Western Ridge Southern Tenements
Flora and Vegetation Desktop Assessment

Prepared for BHP Billiton Iron Ore Pty Ltd
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Onshore Environmental Consultants Pty Ltd
ACN 095 837 120
PO Box 227
YALLINGUP WA 6282
Telephone / Fax (08) 9756 6206
E-mail: darren@onshoreenvironmental.com.au

EXECUTIVE SUMMARY

Onshore Environmental Consultants Pty Ltd (Onshore Environmental) was commissioned by BHP Billiton Iron Ore Pty Ltd (BHP Billiton Iron Ore) to undertake a desktop flora and vegetation assessment of the Western Ridge Southern Tenements E52/3360 and E52/3361 (herein referred to as the study area). The study area is located immediately south of the Mt Whaleback Mine and approximately 7 km west of Newman, and covers approximately 17.5 km^2.

Since the commencement of mining at Mt Whaleback in the 1960s, BHP Billiton Iron Ore has commissioned at least 45 flora and vegetation surveys within a 25 km radius of the study area. Database searches and a literature review identified 27 conservation significant flora potentially occurring within a 50 km radius of the study area. Thirteen of the 27 taxa were determined to be 'likely' to occur within the study area, nine taxa were determined to 'possibly' occur within the study area, and five taxa were determined to be 'unlikely' to occur within the study area.

Nine vegetation associations from BHP Billiton Iron Ore's Pilbara consolidated vegetation mapping were matched across the 12 land units defined in the study area, and then classified under seven landforms and six broad floristic formations. Inference from neighbouring baseline mapping defined 13 vegetation associations within the study area, classified under nine landforms and nine broad floristic formations.

None of the vegetation associations mapped within the study area were federal or state listed Threatened Ecological Communities (TECs) for the Pilbara. However, one vegetation association was closely affiliated to the West Angelas Cracking-Clays Priority Ecological Community (PEC) (Priority 1). A further three vegetation associations supporting Mulga Low Open Forest (to Low Woodland) were representative of 'Valley Floor Mulga' within the Hamersley subregion, which is considered to be an 'ecosystem at risk' by the then Department of Conservation and Land Management (now DPaW) (Kendrick 2001).

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1.0 INTRODUCTION

1.1 Preamble

The Western Ridge Southern Tenements (E52/3360 and E52/3361) are situated immediately south of BHP Billiton Iron Ore's Mt Whaleback Mine and approximately 7 km south-west of Newman in the Pilbara region of Western Australia. The study area is identified in Figure 1, and covers an area of approximately 17.5 km^2.

Onshore Environmental was commissioned by BHP Billiton Iron Ore to undertake a flora and vegetation desktop assessment with land unit mapping and inferred vegetation association mapping of the Western Ridge Southern Tenements. The desktop assessment was required to determine flora and vegetation values that may exist, including the potential occurrence of conservation significant species and communities.

1.2 Previous Biological Surveys

There are 45 relevant flora and vegetation surveys that have previously been completed in close proximity to the study area (Appendix 1). This includes three review documents, 14 targeted surveys, three Level 1 surveys and 25 Level 2 surveys. The previous survey work is summarised in more detail in Section 3.1 noting that none of the previous surveys have been completed within the boundary of the current study area.

The closest previous survey adjoins the northern boundary of the study area and covers BHP Billiton Iron Ore's Western Ridge tenement (E52/2008) (Onshore Environmental 2014a). Other nearby surveys have been completed immediately to the north-west at Orebody 35 and surrounds (GHD 2011), and surrounding the Mt Whaleback mining operations immediately north of the study area (Onshore Environmental 2014b).

1.3 Climate

The study area is located in the south-eastern Pilbara region of Western Australia. The Pilbara has an arid-tropical climate with two distinct seasons; a hot and wet summer from October to April, and a mild, drier season from May to September. Summer rainfall is typically associated with tropical storms in the north, or tropical cyclones that cross the coast and move inland. Winter rainfall is commonly the result of cold fronts moving in a north-easterly direction across the region (Bureau of Meteorology (BoM) 2014).

The nearest BoM weather station is Newman Aero, located approximately 9 km east of the study area. The average annual maximum temperature for Newman is 31.9°C. In summer, mean maximum temperatures reach 39.5°C, while in winter, mean minimum temperatures fall to 6.2°C. This constitutes an average temperature range of 33.3°C, with temperature extremes ranging from 46°C to -2.0°C. Average annual rainfall is 320.6 millimetres (mm). Rainfall is often sporadic, and can occur throughout the year.

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BHPBIO

WESTERN RIDGE SOUTH

Location of the study area

FIGURE 1

Legend

Study Area

GRIFFIN SPATIAL & MAPPING

PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
Ph/Fax +61 (0) 8 9725 3213
Mob 0487 337 226

1.4 Biogeographic Regions

The Interim Biogeographic Regionalisation for Australia (IBRA) describes a system of 85 'biogeographic regions' (bioregions) and 403 subregions covering the entire Australian continent (Thackway and Cresswell 1995). Bioregions are defined on the basis of climate, geology, landforms, vegetation and fauna.

The study area is located within the Hamersley subregion (PIL3) of the Pilbara bioregion, which is characterised by mountain ranges and plateaux of Proterozoic sedimentary rock, dissected by gorges (Kendrick 2001). The vegetation is characterised by Mulga low woodland over bunch grasses on fine textured soils in valley floors, and Snappy Gum (*Eucalyptus leucophloia*) over *Triodia brizoides* on skeletal soils of the ranges (Kendrick 2001).

1.5 Existing Land Use

Land tenure in the Pilbara region and throughout the Hamersley sub-region consists of aboriginal lands and leasehold reserves, national parks and reserves, and Crown land which fall under a range of pastoral and mining leases. The dominant types of land use in the Pilbara are pastoralism (cattle grazing), exploration and mining, conservation (and associated tourism), unallocated Crown land, Crown reserves and urban areas (Kendrick and McKenzie 2001, Kendrick and Stanley 2001).

1.6 Soils

The soils of the Pilbara Region have been defined and mapped at a scale of 1:2,000,000 by Bettanay *et al.* (1967). Tille (2006) collated the most recent and detailed mapping of Western Australia's Rangelands and Arid interior into a hierarchy of soil-landscape mapping units. The study area falls within the Fortescue Province, an area that occupies approximately 160,050 km^2 (6.3% of Western Australia) and includes the towns of Port Hedland, Karratha, Dampier, Roebourne, Newman, Tom Price, Paraburdoo, Pannawonica, Marble Bar, Nullagine and Jigalong. Soils and landforms for the Fortescue Province are described as "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)" (Tille 2006). The Fortescue Province is divided into ten soil-landscape zones:

- Nullagine Hills Zone;
- De Grey-Roebourne Lowlands Zone;
- Chichester Ranges Zone;
- Abydos Plains and Hills Zone;
- Fortescue Valley Zone;
- Hamersley Plateaux Zone;
- Karratha Coast Zone;
- Warrawagine Hills Zone;
- Jigalong Plains Zone; and
- Harding Hills and Plains Zone.

One soil unit occurs within the study area; 285-Hamersley Plateaux, described as hills and dissected plateaux (with some stony plain hardpan wash plains) on

sedimentary and volcanic rocks of the Hamersley Basin (Ophthalmia Ford Belt). Soils are stony red shallow loams and some non-cracking clays and red loamy earth.

1.7 Geology

The ancient continental Western Shield dominates the geology of Western Australia. The Pilbara region makes up a portion of the Western Shield and consists of pre-Cambrian, Proterozoic and Archaean rocks. The area contains some of the earth's oldest rock formations, thought to be around 3.5 billion years old (ANRA 2008). Important mineral reserves, including iron ore, which is prevalent in the Pilbara, are associated with these rock formations.

The Pilbara Craton lies beneath the Proterozoic rocks of the Hamersley and Bangemall Basins. The Hamersley Basin covers the majority of the southern part of the Pilbara Craton and is separated into three stratigraphic groups; the Fortescue, Hamersley and Turee Creek rock groups. The Fortescue Group consists mainly of basalt with beds of siltstone, mudstone, shale, dolomite and jaspilite. These rocks form the Chichester Plateau, which lies beneath the Hamersley Plateau. The Turee Creek Group consists of interbedded mudstone, siltstone, sandstone, conglomerate and carbonate. These rocks are the youngest of the three groups and are exposed mainly in the Ashburton Valley. The Hamersley Group is the most relevant to the study area as it contains both the Brockman Iron Formation and the Marra Mamba Iron Formation, which together provide most of the major iron ore deposits in the Pilbara (O'Brien and Associates 1992). This group forms the Hamersley Range and Plateau and consists of jaspilite and dolomite. The jaspilite produces deposits of haematite and limonite, which are mined for iron ore.

1.8 Regional Vegetation

Vegetation mapping of the Pilbara region was completed on a broad scale (1:1,000,000) by Beard (1975). Shepherd *et al.* (2001) re-assessed the mapping and updated vegetation boundaries to account for clearing in the intensive land use zone, and divided some larger vegetation units into smaller units.

The study area is situated in the Hamersley Plateau, which forms part of the Fortescue Botanical District in the Eremaean Botanical Province of Western Australia (Beard 1975). Two Beard (1975) / Shepherd *et al*. (2001) vegetation types fall within the study area; a_1Li/ 18 and e_{16}Lrt$_3$Hi/ 82 (Table 1 and Figure 2). Vegetation types 18 and 82 have a large distribution, especially within the Pilbara bioregion, and are determined to be of low to medium reservation priority (Table 1), with ten percent and 17 percent situated within conservation reserves respectively. Both vegetation types exist at close to 100 percent of their pre-European extent within the relevant subregions (Shepherd *et al*. 2001, DAFWA 2007). Vegetation types that have more than 50 percent of their pre-European extent remaining are considered of 'Least Concern' (Department of Natural Resources and Environment 2002).

Table 1 Beard (1975) and Shepherd *et al*. (2001) vegetation associations occurring in the study area and their reservation priority (Kendrick 2001).

Code	Vegetation Description	Hamersley Subregion			
		Pre-European Extent (km^2)	Current Extent (km^2)	Extent in study area (km^2)	Reserv. Priority (Kendrick 2001)
a_1Li/ 18	Low woodland; mulga (*Acacia aneura*)	5,812.46	5,771.23	12.1	Medium
$e_{16}Lrt_3Hi$/ 82	Hummock grasslands, low tree steppe; Snappy Gum over *Triodia wiseana*	21,775.72	21,652.35	5.4	Low

1.9 Land Systems

The Department of Agriculture has conducted inventory and condition surveys of the Pilbara (van Vreeswyk *et al.* 2004) using an integrated survey method involving the land system approach to rangeland description evaluation. The primary objective of the surveys was to provide comprehensive descriptions and mapping of the biophysical resources of the region as well as an evaluation on the condition of soils and vegetation. The mapping is based on patterns in topography, soils and vegetation.

A total of 102 land systems were defined in the Pilbara at scale of 1:250,000 (van Vreeswyk *et al.* 2004), with two land systems occurring within the study area (Figure 3).

The Rocklea land system is characterised by basalt hills, plateaux, lower slopes and minor stony plains. It occurs extensively throughout the Pilbara, covering 12.7 percent of the bioregion (van Vreeswyk *et al.* 2004). The study area represents less than 0.03 percent of the total area of the Rocklea land system represented in the Pilbara (Table 2).

The Elimunna land system is geographically restricted to the central south and eastern Pilbara, covering 617 ha or 0.3 percent of the bioregion (Table 2). It is characterised by alluvial, and to a lesser extent eluvial, and basalt surface geology. It contains land units such as plains and drainage floors which support tussock grasslands. These landforms are attractive to pastoral activities and prone to land degradation under high grazing intensity (van Vreeswyk *et al.* 2004). The study area represents 1.54 percent of the total area of the Elimunna land system represented in the Pilbara (Table 2).

Table 2 Land systems occurring within the study area (descriptions from van Vreeswyk *et al.* 2004).

Land System	Description	Distribution in the Pilbara	Area in Pilbara (km²)	% of Pilbara Region	Area within study area (km²)	% of study area	Study area as % of Land System
Elimunna	Stony plains on basalt supporting sparse Acacia and Cassia shrublands and patchy tussock grasslands	Central east and south, common	617	0.3	9.52	54.52	1.54
Rocklea	Basalt hills, plateaux, lower slopes and minor stony plains supporting hard spinifex (and occasionally soft spinifex) grassland	Wide, very common	22,993	12.7	7.94	45.48	0.03

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7410000

7405000

HAMMERSLEY, 82

HAMMERSLEY, 18

KUMARINA HILLS, 29

760000 765000 770000 775000

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WESTERN RIDGE SOUTH
Beard (1975) vegetation complexes within the study area

FIGURE 2

Legend

Study Area

Pre-European Vegetation (Beard 1975)

SYSTEM, VEG_ASSOC

- HAMMERSLEY, 18
- HAMMERSLEY, 82
- KUMARINA HILLS, 29

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PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
+61 8 9725 3213

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Legend

- Study Area

Land Systems

- RGEBGD, Boolgeeda Land System
- RGEEGE, Egerton Land System
- RGEELI, Elimunna Land System
- RGENEW, Newman Land System
- RGEPRA, Prairie Land System
- RGERIV, River Land System
- RGEROB, Robe Land System
- RGEROC, Rocklea Land System
- RGESPH, Spearhole Land System
- RGEX_MINE, Mine

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WESTERN RIDGE SOUTH
Land systems occurring within the study area (descriptions from van Vreeswyk et al. 2004)

FIGURE 3

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PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
+61 8 9725 3213

2.0 METHODOLOGY

2.1 Desktop Assessment

2.1.1 Literature Review

Regional scale reports relevant to the study area locality were reviewed, including:

- a summary of bioregional data (Kendrick 2003);
- land systems mapping (Van Vreeswyk et al. 2004); and
- vegetation description and mapping by Beard (1975a, 1975b).

