
- Non-SRE Habitat

1:80,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.11.2: Land Systems and consolidated SRE habitats of South Flank

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

690000

700000

710000

7460000

7450000

Legend

Full Development Scenario

- South Flank
- Third Party Development

Land System SRE Suitability

- 1 - Low
- 3 - Medium
- 5 - High

Consolidated SRE Habitats Suitability

- 1 - Non-SRE
- 2 - Low/ Medium
- 3 - Medium
- 4 - Medium/High
- 5 - High

1:80,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.11.3: SRE suitability of Land Systems and consolidated SRE habitats of South Flank

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

Ministers North FDS (Figures 5.10.1, 5.10.2 and 5.10.3)

Phase 1

The Ministers North FDS is within the Newman land system, which has been rated as a high suitability (rating 5) land system for supporting SREs.

No terrestrial invertebrate surveys have been conducted within the FDS to date, however, two survey sites are located to the north of the Project area, within the Newman land system.

As this FDS is located entirely within the highly suitabile Newman land system and SREs have been recorded within the Yandi and Mining Area C Operation Tenures to the north and south respectively, it is likely that SRE species may be present within suitable habitats (deep gullies and gorges and / or ridges, vertical faces and plateaux) of the Ministers North FDS.

Phase 2

The Ministers North FDS is similar to the Roy Hill FDS, in that it is only mapped where the Main Rail Line runs through. As such, only 28% of the 1933 ha is mapped.

Where mapping does occur, there are three habitat units present; Drainage foci and Swamp/ depressions (level 4; 18 ha within), Shallow gullies and Drainage foci (level 3; 18 ha within), and Dispersal habitats and Swamp/ depressions (level 3; <0.01 ha within).

Based on the Phase 1 mapping, the entire FDS occurs within the highly suitable Newman land system. Despite this, there has been very little mapping of SRE habitat units that are known to occur within this land system, with only a small amount of the Shallow gullies and Drainage foci, and Deep gullies/ gorges habitat units mapped. This could be attributed to the path of the Main Rail Line avoiding the upper slopes of the Operation Tenure.

While none of the mapped SRE habitat units are currently regarded as anything but a low priority for future management, the high suitability of the unmapped section of the Operation Tenure gives it a high prioirity level.

710000

720000

730000

7480000

7470000

Legend

Full Development Scenario

Ministers North

Third Party Development

SRE Sampling sites

SRE Habitat sites

Selenopidae

Karaops ARA001-DNA

Karaops `sp. nov. Area C`

Mygalomorphae

Aname `MYG195`

1:60,000

0 0.45 0.9 1.8 2.7 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.12.1: Locations of sampling, habitat assessment sites and SRE faunal records of Ministers North

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

710000

720000

730000

7480000

7470000

McKay

Boolgeeda

River

Newman

Platform

Rocklea

Legend

Full Development Scenario

- Ministers North
- Third Party Development

Land Systems

- Boolgeeda
- McKay
- Newman
- Platform
- River
- Robe
- Rocklea

Consolidated SRE Habitats

- Boulders, Outcrops, Ridges and Breakaways
- Deep gullies/ gorges
- Shallow gullies and Drainage foci
- Dispersal habitats
- Dispersal habitats and Swamps/ depressions
- Drainage foci and Swamps/ depressions
- Groves and Drainage foci
- Non-SRE Habitat

1:60,000

0 0.45 0.9 1.8 2.7 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.12.2: Land Systems and consolidated SRE habitats of Ministers North

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

710000

720000

730000

7480000

7470000

Legend

Full Development Scenario

- Ministers North
- Third Party Development

Land System SRE Suitability

- 1 - Low
- 3 - Medium
- 5 - High

Consolidated SRE Habitats Suitability

- 1 - Non-SRE
- 2 - Low/ Medium
- 3 - Medium
- 4 - Medium/High
- 5 - High

1:60,000

0 0.45 0.9 1.8 2.7 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.12.3: SRE suitability of Land Systems and consolidated SRE habitats of Ministers North

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

Jinidi FDS (Figures 5.11.1, 5.11.2 and 5.11.3)

Phase 1

The Jinidi FDS extends across six land systems, however the majority lies within the high SRE suitability Newman land system (rating 5). The Platform (rating 1), Boolgeeda, Egerton (rating 3) and Oakover (rating 5) land systems cover the next largest areas and small areas of the FDS are located within the McKay land system (rating 5).

Terrestrial invertebrate survey sites are located throughout the FDS in all six land systems. Five SRE species (pseudoscorpion and trapdoor spiders) were recorded in the FDS.

One of the trapdoor spiders (*Aname 'MYG098'*), only recorded inside the FDS of the Jinidi Hub, was also recorded within the Newman FDS. However, a single record of another trapdoor spider (*Conothele 'MYG002'*) was only located within the Jinidi FDS and has not been recorded elsewhere.

It is likely that SRE species may be present within this FDS as the majority of the area covers the high SRE suitability Newman land system, in which SRE species have already been recorded. Additionally, the Mining Area C Operation Tenure to the west of the Jinidi Hub has also recorded SRE occurrence, again within the Newman land system. Further survey within suitable habitat of the Newman land system (such as deep gullies and gorges as well as ridges, vertical faces and plateaux) is likely to identify additional SRE records.

Phase 2

The Jinidi FDS covers 6,143 ha, of which 100% has been mapped.

This FDS is dominated by two SRE habitat units; Boulders, Outcrops, Ridges and Breakaways (level 4; 1,227 ha within) and Drainage foci and Swamp/ depressions (level 4; 1,589 ha within). The other habitat units present are Deep gullies/ gorges (level 5; 86 ha within), Shallow gullies and Drainage foci (level 3; 258 ha within), Groves and Drainage foci (level 3; 336 ha within), and a small portion of Dispersal habitats and Swamps/ depressions (level 3; 0.2 ha within).

One habitat (Deep gullies/ gorges) within this FDS is regarded as a high priority for future management with potentially high impact in the north western section.

720000 725000 730000 735000

7465000 7460000 7455000 7450000 7445000

Legend

Full Development Scenario

- Jinidi
- Third Party Development
- SRE Sampling sites

Mygalomorphae

- Aname `MYG098`
- Aname `MYG195`
- Conothele `MYG002`
- Missulena faulderi
- Synothele `MYG055`
- Yilgarnia `MYG033`

Pseudoscorpiones

- Troglochernes `PSE072`

Polydesmida

- Antichiropus `indet.`

1:80,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.13.1: Locations of sampling, habitat assessment sites and SRE faunal records of Jinidi

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

720000
725000
730000
735000
7465000
7460000
7455000
7450000
7445000
Newman
Robe
River
Oakover
Boolgeeda
Calcrete
Pindering
Egerton
McKay
Platform
Spearhole
Wannamunna

Legend

Full Development Scenario
- Jinidi
- Third Party Development

Consolidated SRE Habitats
- Boulders, Outcrops, Ridges and Breakaways
- Deep gullies/ gorges
- Dispersal habitats
- Dispersal habitats and Swamps/ depressions
- Drainage foci and Swamps/ depressions
- Groves and Drainage foci
- Non-SRE Habitat
- Shallow gullies and Drainage foci

Land Systems
- Boolgeeda
- Calcrete
- Egerton
- McKay
- Newman
- Oakover
- Pindering
- Platform
- River
- Robe
- Rocklea
- Spearhole
- Wannamunna

1:80,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.13.2: Land Systems and consolidated SRE habitats of Jinidi

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

720000 725000 730000 735000

7465000 7460000 7455000 7450000 7445000

Legend

Full Development Scenario

- Jinidi
- Third Party Development

Land System SRE Suitability

- 1 - Low
- 2 - Low / Medium
- 3 - Medium
- 5 - High

Consolidated SRE Habitats Suitability

- 1 - Non-SRE
- 2 - Low/ Medium
- 3 - Medium
- 4 - Medium/High
- 5 - High

1:80,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.13.3: SRE suitability of Land Systems and consolidated SRE habitats of Jinidi

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

Gurinbiddy FDS (Figures 5.12.1, 5.12.2 and 5.12.3)

Phase 1

The Gurinbiddy FDS spans five land systems: Newman, Boolgeeda, Wannamunna, Spearhole and Platform. The majority of the FDS lies within the Newman land system that is considered high suitability (rating 5) for SRE species. The majority of the remainder of the FDS lies within the medium suitable land systems of Boolgeeda, Wannamunna and Spearhole (rating 3).

No terrestrial invertebrate surveys have been conducted within FDS; however, SREs have been recorded at survey sites to the east of the FDS within the Egerton, Rocklea and Newman land systems.

It is likely that SRE species may be present within this FDS, particularly in suitable habitat (deep gullies and gorges, ridges and vertical faces, and plateaux) within the Newman land system and the Boolgeeda, Wannamunna and Spearhole land systems (within the Groves and Drainage loci).

Phase 2

The Gurinbiddy FDS covers 5,538 ha, of which 100% is mapped.

This FDS is dominated by two SRE habitat units; Boulders, Outcrops, Ridges and Breakaways (level 4; 1,611 ha within) and Groves and Drainage foci (level 3; 1,042 ha within). The other SRE habitat units present are Deep gullies/ gorges (level 5; 135 ha within), Drainage foci and Swamp/ depressions (level 4; 164 ha within), Shallow gullies and Drainage foci (level 3; 84 ha within), and a small portion of Dispersal habitats and Swamps/ depressions (level 3; <0.01 ha within).

One habitat (Deep gullies/ gorges) within this FDS is regarded as a high priority for future management with potentially high impact in the western section.

690000

700000

710000

7430000

Legend

Full Development Scenario

- Gurinbiddy
- Third Party Development
- SRE Sampling sites
- SRE Habitat sites

Pseudoscorpiones

- Lechytia `wonmunna`

Mygalomorphae

- Anidiops `MYG083`
- Gaius `Wonmunna large`

Polydesmida

- Antichiropus `Wonmunna`

1:80,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.14.1: Locations of sampling, habitat assessment sites and SRE faunal records of Gurinbiddy

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

680000 685000 690000 695000 700000 705000 710000

7435000

7430000

7425000

Rocklea

Egerton

Platform

Newman

Boolgeeda

Wannamunna

Pindering

Spearhole

Legend

Full Development Scenario

- Gurinbiddy
- Third Party Development

Land Systems

- Boolgeeda
- Egerton
- Newman
- Pindering
- Platform
- Rocklea
- Spearhole
- Wannamunna

Consolidated SRE Habitats

- Boulders, Outcrops, Ridges and Breakaways
- Deep gullies/ gorges
- Shallow gullies and Drainage foci
- Dispersal habitats and Swamps/ depressions
- Drainage foci and Swamps/ depressions
- Groves and Drainage foci
- Non-SRE Habitat

1:80,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.14.2: Land Systems and consolidated SRE habitats of Gurinbiddy

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

680000 685000 690000 695000 700000 705000 710000

7435000

7430000

7425000

Legend

Full Development Scenario
- Gurinbiddy
- Third Party Development

Land System SRE Suitability
- 1 - Low
- 3 - Medium
- 5 - High

Consolidated SRE Habitats Suitability
- 1 - Non-SRE
- 3 - Medium
- 4 - Medium/High
- 5 - High

1:80,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.14.3: SRE suitability of Land Systems and consolidated SRE habitats of Gurinbiddy

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

Ophthalmia/ Prairie Downs FDS (Figures 5.13.1, 5.13.2 and 5.13.3)

Phase 1

The Ophthalmia/ Prairie Downs FDS comprises a northern and southern section. The northern section covers six land systems: the majority within the Platform land system (Suitability rating 1) and the remainder within the Rocklea (Suitability rating 5) and the medium risk land systems of Spearhole, Egerton and Boolgeeda.

The southern section of the Hub overlies the high SRE risk Rocklea and Newman land systems (Suitability rating 5), medium risk Spearhole, Egerton, Wannamunna and Nooingnin land systems (Suitability rating 3) and Turee, Elimunna (Suitability rating 2) and Adrian (Suitability rating 1) land systems.

No terrestrial invertebrate surveys have been conducted within the Ophthalmia/ Prairie Downs FDS. Survey sites are located to the west of the northern section of the FDS with two records of SRE species (millipedes). Additionally, a total of 20 SRE species were recorded within the Newman Operation Tenure (predominantly within the Newman land system) to the east of the Ophthalmia/ Prairie Downs FDS.

As a significant proportion of the FDS is within the high SRE suitabile Newman and Rocklea land systems, it is likely that SRE species may be present within this FDS (particularly in deep gullies and gorges as well as ridges, vertical faces and plateaux, outcrops and bare domes). SRE species have already been recorded in similar land systems to the east and west of the FDS.

Phase 2

The Ophthalmia/ Prairie Downs FDS covers 4,073 ha, of which 84.7% is mapped.

This FDS is dominated by the Groves and Drainage foci habitat unit (level 3; 1,586 ha within), with Boulders, Outcrops, Ridges and Breakaways (level 4; 256 ha within), Drainage foci and Swamp/ depressions (level 4; 137 ha within) and Shallow gullies and Drainage foci (level 3; 89 ha within) also common. The other habitat units present are Deep gullies/ gorges (level 5; 6 ha within), and a small portion of Dispersal habitats and Swamps/ depressions (level 3; 0.09 ha within).

Of the currently mapped habitat units, one (Deep gullies/ gorges) is regarded as a medium priority for future management due to the FDS potentially impacting lightly on this high suitability habitat unit. In the unmapped 15.3% of the FDS, the Phase 1 mapping shows the majority of the FDS covers Level 5 suitability areas and, as such, this can be regarded as a high priority for future management.

720000 730000 740000 750000

7440000 7430000 7420000 7410000 7400000

Legend

Full Development Scenario

- Ophthalmia/ Prairie Downs
- SRE Sampling sites

Mygalomorphae

- Aganippe `MYG083`

Polydesmida

- Antichiropus `DIP036`
- Antichiropus `indet.`

1:150,000

0 1 2 4 6 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.15.1: Locations of sampling, habitat assessment sites and SRE faunal records of Ophthalmia/ Prairie Downs

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

720000
730000
740000
750000
7430000
7420000
7410000
7400000
7390000

Spearhole
Wannamunna
Boolgeeda
Newman
Platform
Table
Elimunna
Egerton
Rocklea
Nirran
Adrian
Turee
River
Nooingnin
Warri
Jamindie
Prairie

Legend

Full Development Scenario

- Ophthalmia/ Prairie Downs

Consolidated SRE Habitats

- Boulders, Outcrops, Ridges and Breakaways
- Deep gullies/ gorges
- Dispersal habitats
- Dispersal habitats and Swamps/ depressions
- Drainage foci and Swamps/ depressions
- Groves and Drainage foci
- Non-SRE Habitat
- Shallow gullies and Drainage foci

Land Systems

- Adrian
- Augustus
- Boolgeeda
- Cadgie
- Charley
- Egerton
- Elimunna
- Jamindie
- Kunderong
- Newman
- Nirran
- Nooingnin
- Platform
- Prairie
- River
- Rocklea
- Spearhole
- Table
- Turee
- Wannamunna
- Warri

1:150,000

0 1 2 4 6 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.15.2: Land Systems and consolidated SRE habitats of Ophthalmia/ Prairie Downs

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

720000 730000 740000 750000

7430000 7420000 7410000 7400000 7390000

Legend

Full Development Scenario

- Ophthalmia/ Prairie Downs

Land System SRE Suitability

- 1 - Low
- 2 - Low / Medium
- 3 - Medium
- 5 - High

Consolidated SRE Habitats Suitability

- 1 - Non-SRE
- 2 - Low/ Medium
- 3 - Medium
- 4 - Medium/High
- 5 - High

1:150,000

0 1 2 4 6 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.15.3: SRE suitability of Land Systems and consolidated SRE habitats of Ophthalmia/ Prairie Downs

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

Newman FDS (Figures 5.14.1, 5.14.2 and 5.14.3)

Phase 1

The Newman FDS covers ten land systems - Newman, Rocklea, McKay (Suitability rating 5), Boolgeeda, Wannamunna, Egerton, Washplain (rating 3), Elimunna (rating 2), Platform, River (rating 1). The vast majority of the FDS lies within the high SRE suitability land systems of Newman and Rocklea.

Terrestrial invertebrate surveys have been conducted within the FDS. Survey sites are clustered in three main areas of the FDS with the majority of the sites within highly suitabile SRE land systems. Habitat information was recorded at the majority of the survey sites.

A total of twenty SRE species were recorded throughout the FDS, predominantly from the Newman land system. Three of these species (*Karaops 'ARA003 –DNA', Buddelundia '10NM'* and *Buddelundia '49'*) were also recorded within the Jimblebar Operation Tenure. One mygalomorph species, *Aname 'MYG098'* was also recorded within the Jinidi FDS.

Three species were only recorded inside the FDS (*Aname 'MYG205*, *Aname 'MYG206'* and *Antichiropus 'sp. juv' OB19*).

The Newman FDS is located within an area of land systems that have been classified as having a high suitability for SRE species. It is likely that SRE species may be present within the FDS, particularly within the deep gullies and gorges, ridges, vertical faces and plateaux of the Newman and Rocklea land systems.

Phase 2

The Newman FDS covers 14,394 ha, of which 88.7% is mapped.

This FDS is dominated by the Boulders, Outcrops, Ridges and Breakaways habitat unit (level 4; 2,161 ha within), with Groves and Drainage foci (level 3; 876 ha within), Drainage foci and Swamp/ depressions (level 4; 755 ha within), Shallow gullies and Drainage foci (level 3; 264 ha within), and Deep gullies/ gorges (level 5: 205 ha within) also common, and small sections of Dispersal habitats and Swamps/ depressions (level 3; 31 ha within).

This FDS contains one area of high (Deep gullies/ gorges) and one of medium (Boulders, Outcrops, Ridges and Breakaways) priority for future management. The Deep gullies/ gorges in the northern and south western sections appear to be potentially heavily impacted by the FDS, while the Boulders, Outcrops, Ridges and Breakaways in the south western section appear to be potentially moderately impacted. In the unmapped 21% of the FDS, the Phase 1 mapping shows areas of the FDS cover Level 5 suitability areas and, as such, this can also be regarded as a high priority for future management.

760000 770000 780000 790000

7420000

7410000

NEWMAN

Legend

⊕ Regional Towns

Full Development Scenario

Newman

SRE Sampling sites

SRE Habitat sites

Selenopidae

Karaops 'ARA005-DNA'

Mygalomorphae

Aname `MYG098`

Aname `MYG205`

Aname `MYG206`

Aurecocrypta 'MYG315'

Cethegus 'MYG299'

Conothele 'MYG385'

Isopoda

Buddelundia '16NM'

Buddelundia '49'

Buddelundia '78'

Buddelundia '79'

Buddelundia '80'

Buddelundinae 'OB24'

Polydesmida

Antichiropus `DIP014`

Antichiropus `DIP015`

Antichiropus `OB35_1`

Antichiropus `OB35_2?`

1:90,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.16.1: Locations of sampling, habitat assessment sites and SRE faunal records of Newman (western part)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

790000 800000 810000 820000

7420000

7410000

Legend

Full Development Scenario
- Newman

Selenopidae
- Karaops 'ARA003-DNA'
- Karaops 'ARA004-DNA'
- Karaops 'ARA005-DNA'

Pseudoscorpiones
- Xenolpium `PSE079`

Mygalomorphae
- Aganippe `MYG085`
- Aganippe `MYG384-DNA`
- Cethegus 'MYG299'

Isopoda
- Buddelundia '10NM'
- Buddelundia '16NM'
- Buddelundia '36NM'
- Buddelundia '49'
- Buddelundia '78'
- Buddelundia sp. nov.
- Buddelundinae 'OB24'
- Buddelundinae 'WN'

Polydesmida
- Antichiropus `indet. juv.`

- SRE Sampling sites
- SRE Habitat sites

1:90,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.16.2: Locations of sampling, habitat assessment sites and SRE faunal records of Newman (eastern part)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

760000 770000 780000 790000

7420000

7410000

Newman

Platform

Boolgeeda

McKay

Wannamunna

Disturbed Land

NEWMAN

River

Elimunna

Egerton

Rocklea

Washplain

Spearhole

Divide

Sylvania

Legend

⊕ Regional Towns

Full Development Scenario

Newman

Land Systems

Boolgeeda
Disturbed Land
Divide
Egerton
Elimunna
McKay
Newman
Platform
River
Robe
Rocklea
Spearhole
Sylvania
Wannamunna
Washplain

Consolidated SRE Habitats

Boulders, Outcrops, Ridges and Breakaways
Deep gullies/ gorges
Shallow gullies and Drainage foci
Dispersal habitats
Dispersal habitats and Swamps/ depressions
Drainage foci and Swamps/ depressions
Groves and Drainage foci
Non-SRE Habitat

1:90,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.16.3: Land Systems and consolidated SRE habitats of Newman (western part)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

790000 800000 810000 820000

7420000

7410000

Rocklea

Boolgeeda

Newman

Elimunna

River

Spearhole

Washplain

McKay

Disturbed Land

Cadgie

Jamindie

Laterite

Divide

Sylvania

Prairie

Talga

Legend

Full Development Scenario

- Newman

Land Systems

- Boolgeeda
- Cadgie
- Disturbed Land
- Divide
- Elimunna
- Jamindie
- Laterite
- McKay
- Newman
- Prairie
- River
- Rocklea
- Spearhole
- Sylvania
- Talga
- Washplain

Consolidated SRE Habitats

- Boulders, Outcrops, Ridges and Breakaways
- Deep gullies/ gorges
- Shallow gullies and Drainage foci
- Dispersal habitats
- Dispersal habitats and Swamps/ depressions
- Drainage foci and Swamps/ depressions
- Groves and Drainage foci
- Non-SRE Habitat

1:90,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.16.4: Land Systems and consolidated SRE habitats of Newman (eastern part)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

760000 770000 780000 790000

7420000

7410000

NEWMAN

Legend

⊕ Regional Towns

Full Development Scenario

Newman

Land System SRE Suitability

Disturbed Land
1 - Low
2 - Low / Medium
3 - Medium
5 - High

Consolidated SRE Habitats Suitability

1 - Non-SRE
2 - Low/ Medium
3 - Medium
4 - Medium/High
5 - High

1:90,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.16.5: SRE suitability of Land Systems and consolidated SRE habitats of Newman (western part)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

790000 800000 810000 820000

7420000

7410000

Legend

Full Development Scenario

- Newman

Land System SRE Suitability

- Disturbed Land
- 1 - Low
- 2 - Low / Medium
- 3 - Medium
- 5 - High

Consolidated SRE Habitats Suitability

- 1 - Non-SRE
- 2 - Low/ Medium
- 3 - Medium
- 4 - Medium/High
- 5 - High

1:90,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.16.6: SRE suitability of Land Systems and consolidated SRE habitats of Newman (eastern part)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

Jimblebar FDS (Figures 5.15.1, 5.15.2 and 5.15.3)

Phase 1

The Jimbelbar FDS extends across eight land systems, including three high suitability systems (Newman and McKay – rating 5 and Zebra – rating 4). The majority of the FDS consists of land systems that have a high suitability of supporting SRE species. The majority of the remainder of the Operation Tenure is composed of medium suitability land systems (Boolgeeda, Washplain, Jamindie, Sylvania – all rating 3), with some Divide (rating 2).

