Orebody 31 to Ophthalmia Dam Pipeline
Level 1 Flora, Vegetation and Vertebrate Fauna Survey

Prepared for BHP Billiton Iron Ore Pty Ltd
October 2015

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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 single season Level 1 flora and vegetation survey and Level 1 vertebrate fauna assessment of a proposed pipeline corridor extending 3.5 km east from Ophthalmia Dam (herein referred to as the study area) and intending to service Orebody 31 (OB31) (Figure 1). The study area is situated approximately 17 km east of Newman.

Flora and Vegetation Assessment

No plant taxa gazetted as Threatened Flora (T) pursuant to subsection (2) of Section 23F of the *Wildlife Conservation Act 1950* (WC Act) or listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) were recorded from the study area. One Priority flora taxon was recorded from the study area; *Goodenia nuda* (Priority 4).

A total of ten vegetation associations from ten broad floristic formations were described and mapped within the study area. None of these vegetation associations are listed as Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs). Vegetation condition within the study area ranged from *excellent* to *degraded,* with the majority of the area rated as *very good.*

Vertebrate Fauna Assessment

Database searches, review of previous survey reports and results from the current survey indicated that 247 species of vertebrate fauna (excluding freshwater fish) occur within a 25 km radius of the study area. The number of species occurring in the study area would likely be significantly less due to the limited variation in habitat types. This list comprises 40 species of mammal, 133 species of birds, 69 species of reptiles and five species of amphibians. Of these, 44 species were recorded during the current survey.

Based on the results of previous surveys, a review of regional surveys, and database searches, it was determined that 25 species (seven native mammals, 16 birds and two reptiles) of conservation significance have the potential to occur in the study area. A number of EPBC migratory birds may be present as there is overlap with Ophthalmia Dam. Rainbow Bee-eater (WC Act Schedule 3, EPBC Act Migratory) was the only significant species recorded during the survey.

Five habitats types were recorded during the survey; Mulga, Stony Plain, Sand Plain, Major Drainage Line, and Artificial Habitat - Dam.

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1.0 Introduction

1.1 Preamble

In May 2015 Onshore Environmental was commissioned by BHP Billiton Iron Ore to undertake a single season Level 1 flora and vegetation survey and Level 1 vertebrate fauna assessment of a proposed 3.5 km pipeline corridor extending east from Ophthalmia Dam and intending to service the OB31 project. The flora, vegetation and vertebrate fauna survey results will be used to inform a Native Vegetation Clearing Permit (NVCP) for the proposed pipeline route. The study area is located approximately 17 km east of Newman and immediately east of Ophthalmia Dam (Figure 1).

1.2 Previous Flora and Vegetation Surveys

No previous flora and vegetation surveys have been completed within the boundary of the study area. However, there have been at least 40 previous flora and vegetation surveys completed within a 25 km radius of the study area; these are listed and described in more detail in Section 3.1.1. Onshore Environmental has recently completed a Level 2 Flora and Vegetation survey of BHP Billiton Iron Ore's Dynasty and West Jimblebar tenement situated approximately 5 km south-east of the study area. The southern extent of the Ninga flora and vegetation survey (Astron Environmental 2013) also occurs in close proximity to the eastern boundary of the study area.

From a fauna perspective eight relevant surveys have been completed within a 10 km radius of the study area. These surveys are listed and described in more detail in Section 5.1.2.

160000 170000 180000 190000 200000 210000

7430000 7420000 7410000 7400000

KALGAN
FORTESCUE RIVER
KALGAN CREEK
MARBLE BAR ROAD
JIMBLEBAR JUNCTION
GREAT NORTHERN HIGHWAY
EASTERN RIDGE
Newman Orebody 24-25
Orebody 18
PARNPAJINYA
NEWMAN
Mt Whaleback
MOUNT WHALEBACK
MOUNT WHALEBACK LOOP
Orebody 35
WESTERN RIDGE
Wheelarra 1-4
JIMBLEBAR
CAPRICORN ROADHOUSE
WARRAWANDA CREEK
SHOVELANNA CREEK

LOCATION MAP

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Kilometers

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Datum: GDA94

Projection: MGA Zone 51

FIGURE 1

OB31 TO OPHTHALMIA DAM PIPELINE

Location of the study area

Legend

- Study Area
- Places
- Watercourses
- Roads
- Railways

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1.4 Climate

The climate of the south-eastern Pilbara is arid-tropical with hot summers extending from October to April and mild winters from May to September. The climate is dry and rainfall variable and unreliable. Rainfall occurs in both summer and winter months with the major falls received during summer months. Cyclones that develop over the Indian Ocean bring heavy summer rainfall, especially from January to March. Winter rainfall is generally lighter and typically associated with cold fronts extending from southern parts into the Pilbara region. Annual average rainfall for the Pilbara ranges from 180 mm to over 400 mm (Beard 1975) with a long-term average of 325.9 mm for the town of Newman (recorded from the years 1971 to 2013, Bureau of Meteorology (BOM) 2015).

Average maximum summer temperatures are typically between 35°C to 40°C and winter maximum temperatures range from 22°C and 30°C. Summer temperatures can reach 49°C with frosts occurring occasionally during winter months. The prevailing wind direction for Newman is east-south-east between May and August, with stronger west-north-west winds dominant between September and March.

Rainfall for the six months prior to the July 2015 field survey totalled 399 mm, which is well above the long-term average of 232 mm for the same period (Figure 2). Summer rainfall was relatively poor with December, January and February all recording below average falls. However good autumn rains were received in 2015 with above average falls in March, April and May. Rainfall was particularly high in March with more than four times the monthly average recorded (174.2mm). These autumn rains prior to field assessment resulted in excellent seasonal conditions at the time of survey in July 2015.

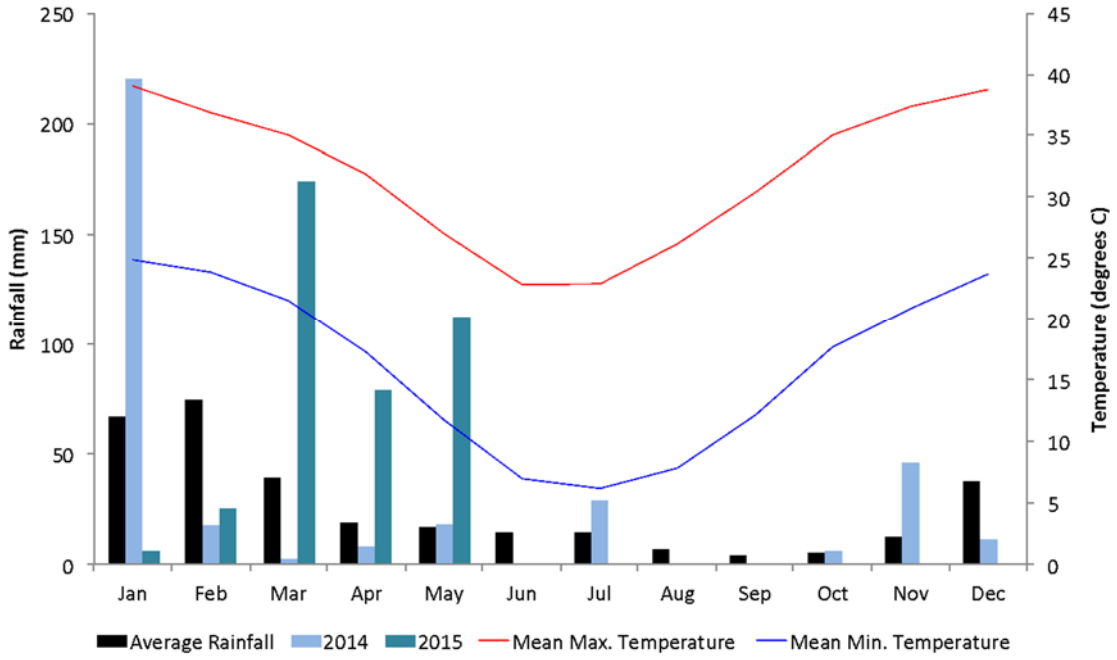

Figure 2 **Climate and rainfall data for Newman between January 2014 to June 2015, with long-term temperature (1996 to 2014) and long-term rainfall (1971 to 2014) figures (Bureau of Meteorology (BOM) 2015).**

1.5 Biogeographic Regions

The Interim Biogeographic Regionalisation for Australia (IBRA) describes a system of 89 'biogeographic regions' (bioregions) and 419 subregions covering the entire Australian continent (IBRA7, Department of Environment 2014a). Bioregions are defined on the basis

of climate, geology, landforms, vegetation and fauna. The study area is located in close proximity to the border between the Pilbara and Gascoyne Bioregions (Thackway and Cresswell 1995). The subregions in the area are the Hamersley subregion (PIL3) of the Pilbara bioregion and the Augustus subregion (GAS03) of the Gascoyne Bioregion.

The Hamersley subregion (PIL3) is 6,215,095 hectares (ha) in size and is described as: "Mountainous area of Proterozoic sedimentary ranges and plateaux, dissected by gorges (basalt, shale and dolerite). Mulga low woodland over bunch grasses on fine textured soils in valley floors, and *Eucalyptus leucophloia* over *Triodia brizoides* on skeletal soils of the ranges. The climate is semi-desert tropical, average 300 mm rainfall, usually in summer cyclonic or thunderstorm events. Winter rain is not uncommon. Drainage into either the Fortescue (to the north), the Ashburton to the south, or the Robe to the west" (Kendrick 2001).
The Hamersley subregion (PIL3) is characterised by mountain ranges of Proterozoic sedimentary rock, dissected by gorges (Kendrick 2001; Australian Natural Resource Atlas [ANRA] 2008). Beard (1975) described the Hamersley subregion as "rounded hills and ranges, mainly of jaspilite and dolomite with some shale, siltstone and volcanics". This plateau supports mulga (*Acacia aneura*) low woodland over bunch grasses on fine textured soils and snappy gum (*Eucalyptus leucophloia*) over hummock grass (*Triodia brizoides*) on skeletal sandy soils of the ranges.

The Augustus subregion has an area of 10,687,739ha. It is described as low rugged ranges of Proterozoic sedimentary and granite ranges interspersed by broad flat valleys. The subregion includes the Narryera Complex and Bryah Basin of the Proterozoic Capricorn Orogen (on northern margin of the Yilgarn Craton), as well as the Archaean Marymia and Sylvania Inliers. The main drainage in the subregion is to the Gascoyne River System however the area also contains the headwaters of the Ashburton and Fortescue Rivers. Extensive areas of alluvial valley-fill deposits occur within this subregion. The vegetation on rises consists of Mulga woodland and *Triodia* on shallow stony loams. The hardpan plains of the subregion are dominated by Mulga parkland with shallow earthy loams (Desmond *et al* 2001).

1.6 Soils

Tille (2006) classified 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 is located near the boundary of the following two soil units:

- 285 - Hamersley Plateaux Zone, located in the Fortescue Province is described as having stony soils with red shallow loams and some red/brown non-cracking clays and red loamy earths; and
- 290 - Bulloo Plains and Hills Zone, located in the Ashburton Province is described as having red shallow loams (often with hardpans), red loamy earths, stony soils and red deep sands with some red shallow sands.

The Australian Soil Resource Information System (ASRIS) provides soil and land resource information across Australia. The following soil types occur within the study area (CSIRO 2014):

- Fa13 - Ranges of banded jaspilite and chert along with shales, dolomites, and iron ore formations; some areas of ferruginous duricrust as well as occasional narrow winding valley plains and steeply dissected pediments. This unit is largely associated with the Hamersley and Ophthalmia Ranges. The soils are frequently stony and shallow and there are extensive areas without soil cover: chief soils are shallow stony earthy loams (Um5.51) along with some (Uc5.11) soils on the steeper slopes. Associated are (Dr2.33, Dr2.32) soils on the limited areas of dissected pediments, while (Um5.52) and (Uf6.71) soils occur on the valley plains; and
- Be6 - Extensive flat and gently sloping plains that sometimes have a surface cover of gravels and on which red-brown hardpan frequently outcrops: chief soils are

shallow earthy loams (Um5.3) with associated (Gn) soils of units My5O and Mz23. As mapped, there are inclusions of units Oc47 and BB9.

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 (Australian Natural Resource Atlas 2008). Important mineral reserves, including iron ore, which is prevalent in the Pilbara, are associated with these rock formations.

The study area is situated in the southern edge of the Pilbara Craton in close proximity to the sedimentary basins that separate the Yilgarn and Pilbara Cratons. These consist of the sandstone and shales of the Collier and Bresnahan Basins and granites of the Sylvania Inlier (Tille 2006).

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.

The surface geology of the nearby Jimblebar tenement is dominated by the Brockman Iron Formation, Marra Mamba Iron Formation, interbedded chert, Wittenoom dolomite and alluvium (Williams and Tyler 1991).

1.8 Flora and Vegetation

The study area is located within the Fortescue Botanical District and close to the border of the Hamersley Botanical District (both within the Pilbara IBRA region), which is part of the Eremaean Province (Beard 1990). It is dominated by tree and shrub - steppe communities consisting mainly of *Eucalyptus* and *Acacia* species; *Triodia pungens* and *Triodia wiseana* and some Mulga (*Acacia aneura*) occur within valley areas and short grass plains occur on alluvia. Vegetation within the local area was defined broadly as Mulga low woodlands (continuous) and Mulga (trees in groves and patches).

The original vegetation mapping undertaken by Beard (1975) was refined by Shepherd *et al.* (2002). One vegetation association was present within the study area; 'Kumarina Hills 29' (Figure 3). While the Pre-European extent for this vegetation association is 100 percent, less than three percent occurs within formal or informal reserves (Table 1).

Table 1 Pre-European extent of vegetation associations occurring within the study area (Shepherd *et al.* 2002).

Vegetation Sub-Association	Description	Pre-Euro. Extent Remaining (%)	% Remaining IUCN Class I-IV Reserves	% Remaining Other Reserves	% Remaining DPaW Managed PL
Kumarina Hills 29	Sparse low woodland; mulga, discontinuous in scattered groups	100.0	0.3	0.0	2.4

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 a scale of 1:250,000 (van Vreeswyk *et al.* 2004), with four land systems occurring within the study area (Figure 4, Table 2). All the land systems occurring within the study area are well represented in the Pilbara covering between 0.5 percent and 2.9 percent of the Pilbara Bioregion (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)
Divide	Sandplains and occasional dunes supporting shrubby hard spinifex grasslands	Mainly south-east, common	5,293 km^2 or 2.9%
McKay	Hills, ridges, plateaux remnants and breakaways of meta sedimentary and sedimentary rocks supporting hard spinifex grasslands.	Wide, common	4,202 km^2 or 2.3%
Washplain	Hardpan plains supporting groved mulga shrublands	South-east, common	917 km^2 or 0.5%
River	Active flood plains and major rivers supporting grassy eucalypt woodlands, tussock grasslands and soft spinifex grasslands.	Wide, common	4,088km^2 or 2.3%

789000 792000 795000 798000 801000 804000 807000

7419000 7416000 7413000 7410000

HAMMERSLEY, 80100104

HAMMERSLEY, 80100053

FORTESCUE VALLEY, 80100562

FORTESCUE VALLEY, 80100668

FORTESCUE VALLEY, 80100482

KUMARINA HILLS, 80100482

KUMARINA HILLS, 80100668

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Projection: MGA Zone 50

FIGURE 3

OB31 TO OPTHALMIA DAM PIPELINE VEGETATION OF THE STUDY AREA, AS MAPPED BY BEARD (1975)

Legend

Study Area

Pre-European Vegetation (Beard 1975)

- FORTESCUE VALLEY, 216
- FORTESCUE VALLEY, 29
- FORTESCUE VALLEY, 82
- HAMMERSLEY, 18
- HAMMERSLEY, 82
- KUMARINA HILLS, 216
- KUMARINA HILLS, 29

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RGEBGD RGEBGD RGEBGD RGEROC RGENEW RGENEW RGENEW RGENEW RGENEW RGEELI RGENEW RGEMCK RGEMCK RGERIV RGEDIV RGEDIV RGEMCK RGEWSP RGEDIV RGESPH RGEWSP RGEDIV RGEDIV RGESYL RGEDIV RGEDIV RGEWSP RGEDIV RGESYL RGECAD

Legend

Study Area

Land Systems

- RGEBGD, Boolgeeda Land System
- RGECAD, Cadgie Land System
- RGEDIV, Divide Land System
- RGEELI, Elimunna Land System
- RGEMCK, McKay Land System
- RGENEW, Newman Land System
- RGERIV, River Land System
- RGEROC, Rocklea Land System
- RGESPH, Spearhole Land System
- RGESYL, Sylvania Land System
- RGEWSP, Washplain Land System

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Meters

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Datum: GDA94

Projection: MGA Zone 50

FIGURE 4

OB31 TO OPTHALMIA DAM PIPELINE
LAND SYSTEM REPRESENTED WITHIN THE STUDY AREA
(AS MAPPED BY VAN VREESWYK et al 2004)

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2.0 Methodology - Flora & Vegetation

2.1 Guidance Statements

The flora survey and vegetation survey was carried out in a manner that was compliant with the following Environmental Protection Authority (EPA) requirements for the environmental surveying and reporting of flora and vegetation in Western Australia:

- Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to Agricultural Areas. Position Statement No. 2 (EPA 2000);
- Terrestrial Biological Surveys as an Element of Environmental Protection. Position Statement No. 3 (EPA 2002); and
- EPA Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia No. 51 (EPA 2004).

The survey was also conducted in accordance with BHP Billiton Iron Ore's *Guidance for Flora and Vegetation Surveys in the Pilbara* (BHP Billiton Iron Ore 2010).

2.2 Database Searches

Searches of three databases were completed for information relating to rare flora (DPaW 2015a), and TECs and PECs (DPaW 2015b) previously recorded within, or in close proximity to, the study area. For this report a database search covering the entire study area was completed. The search was extended beyond the immediate survey limits to place flora values into a local and regional context. The search co-ordinate used was a 50 km radius around the central point of the study area; 797000 mE 7415000 mN (50K GDA94). The State database search investigated three DPaW databases (DPaW 2015a):

1. The DPaW Threatened (Declared Rare) Flora Database;
2. The DPaW Declared Rare and Priority Flora List; and
3. The Western Australian Herbarium Specimen Database for Priority species opportunistically collected in the area of interest.

A search of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters database was undertaken (DoE 2015), as well as a search of the International Union for Conservation of Nature (IUCN) database (IUCN 2015).

A comprehensive literature review of surveys previously completed within or in close proximity to the study area was also undertaken.

2.3 Field Survey Methodology

2.3.1 Timing and Personnel

The field survey was completed by Principal Botanist Dr Jerome Bull between the 13th and 14th of July 2015. A total of two person days were spent in the field completing targeted significant flora searches and vegetation association mapping.

2.3.2 Targeted Surveys for Conservation Significant Flora

The entire length of the study area was traversed walking on either side of the centreline to assess flora and vegetation values (Figure 5). One side of the centreline was surveyed on the outgoing walk with the other side surveyed on the return journey. This allowed for appropriate coverage of the study area and landforms. Where priority flora were recorded a more intensive search of the specific landform and area were undertaken.

2.3.3 Vegetation Mapping

The vegetation mapping utilised high-resolution aerial photography of the entire study area at a scale of 1:10,000, with definition of vegetation polygons based on contrasting shading patterns. Ground-truthing of the study area was completed during the field survey and 61 relevé vegetation descriptions were made within vegetation polygons to confirm dominant structural layers and associated plant taxa.

Description of vegetation structure follows the height, life form and density classes of Specht (1970) as modified by Alpin (1979) and Trudgen (2009) (see Appendix 1). This is largely a structural classification suitable for broader scale mapping, but taking all ecologically significant strata into account. Vegetation condition for each of the sampling sites was determined using a recognised rating scale (based on Keighery 1994, see Appendix 2).

2.3.4 Vouchering

Voucher specimens were taken for all plant taxa that could not be identified in the field, to verify identification utilising resources at the Western Australian Herbarium (WAH). Voucher specimens were provided to Mr Steve Dillon, BHP Billiton Iron Ore's sponsored botanist at the WAH. The species names were checked against FloraBase (WAH 2015) to ensure currency. Nomenclature follows the WAH census.

2.3.5 Field Survey Constraints

The EPA Guidance Statement for Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (EPA 2004) list twelve potential constraints that field surveys may encounter. These constraints are addressed in Table 3.

Table 3 Relevance of constraints, as identified by EPA (2004), to the flora and vegetation survey.

Constraint	Relevance
Scope	The scope was established by BHP Billiton Iron Ore in compliance with relevant EPA Guidance Statements.
Proportion of flora collected and identified	The Level 1 field survey followed three months of very high autumn rainfall and seasonal conditions were rated as excellent.
Sources of information	Onshore Environmental has recently completed a Level 2 flora and vegetation survey at the nearby Dynasty and West Jimblebar tenements to the south-east (Onshore Environmental 2015). There has been additional high intensity sampling from at least 40 neighbouring BHP Billiton Iron Ore tenements within a 25 km radius around the study area, providing an extensive local database. This is confirmed by the intensity of records for the area on FloraBase.
The proportion of the task achieved and further work which might be needed	A comprehensive desktop review of the previous survey work completed within, and in close proximity to the study area, supported an extensive targeted search within the study area. All allocated tasks were achieved during the investigation and no further work is needed at this site.
Timing / weather / season / cycle	The autumn rainfall recorded for months preceding the targeted survey was higher than the long-term annual average. This resulted in excellent seasonal conditions supporting a diverse suite of plant life forms. The timing of sampling was optimum.
Disturbances, e.g. fire, flood	Minor disturbances related to fire and grazing by domestic stock were noted within the study area but did not impact on survey results.

Constraint	Relevance
Intensity	The entire study area was ground truthed at 50 m intervals. A more intensive field survey was completed around habitats where significant flora were most likely to occur.
Completeness	Relevant tasks related to assessing the presence of conservation significant flora and undertaking vegetation mapping were completed.
Resources	Appropriate resources have been applied to surveying the study area during the July 2015 survey.
Access problems	The entire study area was accessed on foot walking from established tracks.
Availability of contextual information	At least 40 previous flora and vegetation surveys have been undertaken within a 25 km radius of the study area, providing an extensive local database.
Experience levels	The Principal Botanist working on the survey has over 15 years experience completing vegetation surveys and flora taxonomy in the Pilbara and has recently completed baseline surveys in close proximity to the study area.