In addition, there was a review of all publicly available literature and internal reports commissioned and held by BHP Billiton Iron Ore. There are 45 relevant flora and vegetation surveys that have previously been completed in close proximity to the study area (Appendix 1). This includes three review documents, 14 targeted surveys, three Level 1 surveys and 25 Level 2 surveys. The previous survey work is summarised in more detail in Section 3.1.

2.1.2 Database Searches

Desktop searches included databases relating to rare flora, TECs and PECs previously collected or described within, or in close proximity to, the study area. For this report the search was extended beyond the study area to place flora values into a local and regional context. The following databases were searched:

- NatureMap1: This database represents the most comprehensive source of information on the distribution of Western Australia's flora, comprising records from the DPaW Threatened Flora database and the WA Herbarium Specimen Database (25 km radial search, accessed 7 September 2016);
- DPaW's Threatened and Priority flora database was searched to confirm the NatureMap results (30 km radial search, accessed 19 September 2016);
- DPaW's TEC, PEC and Environmentally Sensitive Areas (ESAs) database was searched to identify significant communities (50 km radial search);
- BHP Billiton Iron Ore's Threatened and Priority flora database was searched to identify records of significant flora known to be in close proximity of the study area (25 km radial search, accessed 19 September 2016);
- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters database (DoE 2016, accessed 7 September 2016); and
- International Union for Conservation of Nature (IUCN) database (IUCN 2016).

2.1.3 Assessment of Likelihood of Occurrence in the Study Area

A list of conservation significant species occurring within a 50 km radius of the study area was compiled during the literature review and desktop searches. The likelihood of each taxon occurring within the study area was assessed using a set of rankings and criteria (Table 3) based on presence of suitable landform (inferred from aerial imagery with contours overlayed and from knowledge of the adjacent areas) and distance to known records.

Table 3 Ranking system used to assign the likelihood that a species would occur in the study area.

Rank	Criteria
Recorded	The species has been recorded in the study area.
Likely to occur	The species has previously been recorded from a landform which is present within the study area, and there are previous records within a 20 km radius of the study area.
Possible to occur	The species has previously been recorded from a landform which is present within the study area, and there are previous records within a 50 km radius of the study area.
Unlikely to occur	The landform from which the species has previously been recorded is absent within the study area, and/or there are no previous records within a 50 km radius of the study area.

2.2 Vegetation Mapping

2.2.1 Land Unit Mapping

Land system mapping has been completed across the entire Pilbara bioregion at a scale of 1:250,000 (van Vreeswyk *et al.* 2004). There are two land systems represented within the study area. The land system boundaries were overlayed on high resolution aerial photography at a scale of 1:5,000 along with AHD (Australian height datum) contours at 2 m intervals, to form the base maps from which to undertake desktop land unit mapping. A total of 11 base map sheets were required to cover the entire study area.

Land systems are further classified into land units based on the landform, soil and vegetation interactions, as described by van Vreeswyk *et al.* (2004). The land units occurring within each land system are broadly described according to landform, soil, vegetation, and representation (as a percentage of the total land system area) (van Vreeswyk *et al.* 2004). However, the distribution of land units within the Pilbara has not previously been mapped.

Within each broad land system polygon represented within the study area, fine scale boundaries were hand drawn to delineate land units. The land units were identified using a combination of shading patterns and colours evident from the high resolution aerial photography, inference of landform (relief and slope), position in landscape, drainage pattern, and field knowledge from the experienced Principal Botanist undertaking the mapping. Following completion of line work, each of the 11 base map sheets was scanned, georeferenced, and the land unit line work digitised and rectified in a Geographic Information System (GIS). Each land unit polygon digitised was then attributed with a specific land unit code.

For each of the land units, vegetation association descriptions were linked to broad 'site type'[1] descriptions made by van Vreeswyk *et al.* (2004). The site type descriptions were then aligned to vegetation associations from BHP Billiton Iron Ore's Pilbara consolidated vegetation mapping data.

[1] The interrelationships between the physical environment and the plant communities it supports were described by classifying sampling points (inventory sites) into site types. A total of 44 site types were described within the Pilbara bioregion in terms of the particular combination of land surface, dominant plant species, and vegetation formation.

2.2.2 Vegetation Association Mapping

Vegetation association mapping utilised the land unit mapping polygons overlayed on high-resolution aerial photography at a scale of 1:5,000, from which there was finer scale delineation of vegetation association polygons based on contrasting shading patterns evident from the aerial photography.

Previous vegetation association mapping completed at the Orebody 35 (GHD 2011), Western Ridge (Onshore Environmental 2014) and Mt Whaleback (Onshore Environmental 2013) tenements were used to provide vegetation association descriptions for individual polygons defined. Descriptions of vegetation structure follows the height, life form and density classes of Specht (1970) as modified by Aplin (1979) and Trudgen (2009) (see Appendix 2). This is largely a structural classification suitable for broader scale mapping, but taking all ecologically significant strata into account.

2.2.3 Vegetation Association Coding

A vegetation association code is applied to each vegetation association. This code is comprised of the dominate landform on which the vegetation association occurs and the dominant plant taxa in each vegetation stratum.

A unique code has been developed for each of the 2,131 vascular plant species known to occur in the Pilbara based on Western Australian Herbarium (WAH) vouchers; this list is referred to as 'the flora register'. The abbreviation typically comprised the first two letters representing the genus (capital followed by lowercase), e.g. He = *Heliotropium,* followed by one and up to a maximum of three letters representing the species (lowercase), e.g. te = *tenuifolium*[2]*.* For the more common genera including *Acacia, Bidens, Bonamia, Cenchrus, Eucalyptus, Melaleuca* and *Triodia,* a single capital letter is used to represent the genus, e.g. A = *Acacia,* E = *Eucalyptus*. This was also applied for taxa represented in genera starting with the letters U, V, W, X, Y or Z (except *Zornia*), owing to the relatively small number of species represented within genera commencing with these letters.

A two letter capital code was applied as a prefix to the vegetation association code to indicate the dominant landform on which it occurs. The 14 landform categories were developed by Onshore Environmental on the basis of extensive in-field knowledge of the south-east Pilbara, and records made from formal study sites by consultants over an extended period of sampling. The 14 landform categories and associated codes were:

GG = gorges and gullies
HC = hill crests and upper hill slopes
HS = hill slopes and low undulating hills
FS = foot slopes
SP = stony plains
GR = granite outcrops and rockpiles
FP = flood plains
SD = sand dunes
CP = calcrete plains
MI = minor drainage lines
ME = medium drainage lines
MJ = major drainage lines
GP = gilgai plains

[2] Another example: Aa = *Acacia aptaneura,* Aan = *Acacia aneura,* Aanc = *Acacia ancistristrocarpa.*

SF = saline flats and marsh.

A space was inserted after the landform code and followed by the dominant vegetation stratum as determined by the highest ground cover class. Where two vegetation strata provided the same cover class, the taller height class was referred to first. A maximum of three taxa were represented within each stratum. A space between plant taxa reflected a different vegetation stratum, with a maximum of three strata represented in any single code. Table 4 provides three examples with one, two and three vegetation strata represented for the hill slope, foot slope and sand plain landform categories respectively.

Table 4 Example of three vegetation associations represented within the consolidated mapping data, with one, two and three vegetation strata respectively.

Vegetation Code	Landform	Vegetation Description
HS Ts	Hill Slope	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) on red brown sandy loam on hill slopes
FS Tw Ell	Foot Slope	Hummock Grassland of *Triodia wiseana* with Scattered Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* on red silty clay on hill slopes and foot slopes
SA Ast Tsc AtpAccMl	Sand Plain	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 sand plains

3.0 RESULTS

3.1 Desktop Review

3.1.1 Previous Flora and Vegetation Surveys

Numerous flora and vegetation surveys have been undertaken in the Western Ridge Southern Tenements surrounding area. To provide some regional context, 45 previous flora and vegetation surveys completed within a 25 km radius of the study area were reviewed (Table 5). This review aimed to identify the intensity of survey work completed, total flora statistics, and species and communities of conservation significance.

The results are presented in Table 5 below and briefly summarised as follows:

- None of the surveys identified any federal or state listed TECs;
- None of the surveys identified any state listed PECs. However, one vegetation association recorded from the adjacent Western Ridge survey area (Onshore Environmental 2014a) was closely affiliated with the 'West Angelas Cracking-Clays PEC' (Priority 1), described as 'Open tussock grasslands of *Astrebla pectinata, Astrebla elymoides, Aristida latifolia,* in combination with *Astrebla squarrosa* and low scattered shrubs of *Sida fibulifera*, on basalt derived cracking-clay loam depressions and flowlines'.
- There was one Federal listed Threatened Flora taxon *(Lepidium catapycnon)* recorded from the Mt Whaleback mining lease and adjacent Cathedral Gorge tenement situated approximately 7 km north of the study area;
- There were no State listed Threatened Flora recorded from the surveys; and
- A total of 14 currently listed Priority flora taxa have been recorded from the locality.

Table 5 Summary of background and results for previous flora and vegetation surveys completed in close proximity to, the study area.

Project	Survey Timing	Season	Survey Type	Area (ha)	No. Sites	No. Taxa	Significant Flora	Introduced Flora
Cathedral Gorge Level 2 Flora and Vegetation Survey (Onshore Environmental 2016)	September – October 2015	Good	Level 2	5,330	52	390	*Aristida lazaridis* (P2), *Calotis latiuscula* (P3), *Indigofera gilesii* (P3), *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (P3), *Goodenia nuda* (P4), *Lepidium catapycnon* (Vu; P4), *Hibiscus* aff. sp. Canga (P.J.H. Hurter & J. Naaykens 11013) (species of interest)	**Bidens bipinnata, *Cenchrus ciliaris, *Cenchrus setiger, *Malvastrum americanum, *Rumex vesicaria, *Setaria verticillata, *Sonchus oleraceus, *Vachellia farnesiana*
Newman Shopping Centre Powerline Extension (Onshore Environmental 2015)	November 2015	Poor	Level 1		NR	136	None Recorded	**Aerva javanica, *Cenchrus ciliaris, *Cenchrus setiger, *Conyza bonariensis, *Flaveria trinerva, *Lactuca serriola* forma *serriola, *Rumex vesicaria*
Western Ridge Biological Survey (Onshore Environmental 2014a)	June 2014	Good	Single Season Level 2	7,200	12	199	*Calotis latiuscula* (P3), *Aristida* cf. *nitidula* (species of interest)	**Aerva javanica, *Bidens bipinnata, *Cenchrus ciliaris, *Cenchrus setiger, *Malvastrum americanum, *Setaria verticillata, *Vachellia farnesiana*
Mt Whaleback OB29/30/35 Targeted Flora Survey Assessment (Onshore Environmental 2014b)	February 2014	Good	Targeted	8,807	NR	NR	*Lepidium catapycnon* (Vu; P4), *Calotis latiuscula* (P3), *Gymnanthera cunninghamii* (P3), *Eremophila magnifica* subsp. *magnifica* (P4), *Goodenia nuda* (P4)	Not recorded

Project	Survey Timing	Season	Survey Type	Area (ha)	No. Sites	No. Taxa	Significant Flora	Introduced Flora
Flora and Vegetation and Vertebrate Fauna Review Mt Whaleback AML 7/244 (Onshore Environmental 2013)	Desktop Review	NR	Review	8,807	183	352	*Lepidium catapycnon* (Vu; P4), *Calotus latiuscula* (P3), *Eremophila magnifica* subsp. *magnifica* (P4)	**Aerva javanica, *Bidens bipinnata, *Cenchrus ciliaris, *Cenchrus setiger, *Chloris barbata, *Chloris virgata, *Conyza bonariensis, *Cucumis melo subsp. agrestis, *Cynodon dactylon, *Echinochloa colona, *Malvastrum americanum, *Rumex vesicaria, *Schinus molle, *Sisymbrium orientale, *Solanum nigrum, *Sonchus oleraceus, *Tribulus terrestris, *Vachellia farnesiana*
Mt Whaleback East Flora, Vegetation and Fauna Survey (ENV 2011a)	January 2011	Poor	Single Season Level 2	703	15	127	None Recorded	**Agave americana, *Cenchrus ciliaris, *Malvastrum americanum, *Schinus molle, *Tamarindus indicus*
Orebody 35 and Surrounds Flora and Vegetation Survey (GHD 2011)	May 2010 August 2010		Level 2	6,100	88	347	*Indigofera gilesii* (P3), *Gymnanthera cunninghamii* (P3), *Goodenia nuda* (P4)	**Aerva javanica, *Argemone ochroleuca* subsp. *ochroleuca, *Bidens bipinnata, *Cenchrus ciliaris, *Cucumis melo subsp. agrestis, *Cynodon dactylon, *Flaveria trinervia, *Malvastrum americanum, *Rumex vesicaria, *Sisymbrium orientale, *Solanum nigrum, *Sonchus oleraceus, *Vachellia farnesiana*

Project	Survey Timing	Season	Survey Type	Area (ha)	No. Sites	No. Taxa	Significant Flora	Introduced Flora
Mt Whaleback Flora and Vegetation Assessment (ENV 2011b)	May-June 2011	Good	Single Season Level 2	3,729	42	272	*Lepidium catapycnon* (Vu; P4), *Calotis latiuscula* (P3), *Eremophila magnifica* subsp. *magnifica* (P4)	**Aerva javanica, *Agave americana, *Bidens bipinnata, *Cenchrus ciliaris, *Cenchrus setiger, *Chloris barbata, *Chloris virgata, *Conyza bonariensis, *Cucumis melo subsp. agrestis, *Cynodon dactylon, *Echinochloa colona, *Flaveria trinervia, *Malvastrum americanum, *Rumex vesicaria, *Schinus molle, *Solanum nigrum, *Sonchus oleraceus, *Tamarindus indica, *Tribulus terrestris, *Vachellia farnesiana, *Washingtonia filifera*
Mt Whaleback TSF Flora, Vegetation and Fauna Assessment (Astron 2010)	March 2010	Poor	Single Season Level 2	23.5	7	71	None Recorded	**Cenchrus ciliaris, *Vachellia farnesiana*
Orebody 35 VCP area Flora and Fauna Assessment (ENV 2010)	December 2009	Poor	Single Season Level 2	844	29	189	*Tephrosia* sp. Cathedral Gorge (F.H. Mollemans 2420)[3]	**Bidens bipinnata, *Cenchrus ciliaris, *Malvastrum americanum*
Orebody 25 to Newman Flora and Vegetation Assessment (ENV 2009c)	July 2009	Poor		603	33	214	None Recorded	**Bidens bipinnata, *Cenchrus ciliaris, *Cynodon dactylon, *Enteropogon ramosus, *Malvastrum americanum, *Rumex vesicaria, *Setaria verticillata*
Homestead Creek Culvert Flora and Vegetation Assessment (ENV 2009d)	July 2009	Poor	Single Season Level 1	35	-	80	None Recorded	**Cenchrus ciliaris, *Echinochloa colona, *Enteropogon ramosus, *Malvastrum americanum, *Setaria verticillata, *Vachellia farnesiana*

3 *Tephrosia* sp. Cathedral Gorge (F.H. Mollemans 2420) is now known as *Tephrosia oxalidea* and is no longer a Priority flora taxon (WAH 2016).