Terrestrial invertebrate survey sites are scarce throughout the FDS, with more intense survey effort in the areas adjacent the FDS, predominantly located in high suitability land systems (Newman and McKay). Habitat data has been collected for the majority of survey sites.

Twelve SRE species were recorded within or adjacent the Jimblebar FDS (trapdoor spiders, Isopoda, pseudoscorpion, crab spiders), predominantly within the Newman land system. Three of the species were also recorded within the Newman Operation Tenure, in high suitability land systems (Newman, McKay). Four of the SRE species are potential singletons, located outside the Jimblebar FDS; however, a single record of the pseudoscorpion species *Xenolpium 'PSE079'* was only recorded in the FDS within the Newman land system.

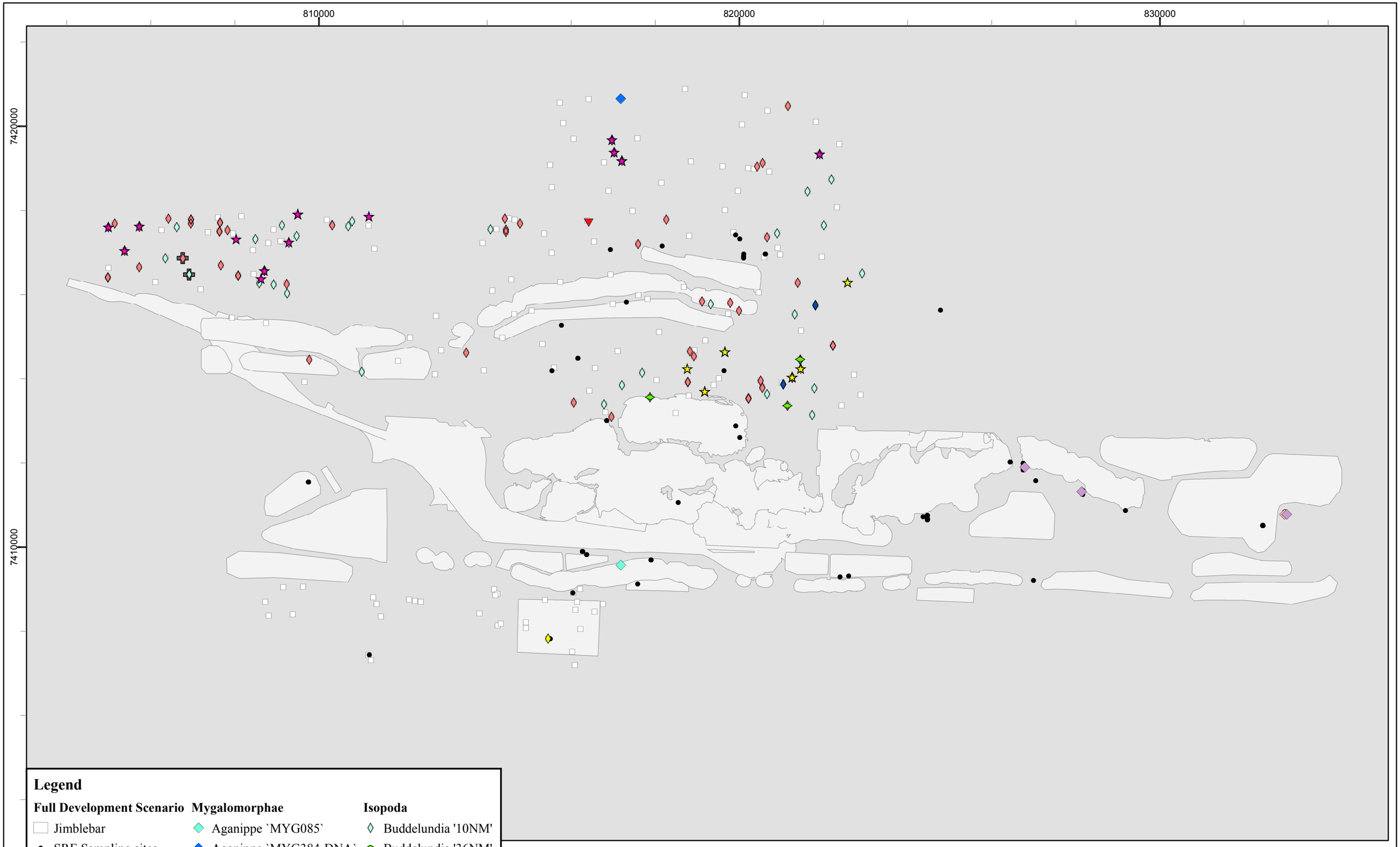
The Jimblebar FDS is located within an area of land systems that have a high suitability of supporting SRE species. Therefore, it is likely that SRE species may be present within the high suitability land systems (Newman, McKay and Zebra) of the FDS, particularly where there are deep gullies and gorges, ridges, vertical faces and plateaux (Newman and McKay) and isolated sands, groves and drainage loci (Zebra).

Phase 2

The Jimblebar FDS covers 8,015 ha, of which 66.5% is mapped.

This FDS is dominated by two SRE habitat units; Drainage foci and Swamp/ depressions (level 4; 496 ha within) and Groves and Drainage foci (level 3; 561 ha within), with Boulders, Outcrops, Ridges and Breakaways (level 4; 240 ha within) and Shallow gullies and Drainage foci (level 3; 102 ha within) also common. The other habitat units present are Deep gullies/ gorges (level 5; 4 ha within) and a small portion of Dispersal habitats and Swamps/ depressions (level 3; 0.2 ha within).

This FDS contains one area of medium (Deep gullies/ gorges) priority for future management. The Deep gullies/ gorges in the north western sections appear to be potentially moderately impacted by the FDS. In the unmapped 32% of the FDS, the Phase 1 mapping shows areas of the FDS cover Level 5 suitability areas and, as such, this can also be regarded as a high priority for future management.



Legend

Full Development Scenario
- Jimblebar
- SRE Sampling sites
- SRE Habitat sites

Selenopidae
- Karaops 'ARA003-DNA'
- Karaops 'ARA004-DNA'

Pseudoscorpiones
- Xenolpium `PSE079`

Mygalomorphae
- Aganippe `MYG085`
- Aganippe `MYG384-DNA`
- Aname aragog
- Missulena occatoria-group

Polydesmida
- Antichiropus `indet. juv.`

Isopoda
- Buddelundia '10NM'
- Buddelundia '36NM'
- Buddelundia '49'
- Buddelundia sp. nov.
- Buddelundinae 'WN'

1:80,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.17.1: Locations of sampling, habitat assessment sites and SRE faunal records of Jimblebar

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

805000 810000 815000 820000 825000 830000 835000

7420000 7415000 7410000 7405000

Boolgeeda
Newman
River
Divide
Washplain
McKay
Disturbed Land
Cadgie
Jamindie
Zebra
Laterite
Sylvania
Talga
Prairie

Legend

Full Development Scenario
- Jimblebar

Land Systems
- Boolgeeda
- Cadgie
- Disturbed Land
- Divide
- Jamindie
- Laterite
- McKay
- Newman
- Prairie
- River
- Sylvania
- Talga
- Washplain
- Zebra

Consolidated SRE Habitats
- Boulders, Outcrops, Ridges and Breakaways
- Deep gullies/ gorges
- Shallow gullies and Drainage foci
- Dispersal habitats
- Dispersal habitats and Swamps/ depressions
- Drainage foci and Swamps/ depressions
- Groves and Drainage foci
- Non-SRE Habitat

1:80,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.17.2: Land Systems and consolidated SRE habitats of Jimblebar

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

805000 810000 815000 820000 825000 830000 835000

7420000

7415000

7410000

7405000

Legend

Full Development Scenario

- Jimblebar

Land System SRE Suitability

- Disturbed Land
- 1 - Low
- 2 - Low / Medium
- 3 - Medium
- 4 - Medium / High
- 5 - High

Consolidated SRE Habitats Suitability

- 1 - Non-SRE
- 2 - Low/ Medium
- 3 - Medium
- 4 - Medium/High
- 5 - High

1:80,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.17.3: SRE suitability of Land Systems and consolidated SRE habitats of Jimblebar

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

Caramulla FDS (Figures 5.16.1, 5.16.2 and 5.16.3)

Phase 1

The Caramulla FDS encompasses eight land systems; however, two land systems dominate: Zebra (Suitability rating 4) and Divide (rating 2), with Jamindie (rating 3), Cadgie (rating 2) and Washplain (rating 3) also featuring prominently. The other land systems within the FDS include: Newman and McKay (rating 5); and River (rating 1).

Terrestrial invertebrate survey effort throughout the FDS is limited two in close proximity to the FDS. Two SRE species (single records) were recorded within the low/ medium suitability Divide land system, trapdoor spiders – *Synothele 'MYG116'* and *Kwonkan 'MYG094'*.

It is likely that SRE species may be present within the Caramulla FDS (particularly in the eastern section) in suitable SRE habitat (deep gullies and gorges, ridges, vertical faces and plateaux) within the higher suitability land systems such as Zebra, Newman, Robertson and Boolgeeda; however, as SRE species have been recorded in lower suitability land systems, SRE species may also be present in suitable habitat (Groves and Drainage foci) within these lower suitability land systems.

Phase 2

The Caramulla FDS covers 1,549 ha, of which 100% has been mapped.

Only two SRE habitat units have been mapped in this FDS; Drainage foci and Swamp/ depressions (level 4; 353 ha within), and Groves and Drainage foci (level 3; 182 ha within).

All the habitats found within the FDS are regarded as low priority for future management; however, this should be viewed within the context of the lack of survey coverage within the FDS (between 1 and 40% coverage).

830000

840000

850000

860000

7410000

7400000

Legend

Full Development Scenario

- Caramulla
- Third Party Development
- SRE Sampling sites
- SRE Habitat sites

Mygalomorphae

- Aname aragog
- Kwonkan `MYG094`
- Missulena occatoria-group
- Synothele `MYG116`

Scorpiones

- Urodacus `Davidson Creek?`

1:80,000

0 0.5 1 2 3 km

N

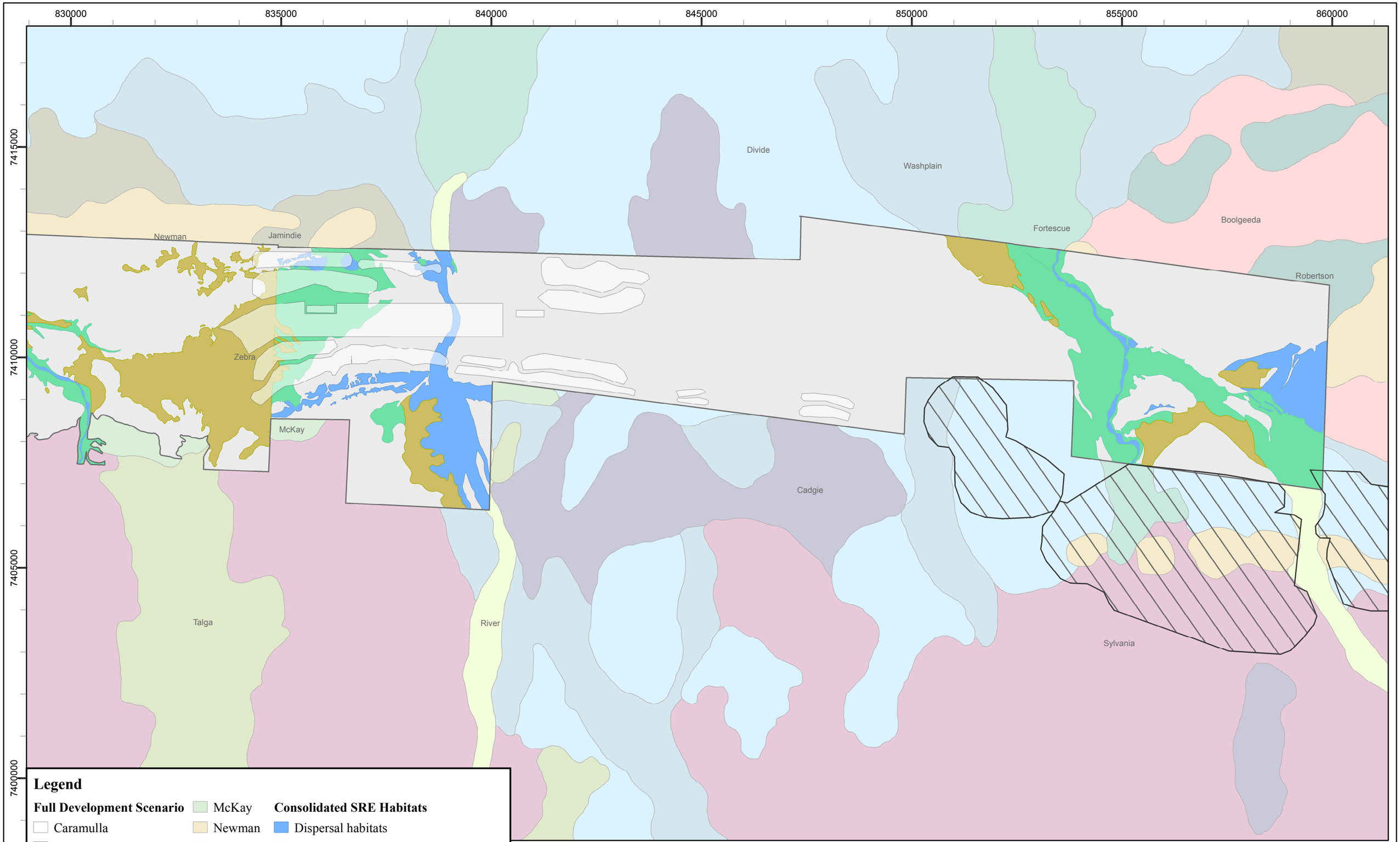
biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.18.1: Locations of sampling, habitat assessment sites and SRE faunal records of Caramulla

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3



Legend

Full Development Scenario
- Caramulla
- Third Party Development

Land Systems
- Boolgeeda
- Cadgie
- Divide
- Fortescue
- Jamindie
- McKay
- Newman
- River
- Robertson
- Sylvania
- Talga
- Washplain
- Zebra

Consolidated SRE Habitats
- Dispersal habitats
- Drainage foci and Swamps/ depressions
- Groves and Drainage foci
- Non-SRE Habitat

1:80,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.18.2: Land Systems and consolidated SRE habitats of Caramulla

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

830000 835000 840000 845000 850000 855000 860000

7415000

7410000

7405000

7400000

Legend

Full Development Scenario

- Caramulla
- Third Party Development

Land System SRE Suitability

- 1 - Low
- 2 - Low / Medium
- 3 - Medium
- 4 - Medium / High
- 5 - High

Consolidated SRE Habitats Suitability

- 1 - Non-SRE
- 2 - Low/ Medium
- 3 - Medium
- 4 - Medium/High

1:80,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.18.3: SRE suitability of Land Systems and consolidated SRE habitats of Caramulla

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

Coondiner FDS (Figures 5.17.1, 5.17.2 and 5.17.3)

Phase 1

The Coondiner FDS encompasses five land systems: Newman, Robe, Boolgeeda, Fan and River. The Newman and Robe land systems are considered to have a high suitability for supporting SRE species (Suitability rating 5) and cover approximately a quarter of the FDS. The majority of the FDS lies within the Boolgeeda land system that has been classified as medium suitability (rating 3) for supporting SRE species.

No terrestrial invertebrate surveys have been conducted within the FDS.

It is likely that SRE species may be present within the Coondiner FDS, particularly in the Newman and Robe land systems (within deep gullies and gorges and ridges and vertical faces and plateaux) and may be present within undisturbed suitable habitats (Groves and Drainage loci) of the Boolgeeda and Fan land systems.

Phase 2

The Coondiner FDS covers 3,041 ha, of which 100% has been mapped.

The FDS is dominated by Drainage foci and Swamp/ depressions habitat unit (level 4; 912 ha within), while the Deep gullies/ gorges habitat unit (level 5; 133 ha within) dominates the south-western section of the FDS. Shallow gullies and Drainage foci (level 3; 89 ha within), and the Boulders, Outcrops, Ridges and Breakaways habitat units (level 4; 19 ha within) also occur.

This FDS contains one area of high (Deep gullies/ gorges) and one of medium (Shallow gullies and Drainage foci) priority for future management. The Deep gullies/ gorges appear to be potentially heavily impacted by the FDS, while the Shallow gullies and Drainage foci appears to have limited extent beyond the FDS.

760000

770000

780000

7470000

7460000

7450000

Legend

Full Development Scenario

- Coondiner
- SRE Sampling sites

Polydesmida

- Antichiropus `indet.`

1:80,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.19.1: Locations of sampling, habitat assessment sites and SRE faunal records of Coondiner

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

760000
770000
780000
7470000
7460000
7450000
Divide
Fan
Boolgeeda
River
Robe
Newman
Rocklea

Legend

Full Development Scenario

- Coondiner

Consolidated SRE Habitats

- Boulders, Outcrops, Ridges and Breakaways
- Deep gullies/ gorges
- Dispersal habitats
- Drainage foci and Swamps/ depressions
- Non-SRE Habitat
- Shallow gullies and Drainage foci

Land Systems

- Boolgeeda
- Divide
- Fan
- Newman
- River
- Robe
- Rocklea

1:80,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.19.2: Land Systems and consolidated SRE habitats of Coondiner

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

760000

770000

780000

7470000

7460000

7450000

Legend

Full Development Scenario

Coondiner

Land System SRE Suitability

1 - Low

2 - Low / Medium

3 - Medium

5 - High

Consolidated SRE Habitats Suitability

1 - Non-SRE

2 - Low/ Medium

3 - Medium

4 - Medium/High

5 - High

1:80,000

0 0.5 1 2 3 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.19.3: SRE suitability of Land Systems and consolidated SRE habitats of Coondiner

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

Rocklea FDS (Figures 5.19.1, 5.19.2 and 5.19.3)

Phase 1

The majority of the Rocklea FDS is within the high SRE suitability Newman and Rocklea land systems, with a very small section of the Boolgeeda (rating 3) land system.

Limited terrestrial invertebrate surveys have been conducted in the area, with none within the FDS. No SRE species have been recorded within or adjacent the FDS.

Given that this FDS is dominated by the high SRE suitability Newman and Rocklea land systems, it is likely that SRE species may be present within suitable habitat (deep gullies and gorges and / or ridges, vertical faces and plateaux).

Phase 2

The Rocklea FDS has not been mapped and, as such, the Phase 1 assessment remains unchanged.

As the FDS potentially impacts heavily on Phase 1 level 5 suitability areas, a high priority for future management is determined.

510000

520000

530000

540000

7470000

7460000

Legend

Full Development Scenario

- Rocklea
- Third Party Development
- SRE Sampling sites

1:100,000

0 0.75 1.5 3 4.5 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.20.1: Locations of sampling, habitat assessment sites and SRE faunal records of Rocklea

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

510000
520000
530000
540000
7470000
7460000
Rocklea
Prairie
Robe
Table
Paraburdoo
Dollar
Boolgeeda
Newman
Marandoo
River
Cheela
Capricorn
Wona
Kooline

Legend

Full Development Scenario
Rocklea
Third Party Development

Land Systems
Boolgeeda
Capricorn
Cheela
Dollar
Kooline
Marandoo
Newman
Paraburdoo
Prairie
River
Robe
Rocklea
Table
Wona

1:100,000

0 0.75 1.5 3 4.5 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.20.2: Land Systems of Rocklea (consolidated SRE habitats not assessed)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

510000
520000
530000
540000
7470000
7460000

Legend

Full Development Scenario	Land System SRE Suitability
Rocklea	1 - Low
Third Party Development	3 - Medium
	5 - High

1:100,000

0 0.75 1.5 3 4.5 km

N

biologic

BHP Billiton Iron Ore

Strategic Assessment of SRE Invertebrates

Fig. 5.20.3: SRE suitability of Land Systems at Rocklea (no consolidated SRE habitats mapped)

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994 Created 30/04/2015. Size: A3

6 CONCLUSIONS

Twelve SRE habitats were identified through the assessment process, based on the presence of microhabitats (relevant to SRE fauna) and the likelihood of SRE fauna occurring. Once ranked, deep gullies and gorges were regarded as the most suitabile for SRE fauna.

The majority of the BHP Billiton Iron Ore Operation Tenures and Third Party project areas occur within land systems that have been identified as high risk for supporting SRE species, particularly the Newman land system. The number of SRE species recorded within the BHP Billiton Iron Ore project areas was more than four times the number recorded within the Third Party project areas; however, this is likely to be a product of sampling bias rather than differences in species occurrence and diversity.

The areas of high sampling intensity and high numbers of SRE fauna records coincide with the BHP Billiton Iron Ore Operation Tenures and Third Party project areas. However, it should be noted that there is no direct link between the high sampling intensity of these Operation Tenure and Third Party project areas and high suitability ratings, as the rating was based around the suitability of land system characteristics for SRE fauna.

Within the BHP Billiton Iron Ore Operation Tenures, Mining Area C, Newman and Jimblebar recorded the highest number of SRE species; however, this is likely to be an artifact of survey intensity rather than presence or absence of SRE fauna. Four Hubs remain to be surveyed for SRE fauna (Ministers North, Coondiner, Gurinbiddy and Ophthalmia/ Prairie Downs) and the known distribution of some species appears limited at some Operation Tenures.

The risk assessment showed a wide range of outcomes within the Operation Tenures, with some Operation Tenures containing up to eight of the ten SRE habitat units (MAC-PAC, Mudlark Well and South Flank) while at least one contained only three SRE habitat units (Caramulla). Two Operation Tenures had less than 25% of the area mapped (Roy Hill [10.5%] and Ministers North [23.5%]) and one (Rocklea) had no mapping at all. As such, assessments for these Operation Tenures were limited to the Phase 1 assessment.

Within this context of this assessment providing guidance for future potential priorities and management, 15 Operation Tenures were assessed as having at least one habitat as likely to be a high priority for future management, with five of these determined based on Phase 1 mapping due to incomplete Phase 2 mapping. Of the remaining Operation Tenures, two were assessed as a low priority, but both have incomplete survey coverage within the FDS, and the third was assessed as a medium priority.