2.4 Assessment of Conservation Significance

The conservation significance of flora and ecological communities are classified on a Commonwealth, State and Local level on the basis of various Acts and Agreements (EPA Guidance Statement No. 51, EPA 2004), including:

Commonwealth Level:

- EPBC Act: The Department of Environment (DoE) lists Threatened Flora and Ecological Communities, which are determined by the Western Australian Threatened Species Scientific Committee according to criteria set out in the Act. The Act lists flora that are considered to be of conservation significance under one of six categories (Appendix 3).

State Level:

- WC Act: At a State level native flora species are protected under the WC Act – Wildlife Conservation (Rare Flora) Notice. A number of plant species are assigned an additional level of conservation significance based on a limited number of known populations and the perceived threats to these locations. Species of the highest conservation significance are gazetted Declared Rare Flora (DRF) under subsection 2 of section 23F of the Act. It is an offence to take or damage DRF without Ministerial approval. Section 23F of the Act defines 'to take' as "to gather, pick, cut, pull up, destroy, dig up, remove or injure the flora or to cause or permit the same to be done by any means".
- DPaW Priority list: DPaW produces a list of Priority flora taxa and ecological communities (PECs) that have not been assigned statutory protection under the WC Act. Priority Flora are under consideration for declaration as 'Rare Flora', classified as in urgent need of further survey (Priority One to Three), require monitoring every 5-10 years (Priority Four) or require a specific conservation program to prevent the taxon becoming threatened within five years (Priority 5), see Appendix 4. The list of PECs identifies those that need further investigation before nomination for TEC status.

Local Level:

- Species may be considered of local conservation significance because of their patterns of distribution and abundance. Although not formally protected by legislation, such species are acknowledged to be in decline as a result of threatening processes, primarily habitat loss through land clearing.

3.0 Methodology - Vertebrate Fauna

3.1 Guidance Statements

The vertebrate fauna survey was carried out in a manner consistent with the Western Australian (WA) Environmental Protection Authority (EPA), WA Department of Parks and Wildlife (DPaW) and BHP Billiton Iron Ore's requirements for the environmental surveying and reporting of fauna, including the following documents:

- EPA (2002, or its revision) Position Statement No. 3, Terrestrial Biological Surveys as an Element of Biodiversity Protection;
- EPA Guidance No. 56, Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (EPA, 2004, or its revision);
- Technical Guide - Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (WA Department of Environment and Conservation [DEC]/EPA, 2010);
- Department of the Environment, Water, Heritage and the Arts (2010) Survey Guidelines for Australia's Threatened Bats;
- Department of the Environment, Water, Heritage and the Arts (2010) Survey Guidelines for Australia's Threatened Birds;
- Department of the Environment, Water, Heritage and the Arts (2010) Survey Guidelines for Australia's Threatened Mammals;
- Department of the Environment, Water, Heritage and the Arts (2010) Survey Guidelines for Australia's Threatened Reptiles;
- Department of the Environment, Water, Heritage and the Arts (2010) Survey Guidelines for Australia's Threatened Frogs;
- BHP Billiton Iron Ore (2011) Guidance for Vertebrate Fauna Surveys in the Pilbara (SPR-IEN-EMS-012);
- BHP Billiton Iron Ore (2010) Terrestrial Fauna Habitat Assessment Proforma (FRM-IEN-EMS-003); and
- BHP Billiton Iron Ore (2013) Biological Survey Data and Digital Photography Requirements (SPR-IENEMS-015).

3.2 Database Searches

Two databases were searched to obtain information on species previously recorded during field surveys (NatureMap), or conservation significant species likely to occur within the study area (Protected Matters Database) (Table 4).

- DPaW's NatureMap database - to determine threatened fauna recorded from the region which also incorporates the results of the Pilbara Biological Survey (DPaW 2015); and
- Department of the Environment (DoE)'s Protected Matters Database - to determine matters of national environmental significance recorded from the area.

Table 4 Databases used for the vertebrate fauna review.

Provider	Database	Parameters
Department of Parks and Wildlife	NatureMap Accessed August 2015	Circle of radius 4 km centred on the point - 119° 54' 56" E, 23° 21' 06" S
Department of Environment	Protected Matters Database Search Tool. Accessed August 2015	Circle of radius 5 km centred on the point -23.35156, 119.9154

3.3 Field Survey Methodology

The purpose of the survey was to verify data collated during the literature and database reviews, map and describe the fauna habitats present within the study area, and undertake a Level 1 survey for vertebrate fauna.

3.3.1 Timing and Personnel

The Level 1 vertebrate fauna field survey was completed between the 13th and 14th of July 2015 by Principal Zoologist Mr Morgan O'Connell. A total of 1.5 person days were spent in the field completing targeted significant fauna searches and fauna habitat mapping.

3.3.2 Targeted transects

Targeted transect locations covered the entire study area (Figure 5). During the targeted transects all the vertebrate fauna species encountered were recorded, either from primary (*i.e.* direct observation) or secondary (*e.g*. burrows, scratchings, diggings and scats) evidence.

3.3.3 Opportunistic Records

Opportunistic records of vertebrate species encountered during the survey were documented. Birds were recorded on a presence/absence basis and were targeted during early morning transects. Presence was determined by call identification, visual identification and/or tracks and traces. Binoculars were used to determine species and to investigate potential nesting sites. Opportunistic reptile encounters were recorded during transects.

3.3.4 Fauna Habitat Mapping and Assessment

Nine fauna habitat assessments were conducted during this survey (Figure 5). Habitats in the study area were assessed using methodology and terminology adapted from the Australian Soil and Land Survey Field Handbook (Commonwealth Scientific and Industrial Research Organisation 2009) and modified to suit the survey requirements according to BHP Billiton Iron Ore guidelines.

Fauna habitats were also assessed for the likelihood that they may support conservation significant fauna. All major fauna habitats present within the study area were sampled and scored for importance (High, Medium or Low) according to the criteria shown in Table 5 below.

Table 5 Fauna habitat importance assessment criteria.

Score	Criteria
High	1) Habitat supports EPBC Act listed threatened fauna. OR 2) Habitat for species listed as above is present in the study area, and there are records of that species within 50 km of the study area. If limited surveys have been undertaken in the vicinity of the study area then a precautionary approach will be used and the species will be considered likely to be present. OR 3) Uncommon habitat is critical habitat for a population of DPaW listed Priority fauna. For example, if habitat is limited in the region and the habitat in the study area forms a significant portion of the known habitat for a Priority species, it would be scored as High significance. OR 4) Habitat that only occurs in small isolated geographic areas.

Score	Criteria
Medium	1) Habitat supports DPaW listed Priority fauna that are largely restricted to that habitat type within the study area. OR 2) Habitat supports EPBC Act listed Migratory fauna. OR 3) Habitat supports a particularly diverse and uncommon faunal assemblage. Habitat that occurs throughout region, and does not occur in small or isolated areas, is excluded.
Low	Habitat is widespread, common, and does not solely support any significant fauna.

Habitat assessments were undertaken to determine the quality of available fauna habitat and the likelihood of habitat to support species of conservation significance. Fauna habitats were identified and mapped using vegetation association mapping and aerial imagery of the study area.

796000 796500 797000 797500 798000 798500

7416000 7415500 7415000 7414500

OPHT9
OPHT8
OPHT6
OPHT7
OPHT5
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OPHT1
OPHT4
OPHT3

796000 796500 797000 797500 798000 798500

ONSHORE ENVIRONMENTAL

Figure:	5	Date:	20/08/2015
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Projection: MGA Zone 50

FIGURE 5

Location of fauna sites sampled within the study area

Legend

- Study Area
- Sample Site Locations

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3.3.5 Field Survey Constraints

The EPA *Guidance Statement for Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004b) list twelve potential constraints that field surveys may encounter. These constraints are addressed in Table 6 below.

Table 6 Relevance of constraints, as identified by EPA (2004b), to the fauna surveys.

Potential limitation or constraint	Applicability to the surveys
Experience of personnel	The Principal Zoologist that conducted this survey is regarded as suitably qalified with over 11 years experience.
Scope	The scope for the survey was established by BHP Billiton Iron Ore and is in compliance with relevant EPA Guidance Statements
Proportion of fauna identified	All observed fauna were identified at the point of observation.
Sources of information (recent or historic) and availability of contextual information	A number of surveys have been undertaken in the study area and the surrounding region. DPaW has also completed the Pilbara Biological Survey, which provided information on regional distribution of selected species. These reports were available at the time of reporting.
Proportion of the task achieved	All allocated tasks have been achieved during the survey.
Disturbances (e.g. fire or flood)	Disturbances within the study area include introduced mammalian species, historical access tracks and exploration activities, and current mining operations. None of these disturbances affected the ability to complete the survey. However, significantly cold conditions prevailed during the current study, which drastically reduce the activity of taxa like reptiles.
Intensity of survey	A level 1 survey was identified by BHP Billiton Iron Ore as the requirement for this survey and the survey was completed adequately to this level.
Completeness of survey	The survey was completed according to the requirements of the scope.
Resources (e.g. degree of expertise available)	All resources required to complete the survey were available.
Remoteness or access issues	All areas in the tenement were accessible either by vehicle or on foot; all habitats within the study area have been surveyed and all habitats considered to be suitable for conservation significant species have been searched.

3.4 Taxonomy and Nomenclature

The latest census lists of mammals, reptiles and amphibians published by the WA Museum were used as a guide to the current taxonomy and nomenclature of these groups. This updated list in turn is formulated using up-to-date taxonomical literature. For birds, the current checklist of Australian birds, maintained by Birds Australia, was used. The bird list is based on the most recent review of the systematics and taxonomy of Australian birds by Christidis and Boles (2008).

3.5 Assessment of Conservation Significance

Within Western Australia, all native fauna is protected under the WC Act and any action that has the potential to impact on native fauna needs to be approved by relevant State and/or Federal departments as dictated by the State *Environmental Protection Act 1986* and the Federal EPBC Act.

Some species of fauna that are determined to be at risk of extinction or decline are afforded extra protection under these Acts. For the purposes of this report, these species are called *conservation significant species*. A summary of applicable legislation and status codes is provided in Table 7. Additional information on Status Codes is provided in Appendix 5.

A number of migratory bird and marine species are prioritised for conservation under the EPBC Act or international agreements. In addition the International Union for the Conservation of Nature (IUCN) compiles a 'Red List' upon which species at risk of extinction are listed. For some species there is insufficient information to determine their status. These species are generally considered by the EPA/DPaW to be of 'conservation significance' for all development related approvals and are listed on a 'Priority List' which is regularly reviewed and maintained by the DPaW.

DPaW also identifies TECs that are naturally occurring biological assemblages found to fit into one of the four categories (Table 7). Possible threatened ecological communities that do not meet these survey criteria are added to DPaWs PECs lists under Priorities 1, 2 and 3.

Table 7 Conservation significance assessment guidelines.

Level	Agreement, Act or List	Status Codes
International	The IUCN *Red List* lists species at risk under nine categories (listed under 'Status Codes').	IUCN Extinct IUCN Extinct in the Wild IUCN Critically Endangered IUCN Endangered IUCN Vulnerable IUCN Near Threatened IUCN Least Concern IUCN Data Deficient IUCN Not Evaluated

Level	Agreement, Act or List	Status Codes
	Migratory taxa listed under the following international conventions are generally listed as Migratory or Marine under the federal *Environment Protection and Biodiversity Conservation Act 1999* (see below): Japan-Australia Migratory Bird Agreement (JAMBA); China-Australia Migratory Bird Agreement (CAMBA); Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA); and, Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention).	Generally listed as Migratory or Marine under the federal Environment Protection and Biodiversity Conservation Act 1999[1]
Federal	Environment Protection and Biodiversity Conservation Act 1999 (EPBC) DSEWPaC lists threatened fauna, which are determined by the Threatened Species Scientific Committee (TSSC) according to criteria set out in the Act. The Act lists fauna that are considered to be of conservation significance under one of eight categories (listed under 'Status Codes').	Extinct3 Extinct in the Wild Critically Endangered Endangered Vulnerable Conservation Dependent Migratory Marine
State	Wildlife Conservation Act 1950 (WC Act) At a state level, native fauna are protected under the *Wildlife Conservation Act 1950*. Species in need of conservation are given a ranking ranging from Critically Endangered to Vulnerable.	Schedule 1 Schedule 2 Schedule 3 Schedule 4
State	DPaW Priority list (DPaW) The DPaW produces a list of Priority species and ecological communities (e.g. Priority Ecological Communities (PECs) or Threatened Ecological Communities (TECs)) that have not been assigned statutory protection under the *Wildlife Conservation Act 1950*. This system gives a ranking from Priority 1 to Priority 5.	Priority 1 Priority 2 Priority 3 Priority 4 Priority 5

[1] Species declared as 'Marine' under section s248 of the EPBC Act were not separately listed in this report.

4.0 Results- Flora and Vegetation

4.1 Desktop Review

4.1.1 Regional Surveys

The flora and vegetation of the Pilbara has been mapped and described at broad scale by Burbidge (1959) and Beard (1975). More recently, the Department of Agriculture compiled an inventory and condition survey of the Pilbara (van Vreeswyk *et al.* 2004), which provides an inventory of flora and a description of land resources in terms of land systems. Data from the Pilbara Region Biological Survey 2002-2009 by DPaW are currently being analysed. With the exception of the weed information (Keighery 2010), vegetation and native flora data have not yet been published. The DPaW survey will provide a regional context that is necessary to assess the likely impact of future development proposals. The survey will provide information on patterns in the distribution of flora and fauna to help stakeholders make decisions about conservation requirements and the sustainable use of natural resources.

4.1.2 Previous Flora and Vegetation Surveys

Since the 1970s, large-scale resource developments of iron ore projects have resulted in the collection of a significant amount of site-specific biological survey data in the region, most of which is undertaken for formal environmental impact assessment.

There have been no previous surveys within the current study area. However, a total of 40 previous surveys occurring within a 25 km radius of the study area were reviewed to provide local context and inform flora and vegetation values that may occur within the area of interest. Table 8 summarises the review findings including previous records for conservation significant flora and introduced weed species.

Table 8 Summary of background and results for previous flora and vegetation surveys completed within, or in close proximity to, the study area.

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
Onshore Environmental (2015a) Riparian Flora and Vegetation Baseline Survey Jimblebar Creek	Partially overlapping the study area	8th - 12th September 2014	19 vegetation associations and seven broad floristic formations	167 plant taxa from 39 families and 97 genera dominant families; Poaceae, Fabaceae, and Malvaceae, dominant genera; *Acacia* (15 taxa), followed by *Senna* (8 taxa), *Eragrostis* (5 taxa) and *Eremophila* (5 taxa) Three weed species; **Bidens bipinnata,* **Cenchrus setiger* and **Cenchrus ciliaris*	No Threatened or Priority flora Three range extensions; *Chamaecrista symonii, Eragrostis speciosa* and *Halgania erecta*
Onshore Environmental (2015b) Dynasty and West Jimblebar Level 2 Flora and Vegetation Survey	Approx. 12km to the south west of the study area	23rd February – 1st March 2015	26 vegetation associations and 11 broad floristic formations	263 plant taxa (from 36 families and 106 genera, dominant families; Fabaceae, Poaceae, Malvaceae, Chenopodiaceae and Amaranthaceae, dominant genera *Acacia* (25 taxa), *Sida* (13 taxa), *Senna* (12 taxa), *Eremophila* (9 taxa) and *Ptilotus* (9 taxa)	No Threatened Flora Three priority species; *Ipomoea racemigera* (Priority 2*), Goodenia nuda* (Priority 4*) and Goodenia berringbinensis (*Priority 4*)* Five range extensions; *Eragrostis speciosa* (150 km south-east), *Hibiscus verdcourtii* (200 km east), *Goodenia berringbinensis* (250 km north), *Eleocharis pallens* (350 km south-east) and *Tribulus* cf. *eichlerianus* (950 km west)

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
Onshore Environmental (2014a) Orebody 31 Level 2 Flora and Vegetation Survey	OB31 is located approximately 35km east-northeast of Newman Adjacent to the study area to the west	1st -14th October 2013 45 quadrats and 146 relevés	35 vegetation associations within 15 broad floristic formations	280 taxa from 35 families and 110 genera, dominant families; Fabaceae, Poaceae, Malvaceae and Chenopodiaceae, dominant genus; *Acacia* (40 taxa), *Senna* (11 taxa), *Sida* (11 taxa) and *Eremophila* (10 taxa), two weed species; **Cenchrus ciliaris* and **Malvastrum americanum*	No Threatened Flora Two priority species: *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3), *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (P3), and one undescribed species; *Acacia* sp. nov (reticulate/anastomosing)[2]
Onshore Environmental (2014b) Targeted Significant Flora Assessment Orebody 31	OB31 is located approximately 35km east-northeast of Newman Adjacent to the study area to the west	24th- 30th April 2014	Not recorded	Not Recorded	No Threatened Flora Three priority species: *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3), *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (P3), *Goodenia nuda* (P4) and one undescribed species; *Acacia* sp. nov (reticulate/anastomosing). One range extension *Acacia clelandii*

[2] Now known as *Acacia* sp. East Fortescue (J. Bull & D. Roberts ONS A 27.01) (Priority 1)

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
Onshore (2014c) Dynasty Flora and Vegetation Review	The Dynasty study area is located approximately 25km east of Newman. Approx. 12km to the south west of the study area	Desktop review (February 2014)	Nine vegetation associations, six broad floristic formations	Not reviewed	No Threatened Flora likely to occur; six Priority flora taxa that may occur on the basis of suitable habitat and previous records nearby; *Aristida jerichoensis* var. *subspinulifera* (P1), *Gymnanthera cunninghamii* (P3), *Goodenia nuda* (P4), *Josephinia* sp. Marandoo (M.E. Trudgen 1554) (P1), *Rhodanthe frenchii* (P2), *Rostellularia adscendens* var. *latifolia* (P3)
Onshore Environmental (2014d) Tenement E52/2238 Level 1 Flora and Vegetation and Vertebrate Fauna Survey	Approx. 9km south-west	8th - 10th July 2014	18 vegetation associations, 11 broad floristic formations	Not recorded	No Threatened or Priority flora
Onshore Environmental (2014e) Orebody 18 to Orebody 31 Proposed Infrastructure Corridor Targeted Flora Survey	Approx. 9km south-west	Targeted flora survey 13th September 2014	Not recorded	Not recorded One weed species; **Cenchrus ciliaris*	No Threatened Flora Two priority flora; *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (P3), *Goodenia nuda* (P4)

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
Syrinx (2014) South West Jimblebar Flora and Vegetation Survey	South West Jimblebar is located approx. 40 km east of Newman, and is adjacent to the existing Jimblebar/Wheelarra Hill mine. Approx. 13km to the southwest of the study area	38 quadrats and four relevés. 14th - 8th March 2011, 27th August -4th September 2013	17 vegetation associations, 10 broad floristic formations	330 plant taxa from 33 families and 93 genera, dominant families; Poaceae, Fabaceae, and Malvaceae, dominant genera; *Acacia* (26 taxa), *Ptilotus* (13 taxa), *Eremophila* and *Senna* (both 11 taxa), Three weed species; **Bidens bipinnata,* *Cenchrus *ciliaris,* **Cenchrus setiger,* **Cucumis melo,* **Malvastrum americanum,* **Taraxacum officinale* and **Vachellia farnesiana*	No Threatened Flora. Three Priority flora taxa; *Aristida jerichoensis* var. *subspinulifera* (P1), *Vittadinia* sp. Coondewanna Flats (S. van Leeuwen 4684) (1) and *Euphorbia inappendiculata* var. *inappendiculata* (P2) Five range extensions: *Abutilon malvifolium, Brachyscome ciliaris* var. *ciliaris, Euphorbia porcata, Leptochloa fusca* subsp. *muelleri* and *Tephrosia sphaerospora*
Onshore Environmental (2013a) Orebody 19 Level 2 Flora and Vegetation Assessment	Approx. 12km to the west of the study area	19th - 27th March 2013, 9th- 22nd September 2013 30 quadrats	22 vegetation associations, 8 broad floristic formations	271 taxa, from 40 families and 108 genera, dominant families; Fabaceae (63 taxa), Poaceae (46 taxa) and Malvaceae (32 taxa) families, four weed species; **Bidens bipinnata,* **Cenchrus ciliaris,* **Cenchrus setaceus* and **Portulaca oleracea*[3]	No Threatened Flora Two priority flora species; *Isotropis parviflora* (P2) and *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (P3)

[3] *Portulaca oleracea* no longer considered to be a weed

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
Onshore (2013b) Orebody 17/18 Derived Vegetation Association Mapping Report	Small area of OB 17/18 located in the Eastern Pilbara, west of the Jimblebar/Wheelarra Hill mining operations. Approx. 10km west of the study area	Desktop survey	Five of the 27 vegetation associations described by ENV (2007d)	Not recorded	No Threatened or Priority Flora
Syrinx (2012) Wheelarra Hill North Level 2 Flora and Vegetation Assessment	Wheelarra Hill is located in the eastern Ophthalmia Range, approx. 40 km east of Newman, adjacent to the existing Jimblebar/Wheelarra Hill mine, south of the study area	83 quadrats 17th-29th May 2011 Second: 4th -12th October 2011 83 quadrats and 19 relevés	25 vegetation associations, 9 broad floristic formations	411 taxa from 49 families and 145 genera, dominant families; Fabaceae (78 taxa), Poaceae (58 taxa) and Malvaceae (47 taxa), dominant genera; *Acacia* (40 taxa), *Ptilotus* (16 taxa) and *Senna* (15 taxa), four weeds species; **Bidens bipinnata, *Cenchrus ciliaris, *Malvastrum americanum* and **Portulaca oleracea*	No Threatened Flora. One priority flora *Aristida ?jerichoensis* var. *subspinulifera* (P1) Nine range extensions: *Sclerolaena minuta, Eragrostis olida, Oldenlandia galioides, Evolvulus alsinoides* var. *decumbens, Phyllanthus erwinii, Phyllanthus maderaspatensis, Santalum spicatum, Cyperus ixiocarpus, Abutilon cunninghamii* and two possible range extensions; *Tephrosia* aff. *sphaerospora, Hibiscus* aff. *apodus*