Project	Survey Timing	Season	Survey Type	Area (ha)	No. Sites	No. Taxa	Significant Flora	Introduced Flora
Newman Power Network, Level 2 Flora and Level 1 Fauna Survey (Biologic 2009)	July 2009	Good	Targeted Search	-	-	319	*Goodenia nuda* (P4)	**Aerva javanica, *Argemone ochroleuca* subsp. *ochroleuca, *Bidens bipinnata, *Cenchrus ciliaris, *Cenchrus setiger, *Cucumis lanatus, *Cynodon dactylon, *Datura leichhardtii, *Malvastrum americanum, *Rumex vesicaria, *Schinus molle, *Solanum nigrum, *Sonchus oleraceus, *Vachellia farnesiana*
Whaleback Flora and Vegetation Survey and Fauna Assessment (Onshore 2009a)	June 2009	Poor	Single Season Level 2	2609	30	201	None Recorded	**Aerva javanica, *Argemone ochroleuca, *Bidens bipinnata, *Cenchrus ciliaris, *Cenchrus setiger, *Chloris barbata, *Cucumis melo* subsp. *agrestis, *Cynodon dactylon, *Echinochloa colona, *Malvastrum americanum, *Rumex vesicaria, *Setaria verticillata, *Sisymbrium orientale, *Solanum nigrum, *Sonchus oleraceus, *Vachellia farnesiana*
Newman to Jimblebar Transmission Line and Newman Town Substation Flora and Vegetation Assessment (ENV 2009a)	April 2009	Poor	Single Season Level 2	-	67	365	*Goodenia nuda* (P4)	**Aerva javanica, *Bidens bipinnata, *Cenchrus ciliaris, *Cenchrus setiger, *Cucumis melo* subsp. *agrestis, *Cynodon dactylon, *Datura leichhardtii, *Echinochloa colona, *Malvastrum americanum, *Rumex vesicaria, *Setaria verticillata, *Sonchus oleraceus, *Tribulus terrestris, *Vachellia farnesiana*
Mount Whaleback Power Station Flora and Vegetation Assessment (ENV 2009b)	April 2009	Good	Single Season Level 2	-	10	124	None Recorded	**Aerva javanica, *Bidens bipinnata, *Cenchrus ciliaris, *Malvastrum americanum*

Project	Survey Timing	Season	Survey Type	Area (ha)	No. Sites	No. Taxa	Significant Flora	Introduced Flora
Rail RGP5 Repeater 9 Access Road Flora and Vegetation Assessment (ENV 2008c)	June 2008	Good	Single Season Level 2	12	7	163	*Rostellularia adscendens* var. *latifolia* (P3)	**Aerva javanica, *Brassica tournefortii, *Cenchrus ciliaris, *Citrullus lanatus, *Cynodon dactylon, *Cucumis melo subsp. agrestis, *Datura leichhardtii, *Malvastrum americanum, *Rumex vesicaria, *Setaria verticillata, *Sonchus asper, *Sonchus oleraceus, *Vachellia farnesiana*
Report for Myopic Project Area Newman, Flora and Fauna Assessment (GHD 2008)	May to June 2008	Good		3,600	141	321	*Triumfetta leptacantha*[4], *Brunonia* sp. Long hairs (D.E. Symon 2440)[5]	**Bidens bipinnata, *Cenchrus ciliaris, *Malvastrum americanum*
Newman Water Pipeline Enhancement Project: Flora and Vegetation Assessment (Ecologia 2008)	April 2008	Good	Single Season Level 1	-	69	353	*Themeda* sp. Hamersley Station (M.E. Trudgen 11431) (P3)	**Aerva javanica, *Bidens bipinnata, *Cenchrus ciliaris, *Centaurium erythraea, *Chloris virgata, *Citrullus colocynthis, *Citrullus lanatus, *Conyza bonariensis, *Cynodon dactylon, *Datura leichhardtii, *Echinochloa colona, *Malvastrum americanum, *Vachellia farnesiana*
Rail RGP5 Summary of Important Findings from RGP5 Railway Project Biological Assessments (ENV 2008a)	April 2008	Good	Single Season Level 2	-	159	-	*Rostellularia adscendens* var. *latifolia* (P3)	**Aerva javanica, *Cenchrus ciliaris, *Cucumis melo* subsp. *agrestis, *Cynodon dactylon, *Malvastrum americanum, *Bidens bipinnata, *Setaria verticillata, *Tribulus terrestris*

4 *Triumfetta leptacantha* has been delisted as a Priority flora taxon (WAH 2016).
5 *Brunonia* sp. Long hairs (D.E. Symon 2440) has been delisted as a Priority flora taxon (WAH 2016).

Project	Survey Timing	Season	Survey Type	Area (ha)	No. Sites	No. Taxa	Significant Flora	Introduced Flora
RPG5 Jimblebar Junction to Yandi Junction Railway Reserve (ENV 2008b)	April 2008	Good	Single Season Level 2	960	137	353	*Eremophila margarethae*[6], *Bulbostylis burbidgeae* (P4), *Goodenia nuda* (P4)	**Aerva javanica, *Bidens bipinnata, *Cenchrus ciliaris , *Cenchrus setiger, *Chloris virgata, *Cucumis melo* subsp. *agrestis, *Cynodon dactylon, *Malvastrum americanum, *Setaria verticillata, *Vachellia farnesiana*
OB25 Rail Spur Siding Declared Rare and Priority Flora Survey (ENV 2007)	November to December 2006	Good	Targeted Search	121.1	-	-	None Recorded	**Cenchrus ciliaris*
Mount Whaleback Newman Kurra Village Extension Area Flora and Vegetation Assessment (ENV 2006e)	September 2006	Good	Single Season Level 2	30	9	117	None Recorded	**Bidens bipinnata, *Cenchrus ciliaris, *Conyza bonariensis, *Cynodon dactylon, *Malvastrum americanum, *Rumex vesicaria, *Solanum nigrum*
Newman Ammonium Nitrate Storage Facility - Phase II conservation significant flora survey (Ecologia 2006b)	April 2006	Very Good	Targeted Searches	76.3		122	None Recorded	**Aerva javanica, *Bidens bipinnata, *Cenchrus ciliaris*
Orebody 24 Flora and Fauna Assessment Phase II (ENV 2006a)	March-April 2006	Very Good	Single Season Level 2	-	84	413	*Abutilon trudgenii*[7], *Eremophila magnifica* subsp. *velutina* (P3), *Gymnanthera cunninghamii* (P3), *Triumfetta leptacantha*[8], *Tephrosia* sp. Cathedral Gorge (F.H. Mollemans 2420)[9]	**Bidens bipinnata, *Cenchrus ciliaris, *Cynodon dactylon, *Echinochloa colona, *Malvastrum americanum, *Rumex vesicaria, *Setaria verticillata, *Solanum nigrum*

6 *Eremophila margarethae* has been delisted as a Priority flora taxon (WAH 2016).
7 *Abutilon trudgenii* is now known as *Abutilon* sp. Pilbara (W.R. Barker 2025) and is no longer a Priority flora taxon (WAH 2016).
8 *Triumfetta leptacantha* has been delisted as a Priority flora taxon (WAH 2016).
9 *Tephrosia* sp. Cathedral Gorge (F.H. Mollemans 2420) is now known as *Tephrosia oxalidea* and is no longer a Priority flora taxon (WAH 2016).

Project	Survey Timing	Season	Survey Type	Area (ha)	No. Sites	No. Taxa	Significant Flora	Introduced Flora
Newman Ammonium Nitrate Storage Facility - Conservation Significant Flora Survey (Ecologia 2006a)	January 2006	Very Good	Targeted Searches	10	-	64	None Recorded	**Cenchrus ciliaris*
Mount Whaleback Flora and Vegetation Assessment Phase III Summary Report (ENV 2006f)	August 2006	Very Good	Single Season Level 2		81	345	*Lepidium catapycnon* (Vu; P4), *Aristida burbidgeae*[10]	**Aerva javanica, *Bidens bipinnata, *Conyza bonariensis, *Cenchrus ciliaris, *Flaveria trinervia, *Malvastrum americanum, *Rumex vesicaria, *Sisymbrium orientale, *Solanum nigrum*
BHP Billiton Iron Ore Western Ridge Exploration Project Biological Survey (Ecologia 2006c)	August 2006	Very Good	Single Season Level 2	-	36	152	*Calotis latiuscula* (P3)	**Bidens bipinnata, *Cenchrus ciliaris, *Malvastrum americanum*
Newman Hub RGP4 Infrastructure Area Flora and Vegetation Assessment (ENV 2006b)	September 2006	Good	Single Season Level 2	250	10	168	None Recorded	**Argemone ochroleuca subsp. ochroleuca, *Bidens bipinnata, *Cenchrus ciliaris, *Conyza bonariensis, *Malvastrum americanum, *Rumex vesicaria, *Sisymbrium orientale, *Solanum nigrum*
Newman Hub Rail Corridor Declared Rare and Priority Flora Survey (ENV 2006d)	September 2006	Good	Targeted Searches	17.8	-	-	*Abutilon trudgenii*[11]	**Cenchrus ciliaris*

10 Previously identified as *Aristida jerichoensis* var. *subspinulifera* (Priority 1), but recently confirmed as the common *Aristida burbidgeae* (Onshore Environmental 2014).
11 *Abutilon trudgenii* is now known as *Abutilon* sp. Pilbara (W.R. Barker 2025) and is no longer a Priority flora taxon (WAH 2016).

Project	Survey Timing	Season	Survey Type	Area (ha)	No. Sites	No. Taxa	Significant Flora	Introduced Flora
Newman Hub RGP4 Topsoil Stockpile and Borrow Areas for Construction Flora and Vegetation Assessment (ENV 2006c)	October 2006	Good	Single Season Level 2	220	45	285	*Acacia kenneallyi* (P3)[12]	**Argemone ochroleuca subsp. ochroleuca, *Bidens bipinnata, *Cenchrus ciliaris, *Conyza bonariensis, *Euphorbia hirta, *Malvastrum americanum, *Helichrysum luteoalbum, *Rumex crispus, *Rumex vesicaria, *Schinus molle, *Sisymbrium orientale, *Solanum nigrum, *Sonchus oleraceus*
Western Ridge Exploration Project Biological Survey (Ecologia 2005)	May 2005	Good	Single Season Level 2	-	7	152	None Recorded	None Recorded
Newman BHP Billiton Ongoing Works - Newman Hub Final Report (Ecologia 2004b)	June 2004	Poor	Targeted Search	-	-	-	None Recorded	**Aerva javanica, *Amaranthus caudatus, *Cenchrus setiger, *Rumex vesicaria*
Newman Village Declared Rare and Priority Flora and Weed Survey (Ecologia 2004c)	June- July 2004	Poor	Targeted Search	-	-	-	None Recorded	**Cenchrus setiger*
Orebody 24 Expansion Biological Survey (Ecologia 2004d)	May 2004	Poor	Single Season Level 2	5200	50	258	*Tephrosia* sp. Cathedral Gorge (F.H. Mollemans 2420)[13], *Triumfetta leptacantha*[14], *Isotropis parviflora* (P2)[15]	**Bidens bipinnata, *Cenchrus ciliaris, *Malvastrum americanum, *Rumex vesicaria*

12 *Acacia kenneallyi* is restricted to the northern Kimberley region of Western Australia and the Whaleback record was a misidentification (Onshore Environmental 2014).
13 *Tephrosia* sp. Cathedral Gorge (F.H. Mollemans 2420) is now known as *Tephrosia oxalidea* and is no longer a Priority flora taxon (WAH 2016).
14 *Triumfetta leptacantha* has been delisted as a Priority flora taxon (WAH 2016).
15 Previously mis-identified as *Isotropis winneckei* (P1).