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Appendix A: Desktop review table

Project Name	Report	Survey details	Taxon	Species	Habitat in which collected
Jimblebar Hub	East Jimblebar Exploration Project Biological Survey (ecologia, 2005)	Comprehensive desktop review on processes effecting SRE fauna.			
BHPBIO	Jimblebar Iron Ore Project Terrestrial invertebrate Short-range Endemic Assessment (Outback Ecology, 2009)	Two phase survey (August 2008, February 2009) Dry pitfall trapping, active searching, leaf litter collection, soil sieving and night searching with UV lights 14 sites overall, with 8 trapping sites, and 6 targeted (opportunistic) sites	No SRE fauna recorded		
	Final Summary Report for BHP Billiton - Wheelara Hill North – SRE Survey (Rapallo, 2011)	Single phase survey (May 2011) 47 sites: litter foraging	No SRE fauna recorded		
West Angelas RioTinto	West Angelas Gas Pipeline Fauna Survey (Biota, 2010)	Single survey June 2010 24 survey sites: searched with active hand searching	No SRE fauna recorded		
Hope Downs 4 Rio Tinto	A Fauna survey of the proposed Hope Downs 4 Mining Area, near Newman, Western Australia (Ninox, 2009)	Two phase surveys: May and September 2008 Six sites Intensive hand searches, leaf and soil samples, foraging, dry pitfalls at Scorpion burrows.	Myriapod Gastropod	*Antichiropus Antichiropus sp.* (juv.) *Bothriembryon sp.*	
Newman Orebodies BHPBIO	OB 35 Short-range Endemic Invertebrate Survey Report	Single season survey (Dates) 30 sample sites: Active searching, leaf and soil	No SRE fauna recorded		

Project Name	Report	Survey details	Taxon	Species	Habitat in which collected
	(Biologic, 2012).	searching			
	Assessment of terrestrial Short-range Endemic Invertebrates in the OB35 – Western Ridge Area near Newman, Western Australia. Report to BHP Billiton Iron Ore Pty Ltd (Australian Museum Business Service, 2011).	Two phase survey (wet and dry) 30 sites in 3 habitat types: gorges/deep gullies, steep south to east facing slopes, and open floodplain. Wet season: 20 wet pitfall sites, 20 active search sites, 20 soil sample sites Dry season: 15 dry pitfall sites, 30 active sites, 30 soil sample sites Diurnal active searches, wet and dry pitfall trapping, soil samples	Pseudoscorpiones Scorpion Mygalomorph Mygalomorph Mygalomorph Myriapod Myriapod	*Austrochthonius* *Urodacus* 'pilbara 12' *Aname* 'MYG098' *Aname* 'MYG205' *Aname* 'MYG206' *Antichiropus* 'OB35_1' *Antichiropus* 'OB35_2'	Gully, steep slope Gully, Steep slope, floodplain Open floodplain, gully Open floodplain Open floodplain Gullies, steep rock slopes Gullies, steep rock slopes
	Orebody 24/25 Upgrade Terrestrial Invertebrate Short-range Endemic Assessment (Outback Ecology, 2008)	Two surveys: Eight sampling sites around south facing ridge/slopes and gullies/gorges along the Ophthalmia Range. Dry pitfall traps, targeted searches, leaf and soil samples, night searching with UV lights.	Myriapods Myriapods	*Paradoxosomatids (juv.)* *Austrostrophus stictopygus*	South facing slope Southern facing rigdeline/slope, breakaway complexes.
Newman Orebodies contd.	Short-range Endemic Study Pseudoscorpions (Chelicerata: Arachnida) OB24/25 (ENV, 2008)	Pseudoscorpions were collected from two ranges separated by floodplain. Six sites per area, with active foraging. Sites sampled were range crests, range slopes, breakaways, gullies and gorges.	No SRE fauna recorded		
Mining Area C BHPBIO	Area C and surrounds Short-range Endemic Invertebrate Fauna Survey (Biota, 2011)	Two phase survey: February 2010 – 27 sites June 2010 – 21 sites Wet pit trapping and hand searching	Mygalomorphs	*Aname* 'MYG104' *Aname* 'MRG195' *Yilgarnia* 'MYG197'	Mulga woodland Hills and ridges, Gullies/Gorges, major Creeks/Drainages

Project Name	Report	Survey details	Taxon	Species	Habitat in which collected
			Myriapods Pseudoscorpion Scorpion	*Antichiropus* 'Area C *sp.* 2' Gen 'indet' sp. 'indet' Synsphyronus 'long hand 2' *Urodacus* 'firetail'	Hills and ridges, Broad valleys Hills and ridges Hills and ridges Hills and ridges Hills an ridges, Mulga woodland, Flood plain, Major creeks/drainage
Mining Area C contd.	Area C Mining Operation Environmental Management Plan (Revision 4) A, D, P1 and P3 Deposits SRE Assessment (Outback Ecology, 2008)	Two phase survey: Preliminary then comprehensive 15 identical sites per phase. Dry pitfalls and hand searching	Mygalomorph Myriapod	*Aname* sp. *Synothele* sp. *Antichiropus* sp. Nov 'Area C'	S-facing ridge S-facing ridge SE-facing ridge
	Area C Mine Short-range Endemic habitat assessment (Outback Ecology, 2009)	Survey builds on previous OES survey in 2008. 23 habitat assessment sites (15 old, 8 new sites)	Mygalomorph	1 trapdoor burrow – sp. unknown	S-facing ridge
	A survey of SRE Invertebrate fauna of Area C West to Yandi (Biota, 2013)	Three surveys: May/June 2011, August 2011, February 2012 Dry pitfall traps, burrow visual searching and excavation, raking soil and leaf litter, bark peeling, searching under rocks, soil sieving	Mygalomorph Mygalomorph Mygalomorph	*Actinopodid* sp. 'A1' *Barychelid* sp. 'B1' *Nemesiid* sp. 'N16'	

Project Name	Report	Survey details	Taxon	Species	Habitat in which collected
		and leaf litter sieving; and nocturnal searching.			
Mining Area C contd.	Assessment of Terrestrial Short-range Endemic Invertebrates, from Area C to Jinayri to Mt Newman Railway (Australian Museum, 2010)	Four surveys total; • 2 within Jinayri, and • 2 from Area C to Jinayri to Mount Newman Railway). Two phase survey: Winter 2008 and Summer 2009 Total survey effort; Winter Area 1 - 20 trap sites, 22 search sites. Winter Area 2 - 12 trap sites, 26 search sites. Summer Area 1 - 20 trap sites, 25 diurnal search sites, 17 nocturnal search sites. Summer Area 2 - 12 trap sites, 26 search sites. Active searching (diurnal and nocturnal) and dry pitfalls, soil sieving.	Pseudoscorpion Mygalomorph Centipede	*Beierolpium sp.* *Beierolpium sp.* 8/2 *Beieropium sp.* 8/3 *Beierolpium sp.* 8/4 (small) *Missulena* 'MYG003' *Aname* 'MYG098' *Conothele* 'MYG002' *Cryptops sp.*	Gully/ gorge Range slope Gully, open plain Range slope Range slope Open plain Open plain
	Targeted survey for Short-range Endemic Invertebrate fauna of Area C West (Biota, 2013)	Two phase survey: February and March/April 2012 26 sample sites Hand foraging, soil and leaf sieving	Mygalomorph	*Barychelid sp.* 'B1' *Barychelid sp.* 'B2' *Barychelid sp.* 'B3' *Barychelid sp.* 'B34' *Ctenizid sp.* 'C3' *Idiopid sp.* 'I2' *Idiopid sp.* 'I7' *Idiopid sp.* 'I55' *Nemesiid sp.* 'N121'	Hardpan plains and drainage lines Hardpan plains and drainage lines Hardpan plains and drainage lines Hardpan plains and drainage lines Stony plains with *Acacia* shrublands and spinifex grasslands Mulga woodlands and groves in broad valleys and drainage

Project Name	Report	Survey details	Taxon	Species	Habitat in which collected
					lines Stony plains with *Acacia* shrublands Hardpan plains and drainage lines Hardpan plains and drainage lines
Yandicoogina HI/Rio Tinto	Yandicoogina Junction South West and Oxbow fauna survey (Biota, 2010)	Single phase survey: July 2008 Oxbow – 5 sample sites Yandicoogina – 1 sample site	No SRE fauna recorded		
Iron Valley Iron Ore Holdings	Short-range Endemic Survey – Iron Ore Holdings Ltd Iron Valley Project (Dalcon, 2011)	Single phase survey: May/June 2010	Mygalomorph	*Aganippe* 'MYG086'	Spinifex grasslands
	Iron Ore Holdings Ltd - Iron Valley Project Targeted Terrestrial Short-range Endemic invertebrate fauna survey (Dalcon, 2012)	N/A	No SRE fauna recorded		
Nyidinghu Mine FMG	Terrestrial invertebrate Short-range Endemic Assessment: Nyidinghu Mine Project (Dalcon, 2012)	Single phase survey: April/May 2011 13 sample sites Wet pitfall traps, hand foraging, little sampling, burrow excavation	Mygalomorph	*Aganippe* 'MYG233' *Anidiops* 'MYG083' *Swolnpes* 'MYG234'	
Marandoo Rio Tinto	Marandoo Mine Phase 2 Seasonal Fauna Survey (Biota, 2008)	Two phase survey: April and November 2007 13 sample sites plus 6 opportunistic sampling sites	No SRE fauna recorded		

Project Name	Report	Survey details	Taxon	Species	Habitat in which collected
Brockman 4 Rio Tinto/ Hamersley Iron	Fauna assemblage of the Brockman Syncline 4 Project, near Tom Price. Report to Hamersley Iron Pty Ltd (Biota, 2005)	Two phase survey: October 2004 and April 2005 Opportunistic and systematic collections (foraging, sieving)	Mollusc Mygalomorph Myriapod	*Rhagada sp*. "Mt Brockman" *Aname* "WA sp. 09" *Synothele* "WA sp. 01" Polydesmid millipede	*Acacia* and Eucalyptus woodlands Triodia hilltop, Mulga habitat, creekline Mulga Triodia
Marillana Project BHPBIO	Targeted survey for Short-range Endemic Fauna in the Marillana Survey Area (Biota, 2013)	Two phase survey: June 2011 and February 2012 36 survey sites Hand foraging, soil and leaf sieving	Mygalomorph Pseudoscorpion	*Actinopodid sp.* 'A3' *Barychelid sp.* 'B6' *Barychelid sp.* 'B13' *Idiopid sp.* 'I5' *Idiopid sp.* 'I9' *Idiopid sp.* 'I56' *Nemesiid sp.* 'N35' *Nemesiid sp.* 'N42' *Nemesiid sp.* 'N43' Nemesiid sp. 'N45' *Nemesiid sp.* 'N46' *Olpiidae* genus 7/4 *Olpiidae* genus indet. *Olpiidae Xenolpium* 'PSE033'	Broad drainage line Rocky hilltop Shallow valleys, rocky hilltops Drainage line Open plain Open plain Rocky ridges, stony hilltops, stony slopes Stony plains, ridges, lower slopes, alluvial floodplains Stony lower slopes Drainage lines Ridge Hilltop, valley plain, woodland Drainage line Ficus, *Acacia*
Marillana Project Brockman Resources	Short-range Endemic Invertebrate report – Marillana Iron Ore Project (Ecologia, 2009)	Three phase survey: July to October 2008 Wet pitfall trapping, grass tufting, searching in rock piles and logs, soil sieving and Scorpion burrow pitfall trapping	Pseudoscorpion Centipede	*Beierolpium sp.* 8/2 *Beierolpium sp.* 8/4 small Geophilomorph *sp.*	Open mulga plain Open mulga plain, Spinifex ridge top Mulga woodland
Roy Hill Roy Hill Iron Ore	Roy Hill Iron Ore Project Short-range Endemic	Single phase survey: June 2006 6 pitfall traps – three	No SRE fauna recorded		

Project Name	Report	Survey details	Taxon	Species	Habitat in which collected
	survey (Ecologia, 2006)	in southern facing slopes and three in drainage lines pitfall traps, leaf/soil sampling, hand searching			
	Roy Hill Iron Ore Project – Additional Short-range Endemic survey (Ecologia, 2008)	Single phase survey: October 2008 10 opportunistic sites	No SRE fauna recorded.		
	Monitoring Short-range Endemic invertebrates at Roy Hill 1 Mine (Bennelongia, 2012)	Single phase survey: February 2012 14 survey sites Intensive targeted survey for the four mygalomorph species listed	Mygalomorph Pseudoscorpion	*Synothele* 'MYG127' *Missulena* 'MYG252-DNA' *Aganippe* 'MYG126' *Idiommata* 'MYG128' *Beierolpium sp.*	Drainage lines on floodplain Drainage lines on floodplain Drainage lines on floodplain
Christmas Creek FMG	Christmas Creek Life of Mine Project Terrestrial SRE invertebrate survey (Subterranean Ecology, 2012)	Single phase survey: March/April 2011 28 survey sites Wet pitfall trapping, active foraging, leaf litter/soil sifting	Pseudoscorpion Isopod Selenopid Millipede	*Beierolpium sp.* indet. XC *Buddelundia sp*. n. 20 *Karaops sp.* indet. XC Paradoxosomatidae sp. indet.	Alluvial plains, vegetation grove, rocky hills/gullies Rocky hills/gullies, gorges Drainage line Drainage line, floodplain, alluvial plain, vegetation grove, rocky hills, gorges/gullies
	Christmas Creek: Fortescue Marsh Samphire (Biologic, 2012)	21 survey sites Active foraging - Focus on samphire habitat	No SRE fauna recorded		
Solomon FMG	Solomon Project: Firetail Short-range Endemic Invertebrate and Habitat Assessment	Single phase survey: June/July 2008	Pseudoscorpion Scorpion	*Synsphyronus gracilis* *Urodacus* 'hamersley black'	*Acacia* shrubland Creekline, rocky spur/slope

Project Name	Report	Survey details	Taxon	Species	Habitat in which collected
	(Ecologia, 2010)				
Solomon FMG	Solomon Project: Kings Mining Area and reference sites (Phoenix, 2010)	Two phase survey: January 2010 and April/May 2010 20 and 40 survey sites in January and April/May, respectively Wet pit trapping and active searches (foraging), leaf litter samples	Mygalomorph Scorpion Pseudoscorpion Mollusc	*Missulena* (sp.) *Aname* 'MYG168' *Kwonkan* 'MYG169' *Yilgarnia* (sp.) *Aops* sp. *Urodacus* 'firetail' *Urodacus* 'hamersley black' *Austrophorus* sp. *Beierolpium* 'sp. 8/4' *Bothriembryon* (sp.) *Quistrachia* c.f. *Q. turneri Camaenidae n. gen.*	Hilltop Gorge/gully Rock spur/slope Gorge/gully Hilltop Broad floodplain/stony plain Minor/major creekline, rock spur/slope Minor creekline Hilltop Gorge/gully, major creekline Gorge/gully Gorge/gully
Cloudbreak FMG	The Short-range Endemic arthropod fauna from the Cloudbreak region (Harvey, 2006)	N/A	Arachnid	Assamiidae – *Dampetrus* 'Pilbara 1'	
Cloudbreak FMG	Cloudbreak Short-range Endemic Invertebrate survey (Ecologia, 2011)	Single phase survey; November 2010 19 survey sites plus targeted searches at sites likely to harbour SRE taxa Wet pitfall trapping, foraging and leaf litter sampling	Mygalomorph Scorpion Pseudoscorpion Myriapod	*Conothele* sp. *Aname* 'MYG001' *Urodacus* sp. *Austrophorus* sp. *Beierolpium* 'sp. 8/2' *Linnaeolpium* sp. *Antichiropus* 'Cloudbreak'	Creekline, Hummock grassland Hummock grassland Creekline, mulga woodland Hummock grassland Creekline, Mulga woodland Mulga woodland Creekline

Project Name	Report	Survey details	Taxon	Species	Habitat in which collected
Davidson Creek Hub FerrAus Ltd	Davidson Creek Iron Ore Project SRE Invertebrate Fauna Survey (Phoenix, 2009)	Single phase survey: October/November 2008 10 survey sites wet pitfall traps, foraging and leaf litter samples	No SRE fauna recorded		
Western Turner Syncline Rio Tinto	A two-phase fauna survey of the West Turner Syncline area (Biota, 2009)	Two phase survey: July/September 2007 and July 2008 Systematic sampling and opportunistic hand searching	Mygalomorph Pseudoscorpion	*Barychelidae* sp. *Synsphyronus* sp. *Afrosternophorus* sp.	Acacia shrubs over Triodia, Mulga habitat Plain, ephemeral creek Plain, ephemeral creek
FerrAus Pilbara Project	FerrAus Pilbara Project: Short-range Endemic Invertebrate fauna survey (Phoenix, 2010)	Single phase survey: April 2010 10 survey sites – foraging 9 survey sites - dry pitfall trapping	Mygalomorph Scorpion	*Aname* 'MYG001' *Aname* 'MYG004' *Anidiops (Gaius)* sp. *Missulena* sp. *Urodacus* 'Davidson Creek'	Rocky outcrop, minor drainage lone/*Acacia* woodland, low shrubland Rocky outcrop, major drainage line, low shrubland Minor drainage line/*Acacia* woodland, low shrubland Open grassland Major drainage line, minor drainage line/*Acacia* woodland
South Flank BHPBIO	Short Range Endemic invertebrate fauna survey – South Flank (Biota, 2011)	Two phase survey: February 2010 and August 2010 Phase 1 – 15 survey sites. Wet pitfall trapping and hand searching Phase 2 – 12 new plus 2 previously surveyed sites. Hand searching	Mygalomorph Myriapod Scorpion	*Aname* 'MYG195' *Antichiropus* 'Area C sp. 2' *Gen. indet sp. indet* *Urodacus 'firetail'*	Rocky slope/gully Mulga plain, rocky gully Rocky slope Mulga plain, rocky gully/slope, drainage line
Angelo River Project	Rio Tinto Iron Ore Angelo River	Single phase survey	Selenopid Mygalomorph	*Karaops* sp. indet. *Teyl* sp. 'MYG027'	Steep slope/gorge

Project Name	Report	Survey details	Taxon	Species	Habitat in which collected
Rio Tinto	Project Baseline survey of terrestrial Short-range Endemic invertebrates (Subterranean Ecology, 2012)	42 survey sites across five potential SRE habitat types: - Drainage lines - Floodplains, Alluvial/Colluvial plains - Rocky hills and gullies - Steep slopes/gorges	Isopod Mollusc Pseudoscorpion	*Buddelundia* sp. 16 *Buddelundia* sp. n 47 *Buddelundia* sp. n. 48 *Bothriembryon* sp. n *Beierolpium* sp. '8/2' *Beierolpium* sp. '8/4 large' *Beierolpium* sp. '8/4 small' *Euryolpium* sp. indet. 'PSEAAA' gen. n. sp. n.	Opportunistic Rocky hills/gullies, steep slopes/gorges Drainage line, Rocky Hills/gullies, Steep slopes/gorges Steep slopes/gorges Opportunistic Alluvial plain Rocky hills/gullies Floodplains, Rocky hills/gullies Floodplain, Steep slope/gorge Rocky hills/gullies
Mudlark BHPBIO (Future site option)	Targeted survey for Short-range Endemic fauna in the Mudlark Survey Area (Biota, 2013)	Three phase survey: March/April 2011, June/July 2011 and February 2012 Phase 1 – 10 survey sites Phase 2 – 33 survey sites Phase 3 – 19 survey sites Hand foraging, leaf and soil sieving	Mygalomorph Pseudoscorpion	*Actinopodid sp.* 'A2' *Barychelid* sp. 'B1' *Barychelid* sp. 'B3' *Barychelid* sp. 'B4' *Barychelid* sp. 'B17' *Ctenizid* sp. 'C1' *Ctenizid* sp. 'C21' *Idiopid* sp. 'I1' *Idiopid* sp. 'I2' *Idiopid* sp. 'I4' *Idiopid* sp. 'I7' *Nemesiid* sp. 'N33' *Nemesiid* sp. 'N37' *Synsphyronus gracilis*	Stoney plains with *Acacia* over Triodia Mulga woodlands Mulga woodlands Mulga woodlands Mulga woodlands Valley floors, drainage lines Mulga woodlands Mulga woodlands Mulga woodlands Mulga woodlands

Project Name	Report	Survey details	Taxon	Species	Habitat in which collected
			Scorpion Snails	*Aops* sp. 'Mudlark' cf. *Pleuroxia s*p. Z cf. *Quistrachia* sp. X	Mulga woodlands Mulga woodlands Mulga woodlands Gullies Gorge/gully S-facing Steep narrow gorges Narrow gully S-facing
Boundary Ridge BHPBIO	Boundary Ridge Trapdoor Spider habitat assessment (Outback Ecology, 2009)	Single phase survey 7 survey sites Intensive hand searching	Mygalomorph	*Missulena sp.* Twig-lined burrow 'Mud plug' burrow	Mulga woodland Mulga woodland Mulga woodland
South Parmelia Rio Tinto	A survey of the Short-range Endemic invertebrate fauna of South Parmelia (Biota, 2012)	Single phase survey: April 2011 22 survey sites Visual searches, soil and leaf sieving, active foraging	Mygalomorph	*Barychelid* sp. 'B1' *Idiommata* sp. *Conothele* sp. "Eastern Pilbara' *Aganippe* sp. 'Lineage IA' *Gaius* sp. 'Pilbara' *Kwonkan* sp. 'sock'	Mulga woodland Low woodland Mulga woodland Very open tree mallee Mulga woodland, broad valleys, drainages Mulga
Jinidi BHPBIO	Jinidi Iron Ore Mine preliminary statement of findings – Terrestrial invertebrate SREs (Biota, 2011)	Single phase survey: April 2011 18 survey sites – hand foraging 4 survey sites – dry pit trapping	N/A		
Jinayri BHPBIO	The SRE invertebrate fauna from Jinayri Western Australia	Specimens submitted to the WAM	Mygalomorph Pseudoscorpion Chilopoda	*Anidiops sp.* *Beierolpium sp. nov* *Geophilida spp.*	