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
Astron (2012) Eastern Mines Weed Survey, Jimblebar	Jimblebar Mine site, 30 km east of the Newman township Approx. 6 km to the south of the study area.	22nd -30th May 2012 25 project monitoring sites and 6 reference monitoring sites	Not recorded	12 weed species; **Acetosa vesicaria, *Aerva javanica, *Bidens bipinnata, *Cenchrus ciliaris, *Chloris barbata, *Chloris virgata, *Citrullus colocynthis, *Cynodon dactylon, *Malvastrum americanum, *Solanum nigrum, *Sonchus asper, *Vachellia farnesiana*	Not recorded
Eco Logical (2012) Level 1 Flora and Fauna surveys along the Great Northern Highway for Jimblebar mine module transport.	Boodarie Staging Yard in Port Hedland south to Jimblebar Mine along the Great Northern Highway near Newman. Site 1: Located approx. 3.8 km southeast of Newman townsite Site 2: Located approx. 9 km northwest of Newman Site 3: Located approx. 98 km northwest of Newman Approx. 5 km west- of the study area.	3 quadrats 18th -19th August 2011	Seven vegetation associations	52 flora taxa from 14 families and 26 genera, dominant families; Poaceae, (12 taxa), Fabaceae (12 taxa), Amaranthaceae (8) taxa and Myrtaceae (5 taxa). One weed species; **Cenchrus ciliaris*	No Threatened or Priority flora

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
Syrinx (2011) OB 31 Flora and Vegetation Assessment	OB 31 is located approx. 35 km east of Newman Adjacent to the study area to the west	10th -15th February and 9th - 13th March 2011 29 quadrats	21 vegetation associations, 12 broad floristic formations	206 taxa from 36 families and 93 genera, dominant families; Fabaceae (10 taxa), Malvaceae (20 taxa) and Chenopodiaceae (12 taxa), three weed species; **Bidens bipinnata*, **Cenchrus ciliaris*, **Malvastrum americanum*	No Threatened or Priority flora
ENV (2010a) RGP6 Jimblebar Hub (Water Pipeline) Flora and Vegetation Assessment	Jimblebar Mine is located 30km east of Newman Approx. 6 km to the south of the study area	16 quadrats and seven relevés November 2009	Fourteen vegetation associations	166 taxa from 33 families and 81 genera, dominant families; Poaceae (29 taxa), Mimosaceae (25 taxa) and Malvaceae (15 taxa), dominant genera; *Acacia* (25 taxa), *Senna* (10 taxa) and *Ptilotus* (8 taxa), two weed species; **Cenchrus ciliaris* and **Malvastrum americanum*	No Threatened or Priority flora
ENV (2010b) Jimblebar Wye Targeted Declared Rare Flora and Priority Listed Flora Assessment	The Jimblebar Wye Project area is approx. 14 km northeast of Newman Approx. 25 km west of the study area	3rd - 5th March 2010 8th -11th June 2010 Transects in habitats known to support the targeted DRF and Priority Listed Flora	Not recorded	Not recorded	No Threatened flora One Priority flora; *Gymnanthera cunninghamii* (P3)

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
Outback Ecology (2010) Jimblebar Iron Ore Project Flora and Vegetation Assessment	The Jimblebar Mine is located 30km east of Newman Approx. 6 km to the south of the study area	128 quadrats July and September 2008, January and March 2009	21 vegetation associations, 12 broad floristic formations	326 taxa from 42 families and 111 genera, dominant genera; *Acacia* (43 taxa), *Senna* (15 taxa), *Ptilotus* (14 taxa), *Eremophila* (14 taxa) and *Sida* (10 taxa), six weed species; **Acetosa vesicaria, *Bidens bipinnata, *Cenchrus ciliaris, *Cucumis melo, *Cucumis myricarpus, *Malvastrum americanum*	No Threatened Flora Two current priority flora; *Josephinia* sp. Marandoo (P1), *Goodenia nuda* (P4)
Outback Ecology (2009a) Wheelarra Hill Iron Ore Mine Modification Flora and Fauna Assessment	The Jimblebar /Wheelarra Hill Mine is located 30km east of Newman Approx. 6 km to the south of the study area	22 quadrats. This report documents the results of supplementary flora and vegetation surveys conducted in October and November 2008 and January 2009	Five vegetation associations	146 plant taxa from 29 families and 62 genera; one introduced weed species, **Cenchrus ciliaris*	No Threatened Flora One current Priority flora, *Goodenia nuda* (P4)

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
Outback Ecology (2009b) Jimblebar Linear Development Flora and Vegetation Assessment	The Jimblebar Linear development is located 15km east of Newman and extends east towards Jimblebar Approx. 25 km west of the study area	66 quadrats, 17 relevés October 2008, March 2009	Sixteen vegetation associations	275 taxa, from 41 families and 111 genera; dominant families; Acacia (33 taxa), Eremophila (14 taxa) and Senna (13 taxa), 11 weed species; **Aerva javanica, *Bidens bipinnata, *Cenchrus ciliaris, *Cenchrus setiger, *Cucumis melo* subsp. *agrestis, *Cynodon dactylon, *Echinochloa colona, *Malvastrum americanum, *Setaria verticillata, *Tribulus terrestris, *Vachellia farnesiana*	No Threatened Flora One priority flora *Aristida jerichoensis* var. *subspinulifera* (P1)
Outback Ecology (2009c) Eastern Pilbara Accommodation Camp Flora and Fauna Assessment	The East Pilbara accommodation camp is located approx. 30 east of Newman Approx. 22km west of the study area	15 quadrats 30th October – 4th November 2008	Sixteen vegetation associations	115 taxa from 23 families and 44 genera; dominant families; Mimosaceae, Poaceae, Caesalpinaceae, Myrtaceae, Papilionaceae, Myoporaceae, and Chenopodiaceae, dominant genera; *Acacia* (23 taxa), *Senna* (12 taxa) and *Eremophila* (8 taxa); no weed species	No Threatened or Priority flora

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
ENV (2009a) Jimblebar Spur 2 Flora and Vegetation Assessment	Approx. 15km west southwest of the study area	10 quadrats and 3 relevés 14th - 18th September 2009	Ten vegetation associations	152 taxa from 33 families and 79 genera, dominant families; Poaceae (28 taxa), Mimosaceae (20 taxa) and Amaranthaceae (11 taxa), dominant genera; *Acacia* (20 taxa), *Ptilotus* (eight taxa), *Senna* and *Goodenia* (7 taxa each), three weed species; **Cenchrus ciliaris,* **Malvastrum americanum* and **Bidens bipinnata*	No Threatened or Priority flora
ENV (2009b) Construction Water Supply Pipeline and Ammonium Nitrate Storage Facility Flora and Vegetation Assessment	The Jimblebar /Wheelarra Hill Mine is located 30km east of Newman Approx. 6 km to the south of the study area	23 quadrats and 8 relevés 17th September and 4th -6th November 2009	Nineteen vegetation associations	213 taxa from 38 families and 91 genera, dominant families; Poaceae, Mimosaceae and Malvaceae, dominant genera; *Acacia* (32 taxa), *Senna* (11 taxa) and *Ptilotus* (10 taxa), two weed species; **Cenchrus ciliaris*, **Malvastrum americanum*	No Threatened Flora One current priority flora *Goodenia nuda* (P4)

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
ENV (2009c) Ammonium Nitrate Storage Facility Flora and Vegetation Assessment	The Jimblebar /Wheelarra Hill Mine is located 30km east of Newman Approx. 6 km to the south of the study area	7 quadrats and one relevé 17th September 2009	Eight vegetation associations	123 taxa from 34 families and 70 genera, dominant families; Poaceae (23 taxa), Mimosaceae (16 taxa), Malvaceae (10 taxa), dominant genera; *Acacia* (16 taxa), *Ptilotus* (7 taxa) and *Senna* (6 taxa), two weed species; **Cenchrus ciliaris* and **Portulaca oleracea*	No Threatened or Priority flora
Pilbara Flora (2008) OB17 Flora and Vegetation Survey	North-east corner of the OB 17/18 Study area 10km west of the study area	October 2008	Six vegetation associations from four landforms	61 taxa from 39 genera and 23 families, dominant families; Fabaceae (35 taxa), Poaceae (20 taxa) and Myrtaceae (8 taxa), no weed species	No Threatened or Priority flora
GHD (2008a) Draft Report for Wheelarra Hill (Jimblebar Mine Site) Priority Species Verification - *Goodenia hartiana*	The Jimblebar /Wheelarra Hill Mine is located 30km east of Newman Approx. 6 km to the south of the study area	12 quadrats 25th -26th September 2007	Not recorded	Not recorded	No Threatened or Priority flora
GHD (2008b) Mesa Gap Biological Survey	Situated between OB 18 and Wheelarra Hill mine sites Approx. 10km south-west of the study area	40 quadrats October 2007	Eight vegetation associations from seven landforms	133 plant taxa from 32 families, dominant families; Fabaceae (15 taxa), Poaceae (9 taxa) and Myrtaceae (6 taxa), no weed species	No Threatened or Priority flora

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
ENV (2008a) Rapid Growth Project 5: Repeater 9 Access Road Flora and Vegetation Assessment	The Jimblebar Wye Project area is approx. 14 km northeast of Newman Approx. 30km west of the Study area	6 quadrats and 1 relevé 12th -13th June 2008	Six broad vegetation communities	163 taxa from 95 genera, dominant families; Poaceae (28 taxa), Mimosaceae (14 taxa), Amaranthaceae (11 taxa) and Malvaceae (11 taxa), dominant genera; *Acacia* (13 taxa), *Eremophila* (9 taxa) and *Senna* (7 taxa), 14 weed species; **Acetosa vesicaria*, **Aerva javanica*, **Brassica tournefortii*, **Cenchrus ciliaris*, **Citrullus lanatus*, **Cucumis melo* subsp. *agrestis*, **Cynodon dactylon*, **Datura leichhardtii*, **Malvastrum americanum*, **Portulaca oleracea, *Setaria verticillata*, **Sonchus asper*, **Sonchus oleraceus* and **Vachellia farnesiana*	No Threatened Flora recorded One current Priority flora species, *Rostellularia adscendens* var. *latifolia* (P3) A second Priority 1 flora recorded *Eremophila* sp. Ophthalmia Range (R. Brearley s.n. 20/3/2004) has since been renamed *Eremophila margarethae* (not Threatened)
ENV (2008b) Jimblebar Access Road Flora and Vegetation Assessment	Project area is 15 km east of Newman township Approx. 23km east of the study area	20th -23rd May 2007. 22 quadrats	Ten vegetation associations	112 taxa from 28 families, three weed species were recorded; **Cenchrus ciliaris*, **Aerva javanica* and **Citrullus lanatus*	No Threatened or Priority flora

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
ENV (2007a) West Jimblebar Exploration Lease Flora and Vegetation Assessment – Management Recommendations	West Jimblebar Exploration Lease area Approx. 15km to the south-west of the study area	29 quadrats 14th -18th May 2007	Not recorded	318 taxa from 113 genera and 44 families, dominant families; Poaceae, Mimosaceae and Malvaceae, three introduced weed species; **Cenchrus ciliaris, *Malvastrum americanum, *Bidens bipinnata*	No Threatened flora One current Priority flora species; *Goodenia nuda* (P4) One range extension; *Thyridolepis xerophila*
ENV (2007b) Jimblebar Wye Rail Junction (Borrow Areas) Flora and Vegetation Assessment	Approximately 30 km west of the study area	20 quadrats 21st -24th August 2007	Eleven vegetation associations	Three introduced weed species; **Cynodon dactylon, *Cenchrus ciliaris, *Vachellia farnesiana*	No Threatened or Priority flora
ENV (2007c) RGP4 Jimblebar Rail Loop Flora and Vegetation Assessment	The Jimblebar / Wheelarra Hill Mine is located 30km east of Newman Approx. 6 km to the south of the study area	4 quadrats 27th November - 1st December 2006	Four vegetation associations classified into three landform types; creekline, floodplain and plain	65 plant taxa (44 genera); dominant families; Poaceae (14 taxa), Mimosaceae (11 taxa) and Malvaceae (5 taxa); two introduced weed species; **Bidens bipinnata, *Cenchrus ciliaris*	No Threatened or Priority flora
ENV (2007d) OB 18 Flora and Vegetation Assessment Phase II	OB 18 is located 32 km east of the Newman townsite in the Ophthalmia Ranges Apex. 10km west of the study area	71 quadrats and relevés July and August 2006	A total of 27 vegetation associations classified into six broad landforms - Hill crests, Hill slopes, Gorges and Gullies, Drainage lines, Footslopes and Flood plains	276 taxa from 46 families; dominant families; Poaceae (41 taxa), Mimosaceae (30 taxa), Amaranthaceae (19 taxa) and Malvaceae (18 taxa); two weed species, **Acetosa vesicaria* and **Cenchrus ciliaris*	No Threatened or Priority flora

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
ENV (2007e) Jimblebar Stage 2, Levee Banks and Communications Tower Redevelopment Flora and Vegetation Assessments	The Jimblebar /Wheelarra Hill Mine is located 30km east of Newman Approx. 6 km to the south of the study area	4 quadrats April - June 2007	Six vegetation associations	103 taxa from 24 families, dominant families; Poaceae (30 species), Mimosaceae (17 species) and Papilionaceae (8 species), five weed species; **Cenchrus ciliaris*, **Cenchrus setiger*, **Citrullus lanatus*, **Bidens bipinnata* and **Cynodon dactylon*	No Threatened or Priority flora
Ecologia (2006) Jimblebar Marra Mamba Exploration Biological Survey	Approx. 13km south-west of the study area	105 quadrats 22nd -28th May 2006	Four vegetation associations	267 plant taxa, dominant families; Poaceae (33 species) and Malvaceae (22 species), two weed species; **Acetosa vesicaria* and **Cenchrus ciliaris*	No Threatened Flora recorded. One current priority flora *Goodenia nuda* (P4). A second Priority 3 flora recorded, *Triumfetta leptacantha* is no longer Threatened
Ecologia (2004a) OB 18 Flora and Fauna Review	OB 18 10km west of the study area	Targeted searches in July 2004	Not recorded	Not recorded	No Threatened Flora One priority flora *Rhodanthe frenchii* (P2) identified from one gorge site. It is noted that the original identification was not confirmed through the WAH and represents a 300 km range extension to the east. It has not been recorded locally during numerous surveys over a 17 year period since the original record

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
Ecologia (2004b) Jimblebar-Wheelarra Hill Expansion Biological Study	The Jimblebar - Wheelarra Hill Mine is located 30 km east of Newman Approx. 6 km to the south of the study area	44 quadrats (100 x 100 m) 9th February – 4th March 2004	Nine vegetation associations	181 plant species from 47 families and 80 genera; dominant genera were *Acacia* (30 species), *Senna* (10 species) and *Eremophila* (7 species), one weed species; **Cenchrus ciliaris*	No Threatened or Priority flora *Goodenia hartiana* (P2) recorded but this taxon later split and now determined to be *Goodenia* sp. Sandy Creek (not Threatened)
Biota (2004) Jimblebar - Wheelarra Hill 3 Flora and Fauna Assessment	The Jimblebar-Wheelarra Hill Mine is located 30 km east of Newman Approx. 6 km to the south of the study area	August 2003. The survey was conducted to review and update existing botanical information and record supplementary floristic data	Six vegetation types described were based on the Ecologia (1999) flora survey of the area	227 taxa from 42 families and 99 genera, dominant genera were *Acacia* (29 taxa), *Senna* (15 taxa) and *Ptilotus* (9 taxa), one weed species was **Acetosa vesicaria*	No Threatened or Priority flora One Priority species, *Tephrosia* sp. Pilbara Ranges (P3). This species has been re-named *Tephrosia oxalidea* and is no longer Threatened

Survey Area	Proximity to Study Area	Survey Timing	Vegetation Associations and Landforms	Taxon Summary	Conservation Significant Flora
Ecologia (1996) Jimblebar Rail Spur Biological Assessment Survey	The Jimblebar /Wheelarra Hill Mine is located 30km east of Newman Approx. 6 km to the south of the study area	2 quadrats (100 m x 100 m), with additional opportunistic vegetation sampling. 6th -8th June 1995	The survey area encompassed the breadth of a creekline, but did not extend to surrounding hills. Two vegetation types were recorded	106 taxa from 32 families and 71 genera, dominant families; Poaceae, Mimosaceae and Chenopodiaceae and Caesalpiniaceae and Malvaceae, dominant genera; Acacia (9 taxa), Senna (6 taxa), Eucalyptus (5 taxa) and Ptilotus (4 taxa), four weed species; **Cenchrus ciliaris, *Acetosa vesicaria, *Malvastrum americanum* and **Sonchus oleraceus*	No Threatened or Priority flora
BHPIO (1994) Jimblebar Mine Site Biological Survey	The Jimblebar /Wheelarra Hill Mine is located 30km east of Newman Approx. 6 km to the south of the study area.	11th -22nd June 1994 22 plotless sampling areas (covering approx. 100m^2 each)	Five broad vegetation associations	132 species, from 30 families, dominant families; Mimosaceae, Poaceae, Myrtaceae and Caesalpiniaceae, dominant genera; *Triodia, Acacia, Senna* and *Eremophila*, one weed species; **Acetosa vesicaria*	No Threatened Flora One Priority 3 taxon, *Cryptandra* sp. Mt Meharry (S. van Leeuwen 682). This is now known as *Cryptandra monticola* and no longer considered to be Threatened
Dames and Moore (1993) Ecological Observations Jimblebar Railway Line	Rail spur extending from Port Hedland - Newman and 32 km east to Jimblebar. Situated approximately 5 km directly south of the study area	19th - 22nd November 1992 39 borrow pits and 2 control areas	The report assessed disturbed borrow pit areas the vegetation data provided is not applicable	Not recorded	No Threatened or Priority Flora

4.1.3 Threatened Flora listed under the EPBC Act

A search of the EPBC Act Protected Matters database was undertaken within a 50 km buffer of the study area (DoE 2015). The database search listed two Threatened Flora or their habitat as likely to occur within the study area; *Lepidium catapycnon* (Hamersley Lepidium) and *Pityrodia augustensis* (Mt Augustus Foxglove). No TECs were recorded during the search.

4.1.4 Threatened Flora listed under the IUCN Red List Database

A search of the International Union for Conservation of Nature (IUCN) database was also conducted (IUCN 2015). No Threatened Flora was listed as likely to occur within the study area from this search.

4.1.5 Threatened Flora listed under the WA Wildlife Conservation (Rare Flora) Notice 2015

The DPaW search identified one Threatened Flora as occurring within a 50 km radius of the study area; *Lepidium catapycnon* (DPaW 2015a).

4.1.6 Priority Flora recognised by DPaW

The DPaW rare flora database search (DPaW 2015a) identified 88 Priority flora taxa as potentially occurring within a 50 km radius of the study area. The likelihood of these 88 taxa occurring within the study area is indicated in Table 9.