Project	Survey Timing	Season	Survey Type	Area (ha)	No. Sites	No. Taxa	Significant Flora	Introduced Flora
BHP Long Term Expansion Pre-feasibility Study (Ecologia 2003)	2003	Not relevant	Review	-	-	-	*Lepidium catapycnon* (Vu; P4), *Euphorbia inappendiculata*[16]	**Argemone ochroleuca, *Bidens bipinnata, *Cenchrus ciliaris, *Cenchrus setiger, *Solanum nigrum, *Sonchus oleraceus, *Rumex vesicarius*
Orebody 25 Priority Flora Species Survey (BHP Billiton Iron Ore 2000a)	June 2000	Very Good	Targeted Search	-	-	2	*Eremophila magnifica*[17], *Triumfetta leptacantha*[18]	None Recorded
Mt Whaleback Priority Flora Species Survey (BHP Billiton Iron Ore 2000b)	July 2000	Good	Targeted Search	-	-	-	*Triumfetta leptacantha*[19]	None Recorded
Baseline Biological and Soil Surveys Mapping for ML244SA West of the Fortescue River (Biota 2000)	September to October 2000	Very Good	Single Season Level 2	17, 060	60	380	*Eriachne tenuiculmis*[20]	**Argemone ochroleuca, *Bidens bipinnata, *Cenchrus ciliaris, *Cenchrus echinatus, *Cenchrus setiger, *Conyza bonariensis, *Cynodon dactylon, *Hypochaeris glabra, *Malvastrum americanum, *Pseudognaphalium luteoalbum, *Rumex vesicaria, *Sisymbrium erysimoides, *Solanum nigrum, *Sonchus oleraceus*
Follow-Up Survey of Mt Whaleback *Lepidium catapycnon* population (HGM 1999)	May 1999	Good	Targeted Search	10.5	-	-	*Lepidium catapycnon* (Vu; P4)	None Recorded

16 *Euphorbia inappendiculata* is now known as *Euphorbia inappendiculata* var. *inappendiculata* (Priority 2). A recent targeted survey did not record this taxon from the previous location point under excellent seasonal conditions (Onshore Environmental 2014), and it has now been removed from the BHP Billiton Iron Ore database.
17 The subspecies of *Eremophila magnifica* was not determined (either subsp. *velutina* Priority 3 or subsp. *magnifica* Priority 4).
18 *Triumfetta leptacantha* has been delisted as a Priority flora taxon (WAH 2016).
19 *Triumfetta leptacantha* has been delisted as a Priority flora taxon (WAH 2016).
20 *Eriachne tenuiculmis* has been delisted as a Priority flora taxon (WAH 2016).

Project	Survey Timing	Season	Survey Type	Area (ha)	No. Sites	No. Taxa	Significant Flora	Introduced Flora
Field Search and Observations of *Lepidium catapycnon* Population Near Mt Whaleback, Newman (BHP Billiton Iron Ore 1999a)	June-August 1999	Good	Targeted Search	-	-	1	*Lepidium catapycnon* (Vu; P4)	None Recorded
Regional Search for *Lepidium catapycnon* in the greater Newman Area (Pilbara), Western Australia (BHP Billiton Iron Ore 1999b)	June-November 1999	Good	Targeted Search	-	-	1	*Lepidium catapycnon* (Vu; P4)	None Recorded
Orebody 23 Extension - Biological Survey Assessment (Ecologia 1998)	June 1997	Good	Single Season Level 2	650	20	233	*Scaevola acacioides*[21]	**Rumex vesicarius, *Cenchrus ciliaris*
Mt Whaleback Soil and Vegetation Mapping (HGM 1997)	November 1996	Poor	Targeted Search	-	-	-	*Lepidium catapycnon* (Vu; P4)	None Recorded
Newman Lease Environmental Appraisal (Maunsell and Partners 1984)	October 1984	Poor		36,100	-	-	None Recorded	None Recorded

21 *Scaevola acacioides* has been delisted as a Priority flora taxon (WAH 2016).

3.1.2 Threatened Flora listed under the EPBC Act

A search of the EPBC Act Protected Matters Database (DoE 2016) identified two Threatened flora occurring within a 10 km radius of the study area; *Lepidium catapycnon* and *Pityrodia augustensis.* Both taxa are currently listed as Vulnerable (Appendix 3); it is noted that the State Conservation Code for *Lepidium catapycnon* has recently been downgraded from Threatened Flora to Priority 4 flora (Appendix 4). There are no known records for either species within the study area.

Lepidium catapycnon (Hamersley Lepidium) is known from at least 32 populations covering approximately 21,736 km^2 in an area stretching roughly between the towns of Newman, Nullagine and Tom Price in the Pilbara Region of Western Australia. There are eight populations of *Lepidium catapycnon* confirmed to occur across the entire extent of Karijini National Park (Onshore Environmental 2013d). *Lepidium catapycnon* exhibits a strong habitat preference for steep upper breakaway slopes of mesa hills where it grows in skeletal light brown loam or sandy loam soils with a large proportion of loose rocks at the surface (50-100 percent) comprising a mixture of banded iron formation (BIF), banded chert and siltstone. The vegetation type most commonly associated with populations of *Lepidium catapycnon* is *Triodia* Hummock Grassland (or Open Hummock Grasslands) of *Triodia wiseana* and/or *Triodia brizoides,* with Scattered Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* and Low Open Shrubland (to Low Scattered Shrubs) of *Acacia bivenosa* and *Senna glutinosa* subsp. *glutinosa* (Onshore Environmental 2013d). It is possible that *Lepidium catapycnon* occurs within the study area.

Pityrodia augustensis (Mt Augustus Foxglove) is restricted to the northern slopes of Mt Augustus approximately 295 km west south west of the study area. It occurs as a bushy shrub up to 1 m in height and is found on rocky slopes or drainage lines. It is unlikely that *Pityrodia augustensis* occurs within the study area.

3.1.3 Threatened Flora listed under the IUCN Red List database

There were no records identified from the IUCN database search. *Lepidium catapycnon* and *Pityrodia augustensis* have not been assessed for the IUCN Red List.

3.1.4 Threatened Flora listed under the WA Wildlife Conservation (Rare Flora) Notice

There were no Threatened Flora taxa recorded from a 25 km radius of the study area within the DPaW rare flora database search (DPaW 2016b) (Table 6).

3.1.5 Priority Flora recognised by the DPaW

NatureMap lists 113 plant taxa occurring within a 10 km radius of the study area, including three conservation significant flora; *Lepidium catapycnon* (P4), *Ipomoea racemigera* (P2) and *Triodia pascoeana* (P1). The DPaW rare flora database search (DPaW 2016a) identified 21 Priority flora taxa as potentially occurring within a 50 km radius of the study area, with a number of additional conservation significant flora recorded from previous surveys in the area.

The likelihood of these conservation significant taxa occurring within the study area is presented in Table 6. Thirteen of 27 taxa identified from the area are likely to occur within the study area, nine may possibly occur, and five are unlikely to occur (Table 6).

Table 6 **Significant flora taxa recorded in or around the survey area from the federal and state database searches, literature review and local knowledge.** Refer Table 3 for ranking determination of likelihood of occurring within the study area.

Taxon	Conservation Status	Life Form	Habitat Preference	Suitable Habitat Present	Closest Record to study area	Likelihood in the study area
Acacia bromilowiana	P4	Perennial	Red skeletal stony loam, laterite, banded ironstone, basalt. Rocky hills, breakaways, scree slopes, gorges, creek beds.	Yes	35 km	Possible
Acacia subtiliformis	P3	Perennial	Rocky calcrete plateaus.	Yes	30 km	Possible
Amaranthus centralis	P3	Annual	River banks. Sand plains. Mulga woodlands.	Yes	45 km	Possible
Aristida aff. *nitidula*	of interest	Perennial	Heavy clay soils on stony gilgai plains.	Yes	3 km	Likely
Aristida jerichoensis var. *subspinulifera*	P1	Perennial	Hardpan plains.	Yes	40 km	Possible
Aristida lazaridis	P2	Perennial	Red clay loam soils on flood plains, often in drainage depressions, typically occurring with Mulga woodland.	Yes	12 km	Likely
Calotis latiuscula	P3	Perennial	Sand, loam. Rocky hillsides, floodplains, rocky creeks or river beds.	Yes	3 km	Likely
Crotalaria smithiana	P3	Annual	Regeneration site on floodplain.	No	35 km	Unlikely
Dampiera metallorum	P3	Perennial	Skeletal red-brown gravelly soil over banded ironstone. Steep slopes, summits of hills.	No	60 km	Unlikely

Taxon	Conservation Status	Life Form	Habitat Preference	Suitable Habitat Present	Closest Record to study area	Likelihood in the study area
Eremophila magnifica subsp. *magnifica*	P4	Perennial	Skeletal soils over ironstone. Rocky screes.	Yes	8 km	Likely
Eremophila magnifica subsp. *velutina*	P3	Perennial	Skeletal soils over ironstone. Summits.	Yes	18 km	Likely
Eremophila rigida	P3	Perennial	Hardpan plains.	Yes	30 km	Possible
Eremophila sp. West Angelas (S, van Leeuwen 4068)	P1	Perennial	High in the landscape. Rocky hill summits.	No	35 km	Unlikely
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)	P3	Biennial	Low undulating calcrete plain.	Yes	30 km	Possible
Goodenia nuda	P4	Annual	Plains and floodplains.	Yes	3 km	Likely
Gymnanthera cunninghamii	P3	Perennial	Sandy soils. Drainage lines.	Yes	3 km	Likely
Hibiscus aff. sp. Canga (P.J.H. Hurter & J. Naaykens 11013)	of interest	Perennial	Rocky drainage lines, gullies and gorges.	Yes	12 km	Likely
Indigofera gilesii	P3	Perennial	Pebbly loam amongst boulders and outcrops. Hills.	Yes	3 km	Likely
Ipomoea racemigera	P2	Annual	Drainage lines, flood plains.	Yes	18 km	Likely

Taxon	Conservation Status	Life Form	Habitat Preference	Suitable Habitat Present	Closest Record to study area	Likelihood in the study area
Isotropis parviflora	P2	Annual	Disturbed stony hill crests and upper hill slopes.	Yes	18 km	Likely
Lepidium catapycnon	P4	Perennial	Skeletal soils. Hillsides.	Yes	6 km	Likely
Oxalis sp. Pilbara (M. E Trudgen 12725)	P2	Annual	Gullies. Base of cliffs. Shady areas associated with high ironstone cliffs.	No	50 km	Unlikely
Rhagodia sp. Hamersley (M. Trudgen 17794)	P3	Perennial	Clay plains. Mulga woodlands.	Yes	35 km	Possible
Rostellularia adscendens var. *latifolia*	P3	Annual	Ironstone soils. Near creeks, rocky hills.	Yes	25 km	Possible
Themeda sp. Hamersley Station (M.E. Trudgen 11431)	P3	Perennial	Clay pan, grass plain.	Yes	30 km	Possible
Triodia pascoeana	P1	Perennial	Limestone. Limestone ranges and gorges, floodplains.	No	700 km	Unlikely
Triodia sp. Mt Ella (M.E. Trudgen 12739)	P3	Perennial	Upper hill slopes, ironstone ranges.	Yes	12 km	Likely

3.1.6 Threatened Ecological Communities (TECs)

A search of DPaW's communities database (DPaW 2016c) confirmed there was one TEC record within a 50 km radius of the study area; the Ethel Gorge aquifer stygobiont community TEC (Figure 4). The Ethel Gorge aquifer stygobiont community TEC is listed as Endangered under the EPBC Act (DoE 2014). It occurs approximately 8 km northeast of the study area along the Fortescue River. However, it is a subterranean community that has no distinctive flora and vegetation features and is therefore not included as part of the scope of this work and will not be discussed further.

3.1.7 Priority Ecological Communities (PECs)

A search of DPaW's communities database (DPaW 2016c) confirmed that one PEC is located approximately 45 km north of the study area (Figure 4). The Priority 3 PEC 'Vegetation of sand dunes of the Hamersley Range / Fortescue Valley' is described as red linear iron-rich sand dunes that 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 such as weed invasion, especially buffel grass, grazing by cattle, frequent fire, erosion and impacts of mining (DPaW 2016c).

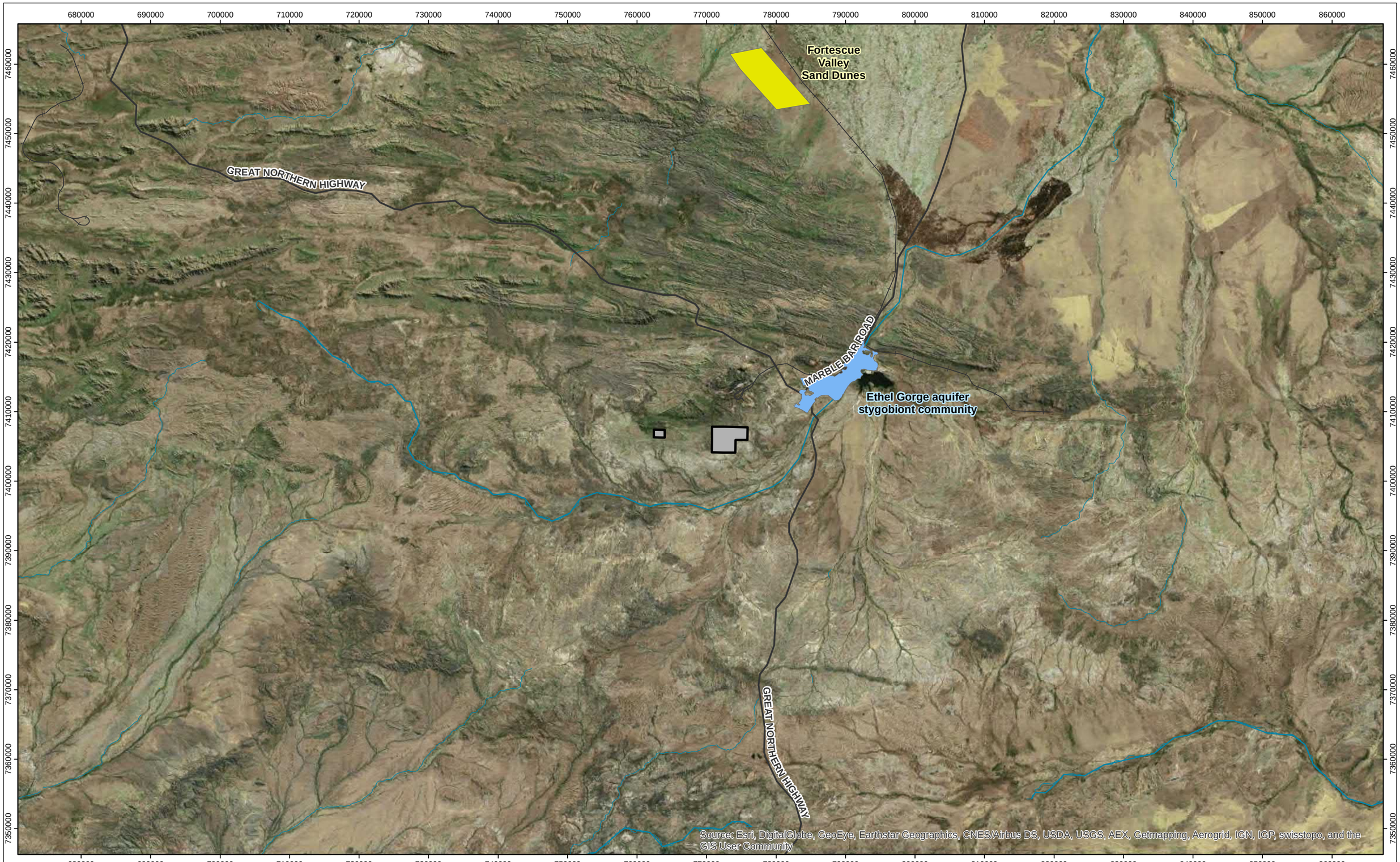

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Figure:	4	Date:	08/09/2016
Sheet Size:	A3	Status:	FINAL
Drawn by GSM	Requested by DB	GSM Reference Western ridge south_TecPec	

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Datum: GDA94
Projection: MGA Zone 50

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WESTERN RIDGE SOUTH
Location of the TECs and PECs within a 100 km radius of the development envelope

Figure 4

Legend

- Study Area
- TEC Boundaries
- PEC Boundaries

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admin@griffinspatial.com.au
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3.2 Flora Species

Flora occurring within the study area has not previously been documented. However, the tenements adjoining the northern boundary of the study area have previously been surveyed (GHD 2011, Onshore Environmental 2014a).