Project Name	Report	Survey details	Taxon	Species	Habitat in which collected
	(WAM, 2008)			*Crytops spp.*	
Blacksmith Flinders Mines Ltd	Blacksmith vertebrate fauna and short range endemic survey (Ecoscape, 2010)	Two phase survey: June and October 2010 5-10 survey sites Wet and dry pitfall trapping, hand foraging	No SRE fauna recorded.		
Goldsworthy BHPBIO	Cundaline and Callawa Mining Operations targeted fauna assessment (Outback Ecology, 2008).	Two phase survey 8 survey sites/phase Soil and litter sieves, hand searching, Ultraviolet spotlighting, Berlese funnel traps	Mygalomorph Pseudoscorpion	*Conothele* sp. *Austrophorus* sp.	S-SW facing ridge S-SW facing ridge, rocky slope, rocky outcrop
Spinifex Ridge Molybdenum Project Moly Mines	Spinifex Ridge Molybdenum Project. SRE invertebrate fauna survey results. Report to Moly Mines Limited. (Outback Ecology, 2007)	N/A	Mollusc	*Quistrachia* sp.	Rocky slopes/ranges
Boodarie Link Project Atlas Iron Ltd	Boodarie Link Project: Terrestrial SRE invertebrate fauna impact assessment (Outback Ecology, 2012)	Single phase survey: March-May 2010 9 survey sites with one additional foraging site Wet pitfall trapping, leaf litter and soil sieving, active searching	Mygalomorph Selenopid Pseudoscorpion Isopod	*Aname* 'MYG208' *Aname* 'MYG209' *Aganippe* 'MYG084' *Karaops sp.* 'Wodgina' *Genus 7/4* *Spherillo sp.*	*Acacia* heath with spinifex *Acacia,* spinifex sandplain habitat *Acacia*, spinifex sandplain habitat Low quartz ridge *Acacia* heath with spinifex Granite outcrop, drainage depression
Abydos DSO Project Atlas Iron Ltd	Abydos Direct Shipping Iron Ore	Wet pitfall trapping, leaf litter/soil sieving,	Scorpion Pseudoscorpion	*Aops* 'Pilbara 2' *Tyrannochthonius* 'near aridus'	

Project Name	Report	Survey details	Taxon	Species	Habitat in which collected
	Project: Terrestrial SRE Assessment (Outback Ecology, 2012)	targeted searching	Isopod Mollusc Myriapod	*Buddelundia 'sp 11'* *Buddelundia 'sp 18'* *'Gen.nov.sp. nov.'* *Antichiropus* 'abydos'	
Mt Dove DSO Project Atlas Iron Limited	Mt Dove DSO Project: Terrestrial Short-range invertebrate endemic fauna assessment (Outback Ecology, 2011)	Wet pitfall trapping, leaf litter collection, soil sieving, ultraviolet spotlighting and targeted searching	Selenopid Pseudoscorpion Isopod	*Karaops* 'Mt Webber' *Troglochernes sp.* 'no. 001' *Tyrannochthonius sp* 'nov. nr aridus' *Buddelundia sp.* '21'	
Mount Webber Iron Ore Project Giralia Resources	Giralia Resources NL Mount Webber Iron Ore Project Short-range Endemic invertebrate survey (Ecologia, 2011)	N/A	Mygalomorph	*Kwonkan* 'MYG200'	South facing slopes
Turner River Hub Atlas Iron Limited	Turner River Hub Project: Terrestrial Short-range Endemic invertebrate fauna baseline survey (Outback Ecology, 2011)	N/A	Selenopid Scorpion Isopod Isopod	*Karaops sp* 'Wodgina' *Karaops sp.* 'Mt Webber' *Urodacus* 'Pilbara 13' *Barrowdillo sp.* nov. 2 *Buddelundia* 'sp. 11'	Calcrete breakaway Ridge (S/E facing), gully Maritime grassland, low *Acacia* heath with spinifex Ridge (S/E facing) Ridge (S/E facing), drainage line
Transport corridors					
Mainline Rail Expansion Project FMG	Mainline Rail Expansion Project: Short-range Endemic Invertebrate fauna survey (Subterranean Ecology, 2012)	Two phase survey: March 2012 and April 2012 80 sample sites within 8 broad habitat classes Leaf and soil sifting and active foraging	Mollusc Isopod	*Quistrachia turneri* *Buddelundia sp.* 11? *Buddelundia sp.* 14FM *Buddelundia sp.* 15 *Buddelundia sp.* 20	Granite dome Steep slopes Marsh Marsh, Acacia thickets Drainage line, steep slopes/outcrop

Project Name	Report	Survey details	Taxon	Species	Habitat in which collected
					s
				Buddelundia sp. 56	Drainage line
			Selenopid	*Buddelundia sp.* 57	Granite domes
			Mygalomorph	*Karaops* indet.	Granite domes, steep slopes
				Synothele sp. 'MYG237'	Steep slope
			Myriapod	*Synothele* indet.	Steep slopes, Mulga
			Cockroach	*Anidiops* indet.	Mulga
				Antichiropus sp. indet.	Granite domes, sandplains
				Nocticola sp. indet.	Granite domes
	Rook East Haul Road Corridor: SRE fauna survey (Outback Ecology, 2012)	Single phase survey Wet pitfall trapping, leaf litter sieving, targeted searching	Mygalomorph	*Aname* 'MYG242'	
				Nemesiidae sp.	
			Pseudoscorpion	*Beierolpium* sp. '8/4'	
				Beierolpium sp. '8/3'	
				Beierolpium sp. '8/2'	
			Isopod	*Buddelundia* sp. 'nov 31'	
Outer Harbour Development Goldsworthy Rail BHPBIO	Outer Harbour Development and Goldsworthy Rail Duplication SRE fauna assessment (Phoenix, 2008)	Single phase survey: October 2008	No SRE fauna recorded		
Murray's Hill Hancock Prospecting	Murray's Hill Transport Corridor. Report for Hancock Prospecting (Phoenix, 2010)	Single phase survey: March 2010	Mygalomorph	*Synothele* 'MYG127'	Breakaway habitat (above medium drainage line) Low stony, rolling hills All habitats surveyed
			Pseudoscorpion	*Synothele* 'MYG160'	
				Beierolpium 8/3	
RGP5 Chichester Deviation Rail BHPBIO	Rail RPG5 Chichester Deviation Short-range Endemic	Two phase survey; April/May 2008 and April to September 2008	No SRE fauna recorded		

Project Name	Report	Survey details	Taxon	Species	Habitat in which collected
	invertebrate survey and A targeted survey for the trapdoor spider *Aurecocrypta* sp. (Ecologia, 2008)	Phase 1 - 18 survey sites Phase 2 – 37 survey sites, Five rounds of sampling for *Aurecocrypta* sp.			
South Flank to Jinidi BHPBIO	A survey of the Short-range Endemic Invertebrate fauna of South Flank to Jinidi (Biota, 2013)	Three phase survey: April 2011, November 2011, January 2012 21 survey sites Dry pit traps, active foraging, soil and litter sieving	Mygalomorph	*Barychelid* sp. 'B1' *Ctenizid* sp. 'C1' *Idiopid* sp. 'I1' *Idiopid* sp. 'I2' *Idiopid* sp. 'I4' *Idiopid* sp. 'I6' *Nemesiid* sp. 'N30' *Nemesiid* sp. 'N34' *Nemesiid* sp. 'N36' *Nemesiid* sp. 'N63' *Nemesiid* sp. 'N64'	Mulga woodlands Gully/plains, Mulga shrublands, spinifex grasslands Valley floors, drainage lines, alluvial fans Mulga woodlands Mulga plains on drainage areas Incised drainage channel Mulga woodlands Mulga woodlands Mulga plains on drainage areas Open plains, gully Gorge/scree/breakaway
Jinidi to Mainline Rail corridor BHPBIO	A survey of Short-range Endemic invertebrates in the Jinidi to Mainline Rail corridor (Biota, 2012)	Single phase survey: July/August 2011 33 survey sites Hand foraging in microhabitats likely to support SRE fauna	Mygalomorph	*Missulena* sp. 'A1' *Conothele* sp. 'C6' *Conothele* sp. 'C13' *Aganippe* sp. 'I1' I*diopid* sp. 'I9' *Kwonkan* sp. 'N38' *Kwonkan* sp. 'N42'	Mulga grove Mulga open shrubland Mulga open shrubland Valley floors, drainage lines, alluvial fans *Acacia* habitats *Eucalyptus*

Project Name	Report	Survey details	Taxon	Species	Habitat in which collected
				Kwonkan sp. 'N43' *Kwonkan* sp. 'N44' *Aname* sp. 'N1' *Aname* sp. 'N16' *Aname* sp. 'N18'	open woodland, Acacia shrubland, hummock grassland Hill ranges *Acacia* woodland over hummock grassland Weeli Wolli Creek *Acacia* habitats *Acacia* habitats Drainage floors, low slopes, plains
Stage B Rail Corridor, Mindy Mindy, Christmas Creek, Mt Lewin, Mt Nicholas Mine Areas FMG	Fauna habitats and fauna assemblages of the proposed FMG Stage B rail corridor and Mindy Mindy, Christmas Creek, Mt Lewin, Mt Nicholas Mine Areas (Biota, 2005)	Two phase survey: March and June/July 2004 Opportunistic and systematic sampling (hand foraging, leaf and soil sieving)	Mygalomorph	*Aganippe* sp. *Synothele* sp.	Stony plain Triodia stony plain
Other studies					
Central Pilbara DEC	Short-range endemism in the Central Pilbara (Durrant, 2011)	Active foraging	Pseudoscorpion Isopod	*Synsphyronus* sp. *Indohya* sp. Isopod gen. nov.	Gully (Mt. Meharry) Gully (Mt. Meharry) Gully (Mt. Meharry)

Appendix B: SRE and potential SRE species recorded within the Study Area (data from WAM and BHP Billiton Iron Ore databases).

Higher Taxon	Species	No. Records
Mygalomorphae	197	
	Aganippe `MYG083`	2
	Aganippe `MYG084`	3
	Aganippe `MYG085`	10
	Aganippe `MYG086`	6
	Aganippe `MYG126`	1
	Aganippe `MYG233`	3
	Aganippe `sp. sigillate`	6
	Aganippe 'sp. MYG384-DNA'	1
	Aname `*armigera* gp.`	3
	Aname `boodarie`	1
	Aname `MYG089`	1
	Aname `MYG093`	3
	Aname `MYG098`	4
	Aname `MYG104`	2
	Aname `MYG106`	1
	Aname `MYG168`	1
	Aname `MYG195`	22
	Aname `MYG205`	3
	Aname `MYG206`	3
	Aname `MYG208`	1
	Aname `MYG209`	1
	Aname aragog	1
	Aname 'Hooded'	6

Higher Taxon	Species	No. Records
	Aname marae	10
	Aname 'Sock'	14
	Aname 'Spray'	1
	Anidiops `MYG083`	17
	Aurecocrypta `MYG246`	2
	Aurecocrypta `paraburdoo`	1
	Aurecocrypta 'MYG315'	1
	Cethegus 'MYG299'	6
	Chenistonia `MYG088 female`	1
	Chenistonia `MYG088`	1
	Conothele `MYG002`	1
	Conothele 'MYG385'	1
	Euoplos `MYG081`	1
	Gaius `Wonmunna large`	4
	Idiommata `MYG128`	2
	Idiommata `MYG247`	1
	Kwonkan `MYG094`	1
	Kwonkan `MYG169`	1
	Kwonkan `MYG200`	1
	Missulena `MYG110`	1
	Missulena `MYG252-DNA`	6
	Missulena `sp. nov. Newman`	3
	Missulena faulderi	3
	Missulena langlandsi	5
	Missulena occatoria-group	3
	Swolnpes `MYG234`	2

Higher Taxon	Species	No. Records
	Synothele `MYG055`	1
	Synothele `MYG114`	1
	Synothele `MYG116`	1
	Synothele `MYG193`	2
	Synothele `MYG237`	1
	Synothele `paraburdoo`	1
	Teyl `MYG027`	2
	Yilgarnia `MYG033`	8
	Yilgarnia `MYG092`	1
	Yilgarnia `MYG197`	4
Selenopidae	*120*	
	Karaops `Mt Webber`	4
	Karaops `sp. BD2`	1
	Karaops `sp. indet. (juv.)`	34
	Karaops `sp. nov. Area C`	1
	Karaops `sp. nov. Mount Dove`	1
	Karaops `sp. nov. Newman`	2
	Karaops `wodgina`	2
	Karaops ARA001-DNA	15
	Karaops ARA002-DNA	2
	Karaops 'ARA003-DNA'	15
	Karaops 'ARA004-DNA'	10
	Karaops 'ARA005-DNA'	31
	Karaops martamarta	2
Pseudoscorpiones	*28*	
	Feaella `PSE007 tealei`	1

Higher Taxon	Species	No. Records
	Feaella `PSE017`	1
	Lechytia `wonmunna`	1
	Oratemnus `PSE018`	2
	Sundochernes `PSE021`	1
	Synsphyronus `PSE006`	1
	Synsphyronus `PSE008`	1
	Synsphyronus `PSE012`	1
	Synsphyronus `PSE069`	2
	Troglochernes `PSE072`	2
	Xenolpium `PSE033`	2
	Xenolpium `PSE063`	12
	Xenolpium `PSE079`	1
Scorpiones	*39*	
	Lychas `kings`	3
	Lychas `marandoo 1`	3
	Lychas `rex`	1
	Lychas `scottae or mjobergi`	1
	Lychas `warramboo 1`	1
	Urodacus `cloudbreak`	10
	Urodacus `Davidson Creek`	4
	Urodacus `hamersley black`	12
	Urodacus `nullagine dark`	2
	Urodacus `nullagine pale`	2
Myriapoda	*99*	
	Antichiropus sp.	2
	Antichiropus `Area C sp. 2`	1

Higher Taxon	Species	No. Records
	Antichiropus `cloudbreak `	1
	Antichiropus `DIP004`	1
	Antichiropus `DIP005`	7
	Antichiropus `DIP006`	1
	Antichiropus `DIP007`	7
	Antichiropus `DIP011`	3
	Antichiropus `DIP012`	2
	Antichiropus `DIP013`	1
	Antichiropus `DIP014`	5
	Antichiropus `DIP015`	2
	Antichiropus `DIP023`	2
	Antichiropus `DIP024`	2
	Antichiropus `DIP025`	4
	Antichiropus `DIP026`	10
	Antichiropus `DIP029`	1
	Antichiropus `DIP031`	5
	Antichiropus `DIP033`	3
	Antichiropus `DIP034`	1
	Antichiropus `DIP035`	3
	Antichiropus `DIP036`	1
	Antichiropus `DIP037`	1
	Antichiropus `DIP038`	1
	Antichiropus `DIP039`	1
	Antichiropus `DIP040`	3
	Antichiropus `DIP042`	1
	Antichiropus `DIP047`	1

Higher Taxon	Species	No. Records
	Antichiropus `indet.`	4
	Antichiropus `OB35_1`	7
	Antichiropus `OB35_2`	2
	Antichiropus `sp. juv.` Jinidi	6
	Antichiropus `sp. juv.` OB19	2
	Antichiropus `Wonmunna`	4
	Antichiropus? `sp. juv`	1
Camaenidae	*60*	
	Quistrachia herberti	11
	Quistrachia turneri	16
	Rhagada angulata	24
	Rhagada pilbarana	9
Isopoda	*269*	
	Buddelundia '10NM'	49
	Buddelundia '16NM'	89
	Buddelundia '36NM'	3
	Buddelundia '49'	69
	Buddelundia '78'	47
	Buddelundia '79'	3
	Buddelundia '80'	1
	Buddelundia sp. nov.	1
	Buddelundiinae 'OB24'	5
	Buddelundiinae 'WN'	2
Grand Total	*144 species*	812 records

Appendix C: Priority Ecological Communities (PECs) within the Study Area

Priority Ecological Communities	Community Description	Category for listing
1. West Angelas cracking clays	Open tussock grasslands of *Astrebla pectinata, A. elymoides, Aristida latifolia*, in combination with *Astrebla squarrosa* and low scattered shrubs of *Sida fibulifera*, on basalt derived cracking-clay loam depressions and flowlines.	Priority 1
2. Weeli Wolli Spring Community	The spring and creekline are noted for their relatively high diversity of stygofauna and this is probably attributed to the large-scale calcrete and alluvial aquifer system associated with the creek.	Priority 1
3. Burrup Peninsula rock pool communities	Calcareous tufa deposits. Interesting aquatic snails.	Priority 1
4. Burrup Peninsula rock pile communities	Comprise a mixture of Pilbara and Kimberley species, communities are different from those of the Hamersley and Chichester Ranges. Short-range endemic land snails.	P1
5. Roebourne Plains Gilgai grasslands	The Roebourne Plains coastal grasslands with gilgai micro-relief occur on deep cracking clays that are self mulching and emerge on depositional surfaces. The Roebourne Plains gilgai grasslands occur on microrelief of deep cracking clays, surrounded by clay plains/flats and sandy coastal and alluvial plains. The gilgai depressions supports ephemeral and perennial tussock grasslands dominated by Sorghum sp. and Eragrostis xerophila (Roebourne Plains grass) along with other native species including *Astrebla pectinata* (barley mitchell grass), *Eriachne benthamii* (swamp wanderrie grass), *Chrysopogon fallax* (golden beard grass) and *Panicum decompositum* (native millet). Restricted to the Karratha area, this community differs from the surrounding clay flats of the Horseflat land system which are dominated by *Eragrostis xerophila* and other perennial tussock grass species (*Eragrostis* mostly).	P1
6. Stony Chenopod association of the Roebourne Plains area	The community is dominated by *Eragrostis xerophila* and chenopods growing in saline clay soils with dense surface strew of pebbles and cobbles. The association appears to be uncommon.	P1
12. Brockman Iron cracking clay communities	Rare tussock grassland dominated by Astrebla lappacea in the Hamersley Range, on the Newman land system.	P1

Priority Ecological Communities	Community Description	Category for listing
	Tussock grassland on cracking clays-derived in valley floors, depositional floors. This is a rare community and the landform is rare. Known from near West Angeles, Newman, Tom Price and boundary of Hamersley and Brockman Stations.	
16. Freshwater claypans of the Fortescue Valley	Important for waterbirds, invertebrates and some poorly collected plants. *Eriachne* spp., *Eragrostis* spp. grasslands. Unique community, has few Coolabah.	Priority 1
17. Fortescue Marsh (Marsh land system)	It is regarded as the largest ephemeral wetland in the Pilbara. It is a highly diverse ecosystem with fringing mulga woodlands (on the northern side), samphire shrublands and groundwater dependant riparian ecosystems. It is an arid wetland utilized by waterbirds and supports a rich diversity of restricted aquatic and terrestrial invertebrates.	Priority 1
20. Coolibah–lignum flats: *Eucalyptus victrix* over *Muehlenbeckia* community; sub type 1, 2 and 3	Coolibah and mulga (*Acacia aneura*) woodland over lignum and tussock grasses on clay plains (Coondewanna Flats and Wanna Munna Flats). Coolibah woodlands over lignum (*Muehlenbeckia florulenta*) over swamp wandiree. Coolibah woodland over lignum and silky browntop (*Eulalia aurea*).	P3(i) P1 P1
21. Four plant assemblages of the Wona Land system	A system of basalt upland gilgai plains with tussock grasslands occurs throughout the Chichester Range in the Chichester-Millstream National Park, Mungaroona Range Nature Reserve and on adjacent pastoral leases. There are a series of community types identified within the Wona land system gilgai plains that are considered susceptible to known threats such as grazing or have constituent rare/restricted species, as follows: Cracking clays of the Chichester and Mungaroona Range. This grassless plain of stony gibber community occurs on the tablelands with very little vegetative cover during the dry season, however during the wet a suite of ephemerals/annuals and short-lived perennials emerge, many of which are	Priority 1

Priority Ecological Communities	Community Description	Category for listing
	poorly known and range-end taxa. Annual Sorghum grasslands on self mulching clays. This community appears very rare and restricted to the Pannawonica-Robe valley end of Chichester Range. Mitchell grass plains (*Astrebela* spp.) on gilgai Mitchell grass and Roebourne Plain grass (*Eragrostis xerophila*) plain on gilgai (typical type, heavily grazed	Priority 1 Priority 3(iii) Priority 3(iii)
24. Stony saline plains of the Mosquito Land system	Described as saltbush community of the duplex plains - Mosquito Creek series (Nullagine). Known to contain two endemic Acacias. One occurrence known on stony plains, and one on rocky ground.	Priority 3(iii)
25. Fortescue Valley Sand dunes	These red linear sand dune communities lie on the Divide Land system at the junction of the Hamersley Range and Fortescue Valley, between Weeli Wolli Creek and the low hills to the west. A small number are vegetated with *Acacia dictyophleba* scattered tall shrubs over *Crotalaria cunninghamii*, *Trichodesma zeylanicum* var. *grandiflorum* open shrubland. They are regionally rare, small and fragile and highly susceptible to threatening processes.	Priority 3(iii)
27. Horseflat Land system of the Roebourne Plains	The Horseflat land system of the Roebourne Plains are extensive, weakly gilgaied clay plains dominated by tussock grasslands on mostly alluvial non-gilgaied, red clay loams or heavy clay loams. Perennial tussock grasses include *Eragrostis xerophila* (Roebourne Plains grass) and other *Eragrostis* spp., *Eriachne* spp. and *Dichanthium* spp. The community also supports a suite of annual grasses including *Sorghum* spp. and rare *Astrebela* spp. The community extends from Cape Preston to Balla Balla surrounding the towns of Karratha and Roebourne.	Priority 3(iii)
28.Invertebrate assemblages (Errawallana	Geologically distinct. Sherlock River system. Permanent spring-fed creek. Has atypical invertebrate community.	Priority 4(ii)

Priority Ecological Communities	Community Description	Category for listing
Spring type) Coolawanya Station		
30.Stygofaunal communities of the Western Fortescue Plains freshwater aquifer	A unique assemblage of subterranean invertebrate fauna.	Priority 4(ii)

Appendix D: Fauna habitat types and descriptions (Biologic 2014b)

Habitat	Distinguishing habitat characteristics	Occurrence of the habitat within the Study Area	Extent of the habitat outside Study Area	Photo
DEGRADED/ CLEARED AREAS				
Artificial Habitats	Artificial habitats are habitats that have being altered by human activity. Within the habitat mapping these areas are called “Cleared” and “Artificial Northern Quoll Habitat”. The latter areas are known to support Northern Quoll.	These artificial habitats are scattered throughout the landscape and include areas such as villages, quarries, rubbish dumps and structures such as culverts. The areas marked as “Artificial Northern Quoll Habitat” are abandoned quarries situated along BHP Billiton Iron Ore’s Mainline Rail.	Camps are scattered throughout the Pilbara and rail and roads dissect much of the Pilbara. Other disturbance is common in the Pilbara but form a very small percentage of the entire Pilbara.	
PLAINS				

Habitat	Distinguishing habitat characteristics	Occurrence of the habitat within the Study Area	Extent of the habitat outside Study Area	Photo
Calcrete Areas	The vegetation occurring on calcrete differs from that of the surroundings, largely due to the differences in soil type. The substrate is white and consists of skeletal soil, gravel and small jagged pebbles. Trees are isolated and the shrub layer tends to be sparse, with a low hummock grassland (*Triodia* sp.) dominant.	This habitat type is mostly low in the landscape and occurs mostly in the central part of the Study Area. This habitat is most common around Jinidi and Mining Area C.	An uncommon habitat type that is found throughout the Pilbara in small isolated areas. Calcrete Areas are small in their total size when compared to other habitats. Not well represented in National Parks in the Pilbara.	
Gilgai (cracking clay)	Often associated with tussock grasses. Cracking clay soils, usually contain weak crabhole (gilgai) microrelief, and which are generally saline at depth. Surface mantles are absent or common to abundant as pebbles and cobbles of ironstone, basalt and other rocks.	This habitat type is low in the landscape and occurs in patches in the north and central areas of the Study Area. There are two distinct locations for this habitat types, they are west of Mining Area C and just north of the Fortescue Marsh in BHP Billiton Iron Ore's Mainline Rail.	An uncommon habitat in the Pilbara. Areas of this habitat occur north of the Marsh and along the coast near Karratha. Not well represented within National Parks in the Pilbara.	