Table 7 Significant flora species recorded in or around the survey area from the federal and state database searches, literature and local knowledge. SCC - State Conservation Code, FCC - Federal Conservation Code

Species	SCC	FCC	Habitat description	Habitat present	Nearest known record	Potential to occur within study area
Acacia bromilowiana	4		Red skeletal stony loam, orange-brown pebbly, gravelly loam, laterite, banded ironstone, basalt. Rocky hills, breakaways, scree slopes, gorges, creek beds	No	Not recorded from previous surveys in close proximity	Unlikely
Acacia daweana	3		Stony red loamy soils. Low rocky rises, along drainage lines	No	Not recorded from previous surveys in close proximity	Unlikely
Acacia effusa	3		Scree slopes of low ranges	No	Not recorded from previous surveys in close proximity	Unlikely
Acacia subtiliformis	3		Rocky calcrete plateau	No	Not recorded from previous surveys in close proximity	Unlikely
Adiantum capillus-veneris	2		Moist, sheltered sites in gorges and on cliff walls	No	Not recorded from previous surveys in close proximity	Unlikely
Amaranthus centralis	3		Alluvial plain	Yes	Has not been recorded from surrounding study areas. Nearest record close to the Fortescue River approximately 40 km north	Possible
Aristida jerichoensis var. *subspinulifera*	3		Hardpan plains	Yes	Recorded from Southwest Jimblebar (adjacent to the east) but species unconfirmed. Also recorded from other previous surveys in close proximity	Likely
Astrebla lappacea	3		Plains and floodplains	Yes	Not recorded from previous surveys in close proximity	Possible
Atriplex flabelliformis	3		Saline flats or marshes	No	Not recorded from previous surveys in close proximity	Unlikely
Atriplex lindleyi subsp. *conduplicata*	3		Crabhole plains	Yes	Not recorded from previous surveys in close proximity	Possible
Barbula ehrenbergii	1		Iron rich weathered conglomerate on gorge walls	No	Not recorded from previous surveys in close proximity	Unlikely

Species	SCC	FCC	Habitat description	Habitat present	Nearest known record	Potential to occur within study area
Bothriochloa decipiens var. cloncurrensis	1		Plains	Yes	Not recorded from previous surveys in close proximity	Possible
Calotis latiuscula	3		Rocky hillsides, floodplains, rocky creeks or river beds	Yes	Not recorded from previous surveys in close proximity	Possible
Calotis squamigera	1		Pebbly loam	Yes	Not recorded from previous surveys in close proximity	Possible
Cochlospermum macnamarae	1		Upper slopes of a low hill in shallow, stony soil (Hislop *et. al.* 2013)	Yes	Not recorded from previous surveys in close proximity	Possible
Crotalaria smithiana	3		Regeneration site on floodplain	Yes	Not recorded from previous surveys in close proximity	Possible
Dampiera anonyma	3		Skeletal red-brown to brown gravelly soil over banded ironstone, basalt, shale and jaspilite. Hill summits, upper slopes (above 1000m)	No	Not recorded from previous surveys in close proximity	Unlikely
Dampiera metallorum	3		Skeletal red-brown gravelly soil over banded ironstone. Steep slopes, summits of hills	No	Not recorded from previous surveys in close proximity	Unlikely
Dicladanthera glabra	2		Along watercourses, near rock pools	Yes	Not recorded from previous surveys in close proximity	Possible
Eragrostis sp. Mt Robinson (S. van Leeuwen 4109)	1		Red-brown skeletal soils, ironstone. Steep slopes, summits	No	Not recorded from previous surveys in close proximity	Unlikely
Eremophila appressa	1		Ridge slopes	No	Not recorded from previous surveys in close proximity	Unlikely
Eremophila forrestii subsp. Pingandy (M.E. Trudgen 2662)	2		Flat plain with thin soil underlain by partly consolidated colluvium	Yes	Not recorded from previous surveys in close proximity	Possible
Eremophila magnifica subsp. magnifica	4		Skeletal soils over ironstone on rocky hill slopes	No	Not recorded from previous surveys in close proximity	Unlikely
Eremophila magnifica subsp. velutina	3		Skeletal soils over ironstone on summits and rocky hill slopes	No	Not recorded from previous surveys in close proximity	Unlikely
Eremophila pilosa	1		Red brown clay loams on sandy plains	Yes	Approximately 20km north of the study area	Possible
Eremophila rigida	3		Hardpan plains, stony clay depressions	Yes	Not recorded from previous surveys in close proximity	Possible

Species	SCC	FCC	Habitat description	Habitat present	Nearest known record	Potential to occur within study area
Eremophila sp. Hamersley Range (K. Walker KW 136) PN	1		High ironstone hill slopes	No	Not recorded from previous surveys in close proximity	Unlikely
Eremophila sp. Rudall River (P.G. Wilson 10512) PN	2		Low rises with dense quartz (gibber) scree	No	Not recorded from previous surveys in close proximity	Unlikely
Eremophila sp. Snowy Mountain (S. van Leeuwen 3737)	1		Rocky hills and slopes, ironstone	No	Not recorded from previous surveys in close proximity	Unlikely
Eremophila sp. West Angelas (S. van Leeuwen 4068)	1		High in landscape, summit of hill, gently undulating to steep terrain, skeletal red gritty soil over massive banded iron of the Brockman Iron Formation.	No	Not recorded from previous surveys in close proximity	Unlikely
Eucalyptus lucens	1		Ironstone. Rocky slopes and mountain tops, high in the landscape	No	Not recorded from previous surveys in close proximity	Unlikely
Eucalyptus rowleyi	3		Hard red soil	Yes	Not recorded from previous surveys in close proximity	Possible
Euphorbia parvicaruncula	1		Hard crusty duplex soils, brown gibber soils, shaded positions	Yes	Not recorded from previous surveys in close proximity	Possible
Fimbristylis sieberiana	3		Mud, skeletal soil pockets. Pool edges, sandstone cliffs	No	Not recorded from previous surveys in close proximity	Unlikely
Geijera salicifolia	3		Skeletal soils, stony soils. Massive rock scree, gorges	No	Not recorded from previous surveys in close proximity	Unlikely
Genus sp. Hamersley Range hilltops (S. van Leeuwen 4345)	1		Skeletal, brown gritty soil over ironstone. Hill summit	No	Not recorded from previous surveys in close proximity	Unlikely
Glycine falcata	3		Along drainage depressions in crabhole plains on river floodplains	Yes	Not recorded from previous surveys in close proximity	Possible
Goodenia hartiana	2		Sand dune swales, sand hills	No	Not recorded from previous surveys in close proximity	Unlikely
Goodenia lyrata	3		Red sandy loam. Near claypan	Yes	Not recorded from previous surveys in close proximity	Possible
Goodenia nuda	4		Plains and floodplains	Yes	Recorded within the study area (ENV 2007)	Likely

Species	SCC	FCC	Habitat description	Habitat present	Nearest known record	Potential to occur within study area
Goodenia sp. East Pilbara (A.A. Mitchell PRP 727)	3		Red-brown clay soil, calcrete pebbles. Low undulating plain, swampy plains	No	Not recorded from previous surveys in close proximity	Unlikely
Grevillea saxicola	1		Steep mulga breakaways and scree slopes	No	Not recorded from previous surveys in close proximity	Unlikely
Gymnanthera cunninghamii	3		Sandy soils along river banks	Yes	Recorded approx. 5 km north-west of the study area	Likely
Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)	2		Rocky ridges and hill slopes	Yes	Not recorded from previous surveys in close proximity	Possible
Hibiscus sp. Mt Brockman (E. Thoma ET 1354) PN	1		Rocky ridges and hill slopes	Yes	Not recorded from previous surveys in close proximity	Possible
Indigofera sp. Bungaroo Creek (S. van Leeuwen 4301)	3		Rocky creek gullies and hill slopes	No	Not recorded from previous surveys in close proximity	Unlikely
Indigofera sp. Gilesii (M.E. Trudgen 15869) PN	3		Pebbly loam amongst boulders & outcrops. Hills	No	Not recorded from previous surveys in close proximity	Unlikely
Iotasperma sessilifolium	3		Cracking clay, black loam. Edges of waterholes, plains	Yes	Not recorded from previous surveys in close proximity	Possible
Ipomoea racemigera	1		Major drainage lines and flood plains	Yes	Not recorded from previous surveys in close proximity	Possible
Isotropis parviflora	2		Valley slope of ironstone plateau	No	Not recorded from previous surveys in close proximity	Unlikely
Josephinia sp. Marandoo (M.E. Trudgen 1554)	1		Gritty soil, granite. Plains, mixed shrubland of *Senna* and *Acacia*	Yes	Recorded approximately 4km east of the study area	Likely
Lepidium catapycnon	T	V	Skeletal soils. Hillsides	No	Previously recorded from Mt Whaleback and other locations around Newman	Unlikely
Maireana prosthecochaeta	3		Laterite, gibber plains, hills, salty places	No	Not recorded from previous surveys in close proximity	Unlikely
Myriocephalus scalpellus	1		Depressions on flood plains	Yes	Not recorded from previous surveys in close proximity	Possible
Nicotiana heterantha	1		Seasonally wet flats	Yes	Not recorded from previous surveys in close proximity	Possible

Species	SCC	FCC	Habitat description	Habitat present	Nearest known record	Potential to occur within study area
Nicotiana umbratica	3		Shallow soils. Rocky outcrops	No	Not recorded from previous surveys in close proximity	Unlikely
Oldenlandia sp. Hamersley Station (A.A. Mitchell PRP 1479)	3		Cracking clay, basalt. Gently undulating plain with large surface rocks, flat crabholed plain	Yes	Not recorded from previous surveys in close proximity	Possible
Olearia mucronata	3		Schistose hills, along drainage channels	No	Not recorded from previous surveys in close proximity	Unlikely
Oxalis sp. Pilbara (M.E. Trudgen 12725)	2		Shaded gully on the lower slopes of a large hill, in the flowline in the gully. Soil: pebbly/gravelly red-brown loam amongst boulders	No	Not recorded from previous surveys in close proximity	Unlikely
Pentalepis trichodesmoides subsp. *hispida*	2		Summits and slopes of low hills, on basaltic soils amongst *Triodia* Hummock Grassland (Orchard and Cross 2012)	No	Not recorded from previous surveys in close proximity	Unlikely
Peplidium sp. fortescue marsh (S. van Leeuwen 4865)	1		Saline marshes and flats	No	Not recorded from previous surveys in close proximity	Unlikely
Pilbara trudgenii	2		Skeletal, red stony soil over ironstone. Hill summits, steep slopes, screes, cliff faces	No	Not recorded from previous surveys in close proximity	Unlikely
Polymeria distigma	3		Sandy soils	Yes	Not recorded from previous surveys in close proximity	Possible
Ptilotus subspinescens	3		Gentle rocky slopes, screes and the bases of screes	No	Not recorded from previous surveys in close proximity	Unlikely
Rhagodia sp. Hamersley (M. Trudgen 17794)	3		Floodplains, hardpan plains	Yes	Not recorded from previous surveys in close proximity	Possible
Rhodanthe frenchii	2		Stony hills, rocky river banks and outcrops	Yes	Recorded approx. 4 km to the north east	Likely
Rhynchosia bungarensis	4		Pebbly, shingly coarse sand amongst boulders. Banks of flow line in the mouth of a gully in a valley wall	No	Not recorded from previous surveys in close proximity	Unlikely
Rostellularia adscendens var. *latifolia*	3		Ironstone soils. Near creeks, rocky hills	Yes	Recorded approx. 10 km northwest	Likely

Species	SCC	FCC	Habitat description	Habitat present	Nearest known record	Potential to occur within study area
Scaevola sp. Hamersley Range basalts (S. van Leeuwen 3675)	2		Skeletal, brown gritty soil over basalt. Summits of hills, steep hills	No	Not recorded from previous surveys in close proximity	Unlikely
Sida sp. Barlee Range (S. van Leeuwen 1642)	3		Skeletal red soils pockets. Steep slope	No	Not recorded from previous surveys in close proximity	Unlikely
Sida sp. Hamersley Range (K. Newbey 10692)	1		Rocky ridges and hill slopes	Yes	Not recorded from previous surveys in close proximity	Possible
Solanum albostellatum	3		Cracking clay soils on open floodplains (Davis and Hurter 2012)	Yes	Not recorded from previous surveys in close proximity	Possible
Solanum kentrocaule	3		High altitude (700-1250m) hilltops and hillslopes and occasionally creekbeds (Bean 2013)	No	Not recorded from previous surveys in close proximity	Unlikely
Spartothamnella puberula	2		Rocky loam, sandy or skeletal soils, clay. Sandplains, hills	Yes	Not recorded from previous surveys in close proximity	Possible
Stemodia sp. Battle Hill (A.L. Payne 1006)	1		Floodplain	Yes	Not recorded from previous surveys in close proximity	Possible
Swainsona thompsoniana	3		Open floodplains on heavy clay soils (Davis and Hurter 2013)	Yes	Not recorded from previous surveys in close proximity	Possible
Tecticornia medusa	3		Red-brown gritty clay on a saline alluvial plain (Shepherd and van Leeuwen 2011)	No	Not recorded from previous surveys in close proximity	Unlikely
Tecticornia sp. Christmas Creek (K.A. Shepherd & T. Colmer et al. KS 1063)	1		Salt flats and marshes	No	Not recorded from previous surveys in close proximity	Unlikely
Tetratheca fordiana	1		Shale pocket amongst ironstone	No	Not recorded from previous surveys in close proximity	Unlikely
Teucrium pilbaranum	1		Crab hole plain in a river floodplain, margin of calcrete table	Yes	Not recorded from previous surveys in close proximity	Possible
Themeda sp. Hamersley Station (M.E. Trudgen 11431)	3		Red clay. Clay pan, grass plain	Yes	Recorded approx. 40 km west northwest	Possible

Species	SCC	FCC	Habitat description	Habitat present	Nearest known record	Potential to occur within study area
Thryptomene wittweri	T	V	Skeletal red stony soils. Breakaways, stony creek beds. Light orange-brown, pebbly loam. Amongst rocks & outcrops, gully slopes	No	Not recorded from previous surveys in close proximity	Unlikely
Triodia sp. Karijini (S. van Leeuwen 4111) PN	1		High hill crests and slopes	No	Not recorded from previous surveys in close proximity	Unlikely
Triodia sp. Mt Ella (M.E. Trudgen 12739)	3		Light orange-brown, pebbly loam. Amongst rocks & outcrops, gully slopes	No	Not recorded from previous surveys in close proximity	Unlikely
Triodia sp. Robe River (M.E. Trudgen et al. MET 12367)	3		Slopes or peaks of mesas	No	Not recorded from previous surveys in close proximity	Unlikely
Triodia triticoides	1		Rocky sandstone and limestone hillslopes	No	Recorded approx. 30 km west north west of the study area	Unlikely
Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684)	1		Floodplains, hardpan plains	Yes	Not recorded from previous surveys in close proximity	Possible
Whiteochloa capillipes	3		Drainage lines and levee banks	No	Not recorded from previous surveys in close proximity	Unlikely

1 Number of records from the Western Australian Herbarium (WAH 2014)
2 Closest records from DPaW flora database search results (DPaW 2014)
3 Likely - suitable habitat, close (<10 km) records and/or field survey completed in sub-optimal season, suggest species is likely to occur;
Possible - suitable habitat, records (<50 km) and/or field survey completed in sub-optimal season, suggests species possibly occurs; and
Unlikely - lack of suitable habitat, no records (<50 km) and/or field survey completed in optimal season, suggest species is unlikely to occur.

4.2 Conservation Significant Flora

4.2.1 Threatened Flora

No plant taxon gazetted as Threatened Flora (T) pursuant to subsection (2) of section 23F of the WC Act or listed under the EPBC Act was recorded from the study area.

4.2.2 Priority Flora

One Priority flora taxon was recorded from within the study area, *Goodenia nuda* (Priority 4) (Table 10, Figure 6).

4.2.3 Range Extensions

One plant taxon was identified as a range extension, *Eragrostis kennedyae.* Although widespread within the Murchison bioregion, this record represents a 250 km north of the nearest documented population, and the first record within the Pilbara bioregion. There is a single record previously made from the Little Sandy bioregion approximately 300 km east of Newman.

Eragrostis kennedyae was recorded as a low perennial grass growing on heavy brown clay and clay loam soils around the eastern fringes of Ophthalmia Dam. The associated vegetation was described as 'Herbs of *Myriocephalus rudallii*, *Alternanthera nodiflora* and *Goodenia lamprosperma* with Low Woodland of *Eucalyptus camaldulensis* and Open Tussock Grassland of *Eragrostis kennedyae* and *Eragrostis tenellula*'.

Table 10 Description of Priority flora occurring within the study area.

Taxon	Photograph	Description	Occurrence in study area
Goodenia nuda (Priority 4)		Occurs on drainage levees, flood plains and sand plains as an erect annual or biennial herb to 0.3 m in height. *Goodenia nuda* is widespread through the Pilbara, with records also from the northern Carnarvon and eastern Gascoyne bioregions. This species is typically recorded from relatively mesic habitats, such as floodplains and drainage areas. *Goodenia nuda* has been recorded from over 80 locations throughout the Pilbara, including Karijini National Park, 200 km to the south east of Newman, Port Hedland and south of Onslow. An isolated record occurs to the east of the Karlamilyi (Rudall River) National Park. Within the south-east Pilbara it has been collected from a number of locations on BHP Billiton Iron Ore's Pilbara tenements.	Recorded from two locations in the northern sector of the study area. Found on the banks and drainage channels of medium drainage lines. Two plants were recorded at one location with the other location supporting approximately 30 plants. The vegetation was described as: • Closed Tussock Grassland of *Chrysopogon fallax, Aristida inaequiglumis* and *Digitaria ammophila* with Low Open Forest of *Acacia aptaneura and Corymbia aspera* and Open Shrubland of *Eremophila forrestii* and *Eremophila fraseri* in broad drainage line; and • Low Open Forest of *Acacia citrinoviridis, Acacia coriacea* subsp. *pendens* and *Eucalyptus victrix* over Open Tussock Grassland of **Cenchrus ciliaris, Eulalia aurea* and *Aristida holathera* var. *holathera* with Very Open Hummock Grassland of *Triodia pungens* on medium drainage lines.

796000 796500 797000 797500 798000 798500

7416000 7415500 7415000 7414500

Goodenia nuda

Goodenia nuda

796000 796500 797000 797500 798000 798500

ONSHORE ENVIRONMENTAL

Figure:	6	Date:	24/08/2015
Sheet Size:	A3	Status:	DRAFT
Drawn by GSM	Requested by GSM	GSM Reference ob31_pipeline_sig_flora	

N

0 100 200 300 400

Meters
1:7,500

Datum: GDA94
Projection: MGA Zone 50

FIGURE 6

Location of significant flora species within the study area

Legend

Study Area

Significant Flora

Goodenia nuda

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4.3 Introduced Species

A total of six introduced weeds species were recorded from the study area; **Acetosa vesicaria, *Bidens bipinnata, *Cenchrus ciliaris, *Cynodon dactylon, *Malvastrum americanum* and **Setaria verticillata* (Table 11, Figure 7, Appendix 6). None of these taxa are listed as a Declared Pest under the BAM Act.

Table 11 Introduced species recorded within the study area.

Taxon (Common Name)	Photograph	Description	Occurrence in study area
**Acetosa vesicaria* (Ruby Dock)		An erect, stout, fleshy, hollow-stemmed annual herb growing between 0.2 metres and 1 meters in height and flowering (pink to red) from July to September. Ruby Dock is found on sandy alluvial soils, or gravelly ironstone soils along roadsides or in disturbed areas. It is a common and widespread weed of the arid zone and is found in a variety of disturbed situations from the Pilbara to the Nullarbor. It is native to North Africa, the Middle East and India (Hussey *et al*. 1997). It is a highly aggressive and prolific colonizer, particularly of disturbed areas, and should be included in all weed management programmes within the Pilbara.	Recorded from one location in the northern sector of the study area on the banks of a medium drainage line. The vegetation was described as Low Open Forest of *Acacia citrinoviridis, Acacia coriacea* subsp. pendens and *Eucalyptus victrix* over Open Tussock Grassland of **Cenchrus ciliaris, Eulalia aurea* and *Aristida holathera* var. *holathera* with Very Open Hummock Grassland of *Triodia pungens* on medium drainage lines.
**Bidens bipinnata* (Bipinnate Beggars Tick)		Erect annual herb that grows up to 1m in height. This species is widespread in the northern parts of WA from Shark Bay up to the Northern Territory Border. It has three pronged barbs on its seeds so it is easily spread by livestock and other animals. In the Pilbara it is common in moist habitats such as drainage lines, flood plains and gorges, and responds vigorously following rainfall.	Recorded from one location in the northern sector of the study area. Scattered plants were growing the banks of a medium drainage line. Vegetation was described as Low Open Forest of *Acacia citrinoviridis, Acacia coriacea* subsp. pendens and *Eucalyptus victrix* over Open Tussock Grassland of **Cenchrus ciliaris, Eulalia aurea* and *Aristida holathera* var. *holathera* with Very Open Hummock Grassland of *Triodia pungens* on medium drainage lines.

Taxon (Common Name)	Photograph	Description	Occurrence in study area
**Cenchrus ciliaris* (Buffel Grass)		Tufted perennial grass originating from the Middle East as a fodder species by pastoralists. It grows in dense tussocks up to 1 metre tall and typically occurs in monospecific stands on loamy plains and creekline levee banks. It is an aggressive colonizing species that has become well established throughout the Pilbara, Gascoyne and Murchison regions of Western Australia, and is continuing to spread in the south-west (Hussey *et al.* 1997).	Recorded from five locations within the study area. Coverage ranged from scattered plants to more than 50 percent. It was found on the banks of a medium drainage line and along tracks within the study area. Vegetation was described as: • Low Open Forest of *Acacia citrinoviridis, Acacia coriacea* subsp. pendens and *Eucalyptus victrix* over Open Tussock Grassland of **Cenchrus ciliaris, Eulalia aurea* and *Aristida holathera* var. *holathera* with Very Open Hummock Grassland of *Triodia pungens* on medium drainage lines; and • Low Open Forest of *Acacia aptanerua* over Low Open Shrubland of *Ptilotus obovatus* and *Ptilotus gaudichaudii* over Very Open Tussock Grassland of *Aristida inaequiglumis* and *Chrysopogon fallax*
**Cynodon dactylon* (Couch Grass)		A prostrate rhizomatous perennial grass like herb that grows up to 0.3 m in height and flowers (green and purple) from June to November/February. Couch grows on sand, loam or clay soils and occurs across Western Australia (Hussey *et al.* 1997). It is usually found in open areas that are prone to disturbances such as grazing, flooding and fire. Couch Grass originates from Africa and southern Europe and was introduced into Western Australia for use as turf and pasture.	Recorded as scattered plants from one location in the southern sector of the study area, on the edge of a lake bed. Vegetation was described as Tussock Grassland of *Elytrophorus spicatus* over Sedges of *Schoenoplectus dissachanthus* (3 merous variant) and *Schoenoplectus laevis* with Low Open Woodland of *Eucalyptus camaldulensis* on wet fringe of lake bed.

Taxon (Common Name)	Photograph	Description	Occurrence in study area
**Malvastrum americanum* (Spiked Malvastrum)		Erect perennial herb or shrub, ranging from 0.5 metres to 1.3 metres in height. It grows in a variety of soil types on stony ridges and hill sides, flood plains and along drainage lines.	Recorded from two locations in the northern sector of the study area adjacent to a medium drainage line. Scattered plants were recorded at both locations. Vegetation was described as Low Open Forest of *Acacia citrinoviridis, Acacia coriacea* subsp. *pendens* and *Eucalyptus victrix* over Open Tussock Grassland of **Cenchrus ciliaris, Eulalia aurea* and *Aristida holathera* var. *holathera* with Very Open Hummock Grassland of *Triodia pungens* on medium drainage lines.
**Setaria verticillata* (Whorled Pigeon Grass		A loosely tufted annual grass-like herb, growing between 0.1 metres and 1.3 metres in height and flowering from December to June. It grows in a variety of soils including sand, clay and loam and has spread over much of Western Australia.	Recorded as scattered plants from one location in the northern sector of the study area, growing on a levee bank adjacent to a medium drainage line. Vegetation was described as Low Open Forest of *Acacia citrinoviridis, Acacia coriacea* subsp. *pendens* and *Eucalyptus victrix* over Open Tussock Grassland of **Cenchrus ciliaris, Eulalia aurea* and *Aristida holathera* var. *holathera* with Very Open Hummock Grassland of *Triodia pungens* on medium drainage lines.

796000 796500 797000 797500 798000 798500

7416000 7415500 7415000 7414500

A.v
C.c
M.a
S.v
B.b
C.c
M.a
C.c
C.c
C.c
C.d

N

0 100 200 300 400

Meters
1:7,500

Datum: GDA94
Projection: MGA Zone 50

FIGURE 7

Location of introduced weed species within the study area

Legend

Study Area

Introduced Flora

- **Acetosa vesicaria (A.v)*
- **Bidens bipinnata (B.b)*
- **Cenchrus ciliaris (C.c)*
- **Cynodon dactylon (C.d)*
- **Malvastrum americanum (M.a)*
- **Setaria verticillata (S.v)*

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Figure:	7	Date:	24/08/2015
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4.4 Vegetation

A total of ten vegetation associations were described and mapped within the study area (Figure 8). The vegetation associations were classified as ten broad floristic formations on the basis of the dominant vegetation stratum (Table 12). Two additional areas devoid of native vegetation were also mapped within the study area; lake bed, and disturbed tracks and embankments.