The Western Ridge tenement E52/2008 was surveyed in June 2014 (Onshore Environmental 2014a). A total of 199 plant taxa from 32 families and 93 genera were recorded with species representation highest among the Fabaceae, Poaceae, Malvaceae, Chenopodiaceae, Asteraceae and Amaranthaceae families. There were no Federal or State listed Threatened Flora recorded from the tenement. However, one Priority flora taxon, *Calotis latiuscula* (Priority 3), was found in medium drainage lines and adjacent flood plains. In addition there was one species of interest recorded, *Aristida* cf. *nitidula,* which could not be matched to any specimens held at the Western Australian Herbarium. It was recorded from heavy clay soils on plains in the eastern sector of the tenement.

The Orebody 35 tenement E52/170 was surveyed in May and August 2010 (GHD 2011). A total of 347 plant taxa from 48 families and 159 genera were recorded with species representation highest among the Fabaceae, Poaceae, Malvaceae, Chenopodiaceae and Scrophulariaceae families. There were no Federal or State listed Threatened Flora recorded from the tenement. However, three Priority flora taxa were found; *Indigofera gilesii* (P3), *Gymnanthera cunninghamii* (P3) and *Goodenia nuda* (P4).

The landforms represented within the study area are similar to those adjoining the northern boundary at Western Ridge and Orebody 35. It is likely that the total flora represented would also reflect that recorded on these adjoining tenements.

3.3 Introduced Flora

Introduced weed species within the study area have not previously been documented. However, field surveys completed at the Orebody 35 (GHD 2011) and Western Ridge (Onshore Environmental 2014a) tenements recorded 13 and seven weed species respectively. All of these introduced species are widespread in the Pilbara and none are listed under the *Biosecurity and Agriculture Management Act 2007* as Declared Pests.

3.4 Vegetation

3.4.1 Land Unit Mapping

There were 12 land units defined within the two land systems occurring in the study area (Table 7). Nine vegetation associations from BHP Billiton Iron Ore's Pilbara consolidated vegetation mapping were aligned to the 12 land units, and then classified under seven landforms and six broad floristic formations (Table 7). The landforms represented included hill crests and upper hill slopes, hill slopes and low undulating hills stony plains, foot slopes, stony plains, flood plains, gilgai plains, and medium drainage lines (Table 7).

Vegetation of potential conservation significance included '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 (FP AaAprAcao ErffDopeSie ArcDiaAri)' which was associated with the Elimunna 5 land unit. This vegetation is representative of 'Valley Floor Mulga' within the Hamersley subregion which was considered to be an 'ecosystem at risk' by the then Department of Conservation and Land Management (now DPaW) (Kendrick 2001). This ecosystem is represented by vegetation associations occurring on valley floors or broad plains, which have a reasonably dense Mulga overstorey (i.e. at least 10-30 percent cover).

Table 7 Land units mapped within the study area with corresponding vegetation association linked to BHP Billiton Iron Ore's Pilbara consolidated vegetation mapping data.

Land Unit Code	Landform	Broad Floristic Formation	Vegetation Code	Vegetation Association	Vegetation Significance
ELI 1, ROC 1	Hill Crest and Upper Hill Slope	*Triodia* Hummock Grassland	HC Tw AiAb InrSeao	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	None
ELI 2	Hill Slope and Undulating Low Hill	*Triodia* Open Hummock Grassland	HS TbTs AsyAaAte ErcuMagSol	Open Hummock Grassland of *Triodia basedowii* and *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) 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	None
ROC 2	Hill Slope and Undulating Low Hill	*Triodia* Hummock Grassland	HS TsTwTp EllCh AhiAaa	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	None
ROC 3	Footslope	*Triodia* Hummock Grassland	FS Tw Ell	Hummock Grassland of *Triodia wiseana* with Scattered Low Trees of *Eucalyptus leucophloia* subsp. *leucophloia* on red silty clay on hill slopes and footslopes	None

Land Unit Code	Landform	Broad Floristic Formation	Vegetation Code	Vegetation Association	Vegetation Significance
ELI 4	Stony Plain	Acacia High Open Shrubland	SP AaAp ArcAri TbTp	High Open Shrubland of *Acacia aptaneura* and *Acacia paraneura* over Scattered Tussock Grasses of *Aristida contorta* and *Aristida inaequiglumis* and Scattered Hummock Grasses of *Triodia basedowii* and *Triodia pungens* on red clay loam on flats and stony plains	None
ELI 5	Flood Plain	*Acacia* Low Woodland	FP AaAprAcao ErffDopeSie ArcDiaAri	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	Representative of 'Valley Floor Mulga' within the Hamersley subregion which was considered to be an 'ecosystem at risk' by the the then Department of Conservation and Land Management (now DPaW) (Kendrick 2001). This ecosystem is represented by vegetation associations occurring on valley floors or broad plains, which have a reasonably dense Mulga overstorey (i.e. at least 10-30 percent cover).
ELI 3, ROC 4	Gilgai Plain	*Eragrostis* Tussock Grassland	GP ErxErbChf AsyAteVf NedTec	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	Not of formal conservation significance, but noteworthy that gilgai plain vegetation can be closely affiliated with the 'West Angelas Cracking-Clays PEC'.

Land Unit Code	Landform	Broad Floristic Formation	Vegetation Code	Vegetation Association	Vegetation Significance
ELI 6, ROC 5	Medium Drainage Line	*Triodia* Hummock Grassland	ME TpTlo ExAciCh PlApypGoro	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	None
ROC 6	Medium Drainage Line	*Eucalyptus* Low Woodland	ME TtEuaEte ApypAtpPl EvCh	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	None

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Drawn by GSM	Requested by DB	GSM Reference West Ridge Sth E52/3361 Land Unit	

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Datum: GDA94
Projection: MGA Zone 50

Western Ridge South
E52/3360
Land Unit Mapping
FIGURE 5

Legend

E52/3360 Study Area

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PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
Ph/Fax +61 (0) 8 9725 3213
Mob 0487 337 226

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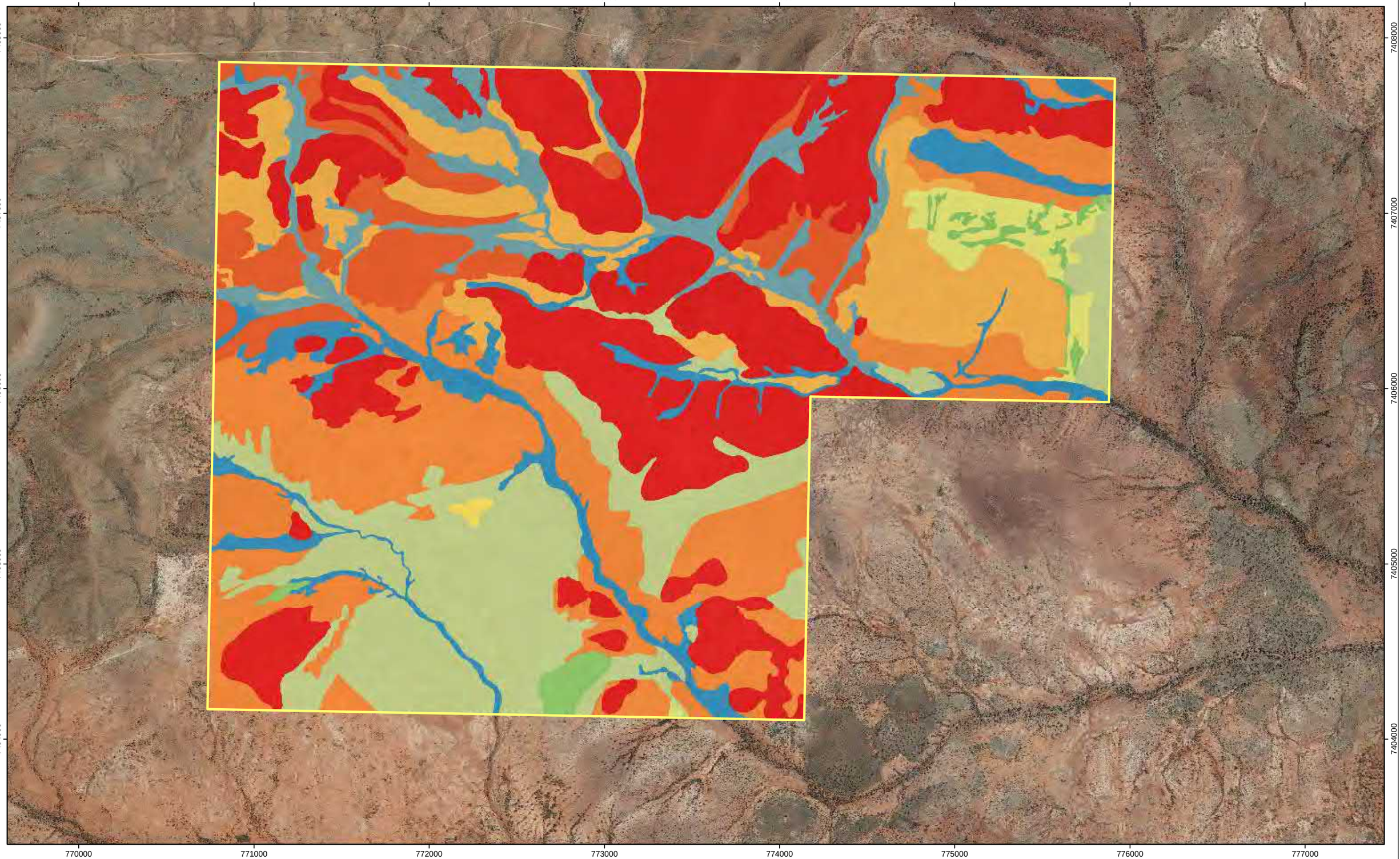

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Datum: GDA94
Projection: MGA Zone 50

Western Ridge South E52/3361

Land Unit Mapping

FIGURE 5

Legend

E52/3361 Study Area

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PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
Ph/Fax +61 (0) 8 9725 3213
Mob 0487 337 226

Legend

Study Area

Land Unit

Medium Drainage Lines

ME TpTlo ExAciCh PlApypGoro	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
ME TtEuaEte ApypAtpPl EvCh	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

Flood Plains

FP AaAprAcao ErffDopeSie ArcDiaAri	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

Gilgai Plains

GP ErxErbChf AsyAteVf NedTec	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

Stony Plains

SP AaAp ArcAri TbTp	High Open Shrubland of Acacia aptaneura and Acacia paraneura over Scattered Tussock Grasses of Aristida contorta and Aristida inaequiglumis and Scattered Hummock Grasses of Triodia basedowii and Triodia pungens on red clay loam on flats and stony plains
Mosaic of SP AaAp ArcAri TbTp & FP AaAprAcao ErffDopeSie ArcDiaAri	Mosaic of High Open Shrubland of Acacia aptaneura and Acacia paraneura over Scattered Tussock Grasses of Aristida contorta and Aristida inaequiglumis and Scattered Hummock Grasses of Triodia basedowii and Triodia pungens on red clay loam on flats and stony plains & 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

Foot Slopes

FS Tw Ell	Hummock Grassland of Triodia wiseana with Scattered Low Trees of Eucalyptus leucophloia subsp. leucophloia on red silty clay on hill slopes and footslopes

Hill Slopes

HS TbTs AsyAaAte ErcuMagSol	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
HS TsTwTp EllCh AhiAaa	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

Hill Crests

HC Tw AiAb InrSeao	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

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Western Ridge South
E52/3360 & E52/3361

Land Unit Mapping Legend

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PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
Ph/Fax +61 (0) 8 9725 3213
Mob 0487 337 226

3.4.2 Vegetation Association Mapping

There were 13 vegetation associations mapped within the study area (Figure 6), classified under nine landforms and nine broad floristic formations (Table 8). The landforms represented included hill crests and upper hill slopes, hill slopes and low undulating hills stony plains, foot slopes, calcrete plains, stony plains, flood plains, gilgai plains, minor drainage lines, and medium drainage lines (Table 8).