Habitat	Distinguishing habitat characteristics	Occurrence of the habitat within the Study Area	Extent of the habitat outside Study Area	Photo
Granite domes & boulders (tors)	This habitat occurs where the surrounding material has eroded, exposing large domes and boulders. Boulder piles and exfoliating rock on the granite domes provide excellent crevices and cracks for fauna to inhabit. Vegetation is sparse through these areas due to the lack of soil availability. These habitats are mapped separately, but combined together in this table. They are almost always surrounded by sand plains.	This habitat type is high in the relation to the surrounding landscape and occurs in the north of the Study Area. The habitat is common and and occurs mostly in BHP Billiton Iron Ore's Mainline Rail.	A reasonably common habitat, patchily distributed through the northern Pilbara. They tend to be isolated features in the landscape varying in size, height and connectivity thus some patches could be considered more important than others. Not well represented in National Parks in the Pilbara.	
Hardpan Plain	Gently inclined alluvial plains with shallow loams. Typically covered by low scattered woodlands of Mulga in groves arranged at right angles to the direction of sheet water flow. In areas where the hardpan is close to the surface and soil depth is insufficient to support trees, an open scrub may persist.	This habitat type is the low in the landscape and is not a regular feature in the Study Area. This habitat is mostly in BHP Billiton Iron Ore's Mudlark tenement and west of Mining Area C.	Common habitat throughout the Pilbara, particular within and south of the Hamersley Range. Occurs within National Parks in the Pilbara.	

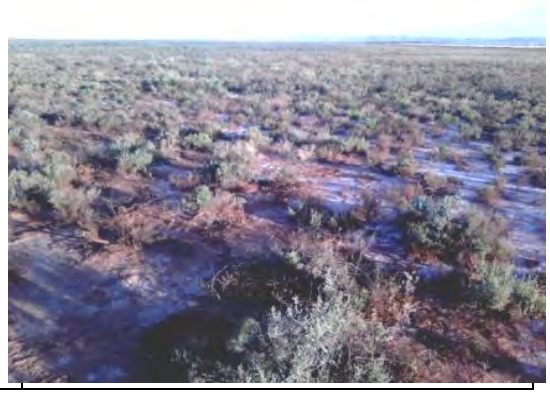
Habitat	Distinguishing habitat characteristics	Occurrence of the habitat within the Study Area	Extent of the habitat outside Study Area	Photo
Mulga	This habitat includes woodlands and other ecosystems in which Mulga (*Acacia aneura*) is dominant, either as the principal *Acacia* species or mixed with others. It consists of disintegrating groves on stony soils with spinifex. This habitat type is grouped with other habitat occurring on the plains; however it is noted that small groves of Mulga occur on ridgelines.	Generally low in the landscape and fairly common in the southern half of the Study Area. This habitat is situated in most of the BHP Billiton Iron Ore's leases including around Mining Area C.	Common habitat throughout the central and southern Pilbara. Mulga woodlands cover much of the region and extend south and east across the central arid zone of the continent. Occurs within National Parks in the Pilbara.	
Sand Dune	Sandridges of loose sand supporting similar species to the surrounding sandplain, dominated by *Triodia* spp. grasslands and areas of *Acacia* spp. shrubland occurring in the Study Area just south of the Fortescue Marsh. Linear ridges of raised relief relative to the surrounding Sand Plains.	Generally low in the landscape and uncommon in the Study Area. This habitat is situated in BHP Billiton Iron Ore's Marillana tenement and Mainline Rail.	Limited extent outside of the Study Area and in the Pilbara. A dune field exists to the east of BHP Billiton Iron Ore's Coondiner and Caramulla tenements. Not represented in National Parks in the Pilbara.	
Sand Plain	Sand Plain habitat is characterised by relatively deep sandy soils supporting dense spinifex grasslands and sparse shrubs. This habitat transitions into patches of Mulga in places. This habitat often occurs as terraces	Generally low in the landscape and common in the north of the Study Area, particularly along BHP Billiton Iron Ore's Mainline Rail and south east towards BHP Billiton Iron Ore's Carramulla tenement.	Common habitat throughout the Pilbara, especially in the north. Sand Plain areas are the predominant habitat type within the Chichester subregion. The south east of the Study Area	

Habitat	Distinguishing habitat characteristics	Occurrence of the habitat within the Study Area	Extent of the habitat outside Study Area	Photo
	along Major Drainage Lines.		approaches the Little Sandy Desert where areas of Sand Plain are extensive. Not well represented in National Parks in the Pilbara.	
Sandy/ Stony Plain	These are predominantly stony plains with localised depositions of sand.	Generally low in the landscape and common in the north of the Study Area, particularly along BHP Billiton Iron Ore's Mainline Rail.	Common habitat throughout the Pilbara, especially in the north. Occurs within National Parks in the Pilbara.	

Habitat	Distinguishing habitat characteristics	Occurrence of the habitat within the Study Area	Extent of the habitat outside Study Area	Photo
Stony plain	These are erosional surfaces of gently undulating plains, ridges and associated footslopes. Mainly support hard spinifex (and occasionally soft spinifex) with a mantle of gravel and pebbles.	Generally low in the landscape and common throughout the Study Area, particularly in the north along BHP Billiton Iron Ore's Mainline Rail.	Common habitat throughout the Pilbara, especially in the north. Occurs within National Parks in the Pilbara.	

Habitat	Distinguishing habitat characteristics	Occurrence of the habitat within the Study Area	Extent of the habitat outside Study Area	Photo
RANGES				
Crest/ Slope	These fauna habitats tend to be more open and structurally simple due to their recent depositional history than other fauna habitats, and are dominated by varying species of spinifex. A common feature of these habitats is a rocky substrate, often with exposed bedrock, and skeletal red soils. These are usually dominated by *Eucalyptus* woodlands, *Acacia* and *Grevillea* scrublands and *Triodia* spp. low hummock grasslands.	This habitat type is high in the landscape and occurs throughout the Study Area. This habitat is found within most of BHP Billiton Iron Ore's lease when Ranges and hills are present.	Extensive areas of Crest/Slope habitat occur throughout the Pilbara. Occurs within National Parks in the Pilbara.	
Gorge/ Gully	Gorges and gullies are rugged, steep-sided valleys incised into the surrounding landscape. Gorges tend to be deeply incised, with vertical cliff faces, while gullies are more open (but not as open as Minor Drainage Lines). Caves and rock pools are most often encountered in this habitat type. Vegetation can be dense and complex in areas of soil deposition or sparse and simple where erosion has occurred.	This habitat type is high in the landscape and occurs throughout the Study Area with the exception of BHP Billiton Iron Ore's Mainline Rail. The habitat occurs in most of BHP Billiton Iron Ore's leases containing large hills and Ranges such as around Mining Area C and Orebody 18 (within Newman mining Operation Tenure).	A reasonably common habitat in the Pilbara, usually associated with ranges; however, because this habitat type is narrow and linear, they only represent a small proportion of the total land area. Occurs within National Parks in the Pilbara.	

Habitat	Distinguishing habitat characteristics	Occurrence of the habitat within the Study Area	Extent of the habitat outside Study Area	Photo
Minor Drainage Line	Located within the minor gullies and depressions, generally through the Crest/Slope habitat. Consists primarily of *Acacia* low shrubland. The understorey generally lacks density and often consists solely of sparse tussock grassland, often including the weed Buffel Grass **Cenchrus ciliaris* where it has been introduced. The substrate can be sandy in places but generally consists of a skeletal loam gravel or stone.	This habitat type is high in the in the landscape, generally running off ridgelines, and fairly common in the Study Area. This habitat is in most of BHP Billiton Iron Ore's leases.	Common habitat throughout the central and southern Pilbara. Mostly associated with the Hamersley and Chichester Ranges. Occurs within National Parks in the Pilbara.	
RIPARIAN ZONES				
Drainage Area	Characterised by *Eucalyptus xerothermica* and *Corymbia hamersleyana* woodland over broad-leafed *Acacia* shrubland on sandy loam soils sometimes with exposed rocky areas. These can have high vegetation density, complexity and diversity, and because they tend to occur on accretional or depositional areas, and often have deeper and richer soils than other fauna habitats. Grasses tend to be dominated by tussock grasses rather than spinifex, or the weed Buffel Grass **Cenchrus ciliaris*.	This habitat type is low in the landscape and occurs throughout the Study area but mostly in the central areas and to the south. This habitat is located in most of BHP Billiton Iron Ore's leases and in particular around Mining Area C, Whaleback and the ore bodies to the east.	A common habitat in central, south, and eastern parts of the Pilbara. Occurs within National Parks in the Pilbara.	

Habitat	Distinguishing habitat characteristics	Occurrence of the habitat within the Study Area	Extent of the habitat outside Study Area	Photo
Drainage Line	Drainage Lines are low lying, linear, gently sloping areas and tend not to support moderately dense Eucalypt forest (unlike Major Drainage Line). This habitat tends not to be associated with ridgelines and hills (unlike Minor Drainage Line).	This habitat type is low in the landscape and occurs mostly in the north of the Study Area. This habitat crosses BHP Billiton Iron Ore's Mainline Rail in numerous locations.	A common habitat in the Pilbara occurring mostly in the north throughout the Chichester subregion. Occurs within National Parks in the Pilbara.	
Fortescue Marsh samphire	Samphire is generally considered a hostile environment with extreme heat and salinity in waterlogged soils. The vegetation consists of members of the family Chenopodiaceae (genus *Tecticornia*).	This habitat type is low in the landscape and occurs in a small patch in the central part of the Study Area. This single patch occurs where BHP Billiton Iron Ore's Mainline Rail passes through the Fortescue Marsh.	An uncommon habitat in the Pilbara but is fairly extensive around the Fortescue Marsh. Samphire are most commonly associated with coastal saline environments and these are quite common and extensive. Not represented within National Parks.	

Habitat	Distinguishing habitat characteristics	Occurrence of the habitat within the Study Area	Extent of the habitat outside Study Area	Photo
Major Drainage Line	Major Drainage Lines comprise mature River Red Gums, Coolibahs and stands of Silver Cadjeput over river pools. Open, sandy or gravelly riverbeds characterise this habitat type. In ungrazed areas, the vegetation adjacent to the main channel or channels is denser, taller and more diverse than adjacent terrain and can include reedbeds around pools.	This habitat type is the lowest in the landscape and fairly common in the Study Area. This habitat is in most of BHP Billiton Iron Ore's leases. Due to its narrow linear nature, this habitat does not represent a large area. *Melaleuca* forest occurs along the Major Drainage Line where the water table is reasonably close to the surface. While not a common habitat in the Pilbara, it does occur at Weeli Wolli Springs, Coondiner Gorge System and Marillana Creek in the Study Area.	Common habitat throughout the Pilbara and are generally associated with the major rivers in the Pilbara, such as the Fortescue, De Grey, Yule and Turner rivers. However, because they tend to be relatively narrow, linear features, they only represent a small proportion of the total land area. These water bodies are, however, significant features in the region, by virtue of their water points. Occurs within National Parks in the Pilbara.	 

Appendix E: Vegetation mapping data (from Onshore 2014)

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
HILL CRESTS AND UPPER HILL SLOPES			
HC Tbr AiAmm	*Triodia* Closed Hummock Grassland	Closed Hummock Grassland of *Trioida brizoides* with Scattered Tall Shrubs of *Acacia inaequilatera* and *Acacia marramamba* on red sandy loam on hill crests	23.90
HC TpTw El NhrOs	*Triodia* Closed Hummock Grassland	Closed Hummock Grassland of *Triodia pungens* and *Triodia wiseana* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* over Scattered Shrubs of *Newcastelia* sp. Hamersley Range (S. van Leeuwen 4264) and *Olearia stuartii* on brown silty loam on high sloping hill crest of Mount Robinson	61.96
HC TeTl ArAiAb	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia epactia* and *Trioida lanigera* with Open Shrubland of *Acacia robeorum, Acacia inaequilatera* and *Acacia bivenosa* on brown sandy loam on low dolerite/basalt hills	121.63
HC Te AiAanAarr	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia epactia* with High Open Shrubland of *Acacia inaequilatera* and *Acacia ancistrocarpa* over Low Open Shrubland of *Acacia arrecta* on brown sandy loam on low undulating hills	161.45
HC Te AdCc Gw	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia epactia* with Open Shrubland of *Abutilon* sp. Dioicum and *Cajanus cinereus* and Scattered Tall Shrubs of *Grevillea wickhamii* subsp. *hispidula* on brown silty loam on dolerite ridges	33.20
HC TpTwTs ElCh AarGoKv	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens, Triodia wiseana* and *Triodia* sp. Shovelanna Hill (S. van Leeeuwin 3835) with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* over Low Shrubland of *Acacia arida, Gompholobium oreophilum* and *Keraudrinia velutina* subsp. *elliptica* on red brown loam on hills	5,284.70
HC Tw Ah EkEgCh	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia wiseana* with Shrubland of Acacia hamersleyensis and Open Mallee of *Eucalyptus kingsmillii* subsp. *kingsmillii, Eucalyptus gamophylla* and *Corymbia hamersleyana* (mallee form) on red brown loam and silty loam on hill crests	4,757.58
HC TwTbrTp ElCh AmaGwAb	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia wiseana, Triodia brizoides* and *Triodia pungens* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* over High Open Shrubland of *Acacia maitlandii, Grevilllea wickhamii* subsp. *hispidula* and *Acacia bivenosa* on red brown sandy loam on hill crests and upper hill slopes	9,186.80

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
HC TwTsTp ElCh Ah	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia wiseana, Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) and *Triodia pungens* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamerselyana* over Open Shrubland of *Acacia hamersleyensis* on red brown clay loam on hill crests and upper hill slopes	7,908.09
HC TpTs El AaAkAsi	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* and *Triodia* sp. Shovelanna Hill with Scattered Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* over Scattered Tall Shrubs of *Acacia aptaneura, Acacia kempeana* and *Acacia sibirica* on red brown loam on hill crests, hill slopes and breakaway slopes	952.34
HC TsTp EkEg	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia* sp. Shovelanna Hill and *Trioidia pungens* with Very Open Mallee of *Eucalyptus kingsmillii* subsp. *kingsmillii* and *Eucalyptus gamophylla* on red sandy loam on hill slopes and hill crests	1,193.96
HC Tw AiAb IrSao	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia wiseana* with High Open Shrubland of *Acacia inaequilatera* and *Acacia bivenosa* over Low Open Shrubland of *Indigofera rugosa* and *Senna artemisioides* subsp. *oligophylla* on red silty loam on dolerite hill crests	10,642.85
HC TbTp ElCh AmoApy	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia basedowii* and *Triodia pungens* with Low Open Woodland of *Eucalyptus leucophloia* and *Corymbia hamersleyana* over Open Shrubland of *Acacia monticola* and *Acacia pyrifolia* var. *pyrifolia* on brown sandy loam on hill slopes and hill crests	277.84
HC TbTp El AatAmmAma	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia basedowii* and *Triodia pungens* with Scattered Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* over Open Shrubland of *Acacia atkinsiana, Acacia marramamba* and *Acacia maitlandii* on brown sandy loam on hill crests and hill slopes	2,075.68
HC TsTp ElAa PcGs	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia* sp. Shovelanna Hill and *Triodia pungens* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Acacia aptaneura* and Very Open Herbs of *Ptilotus calostachyus* and *Goodenia stobbsiana* on red brown sandy loam on hill crests and hill slopes	204.06
HC Tp AaAprAca EllEfrEex	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia pungens* with High Open Shrubland of *Acacia aptaneura, Acacia pruinocarpa* and *Acacia catenulata* subsp. *occidentalis* over Open Shrubland of *Eremophila latrobei* subsp. *latrobei, Eremophila fraseri and Eremophila exilifolia* on orange red sandy loam on laterised hills and rises	185.66
GORGES AND GULLIES			

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
GG CcoCfeEl EmuTmbCa	*Callitris* Low Open Forest	Low Open Forest of *Callitris columellaris*, *Corymbia ferriticola* and *Eucalyptus leucophloia* subsp. *leucophloia* over Open Tussock Grassland of *Eriachne mucronata, Themeda* sp. Mt Barricade (M.E. Trudgen 2471) and *Cymbopogon ambiguus* and Very Open Hummock Grassland of *Triodia pungens* on orange brown loam on upper gorges	582.91
GG AadAca AmuAaAte Tp	*Acacia* Low Open Forest	Low Open Forest of *Acacia adsurgens* and *Acacia catenulata* subsp. *occidentalis* over Open Shrubland of *Acacia mulganeura*, *Acacia aptaneura* and *Acacia tenuissima* over Very Open Hummock Grassland of *Triodia pungens* on skeletal red loams in deeply incised gullies	85.63
GG AaAcaEl DpaEtEj TpTw	*Acacia* Low Woodland	Low Woodland of *Acacia aptaneura, Acacia catenulata* subsp. *occidentalis* and *Eucalyptus leucophloia* subsp. *leucophloia* over Open Shrubland of *Dodonaea pachyneura, Eremophila tietkensii* and *Eremophila jucunda* subsp. *pulcherrima* over Open Hummock Grassland of *Triodia pungens* and *Triodia wiseana* on red brown loam on breakaway slopes, cliff lines and minor gorges	1,262.37
GG CfeElFb AhDvmAha CaEmuTmb	*Corymbia* Low Woodland	Low Woodland of *Corymbia ferriticola, Eucalyptus leucophloia* subsp. *leucophloia* and *Ficus brachypoda*over Open Shrubland of *Acacia hamersleyensis, Dodonaea viscosa* subsp. *mucronata* and *Astrotricha hamptonii* over Open Tussock Grassland of *Cymbopogon ambiguus, Eriachne mucronata* and *Themeda* sp. Mt Barricade on red brown loam along clifflines and gorges	3,588.29
GG TtEmuTmb ElChCfe AtpGrPl	*Themeda* Tussock Grassland	Tussock Grassland of *Themeda triandra, Eriachne mucronata* and *Themeda* sp. Mt Barricade with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia, Corymbia hamersleyana* and *Corymbia ferriticola* over High Shrubland of *Acacia tumida* var. *pilbarensis, Gossypium robinsonii* and *Petalostylis labicheoides* on red brown sandy loam in narrowly incised rocky drainge lines	943.63
GG Tp ElCfe Dpa	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* with Low Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia ferriticola* over Open Shrubland of *Dodonaea pachyneura* on red brown sandy clay loam in gullies	53.81
GG Tp CfeFbAca DpaAh	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia pungens* with Low Open Woodland of *Corymbia ferriticola, Ficus brachypoda* and *Acacia catenulata* subsp. *occidentalis* over High Open Shrubland of *Dodonea pachyneura* and *Acacia hamerselyensis* on red sandy clay loam in gullies and on breakaways	196.14
HILL SLOPES AND LOW UNDULATING HILLS			
HS AcaAaApr SaEllAb TbrTw	*Acacia* Low Open Forest	Low Open Forest of *Acacia catenulata* subsp. *occidentalis, Acacia aptaneura* and *Acacia pruinocarpa* over Open Shrubland of *Scaevola acacioides, Eremophila latrobei* subsp. *latrobei* and *Acacia bivenosa* over Open Hummock Grassland of *Triodia brizoides* and *Triodia wiseana* on red brown clay loam on breakaways and steep hill slopes	3,137.73

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
HS AaApr EjAmmCco TwTp	*Acacia* Low Woodland	Low Woodland of *Acacia aptaneura* and *Acacia pruinocarpa* over Shrubland of *Eremophila jucunda* subsp. *pulcherrima, Acacia marramamba* and *Codonocarpus cotinifolius* over Open Hummock Grassland of *Triodia wiseana* and *Triodia pungens* on red brown loam on hill slopes	714.57
HS AaAh Sgl TaTp	*Acacia* High Shrubland	High Shrubland of *Acacia aptaneura* and *Acacia hamersleyensis* over Shrubland of *Senna glutinosa* subsp. *x luerssenii* over Very Open Hummock Grassland of *Triodia angusta* and *Triodia pungens* on red sandy loam on hill slopes	1.43
HS AaAteApr TaTp Ab	*Acacia* High Shrubland	High Shrubland of *Acacia aptaneura, Acacia tetragonophylla* and *Acacia pruinocarpa* over Open Hummock Grassland of *Triodia angusta* and *Triodia pungens* with Open Shrubland of *Acacia bivenosa* on brown sandy loam on rocky hill slopes	177.57
HS Aci Efr Tw	*Acacia* High Open Shrubland	High Open Shrubland of *Acacia citrinoviridis* with Open Shrubland of *Eremophila fraseri* over Very Open Hummock Grassland of *Triodia wiseana* on red brown clay loam with calcrete stones in two small stands on hills fringing the western edge of Weeli Wolli Creek	12.03
HS ArhEex Apr TsTw	*Acacia* Open Shrubland	Open Shrubland of *Acacia rhodophloia* and *Eremophila exilifolia with* High Open Shrubland of *Acacia pruinocarpa* over Open Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) and *Triodia wiseana* on red brown clay loam on the lower slope on a stony hill	1.86
HS AbAsy TseTaTb	*Acacia* Low Open Heath	Low Open Heath of *Acacia bivenosa* and *Acacia synchronicia* over Hummock Grassland of *Triodia secunda, Triodia angusta* and *Triodia basedowii* on brown sandy loam on stony lower slopes and plains	36.34
HS Tb El AbAiPl	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* over Open Shrubland of *Acacia bivenosa, Acacia inaequilatera* and *Petalostlyis labicheoides* on red brown sandy loam on hill slopes	146.07
HS TbTeTw AtpGw AanAbAac	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia basedowii, Triodia epactia* and *Triodia wiseana* over High Open Shrubland of *Acacia tumida* subsp. *pilbarensis* and *Grevillea wickhamii* over Low Open Shrubland of *Acacia ancistrocarpa, Acacia bivenosa* and *Acacia acradenia* on red brown silty/sandy loam on undulating low hills and stony plains	5,515.81
HS TbrTw El AbPoSgg	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia brizoides* and *Triodia wiseana* with Scattered Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* over Scattered Low Shrubs of *Acacia bivenosa, Ptilotus obovatus* and *Senna glutinosa* subsp. *glutinosa* on brown silty loam on scree slopes	156.97
HS TbrTeTw Ch Aac	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia brizoides*, *Triodia epactia* and *Triodia wiseana* with Low Open Woodland of *Corymbia hamersleyana* over High Open Shrubland of *Acacia acradenia* on brown silty loam on hill slopes	41.18