Table 8 Vegetation descriptions for ten vegetation associations mapped within the study area

Code	Broad Floristic Formation	Description	Characteristics	Condition
1	*Eucalyptus* Woodland	Woodland of *Eucalyptus victrix* over Low Open Woodland of *Acacia citrinoviridis* and *Acacia aptaneura* over High Open Shrubland of *Melaleuca glomerata* and *Acacia pyrifolia* on medium drainage lines	Taller trees of *Eucalyptus victrix*	Very Good
2	*Acacia* Low Open Forest	Low Open Forest of *Acacia citrinoviridis, Acacia coriacea* subsp. pendens and *Eucalyptus victrix* over Open Tussock Grassland of **Cenchrus ciliaris, Eulalia aurea* and *Aristida holathera* var. *holathera* with Very Open Hummock Grassland of *Triodia pungens* on medium drainage lines	*Acacia citrinoviridis* and the presences of dense Buffel grass understorey are distinctive	Good
3	*Acacia* Low Woodland	Low Woodland of *Acacia aptaneura*, *Acacia paraneura* and *Corymbia aspera* over Open Tussock Grassland of *Aristida inaequiglumis, Aristida contorta* and *Enneapogon polyphyllus* with Low Open Shrubland of *Ptilotus obovatus, Solanum lasiophyllum* and *Eremophila lanceolata* on sandy loam plains	Dense overstorey of Mulga with *Aristida* dominated understorey	Very Good
4	*Sclerolaena* Low Shrubland	Low Shrubland of *Sclerolaena cuneata*, *Sclerolaena costata* and *Streptoglossa odora* over Open Tussock Grassland of *Aristida inaequiglumis, Aristida contorta* and *Enteropogon ramosus* with Low Open Woodland of *Acacia aptaneura, Acacia paraneura* and *Hakea lorea* subsp. *lorea* on plains	Bare plains with some Mulga and chenopods	Very Good
5	*Triodia* Hummock Grassland	Hummock Grassland of *Triodia basedowii* with High Open Shrubland of *Acacia aptaneura* and *Acacia pruinocarpa* and Low Open Shrubland of *Scaevola parvifolia, Sida cardiophylla* and *Ptilotus astrolasius* on sand plains	*Triodia basedowii* on sandy plains	Excellent
6	*Triodia* Open Hummock Grassland	Open Hummock Grassland of *Triodia basedowii* over Open Tussock Grassland of *Aristida inaequiglumis* and *Aristida contorta* with Low Open Woodland of *Acacia aptaneura* and *Acacia pruinocarpa* on sandy stony plains	Mix of tussocks and hummocks	Very Good

Code	Broad Floristic Formation	Description	Characteristics	Condition
7	*Chrysopogon* Closed Tussock Grassland	Closed Tussock Grassland of *Chrysopogon fallax, Aristida inaequiglumis* and *Digitaria ammophila* with Low Open Forest of *Acacia aptaneura and Corymbia aspera* and Open Shrubland of *Eremophila forrestii* subsp. *forrestii* and *Eremophila fraseri* in broad drainage line	Broad drainage zone dominated by Mulga	Good
8	*Elytrophorus* Tussock Grassland	Tussock Grassland of *Elytrophorus spicatus* over Sedges of *Schoenoplectus dissachanthus* (3 merous variant) and *Schoenoplectus laevis* with Low Open Woodland of *Eucalyptus camaldulensis* on wet fringe of lake bed	Open overstorey of *Eucalyptus camaldulensis* with tussocks and sedges	Very Good
9	*Aristida* Open Tussock Grassland	Open Tussock Grassland of *Aristida inaequiglumis, Aristida contorta* and *Eulalia aurea* with Low Open Woodland of *Acacia aptaneura* and *Eucalyptus camaldulensis* and Very Open Hummock Grassland of *Triodia basedowii* on plains	Mix of Mulga and *Eucalyptus camaldulensis* in the overstorey with *Aristida inaequiglumis*	Very Good
10	*Gnephosis* Herbs	Herbs of *Myriocephalus rudallii, Alternanthera nodiflora* and *Goodenia lamprosperma* with Low Woodland of *Eucalyptus camaldulensis* and Open Tussock Grassland of *Eragrostis kennedyae* and *Eragrostis tenellula* on drainage zone	Dense herb understorey with *Eucalyptus camaldulensis* overstorey	Very Good
D	Disturbed	Generally covered in weeds, where native species are present they are not consistent with surrounding vegetation	Disturbed areas including old tracks, fencelines and raised bunds for access track	Degraded
L	Lake bed	Open lake bed with dead trees and water	No vegetation	Not relevant

Legend

Study Area

Vegetation Types

Eucalyptus Woodland

1 Woodland of *Eucalyptus victrix* over Low Open Woodland of *Acacia citrinoviridis* and *Acacia aptaneura* over High Open Shrubland of *Melaleuca glomerata* and *Acacia pyrifolia* on medium drainage line

Acacia Low Open Forest

2 Low Open Forest of *Acacia citrinoviridis, Acacia coriacea* subsp. *pendens* and *Eucalyptus victrix* over Open Tussock Grassland of **Cenchrus ciliaris*, *Eulalia aurea* and *Aristida holathera* var. *holathera* with Very Open Hummock Grassland of *Triodia pungens* on medium drainage lines

Acacia Low Woodland

3 Low Woodland of *Acacia aptaneura, Acacia paraneura* and *Corymbia aspera* over Open Tussock Grassland of *Aristida inaequiglumis, Aristida contorta* and *Enneapogon polyphyllus* with Low Open Shrubland of *Ptilotus obovatus, Solanum lasiophyllum* and *Eremophila lanceolata* on sandy loam plains

Sclerolaena Low Shrubland

4 Low Shrubland of *Sclerolaena cuneata, Sclerolaena costata* and *Streptoglossa odora* over Open Tussock Grassland of *Aristida inaequiglumis, Aristida contorta* and *Enteropogon ramosus* with Low Open Woodland of *Acaica aptaneura, Acacia paraneura* and *Hakea lorea* subsp. *lorea* on plains

Triodia Hummock Grassland

5 Hummock Grassland of *Triodia basedowii* with High Open Shrubland of *Acacia aptaneura* and *Acacia pruinocarpa* and Low Open Shrubland of *Scaevola parvifolia, Sida cardiophylla* and *Ptilotus astrolasicus* on sand plains

Triodia Open Hummock Grassland

6 Open Hummock Grassland of *Triodia basedowii* over Open Tussock Grassland of *Aristida inaequiglumis* and *Aristida contorta* with Low Open Woodland of *Acacia aptaneura* and *Acacia pruinocarpa* on sandy stony plains

Chrysopogon Closed Tussock Grassland

7 Closed Tussock Grassland of *Chrysopogon fallax, Aristida inaequiglumis* and *Digitaria ammophila* with Low Open Forest of *Acacia aptaneura* and *Corymbia aspera* and Open Shrubland of *Eremophila forrestii* subsp. *forrestii* and *Eremophila fraseri* in broad drainage line

Elytrophorus Tussock Grassland

8 Tussock Grassland of *Elytrophorus spicatus* over Sedges of *Schoenoplectus dissachanthus* (3 merous variant) and *Schoenoplectus laevis* with Low Open Woodland of *Eucalyptus camaldulensis* on wet fringe of lake bed

Aristida Open Tussock Grassland

9 Open Tussock Grassland of *Aristida inaequiglumis, Aristida contorta* and *Eulalia aurea* with Low Open Woodland of *Acacia aptaneura* and *Eucalyptus camaldulensis* and Very Open Hummock Grassland of *Triodia basedowii* on plains

Gnephosis Herbs

10 Herbs of *Myriocephalus rudallii, Alternanthera nodiflora* and *Goodenia lamprosperma* with Low Woodland of *Eucalyptus camaldulensis* and Open Tussock Grassland of *Eragrostis kennedyae* and *Eragrostis tenellula* on drainage zone

Disturbed

Disturbed Generally covered in weeds, where native species are present they are not consistent with surrounding vegetation

Lake bed

Lake Bed Open lake bed with dead trees and water

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FIGURE 8

Vegetation Association Map Legend

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Figure:	8	Date:	11/08/2015
Sheet Size:	A3	Status:	DRAFT
Drawn by GSM	Requested by GSM	GSM Reference ob31_pipeline_Veg_types	

N

0 100 200 300 400

Meters
1:7,500

Datum: GDA94
Projection: MGA Zone 50

FIGURE 8

Vegetation association map for the study area

Legend

Study Area

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Broad Floristic Formation	*1. Eucalyptus* Woodland
Vegetation Association	Woodland of *Eucalyptus victrix* over Low Open Woodland of *Acacia citrinoviridis* and *Acacia aptaneura* over High Open Shrubland of *Melaleuca glomerata* and *Acacia pyrifolia* on medium drainage lines

Area Mapped	0.38 ha
Releves Sampled	-
Location	Northern part of study area
Soils and Geology	Red/brown sand
Land System	Washplain
Land Form	Medium drainage line
Priority Ecological Community	No
Rare Flora	None
Introduced (Weed) Species	**Cenchrus ciliaris*
Vegetation Condition	Very Good
Disturbances	Weeds, livestock
Average Fire Age	Very Old (>10 years)
Characteristics	Taller trees of *Eucalyptus victrix*
Vegetation Structure & Floristics	
Trees 10-30m	*Eucalyptus victrix*
Trees <10m	*Acacia citrinoviridis, Acacia aptaneura*
Shrubs >2m	*Melaleuca glomerata, Acacia pyrifolia*
Tussock Grasses	**Cenchrus ciliaris*

Broad Floristic Formation	2. *Acacia* Low Open Forest
Vegetation Association	Low Open Forest of *Acacia citrinoviridis, Acacia coriacea* subsp. *pendens* and *Eucalyptus victrix* over Open Tussock Grassland of **Cenchrus ciliaris, Eulalia aurea* and *Aristida holathera* var. *holathera* with Very Open Hummock Grassland of *Triodia pungens* on medium drainage lines

Area Mapped	0.77 ha
Releves Sampled	O30
Location	Northern part of study area
Soils and Geology	Red/brown sand
Land System	Washplain
Land Form	Medium drainage line
Priority Ecological Community	No
Rare Flora	*Goodenia nuda* (Priority 4)
Introduced (Weed) Species	**Cenchrus ciliaris, *Malvastrum americanum, *Bidens bipinnata*
Vegetation Condition	Good
Disturbances	Weeds
Average Fire Age	Very Old (>10 years)
Characteristics	*Acacia citrinoviridis* and the presences of dense **Cenchrus ciliaris* understorey are distinctive
Vegetation Structure & Floristics	
Trees <10m	*Acacia citrinoviridis, Acacia coriacea* subsp. *pendens, Eucalyptus victrix, Corymbia aspera*
Hummock Grasses	*Triodia pungens*
Tussock Grasses	**Cenchrus ciliaris, Eulalia aurea, Aristida holathera* var. *holathera, Aristida inaequiglumis*

Broad Floristic Formation	3. *Acacia* Low Woodland
Vegetation Association	Low Woodland of *Acacia aptaneura*, *Acacia paraneura* and *Corymbia aspera* over Open Tussock Grassland of *Aristida inaequiglumis, Aristida contorta* and *Enneapogon polyphyllus* with Low Open Shrubland of *Ptilotus obovatus, Solanum lasiophyllum* and *Eremophila lanceolata* on sandy loam plains

Area Mapped	12.90 ha
Releves Sampled	O35, O36, O51, O25, O24, O16, O15
Location	Throughout the study area
Soils and Geology	Red sandy loam
Land System	Washplain
Land Form	Sandy loam plains
Priority Ecological Community	No
Rare Flora	None
Introduced (Weed) Species	None
Vegetation Condition	Very Good
Disturbances	Tracks nearby, cattle
Average Fire Age	Old- Very Old (5-10+ years)
Characteristics	Dense overstorey of *Acacia aptaneura* with *Aristida* dominated ground cover
Vegetation Structure & Floristics	
Trees <10m	*Acacia aptaneura, Corymbia aspera*
Shrubs >2m	*Acacia aptaneura, Acacia tetragonophylla, Psydrax latifolia, Senna artemisioides* subsp. *helmsii*
Low Shrubs <1m	*Ptilotus obovatus, Ptilotus gaudichaudii, Sida platycalyx, Eremophila forrestii* subsp. *forrestii, Eremophila lanceolata, Maireana villosa, Indigofera georgei, Gomphrena kanisii*
Hummock Grasses	*Triodia basedowii, Triodia angusta*
Tussock Grasses	*Aristida inaequiglumis, Aristida contorta, Chrysopogon fallax*
Herbs	*Portulaca oleracea, Boerhavia replete, Goodenia prostrata*

Broad Floristic Formation	4. *Sclerolaena* Low Shrubland
Vegetation Association	Low Shrubland of *Sclerolaena cuneata*, *Sclerolaena costata* and *Streptoglossa odora* over Open Tussock Grassland of *Aristida inaequiglumis, Aristida contorta* and *Enteropogon ramosus* with Low Open Woodland of *Acacia aptaneura, Acacia paraneura* and *Hakea lorea* subsp. *lorea* on plains

Area Mapped	1.11 ha
Releves Sampled	O18, O19, O22
Location	Central parts of the study area
Soils and Geology	Red loamy clay
Land System	Washplain
Land Form	Eroded bare plains
Priority Ecological Community	No
Rare Flora	None
Introduced (Weed) Species	None
Vegetation Condition	Very Good
Disturbances	Tracks nearby, livestock
Average Fire Age	Old (5-10 years)
Characteristics	Bare plains with scattered *Acacia aptaneura* and low chenopods
Vegetation Structure & Floristics	
Trees <10m	*Acacia aptaneura, Acacia paraneura, Hakea lorea* subsp. *lorea*
Shrubs 1-2m	*Acacia tetragonophylla, Acacia synchronicia*
Low Shrubs <1m	*Sclerolaena cuneata*, *Sclerolaena costata*, *Streptoglossa odora, Sclerolaena cornishiana, Solanum lasiophyllum, Sida platycalyx*
Tussock Grasses	*Aristida inaequiglumis, Aristida contorta, Enneapogon polyphyllus, Enteropogon ramosus*

Broad Floristic Formation	5. *Triodia* Hummock Grassland
Vegetation Association	Hummock Grassland of *Triodia basedowii* with High Open Shrubland of *Acacia aptaneura* and *Acacia pruinocarpa* and Low Open Shrubland of *Scaevola parvifolia, Sida cardiophylla* and *Ptilotus astrolasius* on sand plains

Area Mapped	2.95 ha
Releves Sampled	O61, O28
Location	Northern part of the study area
Soils and Geology	Red brown sand
Land System	Divide
Land Form	Sand plain
Priority Ecological Community	No
Rare Flora	None
Introduced (Weed) Species	None
Vegetation Condition	Excellent
Disturbances	Livestock, access tracks
Average Fire Age	Old (5-10 years)
Characteristics	*Triodia basedowii* on sandy plains
Vegetation Structure & Floristics	
Trees <10m	*Acacia aptaneura, Acacia pruinocarpa*
Shrubs >2m	*Acacia aptaneura, Acacia pruinocarpa*
Shrubs 1-2m	*Acacia dictyophleba, Acacia pachyacra, Acacia bivenosa, Acacia ancistrocarpa*
Low Shrubs <1m	*Scaevola parvifolia, Sida cardiophylla, Ptilotus astrolasius*
Hummock Grasses	*Triodia basedowii*

Broad Floristic Formation	6. *Triodia* Open Hummock Grassland
Vegetation Association	Open Hummock Grassland of *Triodia basedowii* over Open Tussock Grassland of *Aristida inaequiglumis* and *Aristida contorta* with Low Open Woodland of *Acacia aptaneura* and *Acacia pruinocarpa* on sandy stony plains

Area Mapped	3.48 ha
Releves Sampled	O13, O50
Location	Southern to central part of the study area
Soils and Geology	Red brown loamy sand
Land System	McKay
Land Form	Sandy stony plains
Priority Ecological Community	No
Rare Flora	None
Introduced (Weed) Species	None
Vegetation Condition	Very Good
Disturbances	Livestock, access tracks
Average Fire Age	Old (5-10 years)
Characteristics	Mix of tussocks and hummocks
Vegetation Structure & Floristics	
Trees <10m	*Acacia aptaneura, Acacia pruinocarpa*
Shrubs 1-2m	*Acacia tetragonophylla, Acacia bivenosa, Acacia aptaneura*
Low Shrubs <1m	*Solanum lasiophyllum, Senna artemisioides* subsp. *helmsii, Senna artemisioides* subsp. *oligophylla, Eremophila forrestii* subsp. *forrestii, Ptilotus obovatus*
Hummock Grasses	*Triodia basedowii*
Tussock Grasses	*Aristida inaequiglumis, Aristida contorta, Paraneurachne muelleri*

Broad Floristic Formation	7. *Chrysopogon* Closed Tussock Grassland
Vegetation Association	Closed Tussock Grassland of *Chrysopogon fallax, Aristida inaequiglumis* and *Digitaria ammophila* with Low Open Forest of *Acacia aptaneura and Corymbia aspera* and Open Shrubland of *Eremophila forrestii* subsp. *forrestii* and *Eremophila fraseri* in broad drainage lines

Area Mapped	0.82 ha
Releve´s Sampled	O33
Location	Northern end of the study area
Soils and Geology	Red/brown clay loam
Land System	Washplain
Land Form	Broad mulga drainage zone
Priority Ecological Community	No
Rare Flora	*Goodenia nuda* (O38.01)
Introduced (Weed) Species	**Cenchrus ciliaris*
Vegetation Condition	Good
Disturbances	Weeds
Average Fire Age	Very Old (>10 years)
Characteristics	Broad drainage zone dominated by *Acacia aptaneura*
Vegetation Structure & Floristics	
Trees <10m	*Corymbia aspera, Acacia aptaneura, Eucalyptus xerothermica*
Shrubs 1-2m	*Eremophila forrestii* subsp. *forrestii, Eremophila fraseri*
Tussock Grasses	*Chrysopogon fallax, Aristida inaequiglumis, Digitaria amophilla*
Herbs	*Phyllanthus erwinii, Centipeda minima, Alternanthera nana, Dysphania melanocarpa*

Broad Floristic Formation	*8. Elytrophorus* Tussock Grassland
Vegetation Association	Tussock Grassland of *Elytrophorus spicatus* over Sedges of *Schoenoplectus dissachanthus* (3 merous variant) and *Schoenoplectus laevis* with Low Open Woodland of *Eucalyptus camaldulensis* on wet fringe of lake bed

Area Mapped	0.90 ha
Releves Sampled	O4, O45
Location	Southern end of the study area
Soils and Geology	Red/brown light clay
Land System	River
Land Form	Wet fringe of lake bed
Priority Ecological Community	No
Rare Flora	None
Introduced (Weed) Species	None
Vegetation Condition	Very Good
Disturbances	Dam, livestock
Average Fire Age	Very Old (>10 years)
Characteristics	Open overstorey of *Eucalyptus camaldulensis* with tussocks and sedges
Vegetation Structure & Floristics	
Trees 10-30m	*Eucalyptus camaldulensis*
Trees <10m	*Eucalyptus camaldulensis*
Tussock Grasses	*Elytrophorus spicatus*
Sedges	*Schoenoplectus dissachanthus* (3 merous variant), *Schoenoplectus laevis*
Herbs	*Marsilea hirsuta, Centipeda minima* subsp. *macrocepha*

Broad Floristic Formation	9. *Aristida* Open Tussock Grassland
Vegetation Association	Open Tussock Grassland of *Aristida inaequiglumis, Aristida contorta* and *Eulalia aurea* with Low Open Woodland of *Acacia aptaneura* and *Eucalyptus camaldulensis* and Very Open Hummock Grassland of *Triodia basedowii* on plains

Area Mapped	1.18 ha
Releves Sampled	O11, O46
Location	Southern part of the study area
Soils and Geology	Red brown sandy clay loam
Land System	River
Land Form	Stony loam plains
Priority Ecological Community	No
Rare Flora	None
Introduced (Weed) Species	None
Vegetation Condition	Very Good
Disturbances	Livestock, dam, access track nearby
Average Fire Age	Very Old (>10 years)
Characteristics	Mix of *Acacia aptaneura* and *Eucalyptus camaldulensis* in the overstorey with *Aristida inaequiglumis* ground cover
Vegetation Structure & Floristics	
Trees <10m	*Eucalyptus camaldulensis, Acacia aptaneura, Acacia pruinocarpa*
Shrubs >2m	*Acacia tetragonophylla, Acacia aptaneura*
Shrubs 1-2m	*Senna glutinosa* subsp. *x luerssenii*
Tussock Grasses	*Aristida inaequiglumis, Aristida contorta*
Herbs	*Bergia trimera, Streptoglossa odora, Portulaca oleracea, Synaptantha tilliaecea, Goodenia prostrata*

Broad Floristic Formation	10. *Gnephosis* Herbs
Vegetation Association	Herbs of *Myriocephalus rudallii*, *Alternanthera nodiflora* and *Goodenia lamprosperma* with Low Woodland of *Eucalyptus camaldulensis* and Open Tussock Grassland of *Eragrostis kennedyae* and *Eragrostis tenellula* in drainage zone

Area Mapped	1.43 ha
Releves Sampled	O10
Location	Southern end of study area
Soils and Geology	Brown clay loam
Land System	River
Land Form	Drainage zone
Priority Ecological Community	No
Rare Flora	None
Introduced (Weed) Species	None
Vegetation Condition	Very Good
Disturbances	Livestock, access tracks, dam construction
Average Fire Age	Very Old (5-10 years)
Characteristics	Dense herb understorey with *Eucalyptus camaldulensis* overstorey
Vegetation Structure & Floristics	
Trees <10m	*Eucalyptus camaldulensis*
Shrubs >2m	*Melaleuca glomerata*
Tussock Grasses	*Eragrostis kennedyae, Eragrostis tenellula*
Sedges	*Cyperus iria, Schoenoplectus laevis*
Herbs	*Myriocephalus rudallii, Alternanthera nodiflora, Centipeda minima* subsp. *macrocephala, Goodenia lamprosperma*

4.5 Vegetation Condition

Vegetation condition within the study area ranged from *excellent* to *degraded,* with the majority of vegetation associations (seven) rated as *very good* (Figure 9). Vegetation condition for two vegetation associations occurring along medium drainage lines in the north-east sector of the study area was rated as *good.* The remaining vegetation occurred on a sand plain and condition was rated as *excellent* (Figure 9). The access track running through the centre line of much of the study area was rated as *degraded.* Vegetation in this areas was not consistent with the surrounding vegetation and contained a higher loading of introduced weed species.