None of the 13 vegetation associations mapped within the study area are federal or state listed TECs listed for the Pilbara. However, one vegetation association is closely affiliated to the West Angelas Cracking-Clays PEC (Priority 1), 'Closed Tussock Grassland of *Astrebla pectinata, Astrebla elymoides* and *Aristida latifolia* with Open Shrubland of *Eremophila lachnocalyx* and *Acacia tetragonophylla* and Scattered Low Trees of *Acacia aptaneura* on cracking gilgai clays (GP AspeAselArla ErlcAte Aa)' (Figure 7).

Three vegetation associations are representative of 'Valley Floor Mulga' within the Hamersley subregion which was considered to be an 'ecosystem at risk' by the then Department of Conservation and Land Management (now DPaW) (Kendrick 2001). This ecosystem is represented by vegetation associations occurring on valley floors or broad plains, which have a reasonably dense Mulga overstorey (i.e. at least 10-30 percent cover). The associations are listed below and the distribution represented in Figure 7:

- Low Open Forest (to Low Open Woodland) of *Acacia aptaneura, Acacia pruinocarpa, Acacia ayersiana* and *Acacia catenulata* subsp. *occidentalis* over Shrubland of *Eremophila forrestii* subsp. *forrestii* and *Senna artemisioides* subsp. *oligophylla* and Open Hummock Grassland of *Triodia pungens* forming groves on hardpan plains (FP AaAprAay ErffSeao Tp);
- Low Woodland of *Corymbia hamersleyana, Eucalyptus xerothermica* and *Acacia aptaneura* over High Open Shrubland of *Petalostylis labicheoides, Acacia pyrifolia* subsp. *pyrifolia* and *Acacia maitlandii* over Open Tussock Grassland of *Eriachne tenuiculmis, Themeda triandra* and **Cenchrus ciliaris* along medium drainage lines (ME ChExAa PelApypAma ErtThtCc); and
- Low Open Forest (to Low Woodland) of *Acacia aptaneura, Acacia pruinocarpa* and *Eucalyptus xerothermica* over Shrubland of *Eremophila forrestii* subsp. *forrestii, Sida ectogama* and *Eremophila latrobei* subsp. *latrobei* over Open Tussock Grassland of *Themeda triandra, Aristida inaequiglumis* and **Cenchrus ciliaris* on stony floodplains and unincised drainage zones (ME AaAprEx ErffSieErll ThtAriCc).

Table 8 Vegetation associations mapped within the study area with inference from BHP Billiton Ore's Western Ridge (Onshore Environmental 2014a) and Mt Whaleback (Onshore Environmental 2013).

Landform	Broad Floristic Formation	Vegetation Code	Vegetation Association	Vegetation Significance
Hill Crest and Upper Hill Slope	Triodia Hummock Grassland	HC TsTwTbr AbAtenSegg ErcnPtoAsp	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835), *Triodia wiseana* and/or *Triodia brizoides* with Open Shrubland of *Acacia bivenosa, Acacia tenuissima* and *Senna glutinosa* subsp. *glutinosa* and Low Open Shrubland of *Eremophila canaliculata, Ptilotus obovatus* and *Acacia spondylophylla* on hill crests, steep scree slopes and BIF ridges	None
Hill Crest and Upper Hill Slope	Triodia Closed Hummock Grassland	HC TbrTw Erfr AbAk	Closed Hummock Grassland of *Triodia brizoides* and *Triodia wiseana* with Shrubland of *Eremophila fraseri* and High Open Shrubland of *Acacia bivenosa* and *Acacia kempeana* on high dolerite hills	None
Hill Slope and Undulating Low Hill	Acacia High Open Shrubland	HS AaAsyAte ErcuSolMag Arc	High Open Shrubland of *Acacia aptaneura , Acacia synchronicia* and *Acacia tetragonophylla* over Low Open Shrubland of *Eremophila cuneifolia, Solanum lasiophyllum* and *Maireana georgei* over Very Open Bunch Grassland of *Aristida contorta* on stony chert ironstone plains and rises	None
Footslope	Triodia Hummock Grassland	FS TwTbr AbAi Seao	Hummock Grassland of *Triodia wiseana* ± *Triodia brizoides* with Open Shrubland of *Acacia bivenosa* and *Acacia inaequilatera* and Low Open Shrubland of *Senna artemisioides* subsp. *oligophylla* on dolerite footslopes and undulating low hills	None
Calcrete Plain	Triodia Hummock Grassland	CP TragTw AbAkAsi EsEg	Hummock Grassland of *Triodia angusta* and *Triodia wiseana* with High Shrubland of *Acacia bivenosa, Acacia kempeana* and *Acacia sibirica* and Low Open Mallee of *Eucalyptus socialis* subsp. *eucentrica* or *Eucalyptus gamophylla* on calcrete, quartz and dolerite low hills, stony rises and stony plains	None

Landform	Broad Floristic Formation	Vegetation Code	Vegetation Association	Vegetation Significance
Stony Plain	Acacia Low Open Woodland	SP Aa AteAsy CcArlaErmu	Low Open Woodland of *Acacia aptaneura* over High Open Shrubland of *Acacia tetragonophylla* and *Acacia synchronicia* over Very Open Tussock Grassland of **Cenchrus ciliaris, Aristida latifolia* and *Eriachne mucronata* on quartz plains	None
Stony Plain	Triodia Open Hummock Grassland	SP Tp AaAp AsyAbAte	Open Hummock Grassland of *Triodia pungens* with Low Open Woodland of *Acacia aptaneura* and *Acacia paraneura* and Open Shrubland of *Acacia synchronicia, Acacia bivenosa* and *Acacia tetragonophylla* in red loamy sand on stony plains	None
Flood Plain	Acacia Low Open Forest	FP AaAprAay ErffSeao Tp	Low Open Forest (to Low Open Woodland) of *Acacia aptaneura, Acacia pruinocarpa, Acacia ayersiana* and *Acacia catenulata* subsp. *occidentalis* over Shrubland of *Eremophila forrestii* subsp. *forrestii* and *Senna artemisioides* subsp. *oligophylla* and Open Hummock Grassland of *Triodia pungens* forming groves on hardpan plains	Representative of 'Valley Floor Mulga' within the Hamersley subregion which was considered to be an 'ecosystem at risk' by the then Department of Conservation and Land Management (now DPaW) (Kendrick 2001). This ecosystem is represented by vegetation associations occurring on valley floors or broad plains, which have a reasonably dense Mulga overstorey (i.e. at least 10-30 percent cover).
Gilgai Plain	Astrebla Closed Tussock Grassland	GP AspeAselArla ErlcAte Aa	Closed Tussock Grassland of *Astrebla pectinata, Astrebla elymoides* and *Aristida latifolia* with Open Shrubland of *Eremophila lachnocalyx* and *Acacia tetragonophylla* and Scattered Low Trees of *Acacia aptaneura* on cracking gilgai clays	Closely affiliated with West Angelas Cracking-Clays PEC (Priority 1) - Open tussock grasslands of *Astrebla pectinata, Astrebla elymoides, Aristida latifolia,* in combination with *Astrebla squarrosa* and low scattered shrubs of *Sida fibulifera,* on basalt derived cracking-clay loam depressions and flowlines.

Landform	Broad Floristic Formation	Vegetation Code	Vegetation Association	Vegetation Significance
Gilgai Plain	Aristida Tussock Grassland	GP ArlaAranErx AaAteAsy SifSeaoSeh	Tussock Grassland of *Aristida latifolia, Aristida* cf. *nitidula* and *Eragrostis xerophila* with High Open Shrubland of *Acacia aptaneura, Acacia tetragonophylla* and *Acacia synchronicia* and Low Open Shrubland of *Sida fibulifera, Senna artemisioides* subsp. *oligophylla* and *Senna hamersleyensis* on gilgai drainage flats and minor drainage lines	None
Minor Drainage Line	Triodia Hummock Grassland	MI Tp AbAten	Hummock Grassland of *Triodia pungens* with Open Scrub of *Acacia bivenosa* and *Acacia tenuissima* on minor drainage lines	None
Medium Drainage Line	Corymbia Low Woodland	ME ChExAa PelApypAma ErtThtCc	Low Woodland of *Corymbia hamersleyana, Eucalyptus xerothermica* and *Acacia aptaneura* over High Open Shrubland of *Petalostylis labicheoides, Acacia pyrifolia* subsp. *pyrifolia* and *Acacia maitlandii* over Open Tussock Grassland of *Eriachne tenuiculmis, Themeda triandra* and **Cenchrus ciliaris* along medium drainage lines	Representative of 'Valley Floor Mulga' within the Hamersley subregion which was considered to be an 'ecosystem at risk' by the then Department of Conservation and Land Management (now DPaW) (Kendrick 2001).
Medium Drainage Line	Acacia Low Open Forest	ME AaAprEx ErffSieErll ThtAriCc	Low Open Forest (to Low Woodland) of *Acacia aptaneura, Acacia pruinocarpa* and *Eucalyptus xerothermica* over Shrubland of *Eremophila forrestii* subsp. *forrestii, Sida ectogama* and *Eremophila latrobei* subsp. *latrobei* over Open Tussock Grassland of *Themeda triandra, Aristida inaequiglumis* and **Cenchrus ciliaris* on stony floodplains and unincised drainage zones	Representative of 'Valley Floor Mulga' within the Hamersley subregion which was considered to be an 'ecosystem at risk' by the then Department of Conservation and Land Management (now DPaW) (Kendrick 2001).

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Datum: GDA94
Projection: MGA Zone 50

Western Ridge South
E52/3360

Vegetation Association Mapping

FIGURE 6

Legend

E52/3360 Study Area

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PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
Ph/Fax +61 (0) 8 9725 3213
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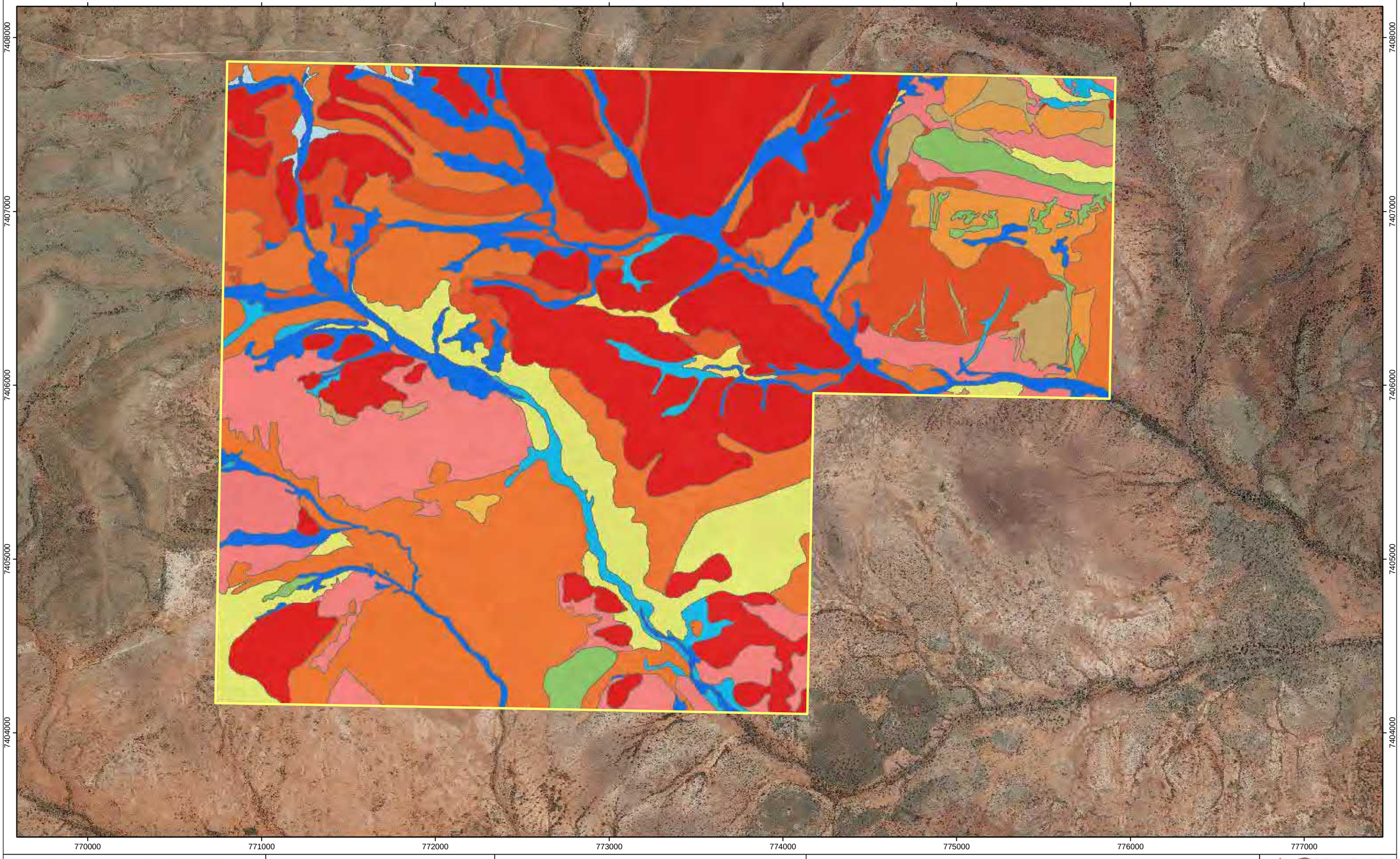

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ON SHORE ENVIRONMENTAL CONSULTANTS		Date:	03/10/2016
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Meters
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Datum: GDA94
Projection: MGA Zone 50

Western Ridge South
E52/3361
Vegetation Association Mapping

FIGURE 6

Legend

E52/3361 Study Area

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PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
Ph/Fax +61 (0) 8 9725 3213
Mob 0487 337 226

Legend

E52/3360 Study Area

Vegetation Association

Minor Drainage Line

MI Tp AbAten — Hummock Grassland of Triodia pungens with Open Scrub of Acacia bivenosa and Acacia tenuissima on minor drainage lines