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
HS TeTw Ch AiAan	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia epactia* and *Triodia wiseana* with Low Open Woodland of *Corymbia hamersleyana* over High Open Shrubland of *Acacia inaequilatera* and *Acacia ancistrocarpa* on red brown sandy loam on granite and quartz hill slopes and footslopes	1,624.88
HS TeTbTw AorAi	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia epactia, Triodia basedowii* and *Triodia wiseana* with High Open Shrubland of *Acacia orthocarpa* and *Acacia inaequilatera* on brown loamy sand on low undulating granite hills	3,974.13
HS TpTb ElCh EmuElAh	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* and *Triodia basedowii* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* over Open Tussock Grassland of *Eriachne mucronata, Eriachne lanata* and *Aristida holathera* subsp. *holathera* on red sandy loam on hill slopes	180.32
HS Tp AaGb AanAbAa	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* with High Open Shrubland of *Acacia aptaneura* and *Grevillea berryana* over Shrubland of *Acacia ancistrocarpa, Acacia bivenosa* and *Acacia aptaneura* on brown loamy sand on low undulating chert hills	5.59
HS Tp Ir Gp	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* with Low Shrubland of *Indigofera rugosa* and Scattered Low Trees of *Grevillea pyramidalis* on brown sandy loam on quartz and granite hill slopes	79.00
HS TpTbTe Ch Ai	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens, Triodia basedowii* and *Triodia epactia* with Scattered Low Trees of *Corymbia hamersleyana* over Scattered Tall Shrubs of *Acacia inaequilatera* on brown sandy clay loam on dolerite hill slopes	1,286.71
HS TsTwTp ElCh AhiAad	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835), *Triodia wiseana* and *Triodia pungens* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* over Low Open Shrubland of *Acacia hilliana* and *Acacia adoxa* var. *adoxa* on red brown sandy loam on hill slopes	42,184.16
HS Tw Cd AarAsiAb ArhAprAa	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia wiseana* with Low Open Woodland of *Corymbia deserticola* subsp. *deserticola* over Low Shrubland of *Acacia arrecta, Acacia sibirica* and *Acacia bivenosa* in red loamy sand on hill slopes with Low Open Woodland of *Acacia rhodophloia, Acacia pruinocarpa* and *Acacia aptaneura* on red sandy loam on rocky hill crests	908.66
HS Tw ElChHc AanAbAa	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia wiseana* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia, Corymbia hamersleyana* and *Hakea chordophylla* and Open Shrubland of *Acacia ancistrocarpa, Acacia bivenosa* and *Acacia aptaneura* on red sandy loam on hill slopes	3,631.58

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
HS TlTwTe AtpAerAcc AiAor	*Triodia* Hummock Grassland	Hummock Grassland of *Trioida lanigera, Triodia wiseana* and *Triodia epactia* with High Shrubland of *Acacia tumida* var. *pilbarensis, Acacia eriopoda* and *Acacia colei* var. *colei* in swales with High Open Shrubland of *Acacia inaequilatera* and *Acacia orthocarpa* on rises on red brown silty clay/sandy loam on undulating hills and swales	1,202.11
HS Tb	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia basedowii* on red sandy loam on low hills	198.29
HS TbrTw AiAprHc EfrEpl	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia brizoides* and *Triodia wiseana* with High Open Shrubland of *Acacia inaequilatera, Acacia pruinocarpa* and *Hakea chordophylla* over Open Shrubland of *Eremophila fraseri* and *Eremophila platycalyx* subsp. *pardalota* on red loamy sand on lower hill slopes and footslopes	16.82
HS Tbr El Er	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia brizoides* with Scattered Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* over Open Mallee of *Eucalyptus repullulans* on gently inclined low breakaway hill slope	29.88
HS TpTs CdEl AanAbAte	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* and *Triodia* sp. Shovelanna Hill with Low Open Woodland of *Corymbia deserticola* subsp. *deserticola* and *Eucalyptus leucophloia* subsp. *leucophloia* over Open Shrubland of *Acacia ancistrocarpa, Acacia bivenosa* and *Acacia tenuissima* on red loamy sand on hill slopes and footslopes	4,479.30
HS Tp Ama Tt	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* with Shrubland of *Acacia maitlandi*i over Very Open Tussock Grassland of *Themeda triandra* on brown loam on low basalt hills	71.39
HS TsTbrTb ElAa Ab	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835), *Triodia brizoides* and *Triodia basedowii* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Acacia aptaneura* over Open Shrubland of *Acacia bivenosa* on red loamy sand on hill slopes	131.54
HS TwTbrTs ElExCh PcaPasAhi	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia wiseana, Triodia brizoides* and *Triodia* sp. Shovellana Hill with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia, Eucalyptus xerothermica* and *Corymbia hamersleyana* over Low Open Shrubland of *Ptilotus calostachyus, Ptilotus astrolasius* and *Acacia hilliana* on brown loam on eroded outcroping upper slopes and crests	13,910.33
HS TwTpTs El AprAaAan	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia wiseana, Triodia pungens* and *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* over Open Shrubland of *Acacia pruinocarpa, Acacia aptaneura* and *Acacia ancistrocarpa* on red brown loam on plains and low hills	1,321.63

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
HS TmTp ElCh MvSarKv	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia melvillei* and *Triodia pungens* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* over Low Open Shrubland of *Mirbelia viminalis, Sida arenicola* and *Keraudrenia velutina* subsp. *elliptica* on red skeletal clay loam on steep slopes.	475.16
HS Ts	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) on red brown sandy loam on hill slopes	1,724.82
HS TsTw Eg GwSggAb	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) and *Triodia wiseana* with Very Open Mallee of *Eucalyptus gamophylla* over Open Shrubland of *Grevillea wickhamii* subsp. *hispidula, Senna glutinosa* subsp. *glutinosa* and *Acacia bivenosa* on red brown sandy clay loam on hill slopes	1,029.87
HS TsTp AaAprAci AaEllSgl	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia* sp. Shovelanna Hill and *Triodia pungens* with High Open Shrubland of *Acacia aptaneura, Acacia pruinocarpa* and *Acacia citrinoviridis* and Open Shrubland of *Acacia aptaneura, Eremophila latrobei* subsp. *latrobei, Senna glutinosa* subsp. x *luerssenii* on red loamy sand on upper hill slopes	1,535.13
HS TwTs HcAbGw AptAhi	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia wiseana* and *Triodia* sp. Shovelanna Hill with Open Shrubland of *Hakea chordophylla, Acacia bivenosa* and *Grevillea wickhamii* subsp. *hispidula* over Low Open Shrubland of *Acacia pytchophylla* and *Acacia hilliana* on red brown sandy loam on upper hill slopes and hill crests	1,120.26
HS TwTpTbr El Ep	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia wiseana, Triodia pungens* and *Triodia brizoides* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* over Open Mallee of *Eucalyptus pilbarensis* on red brown loam on steep hill slopes	1,569.66
HS Tp El SggGwEll	*Triodia* Open Hummock Grassland	Hummock Grassland of *Triodia pungens* with Scattered Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* and Scattered Shrubs of *Senna glutinosa* subsp. *glutinosa, Grevillea wickhamii* subsp. *hispidula*and *Eremophila latrobei* subsp. *latrobei* on skeletal orange brown loam on stony hill slopes	379.68
HS TpTb ElAaAca SsSglEcu	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia pungens* and *Triodia basedowii* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia, Acacia aptaneura* and *Acacia catenulata* subsp. *occidentalis* over Open Shrubland of *Senna stricta, Senna glutinosa* subsp. x *luerssenii* and *Eremophila cuneifolia* on orange sandy loam on hill slopes	72.67

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
HS TbTs AsyAaAte EcuMgSl	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia basedowii* and *Triodia* sp. Shovelanna Hill with Open Shrubland of *Acacia synchronicia, Acacia aptanerua* and *Acacia tetragonophylla* over Low Open Shrubland of *Eremophila cuneifolia, Maireana georgei* and *Solanum lasiophyllum* on red sandy loam on floodplains and lower hill slopes	530.91
HS Tp AaApr EfrAmmSgl	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia pungens* with Low Open Woodland of *Acacia aptaneura* and *Acacia pruinocarpa* over Open Shrubland of *Eremophila fraseri, Acacia marramamba* and *Senna glutinosa* subsp. x *luerssenii* on red brown loam on hills	304.60
HS TmeTp AprAcaAmu CaEmu	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia* sp. Mt Ella and *Triodia pungens* with Low Open Woodland of *Acacia pruinocarpa, Acacia catenulata* subsp. *occidentalis* and *Acacia mulganeura* over Open Tussock Grassland of *Cymbopogon ambiguus* and *Eriachne mucronata* on red bown loam on very steep rivine slopes	632.13
HS TsTpTb AaAprAw AteEexEll	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia* sp. Shovelanna Hill, *Triodia pungens* and *Triodia basedowii* with Low Open Woodland of *Acacia aptaneura, Acacia pruinocarpa* and *Acacia wanyu* and Open Shrubland of *Acacia tetragonophylla, Eremophila exilifolia* and *Eremophila latrobei* subsp. *latrobei* on red sandy loam on hill slopes	5,138.27
HS EliCa EfrAte ImDau	*Enneapogon* Tussock Grassland	Tussock Grassland of *Enneapogon lindleyanus* and *Cymbopogon ambiguus* with Shrubland of *Eremophila fraseri* and *Acacia tetragonophylla* over Low Shrubland of *Indigofera monophylla* and *Dipteracanthus australasicus* on brown sandy clay loam on mudstone outcrops and boulders on lower slopes of The Governor Range	159.76
HS Mosaic low granite hills	Mosaic: *Triodia* Hummock Grassland / Acacia High Open Shrubland	Mosaic: Hummock Grassland of *Triodia epactia, Triodia basebowii* and *Trioida wiseana* with High Shrubland of *Acacia orthocarpa* and *Acacia inaequilatera* in brown loamy sand on low undulating granite hills; High Open Shrubland of *Acacia tumida* var. *pilbarensis* with Scattered Low Trees of *Terminalia canescens* and *Ficus brachypoda* over Very Open Hummock Grassland of *Triodia epactia* over Very Open Tussock Grassland of *Tripogon loliiformis, Aristida contorta* and *Sporobolus australasicus* on skeletal brown sandy loam on granite plateau / sheet outcrops	497.77
HS Mosaic hill crests and slopes	Mosaic: Triodia Open Hummock Grassland/ Triodia Hummock Grassland	Mosaic: Open Hummock Grassland of *Triodia lanigera, Triodia basedowii* and *Triodia epactia* with Scattered Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* over Low Open Shrubland of *Acacia atkinsiana* and *Acacia bivenosa* in brown sandy loam on hill crests and hill slopes; Hummock Grassland of *Triodia basedowii* and *Triodia pungens* with Low Woodland of *Acacia aptaneura* on brown sandy clay loam in drainage basins and on plains	999.32

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
FOOTSLOPES			
FS Tw El	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia wiseana* with Scattered Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* on red silty clay on hill slopes and footslopes	18.82
FS Ts CdHc AanAiGw	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with Low Open Woodland of *Corymbia deserticola* subsp. *deserticola* and Hakea chordophylla over Open Shrubland of *Acacia ancistrocarpa, Acacia inaequilatera* and *Grevillea wickhamii* subsp. *hispidula* on red brown sandy loam on footslopes and stony plains	43,900.73
FS TsTpTw El AbApaAan	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835), *Triodia pungens* and *Triodia wiseana* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and Open Shrubland of *Acacia bivenosa, Acacia pachyachra* and *Acacia ancistrocarpa* on red brown loam on footslopes and low undulating hills	6,748.88
STONY PLAINS			
SP Ax SggSbSg ApeEobEx	*Acacia* Low Open Forest	Low Open Forest of *Acacia xiphophylla* over Low Scattered Shrubs of *Senna glutinosa* subsp. *glutinosa, Streptoglossa bubakii* and *Senna glaucifolia* over Scattered Tussock Grasses of *Astrebla pectinata, Eriachne obtusa* and *Eragrostis xerophila* on red brown medium clay on basalt plains	164.09
SP AaApr TmTwTp TtCfAin	*Acacia* Low Open Forest	Low Open Forest of *Acacia aptaneura* and *Acacia pruinocarpa* over Open Hummock Grassland of *Triodia melvilei, Triodia wiseana* and *Triodia pungens* over Tussock Grassland of *Themeda triandra, Chrysopogon fallax* and *Aristida inaequiglumis* on red brown loam on plains	7,638.46
SP AcaAa AobDamCf	*Acacia* Low Open Forest	Low Open Forest of *Acacia catenulata* subsp. *occidentalis* and *Acacia aptaneura* over Very Open Tussock Grassland of *Aristida obscura, Digitaria ammophila* and *Chrysopogon fallax* on red brown clay loam on stony lower plains	88.65
SP AxAa EffAteAsy CfAcoSau	*Acacia* Low Open Forest	Low Open Forest of *Acacia xiphophylla* and *Acacia aptaneura* over Open Shrubland of *Eremophila forrestii* subsp. *forrestii, Acacia tetragonophylla* and *Acacia synchronicia* over Very Open Tussock Grassland of *Chrysopogon fallax, Aristida contorta* and *Sporobolus australasicus* on red brown sandy clay loam on stony plains	1,701.40
SP AaAanApr TeTs EffGbDpe	*Acacia* Low Open Forest	Low Open Forest of *Acacia aptaneura, Acacia aneura x ayersiana* and *Acacia pruinocarpa* over Hummock Grassland of *Triodia epactia* and *Triodia* sp. Shovelanna Hill with Open Shrubland of *Eremophila forrestii* subsp. *forrestii, Grevillea berryana* and *Dodonaea petiolaris* on red brown loamy sand on stony plains	354.25

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
SP Aa EfrSgl TtAco	*Acacia* Low Woodland	Low Woodland of *Acacia aptaneura* over High Shrubland of *Eremophila fraseri* and *Senna glutinosa* subsp. x *luerssenii* over Very Open Tussock Grassland of *Themeda triandra* and *Aristida contorta* on red brown clay loam on stony dolerite drainage plains	25.68
SP AprAa AiAb Ts	*Acacia* Low Woodland	Low Woodland of *Acacia pruinocarpa* and *Acacia aptaneura* over Scattered Shrubs of *Acacia inaequilatera* and *Acacia bivenosa* over Open Hummock Grassland of *Triodia* sp. Shovelanna Hill on red brown clay loam on stony plains	2.01
SP ChEoCd AanApaAad TbTscTs	*Corymbia* Low Open Woodland	Low Open Woodland of *Corymbia hamersleyana, Eucalyptus odontocarpa* and *Corymbia deserticola* subsp. *deserticola* over Open Shrubland of *Acacia ancistrocarpa, Acacia pachyacra* and *Acacia adsurgens* over Open Hummock Grassland of *Triodia basedowii, Triodia schinzii* and *Triodia* sp. Shovelanna Hill on red brown sandy loam on footslopes and stony plains	123.41
SP AaAprAx Eff Tp	*Acacia* Low Open Woodland	Low Open Woodland of *Acacia aptaneura, Acacia pruinocarpa* and *Acacia xiphophylla* over Open Shrubland of *Eremophila forrestii* subsp. *forrestii* over Open Hummock Grassland of *Triodia pungens* on red brown sandy clay loam on stony plains	17.87
SP TpTb Eg PlAbAan	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* and *Triodia basedowii* with Open Mallee of *Eucalyptus gamophylla* and Shrubland of *Petalostylis labicheoides, Acacia bivenosa* and *Acacia ancistrocarpa* on red brown loamy sand on stony plains and footslopes	2,393.65
SP AsyAxAa AbuMp CcCsCf	*Acacia* Open Scrub	Open Scrub of *Acacia synchronicia, Acacia xiphophylla* and *Acacia aptaneura* over Low Shrubland of *Atriplex bunburyana* and *Maireana pyramidata* over Very Open Tussock Grassland of **Cenchrus ciliaris, *Cenchrus setiger* and *Chrysopogon fallax* on brown silty clay loam on stony plains	638.63
SP TbTp HlAanAi Ch	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia basedowii* and *Triodia pungens* with High Open Shrubland of *Hakea lorea* subsp. *lorea, Acacia ancistrocarpa* and *Acacia inaequilatera* and Scattered Low Trees of *Corymbia hamersleyana* on red brown loamy sand on stony plains	2,0562.78
SP Tb AaApr AwAanAi	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Acacia aptaneura* and *Acacia pruinocarpa* over Open Shrubland of *Acacia wanyu, Acacia ancistrocarpa* and *Acacia inaequilatera* on red brown silty loam on stony plains	349.30
SP TlTe Ai AanAb	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia lanigera* and *Triodia epactia* with High Open Shrubland of *Acacia inaequilatera* over Low Open Shrubland of *Acacia ancistrocarpa* and *Acacia bivenosa* on orange loamy sand on sandy plains	4,135.84

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
SP TpTb AccAi AccAan	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* and *Triodia basedowii* with High Open Shrubland of *Acacia colei* var. *colei* and *Acacia inaequilatera* over Shrubland of *Acacia colei* var. *colei* and *Acacia ancistrocarpa* on red brown sandy loam on stony plains	1,664.14
SP TpTwTs EfrSgpSao	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens, Triodia wiseana* and *Triodia* sp. Shovelanna Hill with Open Shrubland of *Eremophila fraseri, Senna glutinosa* subsp. *pruinosa* and *Senna artemisioides* subsp. *oligophylla* on red brown loamy sand on stony plains and hill slopes	370.00
SP Ts Ai	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with High Open Shrubland of *Acacia inaequilatera* on red brown loamy sand on hill slopes and stony plains	1,441.38
SP Tb AbAprAad	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia basedowii* with Shrubland of *Acacia bivenosa, Acacia pruinocarpa* and *Acacia adsurgens* on red loamy sand on stony plains	366.41
SP TsTwTp EgEt AbApaApr	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835), *Triodia wiseana* and *Triodia pungens* with Very Open Mallee of *Eucalyptus gamophylla* and *Eucalyptus trivalva* over Open Shrubland of *Acacia bivenosa, Acacia pachyacra* and *Acacia pruinocarpa* on red brown sandy loam and clay loam on stony plains	4,301.32
SP TpTm AaExAca ApaEffAad	*Triodia* Open Hummock Grassland	Hummock Grassland of *Triodia pungens* and *Triodia melvillei* with Low Open Woodland of *Acacia aptaneura, Eucalyptus xerothermica* and *Acacia catenulata* subsp. *occidentalis* and Open Shrubland of *Acacia pachyacra, Eremophila forrestii* subsp. *forrestii* and *Acacia adsurgens* on red brown clay loam or silty loam on stony plains and floodplains	34,872.97
SP ApeAinSau SfiCtrTbc Oa	*Astrebla* Tussock Grassland	Tussock Grassland of *Astrebla pectinata, Aristida inaequiglumis* and *Sporobolus australasicus* with Low Open Shrubland of *Sida fibulifera, Corchorus trilocularis* and *Tephrosia* sp. Bungaroo Creek (M.E. Trudgen 11601) and Open Herbs of *Operculina aequisepala* on brown medium clay on basalt plains	837.54
SP CcAbu AaAbGs MgMmPn	**Cenchrus* Open Tussock Grassland	Open Tussock Grassland of **Cenchrus ciliaris* and *Aristida burbidgeae* with High Open Shrubland of *Acacia aptaneura, Acacia bivenosa* and *Grevillea striata* and Low Open Shrubland of *Maireana georgei, Maireana melanocoma* and *Ptilotus notabilis* on brown clay loam on stony plains and floodplains	28.41
SP DrhThiPae	*Dysphania* Herbs	Herbs of *Dysphania rhadinostachya, Tribulus hirsutus* and *Ptilotus aervoides* on brown clay on undulating stony plains	17.14

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
SP Mosaic granite / calcrete	Mosaic: *Triodia* Hummock Grassland/ Acacia High Open Shrubland	Mosaic: Hummock Grassland of *Triodia longiceps, Triodia angusta* and *Triodia wiseana* with Low Open Shrubland of *Acacia bivenosa, Acacia stellaticeps* and *Pluchea ferdinandi-muelleri* on brown sandy clay loam on stony calcrete plains; High Open Shrubland of *Acacia tumida* var. *pilbarensis* with Very Open Hummock Grassland of *Triodia epactia* over Very Open Tussock Grassland of *Tripogon loliiformis* on skeletal brown sandy clay loam on granite plateau / sheet outcrops	894.42
GRANITE OUTCROPS AND ROCK PILES			
GR Atp Te TLOAcoSau	*Acacia* High Open Shrubland	High Open Shrubland of *Acacia tumida* subsp. *pilbarensis* over Very Open Hummock Grassland of *Triodia epactia* and Very Open Tussock Grassland of *Tripogon loliiformis, Aristida contorta* and *Sporobolus australasicus* (with Scattered Low Trees of *Terminalia canescens* and *Ficus brachypoda)* on skeletal brown sandy loam on granite plateaux / sheet outcrops	61.72
GR Te AdTmaCci PclCc	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia epactia* with Open Shrubland of *Abutilon* sp. Dioicum, *Triumfetta maconochieana* and *Cajanus cinereus* over Very Open Tussock Grassland of *Paspaidium clementii* and **Cenchrus ciliaris* on skeletal brown loamy sand on granite rockpiles	557.63
FLOOD PLAINS			
FP AaEv EbEa Mf	*Acacia* Closed Forest	Closed Forest of *Acacia aptaneura* and *Eucalyptus victrix* over Open Tussock Grassland of *Eriachne benthamii* and *Eulalia aurea* with Open Shrubland of *Muehlenbeckia florulenta* on red brown clay on low-lying plains	134.57
FP AaEv EaEb Mf	*Acacia* Open Forest	Open Forest of *Acacia aptaneura* and *Eucalyptus victrix* over Open Tussock Grassland of *Eulalia aurea* and *Eriachne benthamii* with Open Shrubland of *Muehlenbeckia florulenta* on red brown clay loam on alluvial plains	1,853.40
FP Aa CfCc PlaEla	*Acacia* Low Closed Woodland	Low Closed Woodland of *Acacia aptaneura* over Very Open Tussock Grassland of *Chrysopogon fallax* and **Cenchrus ciliaris* with Scattered Shrubs of *Psydrax latifolia and Eremophila lanceolata* on red/brown clay loam on plains	102.12
FP AaApr EcuClSp TpTw	*Acacia* Low Open Forest	Low Open Forest of *Acacia aptaneura* and *Acacia pruinocarpa* over with Low Open Shrubland of *Eremophila cuneifolia, Corchorus lasiocarpus* subsp. *parvus* and *Solanum phlomoides* over Hummock Grassland of *Triodia pungens* and *Triodia wiseana* on red brown clay loam on stony flood plain	265.02
FP AaCa Mv Tm	*Acacia* Low Open Forest	Low Open Forest of *Acacia aptaneura* and *Corymbia aspera* over Low Open Shrubland of *Maireana villosa* over Open Hummock Grassland of *Triodia melvillei* on red brown cracking clays and alluvial loams on floodplains	482.00