The decline in vegetation condition within areas rated as *good* generally occurred on landforms situated lower in the landscape. These areas support palatable grasses which have been subject to higher levels of grazing by domestic stock and typically have a higher loading of introduced weed species in the ground cover. The banks along medium drainage line were dominated by **Cenchrus ciliaris* (Buffel Grass) and supported most of the weed species recorded within the study area.

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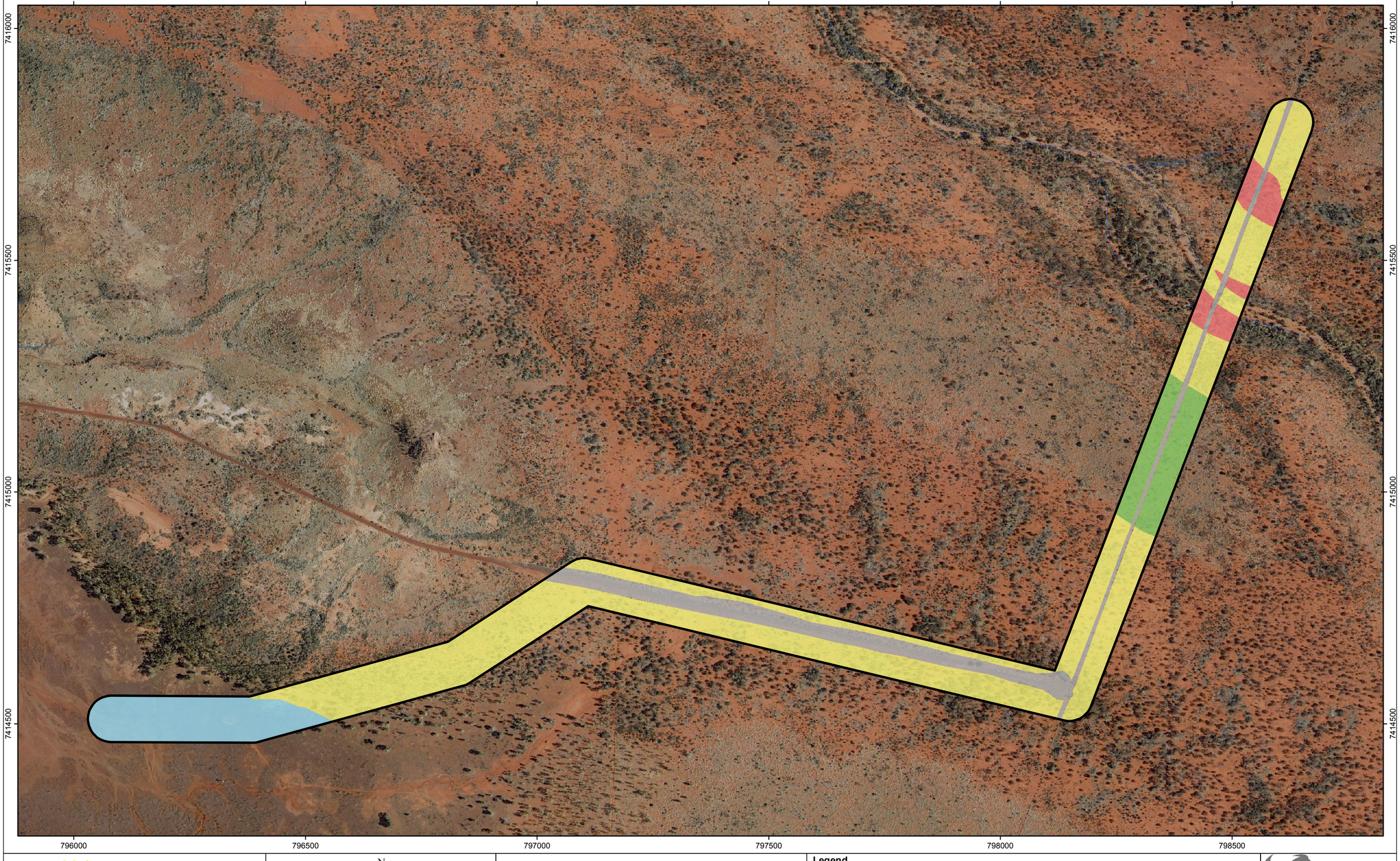

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FIGURE 9

Vegetation condition within the study area

Legend

- Study Area
- **Vegetation Condition**
  - Good
  - Very Good
  - Excellent
  - Disturbed
  - Lake Bed

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5.0 Results - Vertebrate Fauna

5.1 Desktop Review

5.1.1 Previous Vertebrate Fauna Surveys near to the study area

A review of all relevant previous fauna surveys commissioned and held by BHP Billiton Iron Ore within the vicinity of the study area was undertaken. Parameters including surveyor (consultant), location, timing, methodology and findings (including conservation significant species recorded) for the previous surveys are summarised in Table 13.

5.1.2 Database Searches

The NatureMap search, based on a 4 km radius around the study area, reported a total of six mammal species, 66 bird species, 28 reptile species and no amphibian species, totalling 100 vertebrate species (Appendix 7). The conservation significant species identified include:

- Eastern Great Egret *Ardea modesta* - EPBC Act Migratory, WC Act Schedule 3;
- Curlew Sandpiper *Calidris ferruginea* - EPBC Critically Endangered and Migratory, WC Act Schedule 1 and 3;
- Red-necked Stint *Calidris ruficollis* - EPBC Act Migratory, WC Act Schedule 3;
- *Red-capped Plover Charadrius ruficapillus* - EPBC Act Migratory;
- Rainbow Bee-eater *Merops ornatus* – EPBC Act Migratory, WC Act Schedule 3; and
- White-bellied Sea-Eagle *Haliaeetus leucogaster* EPBC Act Migratory, WC Act Schedule 3.

As the study area extends into Ophthalmia Dam, a database search that includes all records from the dam was undertaken. Additional records of EPBC Act Migratory species include Common Sandpiper *Actitis hypoleucos*, Cattle Egret *Ardea ibis*, Sharp-tailed Sandpiper *Calidris acuminate,* Long-toed Stint *Calidris subminuta,* Glossy Ibis *Plegadis falcinellus,* Wood Sandpiper *Tringa glareola* and Common Greenshank *Tringa nebularia.*

The EPBC Act Protected Matters database for a 5 km radius around the study area, identified three Threatened fauna species and five migratory species, or their habitats, as likely to occur within the study area:

Threatened species

- Northern Quoll *Dasyurus hallucatus* - EPBC Act Endangered, WC Act Schedule 1;
- Greater Bilby *Macrotis lagotis* - EPBC Act Vulnerable, WC Act Schedule 1;
- Pilbara Leaf-nosed Bat *Rhinonicteris aurantia* - EPBC Act Vulnerable, WC Act Schedule 1;
- Northern Marsupial Mole *Notoryctes caurinus* - EPBC Act Endangered[4], WC Act Schedule 1; and
- Pilbara Olive Python *Liasis olivaceus barroni* - EPBC Act Vulnerable, WC Act Schedule 1.

Migratory Species

- Fork-tailed Swift *Apus pacificus* - EPBC Act Migratory; WC Act Schedule 3;
- Rainbow Bee-eater *Merops ornatus* - EPBC Act Migratory, WC Act Schedule 3;
- Great Egret *Ardea alba* - EPBC Act Migratory;
- Cattle Egret *Ardea ibis* - EPBC Act Migratory, and WC Act Schedule 3; and
- Oriental Plover *Charadrius veredus* - EPBC Act Migratory and WC Act Schedule 3.

[4] The habitat for this species (sand ridges) is not present within the study area, thus this species is not discussed further.

Table 13 Timing and methodologies followed during previous fauna surveys in the vicinity of the study area.

Report Title	Orebody 25 Biological Assessment Survey	Orebody 23 Extension Biological Assessment Survey	OB 24 Expansion Biological Survey	Eastern Ophthalmia Range Biological Survey	Orebody 25 Biological Review and Environmental Impact Assessment	OB 24 Flora and Fauna Assessment Phase 2	Eastern Ridge (OB23/24/25) Vertebrate Fauna Assessment
Type	One season with trapping	One season with trapping	One season with trapping	One season with trapping	Desktop	One season with trapping	One season without trapping
Consultant	Ecologia	Ecologia	Ecologia	Ecologia	Ecologia	ENV	ENV
Year	1995	1998	2004a	2004b	2005	2006	2012
Study Area	OB 25	OB 23	OB 24			OB 24	
Dist. to study area	Approximately 6km	Approximately 6km	Approximately 7km	Approximately 6km	Approximately 6km	Approximately 6km	Approximately 6km
Dates	6-15 June 1995	17-22 June 1997	14-27 May 2004	18 March-7 April 2004	September 2005	16 Mar-10 Apr 2006	17-21 May 2011
Type of sampling conducted [5]	AS, BC, HA, OS, TR	AS, BC, BR, HA, MN, NS, OS, TR	AS, BC, BR, HA, OS, TR	AS, BC, BR, HA, OS, TR		AS, BC, BR, HA, OS, TR	AS, BC, BR, HA, OS
Trapping effort							
Diurnal surveys (hrs)	0	7	6	29.5	Only a desktop study	37	Not specified
Nocturnal surveys (hrs)	0	0.1	3	5		12 nights	Not specified
Bird census (hrs)	22	9.5	20.8	25.2		61.5	Not specified
Mist netting (hrs)	0	0	0	0		0	0
Anabat nights	0	0	0	2.5		10	3
Cage Trap nights	0	0	0	0		450	0
Pit Trap nights	144	125	370	340		0	0
Funnel Trap nights	0	0	296	272		450	0
Elliott trap nights	400	260	700	680		450	0
Results							
Amphibians	0	0	0	4	Discuss the results of the Orebody 25 Biological Assessment Survey (ecologia, 1995)	3	2
Reptiles	16	18	22	30		34	13
Birds	46	63	65	59		67	46
Mammals	6	8	16	19		16	10
Conservation Significant species	Peregrine Falcon, Western Pebble-mound Mouse	Peregrine Falcon , Western Pebble-mound Mouse	Rainbow Bee-eater	Fork-tailed Swift, Rainbow Bee-eater, Western Pebble-mound Mouse		Ghost Bat, Western Star Finch, Western Pebble-mound Mouse, Pilbara Olive Python	Australian Bustard, Pilbara Olive Python, Rainbow Bee-eater, Western Pebble-mound Mouse
Habitat types	Spinifex Steppe, Narrow Gully and Breakaway	Scree Slopes, Minor Drainage Lines and Ride Tops	Ridge Top, Gully, Hummock Grassland, Grassy Plain and Minor Drainage Line	Range crests, Range slopes, Gorges and Gullies; Breakaways; Foothills; Minor Drainage Channels; Valley Plains; Flood Plains	Scree Slope, Spinifex Drainage, Ridges / Hills, Gully and Spinifex Steppe	Range Crests, Range Slopes, Breakaways, Gorges and Gullies, Minor Drainage Lines and Valley Plains	Gorge/ Gully, Riverine, Minor Drainage Line, Alluvial Plain, Breakaway, Low Hill and Hill Slope/Hill Crest

[5] AS- Active Diurnal Searches; BC- Bird Census; BR- Bat Recording; HA- Habitat Assessments; MN- Mist Netting; NS- Nocturnal Surveys; OS- Opportunistic Surveys; TR- Trapping

5.2 Fauna Species

Database searches, review of previous survey reports and results from the current survey indicated that 247 species of vertebrate fauna (excluding freshwater fish) occur in the general area (Appendix 7). The number of species occurring in the study area would be significantly less due to the limited variation in habitat types. This list comprises 40 species of mammal, 133 species of birds, 69 species of reptiles and five species of amphibians. Of these, 44 species comprising three species of introduced mammal and 41 species of birds were recorded during the current survey. Due to the lack of precise geographic position data, it is impossible to ascertain whether additional species recorded in online databases actually fall within the study area.

A number of species recorded in the vicinity during previous studies have not been recorded to-date within the study area. The absence of these records may be due to a number of reasons, including: 1) the systematic sampling effort within the actual study area is low and thus some species will not have been recorded even if they were present; 2) some species are transient and may only be present on rare occasions and thus have not been recorded during the field survey; 3) these species occur in similar ecological niches to other species present within the study area, and thus are not present due to competition despite suitable habitat being available; and 4) Suitable habitat for these species does not occur in the study area.

5.2.1 Native Mammals

Of the 40 mammals identified in the literature and database review, three species (Cow, Cat and Camel) were recorded during the current survey. Two species (Northern Quoll and Greater Bilby) were identified in online databases to occur in the area but were not recorded in any of the surveys in the general area.

5.2.2 Birds

One hundred and thirty three species of native birds potentially occur in the general area, of which 41 species were recorded during the current survey. The most commonly recorded species are Spinifex Pigeon, Crested Pigeon, Whistling Kite, Brown Falcon, Australian Hobby, Australian Ringneck, Budgerigar, Variegated and White-winged Fairy-wren, Pied Butcherbird and Torresian Crow.

A number of water birds records exist in the database searches as the study area overlaps with Ophthalmia Dam.

5.2.3 Reptiles

Sixty nine reptiles potentially occur in the area, none were recorded during the current survey, possibly due to the cool weather conditions and low survey intensity. The most commonly recorded species in the vicinity are *Ctenophorus caudicinctus, Gehyra punctata, Gehyra variegate and Ctenotus saxatilis.*

5.2.4 Amphibians

Five species of amphibians are likely to occur in the general area, but none were recorded from the study area, possibly due to the cool weather conditions. The Red Tree Frog, *Litoria rubella,* was the most commonly recorded species in the general area.

5.2.5 Introduced Species

Eight introduced species of mammals have been recorded from the general area. The Camel, Cat and Cow were the only introduced species recorded during the survey.

5.3 Fauna Habitats

Five major fauna habitats were identified within the study area; Major Drainage Line, Mulga, Stony Plain, Sand Plain and Artificial Habitat - Dam (see Figure 10). Habitat descriptions are presented in Table 14. The extent of each fauna habitat outside of the study area is provided.

Table 14 Fauna habitat descriptions.

Habitat	Description and habitat characteristics	Extent within the study area	Extent outside study area	Significant species associated with habitat	Photograph
Mulga	This habitat includes woodlands and other ecosystems in which Mulga (*Acacia aptaneura*) is dominant, either as the principal acacia or mixed with others. It consists of disintegrating groves on stony soils with spinifex.	Occurs throughout the study area.	Common habitat throughout the Pilbara. Particularly south of the Fortescue Marsh.	The Pilbara Flat-headed Blindsnake occurs in this habitat type (utilize as living space). The Australian Bustard is frequently encountered foraging in this habitat. Mulga also supports a number of species that are largely restricted to this habitat type such as Bush's Monitor *Varanus bushi*.	
Stony Plain	These are erosional surfaces of gently undulating plains. Mainly support hard spinifex (and occasionally soft spinifex) with a mantle of gravel and pebbles. Within this habitat type there are small patches of sand.	Occurs in two areas in the study area.	Common habitat throughout the Pilbara, especially in the north. Occurs within National Parks in the Pilbara.	The Pilbara Flat-headed Blindsnake and Australian Bustard are known from this habitat type. The patches of sand are highly unlikely to support significant species due to their small size and scattered distribution.	
Sand Plains	Sand Plain habitat is characterised by relatively deep sandy soils supporting dense spinifex grasslands and sparse shrubs. This habitat transitions into patches of Mulga in places.	Occurs in one large patch in the study area.	Large representations of this habitat are located at the border of the Hamersley and Fortescue subregions and then extensively within the Chichester subregion.	Mulgara potentially utilise finer sandy habitats for burrows and foraging in this part of the Pilbara. Australian Bustard is frequently encountered foraging in this habitat. The Pilbara Flat-headed Blindsnake also occurs in this habitat type.	

Habitat	Description and habitat characteristics	Extent within the study area	Extent outside study area	Significant species associated with habitat	Photograph
Major Drainage Line	This habitat comprises mature River Red Gums and Coolibahs over temporary river pools. Open, sandy or gravelly riverbeds characterise this habitat type. In ungrazed areas, the vegetation adjacent to the main channel or channels is denser, taller and more diverse.	Occus in the south west of the Study Area on the edge of the Dam and in the north.	Many flowing water bodies exist within the Hamersley sub region with the Fortescue River (west of the Study Area) being the main drainage line. These habitats tend to be relatively narrow, linear features, and therefore only represent a small proportion of the total land area.	This habitat could support bird species including Star Finch, Rainbow Bee-eater and migratory waders. This habitat also provides potential breeding and/or foraging sites for Peregrine Falcons. The eucalypt species (*E. victrix* and *E. camaldulensis*) typically contain a number of significant tree hollows used by parrots and owls for roosting and nesting. They also provide habitat and dispersal opportunities for Pilbara Olive Pythons.	
Artificial Habitat - Dam	Ophthalmia Dam is one of the largest water bodies in the Pilbara and is a resource for the town of Newman. Leading up to the wet season, the water body generally reduces in size and is likely to no longer overlap the study area.	A very small portion of Ophthalmia Dam occurs in the south west of the study area.	Only a very small percentage of Ophthalmia Dam occurs in the study area.	Like any large water body in the Pilbara, it is an attractive habitat to many species. In particular, EPBC listed migratory birds are regularly recorded here.	

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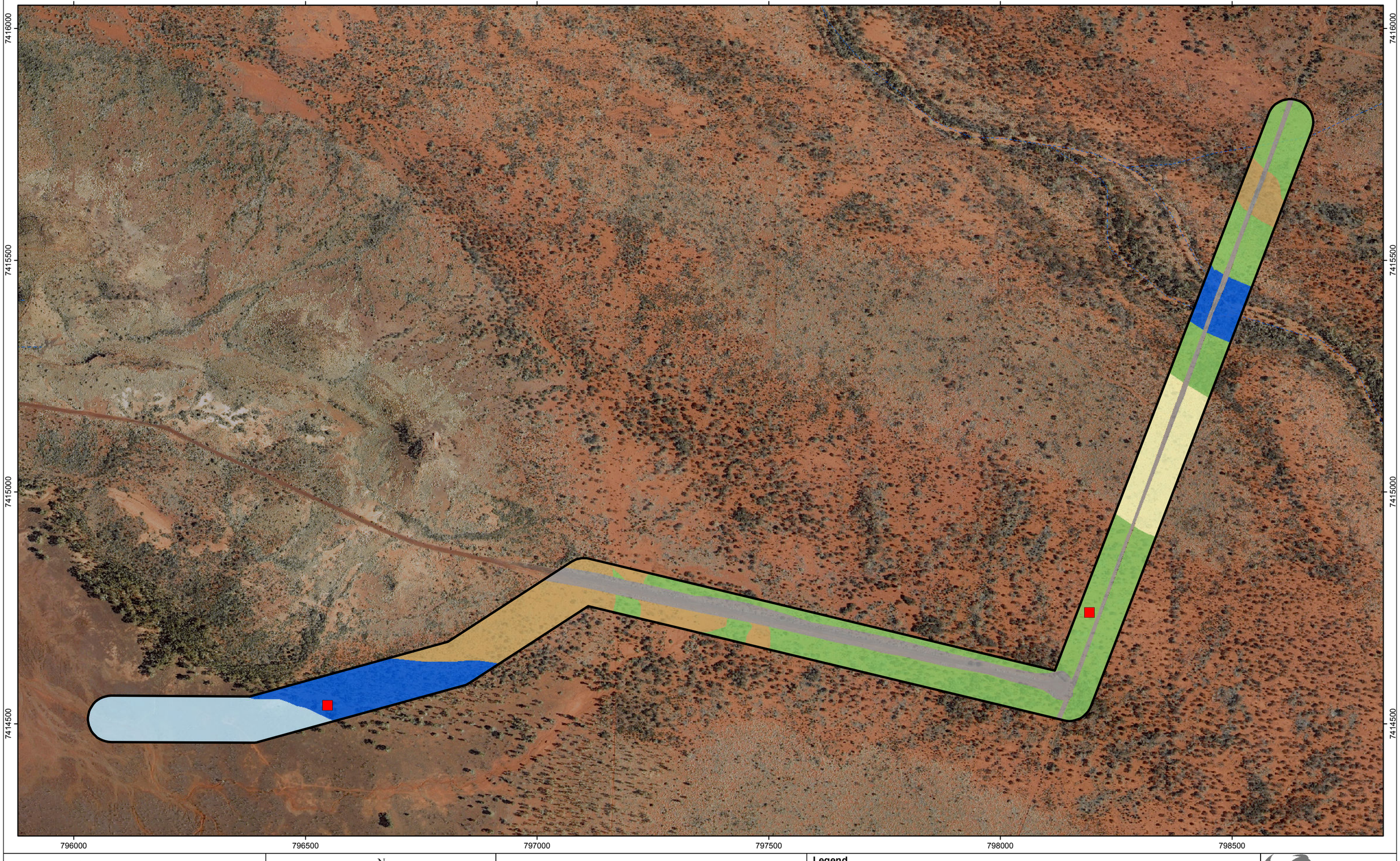

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FIGURE 10

Fauna habitats and significant species within the study area

Legend

- Study Area

Significant Fauna Observation

- Merops ornatus

Habitat Types

- Major Drainage Line
- Mulga
- Sand Plain
- Stony Plain
- Artificial Habitat - Dam
- Cleared Areas

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5.4 Conservation Significant Fauna

Species are defined as 'Conservation Significant' if they are listed under agreements at international (e.g. IUCN, JAMBA, CAMBA, Bonn), regional (EPBC Act) or state (WC Act, Priority list of DPaW) level. Explanations of conservation status under these Acts and Agreements are provided in Appendix 5.