Medium Drainage Line

ME ChExAa PelApypAma ErtThtCc — Low Woodland of Corymbia hamersleyana, Eucalyptus xerothermica and Acacia aptaneura over High Open Shrubland of Petalostylis labicheoides, Acacia pyrifolia subsp. pyrifolia and Acacia maitlandii over Open Tussock Grassland of Eriachne tenuiculmis, Themeda triandra and *Cenchrus ciliaris along medium drainage lines

ME AaAprEx ErffSieErll ThtAriCc — Low Open Forest (to Low Woodland) of Acacia aptaneura, Acacia pruinocarpa and Eucalyptus xerothermica over Shrubland of Eremophila forrestii subsp. forrestii, Sida ectogama and Eremophila latrobei subsp. latrobei over Open Tussock Grassland of Themeda triandra, Aristida inaequiglumis and *Cenchrus ciliaris on stony floodplains and unincised drainage zones

Flood Plains

FP AaAprAay ErffSeao Tp — Low Open Forest (to Low Open Woodland) of Acacia aptaneura, Acacia pruinocarpa, Acacia ayersiana and Acacia catenulata subsp. occidentalis over Shrubland of Eremophila forrestii subsp. forrestii and Senna artemisioides subsp. oligophylla and Open Hummock Grassland of Triodia pungens forming groves on hardpan plains

Calcrete Plains

CP TragTw AbAkAsi EsEg — Hummock Grassland of Triodia angusta and Triodia wiseana with High Shrubland of Acacia bivenosa, Acacia kempeana and Acacia sibirica and Low Open Mallee of Eucalyptus socialis subsp. eucentrica or Eucalyptus gamophylla on calcrete, quartz and dolerite low hills, stony rises and stony plains

Gilgai Plains

GP AspeAselArla ErlcAte Aa — Closed Tussock Grassland of Astrebla pectinata, Astrebla elymoides and Aristida latifolia with Open Shrubland of Eremophila lachnocalyx and Acacia tetragonophylla and Scattered Low Trees of Acacia aptaneura on cracking gilgai clays

GP ArlaAranErx AaAteAsy SifSeaoSeh — Tussock Grassland of Aristida latifolia, Aristida cf. nitidula and Eragrostis xerophila with High Open Shrubland of Acacia aptaneura, Acacia tetragonophylla and Acacia synchronicia and Low Open Shrubland of Sida fibulifera, Senna artemisioides subsp. oligophylla and Senna hamersleyensis on gilgai drainage flats and minor drainage lines

Stony Plain

Mosaic of SP Tp AaAp AsyAbAte & FP AaAprAay ErffSeao Tp — Mosaic of Open Hummock Grassland of Triodia pungens with Low Open Woodland of Acacia aptaneura and Acacia paraneura and Open Shrubland of Acacia synchronicia, Acacia bivenosa and Acacia tetragonophylla in red loamy sand on stony plains & Low Open Forest (to Low Open Woodland) of Acacia aptaneura, Acacia pruinocarpa, Acacia ayersiana and Acacia catenulata subsp. occidentalis over Shrubland of Eremophila forrestii subsp. forrestii and Senna artemisioides subsp. oligophylla and Open Hummock Grassland of Triodia pungens forming groves on hardpan plains

SP Tp AaAp AsyAbAte — Open Hummock Grassland of Triodia pungens with Low Open Woodland of Acacia aptaneura and Acacia paraneura and Open Shrubland of Acacia synchronicia, Acacia bivenosa and Acacia tetragonophylla in red loamy sand on stony plains

SP Aa AteAsy CcArlaErmu — Low Open Woodland of Acacia aptaneura over High Open Shrubland of Acacia tetragonophylla and Acacia synchronicia over Very Open Tussock Grassland of *Cenchrus ciliaris, Aristida latifolia and Eriachne mucronata on quartz plains

Foot Slopes

FS TwTbr AbAi Seao — Hummock Grassland of Triodia wiseana ± Triodia brizoides with Open Shrubland of Acacia bivenosa and Acacia inaequilatera and Low Open Shrubland of Senna artemisioides subsp. oligophylla on dolerite footslopes and undulating low hills

Hill Slope

HS AaAsyAte ErcuSolMag Arc — High Open Shrubland of Acacia aptaneura , Acacia synchronicia and Acacia tetragonophylla over Low Open Shrubland of Eremophila cuneifolia, Solanum lasiophyllum and Maireana georgei over Very Open Bunch Grassland of Aristida contorta on stony chert ironstone plains and rises

Hill Crest

HC TbrTw Erfr AbAk — Closed Hummock Grassland of Triodia brizoides and Triodia wiseana with Shrubland of Eremophila fraseri and High Open Shrubland of Acacia bivenosa and Acacia kempeana on high dolerite hills

ON SHORE ENVIRONMENTAL CONSULTANTS | Date: 03/10/2016
Sheet Size: A3 | Status: Final
Drawn by GSM | Requested by DB | GSM Reference West Ridge Sth Veg Assoc Legend

Western Ridge South
E52/3360 & E52/3361

Vegetation Association Mapping Legend

GRIFFIN SPATIAL & MAPPING
PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
Ph/Fax +61 (0) 8 9725 3213
Mob 0487 337 226

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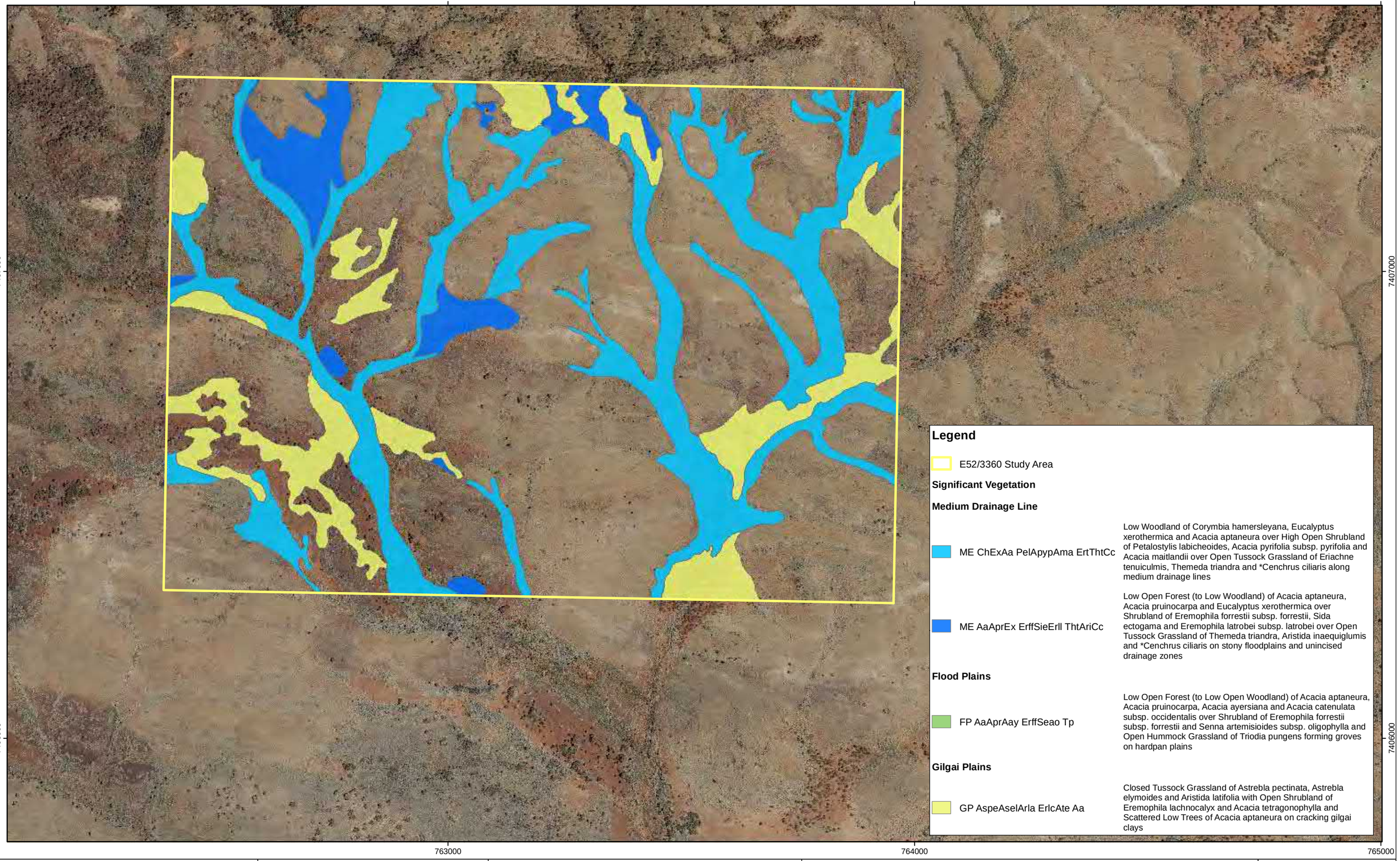

Legend

E52/3360 Study Area

Significant Vegetation

Medium Drainage Line

ME ChExAa PelApypAma ErtThtCc	Low Woodland of Corymbia hamersleyana, Eucalyptus xerothermica and Acacia aptaneura over High Open Shrubland of Petalostylis labicheoides, Acacia pyrifolia subsp. pyrifolia and Acacia maitlandii over Open Tussock Grassland of Eriachne tenuiculmis, Themeda triandra and *Cenchrus ciliaris along medium drainage lines
ME AaAprEx ErffSieErll ThtAriCc	Low Open Forest (to Low Woodland) of Acacia aptaneura, Acacia pruinocarpa and Eucalyptus xerothermica over Shrubland of Eremophila forrestii subsp. forrestii, Sida ectogama and Eremophila latrobei subsp. latrobei over Open Tussock Grassland of Themeda triandra, Aristida inaequiglumis and *Cenchrus ciliaris on stony floodplains and unincised drainage zones

Flood Plains

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Gilgai Plains

GP AspeAselArla ErlcAte Aa	Closed Tussock Grassland of Astrebla pectinata, Astrebla elymoides and Aristida latifolia with Open Shrubland of Eremophila lachnocalyx and Acacia tetragonophylla and Scattered Low Trees of Acacia aptaneura on cracking gilgai clays

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ON SHORE ENVIRONMENTAL CONSULTANTS	Date:	03/10/2016
Sheet Size: A3	Status:	Final
Drawn by GSM	Requested by DB	GSM Reference West Ridge Sth E52/3360 Veg Assoc

N

0 100 200 300 400

Meters
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Datum: GDA94
Projection: MGA Zone 50

Western Ridge South E52/3360

Vegetation Associations of Conservation Significance

FIGURE 7

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PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
Ph/Fax +61 (0) 8 9725 3213
Mob 0487 337 226

770000 771000 772000 773000 774000 775000 776000 777000

7408000 7407000 7406000 7405000 7404000

Legend

E52/3361 Study Area

Significant Vegetation

Medium Drainage Line

ME ChExAa PelApypAma ErtThtCc	Low Woodland of Corymbia hamersleyana, Eucalyptus xerothermica and Acacia aptaneura over High Open Shrubland of Petalostylis labicheoides, Acacia pyrifolia subsp. pyrifolia and Acacia maitlandii over Open Tussock Grassland of Eriachne tenuiculmis, Themeda triandra and *Cenchrus ciliaris along medium drainage lines
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Flood Plains

FP AaAprAay ErffSeao Tp	Low Open Forest (to Low Open Woodland) of Acacia aptaneura, Acacia pruinocarpa, Acacia ayersiana and Acacia catenulata subsp. occidentalis over Shrubland of Eremophila forrestii subsp. forrestii and Senna artemisioides subsp. oligophylla and Open Hummock Grassland of Triodia pungens forming groves on hardpan plains

Gilgai Plains

GP AspeAselArla ErlcAte Aa	Closed Tussock Grassland of Astrebla pectinata, Astrebla elymoides and Aristida latifolia with Open Shrubland of Eremophila lachnocalyx and Acacia tetragonophylla and Scattered Low Trees of Acacia aptaneura on cracking gilgai clays

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ONSHORE ENVIRONMENTAL

ON SHORE ENVIRONMENTAL CONSULTANTS	Date:	03/10/2016
Sheet Size:	A3	Status: Final
Drawn by GSM	Requested by DB	GSM Reference West Ridge Sth E52/3361 Veg Assoc

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0 250 500 750 1,000

Meters
1:20,000

Datum: GDA94
Projection: MGA Zone 50

Western Ridge South E52/3361

Vegetation Associations of Conservation Significance

FIGURE 7

GRIFFIN SPATIAL & MAPPING
PO Box 7215
Eaton WA 6232
admin@griffinspatial.com.au
Ph/Fax +61 (0) 8 9725 3213
Mob 0487 337 226

4.0 SUMMARY

Since the commencement of mining at Mt Whaleback in the 1960s, BHP Billiton Iron Ore has commissioned at least 45 flora and vegetation surveys to support environmental approvals and conditions within a 25 km radius of the Western Ridge Southern tenement. None of the surveys have identified any federal or state listed TECs or state listed PECs, although one vegetation association recorded from the adjacent Western Ridge tenement (Onshore Environmental 2014a) was closely affiliated with the 'West Angelas Cracking-Clays PEC' (Priority 1). There has been one current federal listed Threatened Flora taxon *(Lepidium catapycnon)* and 14 current state listed Priority flora taxa recorded from surrounding BHP Billiton Iron Ore tenements.

Database searches and a literature review identified 27 conservation significant flora potentially occurring within a 50 km radius of the study area. Thirteen of the 27 taxa were determined to be likely to occur within the study area, nine taxa were determined to possibly occur within the study area, and five were determined to be unlikely to occur within the study area.