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
FP AayAaApt Tp Cc	*Acacia* Low Open Forest	Low Open Forest of *Acacia ayersiana, Acacia aptanerua* and *Acacia pteraneura* over Hummock Grassland of *Triodia pungens* and Open Tussock Grassland of **Cenchrus ciliaris* on red brown silty clay on floodplains	11.63
FP AaApaApt TtCfEb	*Acacia* Low Open Forest	Low Open Forest of *Acacia aptaneura, Acacia paraneura* and *Acacia pteraneura* over Open Tussock Grassland of *Themeda triandra, Chrysopogon fallax* and *Eriachne benthamii* on red brown clay loam on plains	1,0214.10
FP AciAa Cc Bb	*Acacia* Low Open Forest	Low Open Forest of *Acacia citrinoviridis* and *Acacia aptanerua* over Tussock Grassland of **Cenchrus ciliaris* over Open Herbs of **Bidens bipinnata* on red brown loamy sand on floodplains	2.02
FP CcaCa AtpAcc Tp	*Corymbia* Low Woodland	Low Woodland of *Corymbia candida* and *Corymbia aspera* over Shrubland of *Acacia tumida* var. *pilbarensis* and *Acacia colei* var. *colei* over Open Hummock Grassland of *Triodia pungens* on brown medium clay on floodplains	73.50
FP AaAprAci ReAa CcCfAin	*Acacia* Low Woodland	Low Woodland of *Acacia aptaneura, Acacia pruinocarpa* and *Acacia citrinoviridis* over Open Shrubland of *Rhagodia eremaea* and *Acacia aptaneura* over Open Tussock Grassland of **Cenchrus ciliaris, Chrysopogon fallax* and *Aristida ingrata* on red loam on floodplains	599.90
FP ApaAaApr AsyEffPo CcAinAco	*Acacia* Low Woodland	Low Woodland of *Acacia paraneura, Acacia aptaneura* and *Acacia pruinocarpa* over Open Shrubland of *Acacia synchronicia, Eremophila forrestii* subsp. *forrestii* and *Ptilotus obovatus* over Open Tussock Grassland of **Cenchrus ciliaris, Aristida inaequiglumis* and *Aristida contorta* on red brown loam on floodplains	328.22
FP AaAprAca EffDpeSe AcoDamAin	*Acacia* Low Woodland	Low Woodland of *Acacia aptanerua, Acacia pruinocarpa* and *Acacia catenulata* subsp. *occidentalis* over Open Shrubland of *Eremophila forrestii* subsp. *forrestii, Dodonaea petiolaris* and *Sida ectogama* over Open Tussock Grassland of *Aristida contorta, Digitaria ammophila* and *Aristida inaequiglumis* on red orange clay loam on floodplains	1,475.17
FP AcaAaEx Eff Tp	*Acacia* Low Woodland	Low Woodland of *Acacia catenulata* subsp. *occidentalis, Acacia aptaneura* and *Eucalyptus xerothermica* over Open Shrubland of *Eremophila forrestii* subsp. *forrestii* over Open Hummock Grassland of *Triodia pungens* on red sandy loam on floodplains	5,019.73
FP AciChAa AanApyPl TtAinCc	*Acacia* Low Woodland	Low Woodland of *Acacia citrinoviridis, Corymbia hamersleyana* and *Acacia aptanerua* over High Shrubland of *Acacia ancistrocarpa, Acacia pyrifolia* var. *pyrifolia* and *Petalostylis labicheoides* over Very Open Tussock Grassland of *Themeda triandra, Aristida inaequiglumis* and **Cenchrus ciliaris* on brown sandy loam on floodplains and medium drainage lines	456.62

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
FP Ev Aa EaEbTt	*Acacia* Low Woodland	Woodland of *Eucalyptus victrix* over Low Woodland of *Acacia aptaneura* over Open Tussock Grassland of *Eulalia aurea, Eriachne benthamii* and *Themeda triandra* on orange clay loam on alluvial plains	122.62
FP AaEv Mf EaEbAco	*Acacia* Low Woodland	Low Woodland of *Acacia aptaneura* and *Eucalyptus victrix* with Scattered Shrubs of *Muehlenbeckia florulenta* over Open Tussock Grassland of *Eulalia aurea, Eriachne benthamii* and *Aristida contorta* on orange brown clay loam on alluvial plains	182.22
FP AaAcaApa ElaSlPo AcoEdAj	*Acacia* Low Open Woodland	Low Open Woodland of *Acacia aptaneura, Acacia catenulata* subsp. *occidentalis* and *Acacia paraneura* over Low Open Shrubland of *Eremophila lanceolata, Solanum lasiophyllum* and *Ptilotus obovatus* over Very Open Tussock Grassland of *Aristida contorta, Eragrostis dielsii and Aristida jerichoensis* var. *subspinulifera* on red brown clay loam on hardpan intergrove plains	5,761.48
FP AaAprCh EfrAteDpe AinCfAco	*Acacia* Low Open Woodland	Low Open Woodland of *Acacia aptaneura, Acacia pruinocarpa* and *Corymbia hamersleyana* with Open Shrubland of *Eremophila fraseri, Acacia tetragonophylla* and *Dodonea petiolaris* over Tussock Grassland of *Aristida inaequiglumis, Chrysopogon fallax* and *Aristida contorta* on red sandy loam on floodplains	1,343.83
FP Ax AsyRe MpMtScu	*Acacia* Low Open Woodland	Low Open Woodland of *Acacia xiphophylla* over High Open Shrubland of *Acacia synchronicia* and *Rhagodia eremaea* over Low Open Shrubland of *Maireana pyramidata, Maireana triptera* and *Sclerolaena cuneata* on red brown sandy clay loam on floodplains	463.57
FP AaAciApr AsyAscAb Tp	*Acacia* Low Open Woodland	Low Open Woodland of *Acacia aptaneura, Acacia citrinoviridis* and *Acacia pruinocarpa* over Open Shrubland of *Acacia synchronicia, Acacia sclerosperma* subsp. *sclerosperma* and *Acacia bivenosa* over Very Open Hummock Grassland of *Triodia pungens* on red brown clay loam on floodplains and medium drainage lines	4,054.54
FP AsuAaArh EcoEcaEff AcoEpo	*Acacia* High Open Shrubland	High Open Shrubland of *Acacia subcontorta, Acacia aptaneura* and *Acacia rhodophloia* over Low Open Shrubland of *Eremophila compacta* subsp. *compacta, Eremophila caespitosa* and *Eremophila forrestii* subsp. *forrestii* over Very Open Tussock Grassland of *Aristida contorta* and *Enneapogon polyphyllus* on red loam on hardpan plains	216.98
FP Aa Ch TtCfAco	*Acacia* High Shrubland	High Shrubland of *Acacia aptaneura* with Low Open Woodland of *Corymbia hamersleyana* over Open Tussock Grassland of *Themeda triandra, Chrysopogon fallax* and *Aristida contorta* on red loamy sand on floodplains	1.81
FP AaAscAan Tp	*Acacia* High Shrubland	High Shrubland of *Acacia aptaneura, Acacia sclerosperma* subsp. *sclerosperma* and *Acacia ancistrocarpa* over Very Open Hummock Grassland of *Triodia pungens* on red brown sandy loam on floodplains and drainage lines	709.03

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
FP AbApr Tp AcoSau	*Acacia* High Shrubland	High Shrubland of *Acacia bivenosa* and *Acacia pruinocarpa* over Open Hummock Grassland of *Triodia pungens* and Very Open Hummock Grassland of *Aristida contorta* and *Sporobolus australasicus* on brown loam on stony dolerite floodplains and outwash zones	108.58
FP ApaAa Efr TsTp	*Acacia* High Open Shrubland	High Open Shrubland of *Acacia paranerua* and *Acacia aptaneura* over Open Shrubland of *Eremophila fraseri* over Very Open Hummock Grassland of *Triodia* sp. Shovelanna Hill and *Triodia pungens* on red clay loam on floodplains and stony plains	5,804.95
FP Ast AtrHl TbTp	*Acacia* Low Open Heath	Low Open Heath of *Acacia stellaticeps* with High Shrubland of *Acacia trachycarpa* and *Hakea lorea* subsp. *lorea* and Open Hummock Grassland of *Triodia basedowii* and *Triodia pungens* on orange brown sand on floodplains	48.85
FP PfmPrCl Ta SauCpePd	*Pluchea* Low Shrubland	Low Shrubland of *Pluchea ferdinandi-muelleri, Pluchea rubelliflora* and *Carrissa lanceolata* over Open Hummock Grassland of *Triodia angusta* and Very Open Tussock Grassland of *Sporobolus australasicus, Chloris pectinata* and *Panicum decompositum* on grey medium clay on crusting plains	52.62
FP EcuFSRE AsyMtSas Aa	*Eremophila* Low Open Shrubland	Low Open Shrubland of *Eremophila cuneifolia*, *Frankenia* sp. (indet) and *Rhagodia eremaea* with Open Shrubland of *Acacia synchronicia , Maireana ? tomentosa* subsp. *tomentosa* and *Senna artemisioides* subsp. x *sturtii* and Scattered Low Trees of *Acacia aptaneura* on orange sandy clay loam on floodplains	79.43
FP MtPoSc AxAsy AinCc	*Maireana* Low Open Shrubland	Low Open Shrubland of *Maireana triptera, Ptilotus obovatus* and *Sclerolaena cuneata* with Scattered Low Trees of *Acacia xiphophylla* and *Acacia synchronicia* and Scattered Tussock Grasses of *Aristida inaequiglumis* and **Cenchrus ciliaris* on red sandy clay loam on wind scalded plains	75.19
FP Ths Ca PoSau	*Themeda* Closed Tussock Grassland	Closed Tussock Grassland of *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) with Low Open Woodland of *Corymbia aspera* over Low Open Shrubland of *Ptilotus obovatus* and *Salsola australis* on orange light clay on level flood plains	63.38
FP TtEa ExAa AprAtpElo	Themeda *Tussock Grassland*	Tussock Grassland of *Themeda triandra* and *Eulalia aurea* with Low Woodland of *Eucalyptus xerothermica* and *Acacia aptaneura* over Open Shrubland of *Acacia pruinocarpa, Acacia tumida* var. *pilbarensis* and *Eremophila longifolia* on red brown clay loam on unincised drainage lines and floodplains	1,934.84
FP TtEaCc ChEx AdAaAmc	*Themeda* Tussock Grassland	Tussock Grassland of *Themeda triandra, Eulalia aurea* and **Cenchrus ciliaris* with Low Open Woodland of *Corymbia hamersleyana* and *Eucalyptus xerothermica* over High Open Shrubland of *Acacia dictyophleba, Acacia ancistrocarpa* and *Acacia macraneura* on brown silty clay loam on floodplains	53.45
FP TlTp AscAbMg	*Triodia* Closed Hummock Grassland	Closed Hummock Grassland of *Triodia longiceps* and *Triodia pungens* with Shrubland of *Acacia sclerosperma* subsp. *sclerosperma, Acacia bivenosa* and *Melaleuca glomerata* on brown sandy clay loam on undulating floodplains	382.48

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
FP TbTp AaGb Go	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia basedowii* and *Triodia pungens* with Low Woodland of *Acacia aptaneura* and *Grevillea berryana* over Low Open Shrubland of *Gompholobium oreophilum* on brown sandy clay loam on drainage depressions	206.29
FP Tb AaApr Eff	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Acacia aptaneura* and *Acacia pruinocarpa* over Open Shrubland of *Eremophila forrestii* subsp. *forrestii* on red sandy loam on floodplains	2,834.23
FP Tp ChApr GwApyAb	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* with Scattered Low Trees of *Corymbia hamersleyana* and *Acacia pruinocarpa* over Open Shrubland of *Grevillea wickhamii* subsp. *hispidula, Acacia pyrifolia* var. *pyrifolia* and *Acacia bivenosa* on brown loamy sand on floodplains	145.73
FP Tp EtEg AbAanPl	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* with Very Open Mallee of *Eucalyptus trivalva* and *Eucalyptus gamophylla* over Shrubland of *Acacia bivenosa, Acacia ancistrocarpa* and *Petalostylis labicheoides* on red brown loam on uninsised drainage tracts on stony plains	332.45
FP TsTl AbAsPfm	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia secunda* and *Triodia longiceps* with Low Open Shrubland of *Acacia bivenosa, Acacia stellaticeps* and *Pluchea ferdinandi-muelleri* on orange sandy clay loam on stony floodplains	1,588.92
FP Ts Eg AayAaAca	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with Scattered Mallees of *Eucalyptus gamophylla* over High Shrubland of *Acacia ayersiana*, *Acacia aptaneura* and *Acacia catenulata* subsp. *occidentalis* on red brown loam on floodplains.	9.73
FP TscTp ExAaApr AteAscGw	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia schinzii* and *Triodia pungens* with Low Open Woodland of *Eucalyptus xerothermica, Acacia aptaneura* and *Acacia pruinocarpa* over Scattered Shrubs of *Acacia tetragonophylla, Acacia sclerosperma* subsp. *sclerosperma* and *Grevillea wickhamii* subsp. *hispidula* on red brown clay loam on floodplains	69.53
FP CcCs ChAa AtpAan	**Cenchrus* Closed Tussock Grassland	Closed Tussock Grassland of **Cenchrus ciliaris* and **Cenchrus setiger* with Low Open Woodland of *Corymbia hamersleyana* and *Acacia aptaneura* and Open Shrubland of *Acacia tumida* var. *pilbarensis* and *Acacia ancistrocarpa* on red brown silty loam on floodplains	38.01
FP Cc ApyAsyApr	**Cenchrus* Tussock Grassland	Tussock Grassland of **Cenchrus ciliaris* with Shrubland of *Acacia pyrifolia* var. *pyrifolia, Acacia synchronicia* and *Acacia pruinocarpa* on brown sand or loamy sand on floodplains	1,288.63
FP EbEa Hl Acc	*Eriachne* Tussock Grassland	Tussock Grassland of *Eriachne benthamii* and *Eulalia aurea* with High Open Shrubland of *Hakea lorea* subsp. *lorea* over Open Shrubland of *Acacia colei* var. *colei* on brown medium clay on floodplains	3.13

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
FP EbEaTt Ev Mf	*Eriachne* Tussock Grassland	Tussock Grassland of *Eriachne benthamii, Eulalia aurea* and *Themeda triandra* with Woodland of *Eucalyptus victrix* over Open Shrubland of *Muehlenbeckia florulenta* on orange brown loamy clay on alluvial plains	941.29
FP EaEbTt EvAa Mf	*Eulalia* Tussock Grassland	Tussock Grassland of *Eulalia aurea, Eriachne benthamii* and *Themeda triandra* with Woodland of *Eucalyptus victrix* and *Acacia aptaneura* over Open Shrubland of *Muehlenbeckia florulenta* on red brown clay loam on alluvial plains	31.15
FP AlaESEApe SfSh	*Aristida* Open Tussock Grassland	Open Tussock Grassland of *Aristida latifolia, Eragrostis setifolia* and *Astrebla pectinata* with Scattered Low Shrubs of *Senna ferraria* and *Senna hamersleyensis* over Open Herbs on red loam on floodplains	12.30
FP CfEaEo ChCca GwCci	*Chrysopogon* Open Tussock Grassland	Open Tussock Grassland of *Chrysopogon fallax, Eulalia aurea* and *Eriachne obtusa* with Low Open Woodland of *Corymbia hamersleyana* and *Corymbia candida* over High Open Shrubland of *Grevillea wickhamii* subsp. *hispidula* and *Cajanus cinereus* on red silty loam on floodplains	125.39
FP Cc Sco	**Cenchrus* Scattered Tussock Grasses	Scattered Tussock Grasses of **Cenchrus ciliaris* over Scattered Herbs of *Sclerolaena cornishiana* on pale brown sitly clay on floodplains	26.77
FP Mosaic mulga snakewood	Mosaic: Acacia Low Open Woodland/ Acacia Low Woodland	Mosaic: Low Woodland of *Acacia paraneura, Acacia aptaneura* and *Acacia pruinocarpa* over Open Shrubland of *Acacia synchronicia, Eremophila forrestii* subsp. *forrestii* and *Ptilotus obovatus* over Very Open Tussock Grassland of **Cenchrus ciliaris;* Low Open Woodland of *Acacia xiphophila* over High Open Shrubland of *Acacia synchronicia* and *Rhagodia eremaea* over Low Open Shrubland of *Maireana pyramidata, Maireana triptera* and *Sclerolaena cuneata* on red loamy sand on plains	160.80
FP Mosaic snakewood angusta	Mosaic: Acacia Low Open Woodland/ Triodia Closed Hummock Grassland	Mosaic: Low Open Woodland of *Acacia xiphophila* over High Open Shrubland of *Acacia synchronica* and *Rhagodia eremaea* over Low Open Shrubland of *Maireana pyramidata;* Closed Hummock Grassland of *Triodia angusta* on red brown sandy clay loam on undulating plains	64.15
SAND DUNES			
SD TscTb Ad CtCcuSc	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia schinzii* and *Triodia basedowii* with High Open Shrubland of *Acacia dictyophleba* over Low Open Shruland of *Corchorus tectus, Crotalaria cunninghamii* and *Sida cardiophylla* on red sand on linear sand dunes	62.03
SAND PLAINS			

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
SA Aa TpTwTb CcCf	*Acacia* Low Open Forest	Low Open Forest of *Acacia aptaneura* over Open Hummock Grassland of *Triodia pungens, Triodia wiseana* and *Triodia basedowii* over Open Tussock Grassland of **Cenchrus ciliaris* and *Chrysopogon fallax* on red brown sandy loam on sandy plains and undulating hills	44.58
SA ChAprGs GstApaAan TbTsc	*Corymbia* Low Open Woodland	Low Open Woodland of *Corymbia hamersleyana, Acacia pruinocarpa* and *Grevillea striata* over High Open Shrubland of *Grevillea stenobotrya, Acacia pachyacra* and *Acacia ancistrocarpa* over Very Open Hummock Grassland of *Triodia basedowii* and *Triodia schinzii* on red sandy loam on sand plains	19.44
SA Ast Tsc AtpAccMl	*Acacia* Low Open Heath	Low Open Heath of *Acacia stellaticeps* over Hummock Grassland of *Triodia schinzii* with High Open Shrubland of *Acacia tumida* var. *pilbarensis, Acacia colei* var. *colei* and *Melaleuca lasiandra* on red brown loamy sand on sandplains	1,170.07
SA SahCpEla HlAmc AcoPclEar	*Senna* Low Open Shrubland	Low Open Shrubland of *Senna artemisioides* subsp. *helmsii, Chrysocephalum pterochaetum* and *Eremophila lanceolata* with Scattered Tall Shrubs of *Hakea lorea* var. *lorea* and *Acacia macraneura* over Scattered Tussock Grasses of *Aristida contorta, Paspalidium clementii* and *Eriachne aristidea* on red brown sandy loam on sandy plains and floodplains	163.12
SA TbTl AsyAscElo Aa	*Triodia* Closed Hummock Grassland	Closed Hummock Grassland of *Triodia basedowii* and *Triodia longiceps* with High Shrubland of *Acacia synchronicia, Acacia sclerosperma* subsp. *sclerosperma* and *Eremophila longifolia* and Low Open Woodland of *Acacia aptaneura* on red brown clay loam on plains	84.79
SA Tb ChEg SpBeKp	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Corymbia hamersleyana* and *Eucalyptus gamophylla* over Low Open Shrubland of *Scaevola parvifolia, Bonamia erecta* and *Kennedia prorepens* on red loamy sand on sand plains	5,954.30
SA Tb AaApr Aan	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia basedowii* with Scattered Tall Trees of *Acacia aptaneura* and *Acacia pruinocarpa* over High Open Shrubland of *Acacia ancistrocarpa* on red sand on sand plains	254.32
SA TeTl Ai Aco	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia epactia* and *Triodia lanigera* with Open Shrubland of *Acacia inaequilatera* over Open Tussock Grassland of *Aristida contorta* on red brown sandy clay loam on raised plains and quartz hills	180.35
SA Tl AiAan Ast	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia lanigera* with High Open Shrubland of *Acacia inaequilatera* and *Acacia ancistrocarpa* over Low Open Shrubland of *Acacia stellaticeps* on red orange sandy loam on sandy plains	4,996.59
SA Tp Ev AccAst	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* with Low Woodland of *Eucalyptus victrix* over Low Shrubland of *Acacia colei* var. *colei* and *Acacia stellaticeps* on grey brown sandy loam on sandy plains	91.49