Based on the results of previous surveys, a review of regional surveys, and database searches, it was determined that 25 species (seven native mammals, 16 birds and two reptiles) of conservation significance have the potential to occur in the study area (Table 15). One was recorded during the current survey.

Table 15 shows conservation significant species recorded from adjacent areas and those that potentially occur within the study area.

Table 15 Summary of conservation significant fauna recorded adjacent to the study area and those potentially occur in the study area.

		CONSERVATION STATUS				DATABASE SEARCHES		SURVEYS							
Species	Common Name	EPBC	WA Act	DPaW	IUCN	NatureMap	EPBC	A	B	C	D	F	G	H	I
Mammalia															
Dasyurus hallucatus	Northern Quoll	EN	S 1		EN		●								
Dasycercus blythi	Brush-tailed Mulgara			P4										●	
Rhinonicteris aurantius	Pilbara Leaf-nosed Bat	VU	S 1				●							●	
Macroderma gigas	Ghost Bat			P4	VU							●		●	
Pseudomys chapmani	Western Pebble-mound Mouse			P4				●	●		●	●	●	●	
Macrotis lagotis	Greater Bilby	VU	S 1		VU		●								
Notoryctes caurinus	Northern Marsupial Mole	EN	S1				●								
Aves															
Actitis hypoleucos	Common Sandpiper	MI	S 3			●									
Ardea modesta	Eastern Great Egret	MI	S 3			●									
Ardea ibis	Cattle Egret	MI	S 3			●	●								
Ardeotis australis	Australian Bustard			P4									●		
Calidris acuminata	Sharp-tailed Sandpiper	MI	S 3			●									
Calidris ferruginea	Curlew Sandpiper	CE	S1 S3			●									
Calidris ruficollis	Red-necked Stint	MI	S 3			●									
Calidris subminuta	Long-toed Stint	MI	S 3			●									
Haliaeetus leucogaster	White-bellied Sea-eagle	MI	S 3			●									
Falco peregrinus	Peregrine Falcon		S4					●	●					●	
Merops ornatus	Rainbow Bee-eater	MI	S 3			●	●			●	●		●	●	●
Tringa nebularia	Common Greenshank					●									
Charadrius veredus	Oriental Plover	MI	S 3				●								
Apus pacifica	Fork-tailed Swift	MI	S 3				●				●				
Neochmia ruficauda subclarescens	Star Finch			P4								●			
Reptilia															
Liasis olivaceus barroni	Pilbara Olive Python	VU	S 1				●					●	●	●	
Ramphotyplops ganei	Pilbara Flat-headed Blindsnake			P1		●									

Database Searches: DPaW NatureMap search within 15 km buffer | EPBC Protected Matters search with 15 km buffer | DPaW Threatened Species Database search within 30 km buffer

Surveys: A Orebody 25 Biological Assessment Survey (ecologia 1995) | B Orebody 23 Extension Biological Assessment Survey (ecologia 1998) | C Orebody 24 Expansion Biological Survey (ecologia 2004) D Eastern Ophthalmia Range Biological Survey (ecologia 2004) | F OB 24 Flora and Fauna Assessment Phase II (ENV Australia 2006) | G Eastern Ridge (OB23/24/25) Vertebrate Fauna Assessment (ENV Australia 2011) | H OB24 Targeted Vertebrate Fauna Survey (Biologic 2013) | I Current survey

5.5 Conservation Significant Fauna Potentially Occurring at the Study Area

Twenty five species of conservation significant fauna have been recorded during surveys in the vicinity or were identified as potentially occurring in the area (Table 15). Twenty one species are discussed below as likely to occur.

5.5.1 Birds

Australian Bustard (*Ardeotis australis*)

The Australian Bustard is listed as Priority 4 by the DPaW and as Least Concern by the IUCN. It occurs across most of mainland Australia, but is listed in WA primarily due to a decline in its range in the south of the state. It is a nomadic species occurring in a wide variety of habitats including sand plains, gravel plains, riverine habitats and open or lightly wooded grasslands (Johnstone and Storr 2008).

While not recorded during the current survey, it is likely to occasionally utilise most of the study area (all habitats except Major Drainage Line and Artificial Habitat - Dam).

Rainbow Bee-eater (*Merops ornatus*)

The Rainbow Bee-eater is listed as Migratory under the EPBC Act and Schedule 3 under the WC Act. This species has broad habitat preferences and lives almost anywhere suitable for hawking insects. The demographics of the species are complex, with populations in WA being resident, breeding visitors, post-nuptial nomads, passage migrants and winter visitors (Johnstone and Storr 2008). Many individuals move northwards to overwinter in Indonesia.

Recorded in two locations (see Figure 10) within the current study area and expected to occur within Major Drainage Line habitat on regular basis.

Fork-tailed Swift (*Apus pacificus)*

This species is entirely aerial within the Pilbara and thus does not utilise the terrestrial surface. It is listed as Migratory under the EPBC Act and Schedule 3 under the WC Act, as it breeds in north-east and eastern Asia, wintering in Australia and southern New Guinea (Johnstone and Storr 2008).

Like any study area in the Pilbara, this species may occur as a flyover.

Cattle Egret (*Ardea ibis*)

Cattle Egrets are listed as Migratory under the EPBC Act and Schedule 3 under the WC Act. It is a widespread and common species according to migration movements and surveys of breeding localities. Two major distributions have been located; from north-east Western Australia to the top end of the Northern Territory and around south-east Australia. In Western Australia and the Northern Territory, the Cattle Egret is located from Wyndham to Arnhem Land. The Cattle Egret utilises a variety of natural and anthropogenic habitats and occurs in tropical and temperate grasslands, inland wetlands, wooded lands and farm lands. It has also been seen in arid and semi-arid regions; however this is extremely rare. This species has a symbiotic relationship with grazers.

Online databases identified this species as likely to occur in the area. This species could only occur within Ophthalmia Dam.

Eastern Great Egret (*Ardea modesta)*

The Eastern Great Egret is listed as Migratory under the EPBC Act and Schedule 3 under the WC Act. This species is described as dispersive and migratory in parts of its range (DOE 2015), with some regular seasonal movements. Non-breeding birds have been

recorded across most of Australia, but avoid the driest regions of the western and central deserts (Marchant & Higgins 1993). Favoured breeding habitat relevant to the study area includes wooded swamps and river pools with *Eucalyptus camaldulensis* and *Melaleuca argentea* (Johnstone and Storr 2008).

Online databases identified this species as likely to occur in the area. This species could only occur within the Ophthalmia Dam.

Oriental Plover (*Charadrius veredus*)

The Oriental Plover is listed as Migratory under the EPBC Act and Schedule 3 under the WC Act. It is a non-breeding visitor to Australia, where it occurs in both coastal and inland areas. Along the coast the Oriental Plover inhabits estuarine mudflats, beaches and near coastal grasslands. Inland it occurs in flat, open, semi-arid or arid grasslands (DOE, 2015). On migration to Northern Australia (September - November), Oriental Plovers gather in flocks on open, thinly vegetated, grassland plains (Morcombe 2004).

Online databases identified this species as likely to occur in the area. There are few records of the Oriental Plover in the Pilbara (Johnston et al. 2013) and it is possible that this species may be an infrequent transient visitor to the study area.

Star Finch (western subspecies) (*Neochmia ruficauda subclarescens*)

The 'western' population of the Star Finch (western subspecies) is considered by the DPaW to represent a separate subspecies (*N r subclarescens*), distinct from Kimberley and Northern Territory birds (*N. r. clarescens*). These birds are generally uncommon and patchily distributed in the Pilbara and are listed as Priority 4 by the DPaW and as Near Threatened by the IUCN. The Star Finch prefers areas of dense vegetation, such as reedbeds (Johnstone and Storr 2008) and woodlands near water.

This species was recorded travelling to the study area, approximately 1.5km from the south west corner. This species is likely to occur occasionally within Major Drainage Line habitat and Aritificial Habitat – Dam.

White-bellied Sea-eagle (*Haliaeetus leucogaster*)

This large raptor is listed as Migratory under the EPBC Act and Schedule 3 under the WC Act. It is considered to be moderately common in Pilbara islands as well as in large inland water bodies. This species also visits near-coastal wetlands and other lotic waters in the region.

Online databases identified this species as likely to occur in the area. This species may utilise the Dam for hunting.

Peregrine Falcon (*Falco peregrinus*)

The Peregrine Falcon is listed as Vulnerable under the EPBC Act and Schedule 4 under the WC Act, and is considered rare or scarce over much of its range, including the Pilbara (Johnstone and Storr, 2008). Inland it is most often encountered along cliffs above rivers, ranges and wooded watercourses and lakes, where it hunts birds (Johnstone and Storr, 2008). It nests on rocky ledges in tall, vertical cliff faces and tall trees associated with drainage lines.

Waders

As the study area overlaps with Ophthalmia Dam a number of migratory waders are expected to occur in the study area, this includes Common Sandpiper *Actitis hypoleucos*, Cattle Egret *Ardea ibis*, Sharp-tailed Sandpiper *Calidris acuminate,* Long-toed Stint *Calidris subminuta,* Glossy Ibis *Plegadis falcinellus,* Wood Sandpiper *Tringa glareola*, Common Greenshank *Tringa nebularia,* Curlew Sandpiper *Calidris ferruginea* (WC Act Schedule 1 and 3, EPBC Critically Endangered), Red-necked Stint Calidris ruficollis and Long-toed Stint Calidris subminuta.

As the study area only overlaps with a very small fraction of Ophthalmia Dam, waders are expected to infrequently occur within the study area. In addition to this, Ophthalmia Dam reduces significantly in size leading up to the wet season so the water body is likely to recede away from the study area.

5.5.2 Reptiles

Pilbara Olive Python (*Liasis olivaceus barroni*)

The Pilbara Olive Python is listed as Vulnerable under the EPBC Act and Schedule 1 under the WC Act. This species is primarily nocturnal and tends to shelter in small caves or under vegetation during the day, although it is occasionally active after sunrise, particularly in the warmer summer months (DOE 2015). The Pilbara Olive Python is known from a number of sites throughout the Pilbara and is associated with drainage systems, including areas with localised drainage and semi-permanent watercourses (DOE 2015). In the Hamersley subregion, the Pilbara Olive Python is most often encountered in the vicinity of permanent waterholes in rocky ranges or among riverine vegetation (Pearson 1993, DOE 2015).

This species may utilise Major Drainage Line habitat for hunting and dispersal.

Pilbara Flat-headed Blindsnake (*Anilios ganei*)

The Pilbara Flat-headed Blindsnake *Anilios ganei* is listed as Priority 1 by the DPaW and is endemic to the Pilbara. Given its cryptic fossorial habit, this species is rarely encountered. Little is known of this species' ecology but like most other blind snakes, it is insectivorous, feeding on termites and their eggs, and larvae and pupae of ants (Wilson and Swan 2010). *Anilios ganei* is associated with moist gorges and gullies (Wilson and Swan 2010), and potentially with a wide range of other stony habitats.

This species is likely to be recorded from most habitats within the study area (all habitats except for Artificial Habitat - Dam).

5.6 Important Fauna Habitats

The expected faunal richness in an area is proportional to the amount of habitat variation and floristic diversity, since both of these influences the number of different habitats available for fauna. Accordingly, an area with high variation of habitat types could harbour a higher diversity of fauna and vice versa. Across the study area, four different habitats were encountered.

Major Drainage Line habitat and Artificial Habitat - Dam was deemed to be of high importance for their ability to support Pilbara Olive Python and migratory waders, respectively. Sand Plain habitat was deemed to be of medium importance as it may support Mulgara, although the habitat patch is not large and does appear isolated from larger nearby Sand Plains.

6.0 Consideration for the Ten Clearing Principles

Sensitivities of the study area in respect to application for a Native Vegetation Clearing Permit (NVCP) can be addressed in relation to the ten Clearing Principles (Table 16), as specified in Schedule 5 of the *Environmental Protection Act 1986*. None of the Clearing Principles are regarded as being sensitive.

Table 16 NVCP Table

Principle	Criterion	Assessment	Outcome
a) Native vegetation should not be cleared if it comprises a high level of biological diversity.	a1) Native vegetation should not be cleared if it is representative of an area of outstanding biodiversity in the Bioregion.	The native vegetation present within the study area is widespread and common within the south-eastern Pilbara. It does not represent an area of outstanding biodiversity.	Not at variance with the clearing principle.
	a2) Native vegetation should not be cleared if it has higher diversity of indigenous aquatic or terrestrial plant or fauna species than native vegetation of that ecological association in good or better condition in the Bioregion.	The native vegetation within the study area, it is not considered to contain a higher diversity of species than similar vegetation within the Hamersley or Fortescue Bioregions.	Not at variance with the clearing principle.
	a3) Native vegetation should not be cleared if it has higher diversity of indigenous aquatic or terrestrial plant or fauna species than the remaining vegetation of that ecological association in the local area.	The native vegetation within the study area is not considered to contain a higher diversity of species than similar vegetation within the local area. The vegetation associations within the study area are contiguous with the surrounding areas.	Not at variance with the clearing principle.
	a4) Native vegetation should not be cleared if it has higher ecosystem diversity than other native vegetation of that local area.	The vegetation within the study area is similar to other areas within the local area and is unlikely to have higher values than the surrounding vegetation.	Not at variance with the clearing principle.
	a5) Native vegetation should not be cleared if it has higher genetic diversity than the remaining native vegetation of that ecological association.	Based on the total recorded during the Level 1 survey, native vegetation is not considered to have a higher genetic diversity than the remaining native vegetation of that ecological association.	Not at variance with the clearing principles

Principle	Criterion	Assessment	Outcome
b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	b1) Native vegetation should not be cleared if it is or is likely to be habitat for fauna that is declared Specially Protected under the Wildlife Conservation Act.	The Rainbow Bee-eater (Schedule 3, S3) was the only species recorded in the Study Area listed under the *Wildlife Conservation Act.* This species is common in the region and is very unlikely to be adversely affected by the proposed activity. Other species listed under the WC Act that may occur in the study area include: Fork-tailed Swift; Cattle Egret; East Great Egret; Oriental Plover, White bellied Sea-eagle; Peregrine Falcon and Pilbara Olive Python. Due to the small amount of suitable habitat within the study that may be disturbed, it is unlikely these species or local populations will be adversely affected by the proposed activity. A number of Wader species listed under the WC Act may occur in the study area as it overlaps with Ophthalmia Dam. According to database searches, the following species may occur: Common Sandpiper; Sharp-tailed Sandpiper; Long-toed Stint; Glossy Ibis; Wood Sandpiper; Common Greenshank; Curlew Sandpiper; Red-necked Stint; and Long-toed Stint. Due to the small amount of suitable habitat within the study area that may be disturbed, it is unlikely these species will be adversely affected by the proposed activity. In addition to this, Ophthalmia Dam reduces in size leading up to the wet season, therefore it is possible that suitable habitat for these species will not occur within the study area for a proportion of the year.	Not at variance with the clearing principle.

Principle	Criterion	Assessment	Outcome
	b2) Native vegetation should not be cleared if it is or is likely to be habitat for Priority Listed Fauna.	No priority listed fauna were recorded duting the survey. A number of priority listed fauna may occur in the study area, including: Australian Bustard, Star Finch and Pilbara Flat-headed Blindsnake. These species are common in the region and are very unlikely to be adversely affected by the proposed activity.	Not at variance with the clearing principle.
	b3) Native vegetation should not be cleared if it is or is likely to be habitat for fauna that is otherwise significant.	No fauna that is otherwise significant were recorded or are expected to occur within the study area.	Not at variance with the clearing principle.
	b4) Native vegetation should not be cleared if it provides significant habitat for fauna species in the local area.	The habitat in the study area does not provide significant habitat for the fauna species in the local area. Ample habitat surrounds the study area that is used by the fauna species in the local area.	Not at variance with the clearing principle.
	b5) Native vegetation should not be cleared if it maintains ecological functions and processes that protect significant habitat for fauna.	Native vegetation in the study area does not maintain the ecological functions and processes that protect significant habitat for fauna.	Not at variance with the clearing principle.
	b6) Native vegetation should not be cleared if it forms, or is part of, an ecological linkage that is necessary for the maintenance of fauna.	Native vegetation in the study area does not form, or is part of, an ecological linkage that is necessary for the maintenance of fauna.	Not at variance with the clearing principle.
	b7) Native vegetation should not be cleared if it provides significant habitat for fauna associations (assemblages) and metapopulations.	Native vegetation in the study area does not provide significant habitat for fauna associations (assemblages) and metapopulations.	Not at variance with the clearing principle.
c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.	c1) Native vegetation should not be cleared if it is necessary for the continued in situ existence of populations of Declared Rare Flora under the Wildlife Conservation Act 1950.	No Threatened Flora (DRF) recorded.	Not at variance with the clearing principles

Principle	Criterion	Assessment	Outcome
	c2) Native vegetation should not be cleared if it is necessary for the continued in situ existence of other significant flora.	One Priority flora taxon recorded, the Priority 4 taxon *Goodenia nuda.* This species is widespread at surrounding localities and has a relatively widespread distribution across the Pilbara Bioregion.	Not at variance with the clearing principles
	c3) Native vegetation should not be cleared if it is necessary for the continued in situ existence of significant habitat for priority flora species published by the Department of Environment and Conservation.	Habitat that may support Priority flora was thoroughly assessed during the survey. The Priority 4 taxon *Goodenia nuda* was recorded from two locations in the northern sector of the study area, found on the banks and drainage channels of a medium drainage line. Two plants were recorded at one location with the other location supporting approximately 30 plants.	Unlikely to be at variance with the clearing principles
d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened community.	d1) Native vegetation should not be cleared if threatened ecological associations listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999 are present.	No EPBC Act TECs will be impacted by the proposed works.	Not at variance with the clearing principles
	d2) Native vegetation should not be cleared if it is necessary for the maintenance of Threatened Ecological Communities listed under the Commonwealth Environment Protection and Biodiversity Conservation Act 1999.	No EPBC Act TECs will be impacted by the proposed works.	Not at variance with the clearing principles
	d3) Native vegetation should not be cleared if other significant ecological communities are present.	No other significant ecological communities are known from the study area.	Not at variance with the clearing principles
	d4) Native vegetation should not be cleared if it is necessary for the maintenance of other significant ecological communities.	No DPaW listed TECs or associated native vegetation will be will be impacted by the proposed works.	Not at variance with the clearing principles

Principle	Criterion	Assessment	Outcome
	d5) Native vegetation should not be cleared if it is necessary for the continued in situ existence of significant examples of priority threatened ecological communities published by the Department of Parks and Wildlife	No PECs are known from within the vicinity of the survey area.	Not at variance with the clearing principles
e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.	e1) Native vegetation should not be cleared if the remaining native vegetation represents less than 30%, or the clearing would reduce the representation of remaining native vegetation to less than 30% in the Bioregion (or subregion where applicable).	Clearing native vegetation within the study area will not significantly reduce the known extent from pre-European extents.	Not at variance with the clearing principles
	e2) Native vegetation should not be cleared if an ecological community represents less than 30% of its original extent or clearing would reduce the representation of any ecological community to less than 30% of its original extent in the Bioregion (or subregion where applicable).	Clearing Native vegetation within the study area will not significantly reduce the known extent from pre-European extents.	Not at variance with the clearing principles
	e3) Native vegetation should not be cleared if clearing would reduce an community to less than 1% of the Bioregion (or subregion where applicable)	Clearing Native vegetation within the study area will not significantly reduce the known extent from pre-European extents.	Not at variance with the clearing principles
	e4) Native vegetation should not be cleared if the remaining native vegetation represents less than 30% or the clearing would reduce the representation of remaining native vegetation to less than 30% in the Local Area.	Clearing Native vegetation within the study area will not significantly reduce the known extent from pre-European extents.	Not at variance with the clearing principles
	e5) Native vegetation should not be cleared if an ecological community represents less than 30% of its original extent or clearing reduce the representation of any ecological community to less than 30% of its original extent in the Local Area.	Clearing Native vegetation within the study area will not significantly reduce the known extent from pre-European extents.	Not at variance with the clearing principles

Principle	Criterion	Assessment	Outcome
	e6) Native vegetation should not be cleared if clearing would reduce any ecological community to less than 1% of the Local Area.	Clearing Native vegetation within the study area will not significantly reduce the known extent from pre-European extents.	Not at variance with the clearing principles
f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.	f1) Native vegetation should not be cleared if it is growing in a watercourse or wetland that has been identified as having significant environmental values.	The western end of the study area terminates at the man-made wetland of Ophthalmia Dam. The proposed works will not have any significant impact on the environmental values of the dam.	Not at variance with the clearing principles
	f2) Native vegetation should not be cleared if it provides a buffer area for watercourses and wetlands identified in criteria (f1) and (f2).	The western end of the study area terminates at the man-made wetland of Ophthalmia Dam. It is proposed that surplus water from the OB31 mining operations will be dischared into Ophthalmia Dam under regulated conditions and utilising a narrow service corridor.	Not at variance with the clearing principles
	f3) Native vegetation should not be cleared if water tables are likely to change and adversely affect ecological communities that are wetland or groundwater dependent.	Due to the scale of clearing for this specific project it is not considered likely to adversely alter water tables, and as such will not impact on any ecological communities that are wetland or groundwater dependent.	Not at variance with the clearing principles
	f4) Native vegetation should not be cleared if it is growing in other watercourses or wetlands.	There is no vegetation growing on the bed of Ophthalmia Dam, and fringing vegetation associations are not of conservation significance. It is noted that the dam is a man-made structure.	Not at variance with the clearing principles
g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	g1) Native vegetation should not be cleared if wind or water erosion of soil is likely to be increased (on or off site).	Short-term soil erosion may be associated with clearing. Soil erosion can be mitigated by use of appropriate water management and rehabilitation regimes.	Not at variance with the clearing principles

Principle	Criterion	Assessment	Outcome
	g2) Native vegetation on land with soils with high or low pH should not be cleared.	The study area is not considered to contain soils at risk of having Acid Sulphate Soils present. No vegetation on soils with significantly low (or high) pH will be impacted by the proposed works.	Not at variance with the clearing principles
	g3) Native vegetation should not be cleared if water logging is likely to be increased (on or off site).	It not expected that waterlogging would be increased by the clearing of native vegetation within the study area.	Not at variance with the clearing principles
	g4) Native vegetation should not be cleared if land salinisation is likely to be increased (on or off site).	Soil salinity is not considered to be increased in the study area (on or off site) by the clearing of native vegetation.	Not at variance with the clearing principles
h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values	h1) Native vegetation should not be cleared if it contributes significantly to the environmental values of a conservation area.	The study area does not form any part of a conservation area.	Not at variance with the clearing principles
	h2) Native vegetation should not be cleared if that vegetation provides a buffer to a conservation area.	The study area does not form a buffer area to any conservation areas.	Not at variance with the clearing principles
	h3) Native vegetation should not be cleared if the land contributes to an ecological linkage to a conservation area.	The study area does not form an ecological linkage to any conservation areas.	Not at variance with the clearing principles
	h4) Native vegetation should not be cleared if it provides habitats not well represented on conservation land.	There are no habitats within the study area that are not well represented on conservation land.	Not at variance with the clearing principles
i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	i1) Native vegetation should not be cleared if clearing the vegetation will reduce the quality of surface or underground water in proclaimed, gazetted or declared areas or catchments.	The clearing of native vegetation is not considered likely to alter the quality of surface or ground waters within the study area due to the small size of the areas cleared.	Not at variance with the clearing principles
	i2) Native vegetation should not be cleared if sedimentation, erosion, turbidity or eutrophication of water bodies on or off site is likely to be caused or increased.	The clearing of native vegetation is not considered likely to impact Jimblebar Creek due to the small area being cleared.	Not at variance with the clearing principles

Principle	Criterion	Assessment	Outcome
	i3) Native vegetation should not be cleared if water tables are likely to change significantly altering salinity or pH.	The clearing of native vegetation is not considered likely to alter the quality of surface or ground waters within the study area.	Not at variance with the clearing principles
	i4) Native vegetation should not be cleared if the clearing is likely to alter the water regimes of groundwater dependent ecosystems (GDEs) on or off site, causing degradation to the biological associations associated with these systems.	The clearing of native vegetation is not considered likely to alter the regimes of surface or groundwater dependent vegetation within the study area.	Not at variance with the clearing principles
j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.	j1) Native vegetation should not be cleared if it is likely to lead to an incremental increase in peak flood height.	The clearing of native vegetation is not considered likely to cause any alteration to flood duration or flood height.	Not at variance with the clearing principles

7.0 Summary

Flora and Vegetation

A Level 1 flora and vegetation survey completed under excellent seasonal conditions in mid July 2015 did not record any Threatened Flora taxa from within the study area. One Priority flora taxon, *Goodenia nuda* (Priority 4), was recorded from two locations in the northern sector of the study area, growing on the banks and within the main channel of a medium drainage line. A total of ten vegetation associations were described and mapped from the study area. None of the vegetation associations are currently listed TECs or PECs, and all appear to be well represented regionally.