Desktop vegetation mapping was undertaken using two methods: a) inference of land units within the two land systems represented, and b) inference to vegetation associations previously mapped at neighbouring tenements. There were 12 land units defined in the study area. Nine vegetation associations from BHP Billiton Iron Ore's Pilbara consolidated vegetation mapping were aligned across the 12 land units, and then classified under seven landforms and six broad floristic formations. Inference from neighbouring baseline mapping defined 13 vegetation associations within the study area, classified under nine landforms and nine broad floristic formations.

None of the vegetation associations mapped within the study area were federal or state listed TECs for the Pilbara. However, one vegetation association was closely affiliated to the West Angelas Cracking-Clays PEC (Priority 1). A further three vegetation associations supporting Mulga Low Open Forest (to Low Woodland) were representative of 'Valley Floor Mulga' within the Hamersley subregion, which was considered to be an 'ecosystem at risk' by the then Department of Conservation and Land Management (now DPaW) (Kendrick 2001).

5.0 STUDY TEAM

The desktop flora and vegetation survey for the Western Ridge Southern Tenements was planned, coordinated and executed by the following personnel:

Onshore Environmental Consultants P/L
ABN 41 095 837 120
PO Box 227
YALLINGUP WA 6282
pf 08 9756 6206 m 0427 339 842
email onshoreenv@westnet.com.au

Project Staff

Dr Darren Brearley	PhD	Project Manager
Ms Jessica Waters	BSC	Botanist
Mr Todd Griffin		GIS Specialist

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APPENDIX 1

Summary of previous flora and vegetation surveys completed within a 25 km radius of the study area

Project	Survey Timing	Season	Survey Type	Area (ha)	No. Sites	No. Taxa	No. Significant Flora	No. Weeds
Newman Lease Environmental Appraisal (Maunsell and Partners 1984)	October 1984	Poor	Review	36,100	-	-	0	0
Mt Whaleback Soil and Vegetation Mapping (HGM 1997)	November 1996	Poor	Targeted Search	-	-	-	1	0
Orebody 23 Extension - Biological Survey Assessment (Ecologia 1998)	June 1997	Good	Single Season Level 2	650	20	233	0	2
Follow-Up Survey of Mt Whaleback *Lepidium catapycnon* population (HGM 1999)	May 1999	Good	Targeted Search	10.5	-	-	1	0
Field Search and Observations of *Lepidium catapycnon* Population Near Mt Whaleback, Newman (BHP Billiton Iron Ore 1999a)	June-August 1999	Good	Targeted Search	-	-	1	1	0
Regional Search for *Lepidium catapycnon* in the greater Newman Area (Pilbara), Western Australia (BHP Billiton Iron Ore 1999b)	June-November 1999	Good	Targeted Search	-	-	1	1	0
Orebody 25 Priority Flora Species Survey (BHP Billiton Iron Ore 2000a)	June 2000	Very Good	Targeted Search	-	-	2	1	0
Mt Whaleback Priority Flora Species Survey (BHP Billiton Iron Ore 2000b)	July 2000	Good	Targeted Search	-	-	-	0	0

Project	Survey Timing	Season	Survey Type	Area (ha)	No. Sites	No. Taxa	No. Significant Flora	No. Weeds
Baseline Biological and Soil Surveys Mapping for ML244SA West of the Fortescue River (Biota 2000)	September to October 2000	Very Good	Single Season Level 2	17, 060	60	380	0	14
BHP Long Term Expansion Pre-feasibility Study (Ecologia 2003)	September 2003	Not Relevant	Review	-	-	-	2	7
Orebody 24 Expansion Biological Survey (Ecologia 2004d)	May 2004	Good	Single Season Level 2	5200	50	258	1	4
Newman BHP Billiton Ongoing Works - Newman Hub Final Report (Ecologia 2004b)	June 2004	Poor	Targeted Search	-	-	-	0	4
Newman Village Declared Rare and Priority Flora and Weed Survey (Ecologia 2004c)	June- July 2004	Poor	Targeted Search	-	-	-	0	1
Western Ridge Exploration Project Biological Survey (Ecologia 2005)	May 2005	Poor	Single Season Level 2	-	7	152	0	0
Newman Ammonium Nitrate Storage Facility - Conservation Significant Flora Survey (Ecologia 2006a)	January 2006	Very Good	Targeted Searches	10	-	64	0	1
Orebody 24 Flora and Fauna Assessment Phase II (ENV 2006a)	March-April 2006	Very Good	Single Season Level 2	-	84	413	2	8
Newman Ammonium Nitrate Storage Facility - Phase II conservation significant flora survey (Ecologia 2006b)	April 2006	Very Good	Targeted Searches	76.3		122	0	3

Project	Survey Timing	Season	Survey Type	Area (ha)	No. Sites	No. Taxa	No. Significant Flora	No. Weeds
BHP Billiton Iron Ore Western Ridge Exploration Project Biological Survey (Ecologia 2006c)	August 2006	Very Good	Single Season Level 2	-	36	152	1	3
Mount Whaleback Flora and Vegetation Assessment Phase III Summary Report (ENV 2006f)	August 2006	Very Good	Single Season Level 2		81	345	1	9
Newman Hub RGP4 Infrastructure Area Flora and Vegetation Assessment (ENV 2006b)	September 2006	Good	Single Season Level 2	250	10	168	0	8
Newman Hub Rail Corridor Declared Rare and Priority Flora Survey (ENV 2006d)	September 2006	Good	Targeted Searches	17.8	-	-	0	1
Mount Whaleback Newman Kurra Village Extension Area Flora and Vegetation Assessment (ENV 2006e)	September 2006	Good	Single Season Level 2	30	9	117	0	7
Newman Hub RGP4 Topsoil Stockpile and Borrow Areas for Construction Flora and Vegetation Assessment (ENV 2006c)	October 2006	Good	Single Season Level 2	220	45	285	1	13
OB25 Rail Spur Siding Declared rare and Priority Flora Survey (ENV 2007)	November to December 2006	Good	Targeted Search	121.1	-	-	0	1
Rail RGP5 Summary of Important Findings from RGP5 Railway Project Biological Assessments (ENV 2008a)	April 2008	Good	Single Season Level 2	-	159	-	1	10

Project	Survey Timing	Season	Survey Type	Area (ha)	No. Sites	No. Taxa	No. Significant Flora	No. Weeds
RPG5 Jimblebar Junction to Yandi Junction Railway Reserve (ENV 2008b)	April 2008	Good	Single Season Level 2	960	137	353	3	11
Newman Water Pipeline Enhancement Project: Flora and Vegetation Assessment (Ecologia 2008)	April 2008	Good	Single Season Level 1	-	69	353	1	14
Report for Myopic Project Area Newman, Flora and Fauna Assessment (GHD 2008)	May to June 2008	Good	Single Season Level 2	3,600	141	321	0	3
Rail RGP5 Repeater 9 Access Road Flora and Vegetation Assessment (ENV 2008c)	June 2008	Good	Single Season Level 2	12	7	163	1	14
Newman to Jimblebar Transmission Line and Newman Town Substation Flora and Vegetation Assessment (ENV 2009a)	April 2009	Poor	Single Season Level 2	-	67	365	1	15
Mount Whaleback Power station Flora and Vegetation Assessment (ENV 2009b)	April 2009	Poor	Single Season Level 2	-	10	124	0	5
Biological Survey - Myopic Exploration Leases (Onshore 2009)	June 2009	Poor	Single Season Level 1	-	75	274	3	8
Flora and Vegetation Survey and Fauna Assessment (Onshore/Biologic 2009)	June 2009	Poor	Single Season Level 2	2609	30	201	0	17
Orebody 25 to Newman Flora and Vegetation Assessment (ENV 2009c)	July 2009	Poor	Single Season Level 2	603	33	214	0	7

Project	Survey Timing	Season	Survey Type	Area (ha)	No. Sites	No. Taxa	No. Significant Flora	No. Weeds
Homestead Creek Culvert Flora and Vegetation Assessment (ENV 2009d)	July 2009	Poor	Single Season Level 1	35	-	80	0	6
Newman Power Network, Level 2 Flora and Level 1 Fauna Survey (Biologic 2009)	July 2009	Good	Targeted Search	-	-	319	1	14
Orebody 35 VCP area Flora and Fauna Assessment (ENV 2010)	December 2009	Poor	Single Season Level 2	844	29	189	0	3
Mt Whaleback TSF Flora, Vegetation and Fauna Assessment (Astron 2010)	March 2010	Poor	Single Season Level 2	23.5	7	71	0	2
Mt Whaleback East Flora, Vegetation and Fauna Survey (ENV 2011a)	January 2011	Poor	Single Season Level 2	703	15	127	0	6
Mt Whaleback Flora and Vegetation Assessment (ENV 2011b)	May-June 2011	Good	Single Season Level 2	3,729	42	272	3	11
Flora and Vegetation and Vertebrate Fauna Review Mt Whaleback AML 7/244 (Onshore Environmental 2013)	-	-	Review	-	183	352	4	19
Mt Whaleback OB29/30/35 Targeted Flora Survey Assessment (Onshore 2014)	February 2014	Good	Targeted	8,807	-	-	5	-
Cathedral Gorge Level 2 Flora and Vegetation Survey	September / October 2015	Good	Level 2	5,330	52	390	7	8
Newman Shopping Centre Powerline Extension Level 1 Flora, Vegetation and Vertenrate Fauna Survey	November 2015	Poor	Level 1	15	-	136	0	7

APPENDIX 2

Vegetation Classifications for the Pilbara based on Specht (1970), as modified by Aplin (1979) and Trudgen (2009)

Height Class	Canopy Cover				
	100 - 70%	70 - 30%	30 - 10%	10 - 2%	< 2%
Trees > 30 m	High Closed Forest	High Open Forest	High Woodland	High Open Woodland	Scattered Tall Trees
Trees 10-30 m	Closed Forest	Open Forest	Woodland	Open Woodland	Scattered Trees
Trees < 10 m	Low Closed Woodland	Low Open Forest	Low Woodland	Low Open Woodland	Scattered Low Trees
Mallee	Closed Mallee	Mallee	Open Mallee	Very Open Mallee	Scattered Mallees
Shrubs > 2 m	Closed Scrub	Open Scrub	High Shrubland	High Open Shrubland	Scattered Tall Shrubs
Shrubs 1-2 m	Closed Heath	Open Heath	Shrubland	Open Shrubland	Scattered Shrubs
Shrubs < 1 m	Low Closed Heath	Low Open Heath	Low Shrubland	Low Open Shrubland	Low Scattered Shrubs
Hummock Grass	Closed Hummock Grassland	Hummock Grassland	Open Hummock Grassland	Very Open Hummock Grassland	Scattered Hummock Grass
Tussock Grass	Closed Tussock Grassland	Tussock Grassland	Open Tussock Grassland	Very Open Tussock Grassland	Scattered Tussock Grass
Bunch Grass	Closed Bunch Grassland	Bunch Grassland	Open Bunch Grassland	Very Open Bunch Grassland	Scattered Bunch Grass
Sedges	Closed Sedges	Sedges	Open Sedges	Very Open Sedges	Scattered Sedges
Herbs	Closed Herbs	Herbs	Open Herbs	Very Open Herbs	Scattered Herbs

Source: S. Van Leeuwen (DPaW)

APPENDIX 3

Conservation Codes for Western Australian Flora and Fauna

Specially protected fauna or flora are species* which have been adequately searched for and are deemed to be, in the wild, either rare, at risk of extinction, or otherwise in need of special protection, and have been gazetted as such. Categories of specially protected fauna and flora are:

T Threatened Species

Published as Specially Protected under the *Wildlife Conservation Act 1950,* and listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora (which may also be referred to as Declared Rare Flora).
Threatened fauna is that subset of 'Specially Protected Fauna' declared to be 'likely to become extinct' pursuant to section 14(4) of the Wildlife Conservation Act.
Threatened flora is flora that has been declared to be 'likely to become extinct or is rare, or otherwise in need of special protection', pursuant to section 23F(2) of the Wildlife Conservation Act.
The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

CR Critically endangered species

Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

EN Endangered species

Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

VU Vulnerable species

Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna and Wildlife Conservation (Rare Flora) Notice for Threatened Flora.

EX Presumed extinct species

Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna and Wildlife Conservation (Rare Flora) Notice for Presumed Extinct Flora.

IA Migratory birds protected under an international agreement

Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.

CD Conservation dependent fauna

Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice.

OS Other specially protected fauna

Fauna otherwise in need of special protection to ensure their conservation. Published as Specially Protected under the *Wildlife Conservation Act 1950,* in Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice.

Priority Species

Possibly threatened species that do not meet survey criteria, or are otherwise data deficient, are added to the Priority Fauna or Priority Flora Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened flora or fauna.

Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring.

Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

1: Priority One - Poorly Known Taxa

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

2: Priority Two - Poorly Known Taxa

Species that are known from one or a few collections (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

3: Priority Three - Poorly Known Taxa

Species that are known from collections or sight records from several localities not under imminent threat, or from few but widespread localities with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several localities but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

4: Priority Four - Rare, Near Threatened and other taxa in need of monitoring

(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands.

(b) Near Threatened. Species that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.

(c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

APPENDIX 4

Conservation categories for flora described under the EPBC Act

Category	Description
Extinct	A species is extinct if there is no reasonable doubt that the last member of the species has died.
Extinct in the Wild	A species is categorised as extinct in the wild if it is only known to survive in cultivations, in captivity, or as a naturalised population well outside its past range; or if it has not been recorded in its known/expected habitat, at appropriate seasons, anywhere in its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered	The species is facing an extremely high risk of extinction in the wild and in the immediate future.
Endangered	The species is likely to become extinct unless the circumstances and factors threatening its abundance, survival, or evolutionary development cease to operate; or its numbers have been reduced to such a critical level, or its habitats have been so drastically reduced, that it is in immediate danger of extinction.
Vulnerable	Within the next 25 years, the species is likely to become endangered unless the circumstances and factors threatening its abundance, survival or evolutionary development cease to operate.
Conservation Dependent	The species is the focus of a specific conservation program, the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.