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
SA Tsc HlApaAd ScDcSp	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia schinzii* with Open Shrubland of *Hakea lorea* subsp. *lorea, Acacia pachyacra* and *Acacia dictyophleba* over Low Open Shrubland of *Sida cardiophylla, Dicrastylis cordifolia* and *Scaevola parviflora* on red loamy sand on sandy plains	211.47
SA Tl CzCh Ai IaImTbc	*Triodia* Open Hummock Grassland	Open Hummock Grassland *of Triodia lanigera* with Low Open Woodland of *Corymbia zygophylla* and *Corymbia hamersleyana* over Open Shrubland of *Acacia inaequilatera* over Low Open Shrubland of *Isotropis atropurpurea, Indigofera monophylla* and *Tephrosia* sp. Bungaroo Creek (M.E. Trudgen 11601) on orange red loamy sand on sand plains	695.00
SA Tl AanApa ApaAprCh	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia lanigera* with Open Shrubland of *Acacia ancistrocarpa* and *Acacia pachyacra* and Scattered Low Trees of *Acacia paraneura, Acacia pruinocapra* and *Corymbia hamerselyana* on red sandy loam on stony plains	2206.94
SA Mosaic sand plains	Mosaic: *Triodia* Hummock Grassland	Mosaic: Hummock Grassland of *Triodia secunda* and *Triodia epactia* with Low Open Shrubland of *Acacia stellaticeps* over Scattered Tussock Grasses of *Sporobolus australasicus;* Hummock Grassland of *Triodia epactia* and *Triodia lanigera* with Scattered Low Trees of *Corymbia hamersleyana* over High Open Shrubland of *Acacia inaequilatera, Acacia ancistrocarpa* and *Acacia colei* var. *colei* on red orange sandy clay loam on plains	1,891.39
SA Mosaic granitic plains	Mosaic: *Triodia* Hummock Grassland/Acacia High Open Shrubland	Mosaic: Hummock Grassland of *Triodia lanigera* with High Open Shrubland of *Acacia ancistrocarpa* over Low Open Shrubland of *Acacia stellaticeps;* High Open Shrubland of *Acacia tumida* subsp. *pilbarensis* with Scattered Low Trees of *Terminalia canescens* and *Ficus brachypoda* over Very Open Hummock Grassland of *Triodia epactia* (and Very Open Tussock Grassland of *Tripogon loliiformis*) on orange loamy sand on undulating granitic plains with granitic outcrops	963.82
CALCRETE PLAINS			
CP TlTe AbAstPfm	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia longiceps* and *Tridoia epactia* with Low Open Shrubland of *Acacia bivenosa, Acacia stellaticeps* and *Pluchea ferdinandi-muelleri* on brown sandy clay loam on stony calcrete plains	1,242.44
CP TwTa Es AbPlApy	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia wiseana* and *Triodia angusta* with Open Mallee of *Eucalyptus socialis* subsp. *eucentrica* and Open Shrubland of *Acacia bivenosa, Petalostylis labicheoides* and *Acacia pyrifolia* var. *pyrifolia* on light brown clay loam on calcrete plains and rises	9,926.13
CP EinTlBe Apr Es	*Enneapogon* Open Tussock Grassland	Open Tussock Grassland of *Enneapogon intermedius, Tripogon loliiformis* and *Bothriochloa ewartiana* with High Open Shrubland of *Acacia pruinocarpa* with Scattered Mallee of *Eucalyptus socialis* subsp. *eucentrica* on light brown loam on low calcrete rises	6.65

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
MINOR DRAINAGE LINES			
MI CcAa CcCs Tb	*Corymbia* Low Open Woodland	Low Open Woodland of *Corymbia candida* subsp. *dipsodes* and *Acacia aptaneura* over Open Tussock Grassland of **Cenchrus ciliaris* and **Cenchrus setiger* and Very Open Hummock Grassland of *Triodia basedowii* on red brown loam on floodplains and minor drainage lines	774.68
MI AtpGwApy TpTb CcCs	*Acacia* Open Scrub	Open Scrub of *Acacia tumida* var. *pilbarensis, Grevillea wickhamii* subsp. *hispidula* and *Acacia pyrifolia* var. *pyrifolia* over Hummock Grassland of *Triodia pungens* and *Triodia basedowii* over Open Tussock Grassland of **Cenchrus ciliaris* and **Cenchrus setiger* on brown sandy loam on minor drainage lines and floodplains	2,448.09
MI AtpPlAmo TpTs ChEl	*Acacia* Open Scrub	Open Scrub of *Acacia tumida* var. *pilbarensis*, *Petalostylis labicheoides* and *Acacia monticola* over Open Hummock Grassland of *Triodia pungens* and *Triodia* sp. Shovelanna Hill (S.van Leeuwen 3835) with Low Open Woodland of *Corymbia hamerselyana* and *Eucalyptus leucophloia* subsp. *leucophloia* on red brown sandy loam on minor drainage lines	5,187.88
MI AccAbAtp TlTe AstPfmPt	*Acacia* High Shrubland	High Shrubland of *Acacia colei* var. *colei, Acacia bivenosa* and *Acacia tumida* var. *pilbarensis* over Open Hummock Grassland of *Triodia lanigera* and *Triodia epactia* with Low Open Shrubland of *Acacia stellaticeps, Pluchea ferdinandi-muelleri* and *Pluchea tetranthera* on orange sand on minor drainage lines and floodplains	485.33
MI AadAluDpa Tp ElCh	*Acacia* Open Heath	Open Heath of *Acacia adsurgens, Androcalva luteiflora* and *Dodonaea pachyneura* over Open Hummock Grassland of *Triodia pungens* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* on brown loamy sand on minor drainage lines	419.63
MI AbAdAma Tp TtPmEa	*Acacia* Shrubland	Shrubland of *Acacia bivenosa, Acacia dictyophleba* and *Acacia maitlandii* over Open Hummock Grassland of *Triodia pungens* over Open Tussock Grassland of *Themeda triandra, Paraneurachne muelleri* and *Eulalia aurea* on brown sandy loam on minor drainage lines	119.61
MI AmoAanPl ChEl TtAin	*Acacia* Shrubland	Shrubland of *Acacia monticola, Acacia ancistrocarpa* and *Petalostylis labicheoides* with Scattered Low Trees of *Corymbia hamerselyana* and *Eucalyptus leucophloia* subsp. *leucophloia* over Open Tussock Grassland of *Themeda triandra* and *Aristida inaequilatera* on red loamy sand on minor drainage lines	609.40
MI PlAtpAmo ChEl TwTp	*Petalostylis* Shrubland	Shrubland of *Petalostylis labicheoides, Acacia tumida* var. *pilbarensis* and *Acacia monticola* with Low Open Woodland of *Corymbia hamerselyana* and *Eucalyptus leucophloia* subsp. *leucophloia* over Open Hummock Grassland of *Triodia wiseana* and *Triodia pungens* on red brown loam on minor drainage lines	1,069.60

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
MI EaTt AxAcp AanAtp	*Eulalia* Open Tussock Grassland	Open Tussock Grassland of *Eulalia aurea* and *Themeda triandra* with Low Open Woodland of *Acacia xiphophylla* and *Acacia coriacea* subsp. *pendens* and Open Shrubland of *Acacia ancistrocarpa* and *Acacia tumida* var. *pilbarensis* on red brown clay on minor drainage lines	30.89
MI TlTe Ch AtrAanAac	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia longiceps* and *Triodia epactia* with Scattered Low Trees of *Corymbia hamersleyana* over High Shrubland of *Acacia trachycarpa, Acacia ancistrocarpa* and *Acacia acradenia* on brown loamy sand on minor drainage lines	250.79
MI TsTp AanAmoGw	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) and *Triodia pungens* with Shrubland of *Acacia ancistrocarpa, Acacia monticola* and *Grevillea wickhamii* subsp. *hispidula* on brown sandy loam on minor drainage lines	64.42
MI TeTb Ch CciApy	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia epactia* and *Trioida basedowii* with Scattered Low Trees of *Corymbia hamersleyana* over Open Shrubland of *Cajanus cinereus* and *Acacia pyrifolia* var. *pyrifolia* on red sandy loam on minor drainge lines	45.78
MI Eb VfAteAa PhCmPg	*Eriachne* Tussock Grassland	Tussock Grassland of *Eriachne benthamii* with Shrubland of **Vachellia farnesiana, Acacia tetragonophylla* and *Acacia aptaneur*a over Low Open Herbland of *Pimelea holroydii, Centipeda minima* and *Ptilotus gomphrenoides* on red silty loam on basalt parent rock along small drainage lines	95.85
MI TtCobEmu ChEg GwPlEt	*Themeda* Tussock Grassland	Tussock Grassland of *Themeda triandra, Cymbopogon obtectus* and *Eriachne mucronata* with Open Woodland of *Corymbia hamersleyana* and *Eucalyptus gamophylla* over High Open Shrubland of *Grevillea wickhamii* subsp. *hispidula, Petalostylis labicheoides* and *Eremophila tietkensii* on red loamy sand on minor drainage lines	34.51
MI EbEfCf Ca AtrAcc	*Eriachne* Open Tussock Grassland	Open Tussock Grassland of *Eriachne benthamii, Eriachne flaccida* and *Chrysopogon fallax* with Scattered Low Trees of *Corymbia aspera* over High Open Shrubland of *Acacia trachycarpa* and *Acacia colei* var. *colei* on brown loamy sand along minor drainage lines	32.71
MEDIUM DRAINAGE LINES			
ME EvAcp AtpAtrApy Tp	*Eucalyptus* Low Woodland	Low Woodland of *Eucalyptus victrix* and *Acacia coriacea* subsp. *pendens* over Shrubland of *Acacia tumida* var. *pilbarensis, Acacia trachycarpa* and *Acacia pyrifolia* var. *pyrifolia* over Open Hummock Grassland of *Triodia pungens* on brown loamy sand along minor and medium drainage lines	932.98
ME TtEaEte ApyAtpPl EvCh	*Eucalyptus* Low Woodland	Tussock Grassland of *Themeda triandra, Eulalia aurea* and *Eriachne tenuiculmis* with High Shrubland of *Acacia pyrifolia* var. *pyrifolia, Acacia tumida* var. *pilbarensis* and *Petalostylis labicheoides* and Open Woodland of *Eucalyptus victrix* and *Corymbia hamersleyana* on red brown silty loam on medium drainage lines and flood plains	1,032.77

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
ME Ev PrPfmAbu Ecu	*Eucalyptus* Low Open Woodland	Low Open Woodland of *Eucalyptus victrix* over Low Open Shrubland of *Pluchea rubelliflora, Pluchea ferdinandi-muelleri*and *Atriplex bunburyana* with Scattered Tussock Grasses of *Eragrostis cumingii* on brown silty clay loam on drainage depressions	11.28
ME AtpAanAcc TeTl Ch	*Acacia* Open Scrub	Open Scrub of *Acacia tumida* var. *pilbarensis, Acacia ancistrocarpa* and *Acacia colei* var. *colei* over Hummock Grassland of *Triodia epactia* and *Triodia lanigera* with Scattered Low Trees of *Corymbia hamersleyana* on brown sandy loam along minor and medium drainage lines	227.03
ME AamAtrAcp CcEb Cv	*Acacia* High Shrubland	High Shrubland of *Acacia ampliceps, Acacia trachycarpa* and *Acacia coriacea* subsp. *pendens* over Open Tussock Grassland of **Cenchrus ciliaris* and *Eriachne benthamii* with Very Open Sedges of *Cyperus vaginatus* on brown sand along medium drainage lines	229.52
ME TscTs Ch AadELOAan	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia schinzii* and *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with Scattered Low Trees of C*orymbia hamersleyana* over Open Shrubland of *Acacia adsurgens, Eremophila longifolia* and *Acacia ancistrocarpa* on red sandy loam on medium drainage lines	10.14
ME TpTb Ch AtpAcc	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* and *Triodia basedowii* with Low Open Woodland of *Corymbia hamersleyana* over High Open Shrubland of *Acacia tumida* var. *pilbarensis* and *Acacia colei* var. *colei* on red brown loamy sand on levee banks and floodplains	215.40
ME TpTl ExAciCh PlApyGr	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia pungens* and *Triodia longiceps* with Low Woodland of *Eucalyptus xerothermica, Acacia citrinoviridis* and *Corymbia hamerselyana* over High Shrubland of *Petalostylis labicheoides, Acacia pyrifolia var. pyrifolia* and *Gossypium robinsonii* on red brown clay loam on medium drainage lines and surrounding floodplains	1,2126.98
ME Tt ExChAa ApaAaAci	*Themeda* Closed Tussock Grassland	Closed Tussock Grassland of *Themeda triandra* with Low Woodland of *Eucalyptus xerothermica, Corymbia hamersleyana* and *Acacia aptaneura* over High Open Shrubland of *Acacia pachyacra, Acacia aptaneura* and *Acacia citrinoviridis* on red brown clay loam along unincised medium drainage lines	106.21
ME EbEf Ev Te	*Eriachne* Tussock Grassland	Tussock Grassland of *Eriachne benthamii* and *Eriachne flaccida* with Low Woodland of *Eucalyptus victrix* over Hummock Grassland of *Triodia epactia* on brown grey silty loam on drainage depressions	55.35
ME TtCfEa ExEvCh PlApaApy	*Themeda* Tussock Grassland	Tussock Grassland of *Themeda triandra, Chrysopogon fallax* and *Eulalia aurea* with Low Open Woodland of *Eucalyptus xerothermica, Eucalyptus victrix* and *Corymbia hamersleyana* and Shrubland of *Petalostylis labicheoides, Acacia pachyacra* and *Acacia pyrifolia* var. *pyrifolia* on red sandy loam on medium drainage lines	1,230.16

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
ME TtAinCa ChEl AmoPlAlu	*Themeda* Open Tussock Grassland	Open Tussock Grassland of *Themeda triandra, Aristida inaequiglumis* and *Cymbopogon ambiguus* with Low Open Woodland of *Corymbia hamerselyana* and *Eucalyptus leucophloia* subsp. *leucophloia* over Open Shrubland of *Acacia monticola, Petalostylis labicheoides* and *Androcalva luteiflora* on red brown alluvium on minor and medium drainge lines	1,565.97
ME Gl Ev Sn	*Glinus* Herbs	Herbs of *Glinus lotoides* with Low Open Woodland of *Eucalyptus victrix* and Scattered Low Shrubs of *Senna notabilis* on pale brown loam on medium drainage lines	13.54
MAJOR DRAINAGE LINES			
MA MaEcEv MgAcpAtr Cv	*Melaleuca* High Open Forest	High Open Forest of *Melaleuca argentea, Eucalyptus camaldulensis* var. *refulgens* and *Eucalyptus victrix* over High Open Shrubland of *Melaleuca glomerata, Acacia coriacea* subsp. *pendens* and *Acacia trachycarpa* over Very Open Sedges of *Cyperus vaginatus* on alluvial gravelly soils on major drainage channels with Seasonal pools	2,098.89
MA MaEc AciAcpAam TdCv	*Melaleuca* Open Forest	Open Forest of *Melaleuca argentea* and *Eucalyptus camaldulensis* var. *refulgens* over Low Woodland of *Acacia citrinoviridis, Acacia coriacea* subsp. *pendens* and *Acacia ampliceps* over Open Sedges of *Typha domingensis, Cyperus vaginatus* and *Fimbristylis sieberiana* on immediate banks and within stream channels with permanent water at Weeli Wolli Spring	280.00
MA EcMaEv AciAcp AbGsGr	*Eucalyptus* Open Forest	Open Forest of *Eucalyptus camaldulensis* var. *refulgens, Melaleuca argentea* and *Eucalyptus victrix* over Low Open Woodland of *Acacia citrinoviridis* and *Acacia coriacea* subsp. *pendens* over Shrubland of *Acacia bivenosa, Gossypium sturtianum* and *Gossypium robinsonii* on brown silty sand and clay along Weeli Wolli Creek	179.67
MA EcEvMa AcpAamAh TdCv	*Eucalyptus* Open Forest	Open Forest of *Eucalyptus camaldulensis* var. r*efulgens, Eucalyptus victrix* and *Melaleuca argentea* over Low Open Forest of *Acacia coriacea* subsp. *pendens, Acacia ampliceps* and *Atalaya hemiglauca* over Open Sedges of *Typha domingensis* and *Cyperus vaginatus* on brown sandy clay loam along major rivers with permanent water	32.88
MA EcEv AciApyMg CcEaTt	*Eucalyptus* Woodland	Woodland of *Eucalyptus camaldulensis* subsp. *refulgens* and *Eucalyptus victrix* over High Open Shrubland of *Acacia citrinoviridis, Acacia pyrifolia* var. *pyrifolia* and *Melaleuca glomerata* over Tussock Grassland of **Cenchrus ciliaris, Eulalia aurea* and *Themeda triandra* on brown clay loam on banks of major drainage lines	1,399.21

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
MA EvAciEc TrcCcrApy CcEaTt	*Eucalyptus* Woodland	Woodland of *Eucalyptus victrix, Acacia citrinoviridis* and *Eucalyptus camaldulensis* subsp. *refulgens* over Low Open Shrubland of *Tephrosia rosea* var. *clementii, Corchorus crozophorifolius* and *Acacia pyrifolia* var. *pyrifolia* over Very Open Tussock Grassland of **Cenchrus ciliaris, Eulalia aurea* and *Themeda triandra* on brown loamy sand on channels of major drainage lines	1,053.37
MA AciAprAa SahSgl	*Acacia* Low Closed Woodland	Low Closed Woodland of *Acacia citrinoviridis, Acacia pruinocarpa* and *Acacia aptaneura* over Open Shrubland of *Senna artemisioides* subsp. *helmsii* and *Senna glutinosa* subsp. *x luerssenii* on brown clay loam on levee banks of major drainage lines	43.32
MA EcEvEx ApyAtpGr TtEaCpr	*Eucalyptus* Low Open Forest	Low Open Forest of *Eucalyptus camaldulensis* subsp. *refulgens, Eucalyptus victrix* and *Eucalyptus xerothemica* over High Shrubland of *Acacia pyrifolia* var. *pyrifolia, Acacia tumida* var. *pilbarensis* and *Gossypium robinsonii* over Open Tussock Grassland of *Themeda triandra, Eulalia aurea* and *Cymbopogon procerus* on red brown clay loam on major drainage lines	2,120.24
MA AaAciApr CcTtCf EvEc	*Acacia* Low Open Forest	Low Open Forest of *Acacia aptaneura, Acacia citrinoviridis* and *Acacia pruinocarpa* ver Open Tussock Grassland of **Cenchrus ciliaris, Themeda triandra* and *Chrysopogon fallax* with Open Woodland of *Eucalyptus victrix* and *Eucalyptus camaldulensis* subsp. *refulgens* on brown loamy sand on major drainage lines with broad and deeply incised drainage channels	197.10
MA ChEv ApyCci Cf	*Corymbia* Low Woodland	Low Woodland of *Corymbia hamersleyana* and *Eucalyptus victrix* over Shrubland of *Acacia pyrifolia* var. *pyrifolia* and *Cajanus cinereus* over Very Open Tussock Grassland of *Chrysopogon fallax* on red brown silty loam along major drainage lines	13.32
MA AtpApyAse Ec TmbTtCpr	*Acacia* High Shrubland	High Shrubland of *Acacia tumida* var. *pilbarensis, Acacia pyrifolia* var. *pyrifolia* and *Acacia sericophylla* with Scattered Trees of *Eucalyptus camaldulensis* subsp. *refulgens* over Open Tussock Grassland of *Themeda* sp. Mt Barricade (M.E. Trudgen 2471), *Themeda triandra* and *Cymbopogon procerus* on brown loam and gravels on major drainage channels	257.85
MA CcCs EvAciAh	**Cenchrus* Tussock Grassland	Tussock Grassland **Cenchrus ciliaris* and **Cenchrus setiger* with Low Woodland of *Eucalyptus victrix, Acacia citrinoviridis* and *Atalaya hemiglauca* on brown sandy loam on major drainage lines and adjacent flood plains	2,198.48
MA Cc	**Cenchrus* Tussock Grassland	Tussock Grassland of **Cenchrus ciliaris* on red brown loam on levee banks of major drainage lines	30.23

Vegetation Map Code	Broad Floristic Formation	Vegetation Association	Area (ha)
MA CcTtEa ChCa AbAtpAsc	**Cenchrus* Tussock Grassland	Tussock Grassland of **Cenchrus ciliaris, Themeda triandra* and *Eulalia aurea* with Low Open Woodland of *Corymbia hamersleyana* and *Corymbia aspera* over High Open Shrubland of *Acacia bivenosa, Acacia tumida* var. *pilbarensis and Acacia sclerosperma* subsp. *sclerosperma* on brown loamy sand on levee banks of major drainage lines	282.91
MA TtCc PlAbAlu ElCh	*Themeda* Tussock Grassland	Tussock Grassland of *Themeda triandra* and **Cenchrus ciliaris* with Shrubland of *Petalostylis labicheoides, Acacia bivenosa* and *Androcalva luteiflora* and Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* on red brown loam on drainage levees	120.35
MA TdCv EcEv AciAcp	*Typha* Sedges	Sedges of *Typha domingensis* and *Cyperus vaginatus* with Open Woodland of *Eucalyptus camaldulensis* subsp. *refulgens* and *Eucalyptus victrix* over Low Open Woodland of *Acacia citrinoviridis* and *Acacia coriacea* subsp. *pendens* on brown clayey sand on permanent pools along major drainage lines	200.91
GILGAI PLAINS			
GP Asy AsySaoEla CcCsCf	*Acacia* High Open Shrubland	High Open Shrubland of *Acacia synchronicia* over Low Open Shrubland of *Acacia synchronicia, Senna artemisioides* subsp. *oligophylla* and *Eremophila lanceolata* over Very Open Tussock Grassland of **Cenchrus ciliaris, *Cenchrus setiger* and *Chrysopogon fallax* on red light clay on gilgai plains	1,645.94
GP ExeEbCf AsyAteVf NdTc	*Eragrostis* Tussock Grassland	Tussock Grassland of *Eragrostis xerophila, Eriachne benthamii* and *Chrysopogon fallax* with Open Shrubland of *Acacia synchronicia, Acacia tetragonophylla* and **Vachellia farnesiana* over Very Open Herbs of *Neptunia dimorphantha* and *Tephrosia clementii* on red light clay on gilgai plains	2,177.13
GP EbEf Aa Asy	*Eriachne* Tussock Grassland	Tussock Grassland of *Eriachne benthamii* and *Eriachne flaccida* with Low Open Woodland of *Acacia aptaneura* and Open Shrubland of *Acacia synchronicia* on red brown clay on gilgai plains	4.75
GP CcCs AaApr AsyAa	**Cenchrus* Open Tussock Grassland	Open Tussock Grassland of **Cenchrus ciliaris* and **Cenchrus setiger* with Low Open Woodland of *Acacia aptaneura* and *Acacia pruinocarpa* over High Open Shrubland of *Acacia synchronicia* and *Acacia aptaneura* on red sandy clay loam on gilgai plains	6,243.29
GP SfScoGpr	*Sida* Very Open Herbs	Very Open Herbs of *Sida fibulifera, Sclerolaena cornishiana* and *Goodenia prostrata* on brown clay on stony gilgai plain	4.83
SALINE FLATS AND MARSH			
SF Fs Cc	*Frankenia* Low Open Shrubland	Low Open Shrubland of *Frankenia setosa* with Scattered Tussock Grasses of **Cenchrus ciliaris* on red brown clay loam on saline flats	99.01

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SF TdcTibMf Ep	*Tecticornia* Low Open Heath	Low Open Heath of *Tecticornia* sp. Dennys Crossing (K.A. Shepherd & J English KS552), *Tecticornia indica* subsp. *bidens* and *Muehlenbeckia florulenta* over Very Open Tussock Grassland of *Eragrostis pergracilis* on brown medium clay on saline flats and marsh	362.38
DISTURBED			
Cleared	Disturbed	Cleared	12,794.41
Disturbed	Disturbed	Highly degraded vegetation: Open Tussock Grassland of **Cenchrus ciliaris* with Scattered Tall Shrubs of *Acacia bivenosa* and *Petalostylis labicheoides* over Scattered Low Shrubs of *Ptilotus nobilis*	425.86