Vertebrate Fauna

The Level 1 vertebrate fauna survey completed in mid July 2015 recorded one conservation significant species, Rainbow Bee-eater (WC Act Schedule 3, EPBC Act Migratory). Of the five fauna habitats identified within the study area, two were considered to be of high importance due to the ability to support significant species; Major Drainage Line and Aritificial Habitats – Dam.

8.0 References

Armstrong , K. and S. Anstee (2000) The ghost bat in the Pilbara: 100 years on. Australian Mammalogy **22**:93-101.

Armstrong, K. N. (2001) The distribution and roost habitat of the orange leaf-nosed bat, Rhinonicteris aurantius, in the Pilbara region of Western Australia. Wildlife Research 28:95–104.

Astron Environmental Services (2012) *Eastern Mines Weed Survey, Jimblebar*. Consultants report prepared for BHP Billiton Iron Ore.

Australian Natural Resource Atlas (2008). Biodiversity Assessment - Pilbara. Australian Natural Resources Atlas, website.

Beard J. S. (1975) Pilbara. Explanatory Notes and Map Sheet 5, 1:1 000 000 series Vegetation Survey of Western Australia. University of Western Australia Press: Nedlands.

Beard J. S. (1990) *Plant Life of Western Australia*. Kangaroo Press, Perth.

BHP Billiton Iron Ore (2010) *Guidance for Vegetation and Flora Surveys in the Pilbara Region*. BHP Billiton. BHP Billiton Iron Ore, Perth, Western Australia.

BHP Billiton Iron Ore (2010) Terrestrial Fauna Habitat Assessment Proforma (FRM-IEN-EMS-003).

BHP Billiton Iron Ore (2011) Guidance for Vertebrate Fauna Surveys in the Pilbara (SPR-IEN-EMS-012).

BHP Billiton Iron Ore (2013) Biological Survey Data and Digital Photography Requirements (SPR-IENEMS-015).

BHPIO (1994) Jimblebar Mine Site Biological Survey, Report prepared for BHP Billiton Iron Ore.

Biologic (2013b) Orebody 19 Level 2 Vertebrate Fauna Survey Unpublished report to BHP Billiton Iron Ore.

Biologic (2013c) Orebody 31 Vertebrate Fauna Survey. Unpublished report to BHP Billiton Pty Ltd.

Biota (2004) *Jimblebar - Wheelarra Hill 3 Flora and Fauna Assessment*. Consultant report prepared for BHP Billiton Iron Ore.

Biota Environmental Science (2008) Hope Downs Northern Quoll Position Paper. Unpublished report for Rio Tinto on behalf of Hammersley HMS., Perth WA.

Burbidge, NT (1959) Notes on Plants and Plant Habitats Observed in the Abydos-Woodstock Area, Pilbara District, Western Australia. CSIRO Div. Plant Ind. Tech. Paper 12.

Bureau of Meteorology (2015) *Climate Data Online - Newman.* Available from: http://www.bom.gov.au/climate/data

Bush, B., and B. Maryan (2011) Field guide to the snakes of the Pilbara, Western Australia.

Christidis, L., and Boles, W. (2008) Systematics and Taxonomy of Australian Birds. . Collingwood, Australia: CSIRO.

Churchill, S. K. (2008) Australian Bats 2nd Edition. Allen and Unwin, Crow's Nest, NSW, Australia.

CSIRO (2014) Australian Soil Resource Information System (ASRIS), Available from: http://www.asris.csiro.au/index.html, Accsessed 04/5/2014.

Dames and Moore (1993) *Ecological Observations Jimblebar Railway Line.* Consultant report prepared for BHP Iron Ore.

del Hoyo, J., A. Elliott, and J. Sargatal. (1996) Handbook of the Birds of the World, vol. 3: Hoatzin to Auks. . Lynx Edicions, Barcelona, Spain.

Department of Environment (2015) Interactive Environmental Database Reporting Tool Search, performed May 2015. www.environment.gov.au.

Department of Environment (2014a) *Maps: Australia's Bioregions (IBRA)* Available from: <www.environment.gov.au/parks/nrs/science/bioregion-framework/ibra/index.html

Department of Environment (2014b) *EPBC Act Protected Matters Report.* Report created online at http://www.environment.gov.au/webgis-framework/apps/pmst/pmst.jsf

Department of Environment and Conservation and the Western Australian Museum (2015) NatureMap: Mapping Western Australia's biodiversity.

Department of Parks and Wildlife (DPaW) (2014b) List of Threatened Ecological Communities on the Department of Conservation and Land Management's Threatened Ecological Community (TEC) Database endorsed by the Minister for the Environment. WA Threatened Species and Communities Unit, Department of Parks and Wildlife.

DSEWPaC (2010) Survey Guidelines for Australia's Threatened Bats.

DSEWPaC (2010) Survey Guidelines for Australia's Threatened Birds.

DSEWPaC (2010) Survey Guidelines for Australia's Threatened Frogs.

DSEWPaC (2010) Survey Guidelines for Australia's Threatened Mammals.

DSEWPaC (2010) Survey Guidelines for Australia's Threatened Reptiles.

DSEWPaC (2011a) Dasyurus hallucatus in Species Profile and Threats Database, Department of Sustainability, Environment, Water, Population and Communities, Canberra.

DSEWPaC (2011b) Survey guidelines for Australia's threatened mammals. EPBC Act survey guidelines 6.5.

DSEWPaC (2012) Invitation to comment on the proposed delisting of Dasycercus hillieri and listing of Dasycercus blythi under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act). Pages 1-6 in A. Government, editor. Department of Sustainability, Environment, Water, Population and Communities.

Ecologia Environment (1995) Orebody 18 Biological Assessment Survey. An unpublished report to BHP Iron Ore Pty. Ltd. Page 120, Perth, Western Australia.

Ecologia Environment (1996) *Jimblebar Rail Spur Biological Assessment Survey*. Report prepared for BHP Billiton Iron Ore.

Ecologia Environment (2004a*) OB 18 Flora and Fauna Review*. Report prepared for BHP Billiton Iron Ore.

Ecologia Environment (2004b) *Jimblebar-Wheelarra Hill Expansion Biological Study*. Report prepared for BHP Billiton Iron Ore.

Ecologia Environment (2005) *Jimblebar East Exploration Project Biological Survey*. Report prepared for BHP Billiton Iron Ore.

Ecologia Environment (2006) *Jimblebar Marra Mamba Exploration Biological Survey.* Prepared for BHP Billiton Iron Ore.

EcoLogical (2012) Level 1 flora and fauna surveys along the Great Northern Highway for Jimblebar mine module transport. Prepared for BHP Billiton Iron Ore.

ecologia. (1995). Orebody 25 Biological Assessment Survey: Unpublished report to BHP Billiton Iron Ore Pty Ltd, Perth, Western Australia.

ecologia. (1998). Orebody 23 Extension Biological Assessment Survey: Unpublished report to BHP Billiton Iron Ore Pty Ltd, Perth Western Australia.

ecologia. (2004a). Eastern Ophthalmia Range Biological Survey: Unpublished report for BHP Billiton Iron Ore.

ecologia. (2004b). Orebody 24 Expansion Biological Survey: Unpublished report to BHP Billiton Iron Ore Pty Ltd, Perth Western Australia.

ecologia. (1998). Orebody 23 Extension Biological Assessment Survey: Unpublished report to BHP Billiton Iron Ore Pty Ltd, Perth Western Australia.

ecologia. (2005). Orebody 25 Biological Review and Environmental Impact Assessment: Unpublished report to BHP Billiton Iron Ore Pty Ltd, Perth Western Australia.

ENV. (2006). OB24 Flora and Fauna Assessment Phase II: Unpublished report for BHP Billiton Iron Ore.

ENV. (2012). Eastern Ridge (OB23/24/25) Fauna Assessment: Unpublished report to BHP Billiton Iron Ore Pty Ltd.

ENV Australia (2007a) West Jimblebar Exploration Lease Flora and Vegetation Assessment - Management Recommendations, Report prepared for BHP Billiton Iron Ore.

ENV Australia (2007b) Jimblebar Wye Rail Junction (Borrow Areas) Flora and Vegetation Assessment, Report prepared for BHP Billiton Iron Ore.

ENV Australia (2007c) RGP4 Jimblebar Rail Loop Flora and Vegetation Assessment, Report prepared for BHP Billiton Iron Ore.

ENV Australia (2007d) OB 18 Flora and Vegetation Assessment Phase II, Report prepared for BHP Billiton Iron Ore.

ENV Australia (2007e) Jimblebar Stage 2, Levee Banks and Communications Tower Redevelopment Flora and Vegetation Assessments, Report prepared for BHP Billiton Iron Ore.

ENV Australia (2008a) Rapid Growth Project 5: Repeater 9 Access Road Flora and Vegetation Assessment, Report prepared for BHP Billiton Iron Ore.

ENV Australia (2008b) Jimblebar Access Road Flora and Vegetation Assessment, Report prepared for BHP Billiton Iron Ore.

ENV Australia (2009a) Jimblebar Spur 2 Flora and Vegetation Assessment, Report prepared for BHP Billiton Iron Ore.

ENV Australia (2009b) Construction Water Supply Pipeline and Ammonium Nitrate Storage Facility Flora and Vegetation Assessment, Report prepared for BHP Billiton Iron Ore.

ENV Australia (2009c) Ammonium Nitrate Storage Facility Flora and Vegetation Assessment, Report prepared for BHP Billiton Iron Ore.

ENV Australia (2010a) RGP6 Jimblebar Hub (Water Pipeline) Flora and Vegetation Assessment, Report prepared for BHP Billiton Iron Ore.

ENV Australia (2010b) Jimblebar Wye Targeted Declared Rare Flora and Priority Listed Flora Assessment, Report prepared for BHP Billiton Iron Ore.

Environmental Protection Authority (EPA) (2002) Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3, EPA, Perth.

Environmental Protection Authority (EPA) (2004) EPA Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51, EPA, Perth.

Environmental Protection Authority [EPA] (2000) Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to Agricultural Areas. Position Statement No. 2. EPA, Perth, Western Australia.

EPA (2004b) Guidance No. 56, Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia.

EPA (2010) Technical Guide - Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment.

GHD (2008a) Draft Report for Wheelarra Hill (Jimblebar Mine Site) Priority Species.

GHD (2008b) *Mesa Gap Biological Survey*. Report prepared for BHP Billiton Iron Ore.

Hutson, A. M., S. P. Mickelburgh, and P. A. Racet (2001) Microchiropteran Bats: Global Status Survey and Conservation Action Plan. IUCN Publication Services Unit.

Hussey, B. M. J., Keighery, G. J., Cousens, R. D., Dodd, J. and Lloyd, S. G. (1997) Western Weeds. The Plant Protection Society of Western Australia and Agriculture Western Australia. Kensington, W.A.

International Union for Conservation of Nature (IUCN) (2014) Interactive Environmental Database Reporting Tool Search. www.iucnredlist.org

Johnston, R. E., A. H. Burbidge, and J. C. Darnell (2013) Birds of the Pilbara region, including seas and offshore islands, Western Australia: distribution, status and historical changes. Records of the Western Australian Museum Supplement 78:343–441.

Johnstone, R. and G. Storr (2008) Handbook of Western Australian Birds Vol 2 - Passerines (Blue-winged Pitta to Goldfinch). Western Australian Museum, Perth, Australia.

Keighery, G. (2010) *The Naturalised Vascular Plants of the Pilbara Region, Western Australia.* Records of the Western Australian Museum, Supplement **78:** 299-311.

Kendrick (2001) Bioregion: Pilbara 3 Subregion (PIL3). Department of Conservation and Land Management, Perth.

Desmond, A. Kendrick, P and Chant, A. (2001) Bioregion: Gascoyne 3 Subregion (GAS3). Dempartment of Conservation and Land Management, Perth.

Marchant, S., & Higgins, P. J. (Eds.). (1993). *Handbook of Australian, New Zealand and Antarctoc birds Vols 1 and 2*. Melbourne: Oxford University Press.

Morcombe, M. (2004) Field Guide to Australian Birds. Steve Parish Publishing, Archerfield, Australia.

O'Brien, B.J. and Associates Pty. Ltd. (1992) *Marandoo Iron Ore Mine and Central Pilbara Railway.* Environmental Review and Management Programme. Report to Hamersley Iron Pty Ltd.

Oakwood, M. (2008) Northern Quoll Dasyurus hallucatus in R. Strahan, editor. The Mammals of Australia. Reed new Holland, Sydney.

Onshore Environmental (2013a) Orebody 19 Level 2 Flora and Vegetation Assessment, Report prepared for BHP Billiton Iron Ore.

Onshore Environmental (2013b) Orebody 17/18 Derived Vegetation Association Mapping Report, Report prepared for BHP Billiton Iron Ore.

Onshore Environmental (2013c) Vegetation Mapping Review Coolibah-lignum Flats Priority Ecological Community. Prepared for BHP Billiton Iron Ore.

Onshore Environmental (2013d) Level 2 Flora and Vegetation Survey Mudlark Leases. Prepared for BHP Billiton Iron Ore.

Onshore Environmental (2013e) Level 2 Flora and Vegetation Survey Tandanya. Prepared for BHP Billiton Iron Ore.

Onshore Environmental (2014a) Targeted Significant Flora Assessment Orebody 31, Report prepared for BHP Billiton Iron Ore.

Onshore Environmental (2014b) Orebody 31 Level 2 Flora and Vegetation Survey.

Onshore Environmental (2014c) Dynasty Flora and Vegetation Review, Report prepared for BHP Billiton Iron Ore.

Onshore Environmental (2014d) Tenement E52/2238 Level 1 Flora & Vegetation and Vertebrate Fauna Survey, Report prepared for BHP Billiton Iron Ore.

Onshore Environmental (2014e) Orebody 18 to Orebody 31 Proposed Infrastructure Corridor Targeted Flora Survey, Report prepared for BHP Billiton Iron Ore.

Onshore Environmental (2015) Dynasty and West Jimblebar Level 2 Flora and Vegetation Survey, Report prepared for BHP Billiton Iron Ore.

Outback Ecology Services (2009a) Wheelarra Hill Iron Ore Mine Modification Flora and Fauna Assessment, Report prepared for BHP Billiton Iron Ore.

Outback Ecology Services (2009b) Jimblebar Linear Development Flora and Vegetation Assessment, Report prepared for BHP Billiton Iron Ore.

Outback Ecology Services (2009c) Eastern Pilbara Accommodation Camp Flora and Fauna Assessment, Report prepared for BHP Billiton Iron Ore.

Outback Ecology Services (2010) Jimblebar Iron Ore Project Flora and Vegetation Assessment, Report prepared for BHP Billiton Iron Ore.

Outback Ecology Services (2009d) Jimblebar Iron Ore Project: Terrestrial Vertebrate Fauna Assessment. Unpublished report for BHP Billiton Pty Ltd. Perth, Western Australia.

Pavey, C. R., C. E. M. Nano, S. J. B. Cooper, J. R. Cole, and P. J. McDonald (2012) Habitat use, population dynamics and species identification of mulgara, Dasycercus blythi and D. cristicauda, in a zone of sympatry in central Australia. Australian Journal of Zoology 59:156-169.

Pearson, D. (1993) Distribution, ststus and conservation of pythons in Western Australia. in D. Lunney, and D. Ayers, editors. Herpetology in Australia: a diverse discipline. Royal Zoological Society of New South Wales, Sydney.

Pilbara Flora (2008) OB17 Flora and Vegetation Survey, Report prepared for BHP Billiton Iron Ore.

Shepherd, D., Beeston, G and Hopkins, A. (2002) Native Vegetation in Western Australia. Extent, Type and Status. *Resource Management Technical Report 249*. Department of Agriculture, South Perth.

Southgate, R. (1990a) Distribution and abundance of the greater bilby Macrotis lagotis Reid (Marsupialia: Peramelidae). . Pages 293-302 in J. H. Seeback, P. R. Brown, R. L. Wallis, and C. M. Kemper, editors. Bandicoots and Bilbies. Surrey Beatty and Sons.

Southgate, R. (1990b) Habitat and diet of the greater bilby Macrotis lagotis Reid (Marsupialia: Peramelidae). . Pages 303-309 in J. H. Seeback, P. R. Brown, R. L.

Specialised Zoological (2008) Area C Environmental Management Plan Revision 4: Bat Survey and Assessment. Unpublished report by Specialised Zoological to BHP Billiton Iron Ore Ltd.

Syrinx Environmental (2011) OB 31 Flora and Vegetation Assessment, Report prepared for BHP Billiton Iron Ore.

Syrinx Environmental (2012) Wheelarra Hill North Level 2 Flora and Vegetation Assessment, Report prepared for BHP Billiton Iron Ore.

Syrinx Environmental (2014) South West Jimblebar Flora and Vegetation Survey, Report prepared for BHP Billiton Iron Ore.

Tidemann, C., D. Priddel, J. Nelson, and J. Pettigrew (1985) Foraging Behaviour of the Australian Ghost Bat, Macroderma gigas (Microchiroptera: Megadermatidae). Australian Journal of Zoology 33:705-713.

Tille, P. (2007) Resource Management Technical Report 313. *Soil-Landscapes of Western Australia's Rangelands and Arid Interior.* Department of Agriculture and Food Government of Western Australia.

Trudgen, M.E. and Casson, N. (1998) Flora and Vegetation Surveys of Orebody A and Orebody B in the West Angela Hill area and area surrounding them, and of rail route options considered to link them to the existing Robe River Iron Associates rail line. Unpublished report prepared for Robe River Iron Associates, Volume 1, March 1998.

Van Dyck, S., and R. Strahan, editors (2008) Mammals of Australia 3rd Erdition. Australian Museum, Sydney.

van Vreeswyk, A.M.E, Payne, A.L, Leighton, K.A. and Hennig, P. (2004) An inventory and condition survey of the Pilbara region, Western Australia. Western Australian Department of Agriculture Technical Bulletin No. 92.

Western Australian Herbarium [WAH] (2014) *Florabase - Information on the Western Australian Flora*. Department of Parks and Wildlife, Perth, Western Australia. Online: *http://florabase.dpaw.wa.gov.au*

Wildlife Acoustics (2010) A Quick-start Guide to Recording Bats. Available online at http://www.wildlifeacoustics.com

Williams I.R and Tyler, I.M. (1991) Robertson, Western Australia. 1:250 000 Geological Series - Explanatory Notes, Geological Survey of Western Australia, Perth, Western Australia.

Wilson, S., and G. Swan (2010) A complete Guide to Reptiles of Australia. New Holland Publishers, Sydney, Australia.

9.0 Study Team

The Level 1 flora and vegetation survey and Level 1 vertebrate fauna survey was planned, coordinated and executed by the following personnel:

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Mr Morgan O'Connell	BSc	Principal Zooligist (Biologic)
Ms Jessica Waters	Bsc	Botanist
Mrs Kerry Keenan		Data Analyst
Mr Todd Griffin		GIS Specialist

Licences
The field survey was conducted under the authorisation of the following licences issued by the Department of Parks and Wildlife:

- Jerome Bull, Onshore Environmental Consultants 'Licence to take flora for scientific & other prescribed purposes' Licence No. SL009579

APPENDIX 1

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 (DEC)

APPENDIX 2

Vegetation condition scale (as developed by Keighery 1994)

Condition	Code	Description
Pristine	1	Pristine or nearly so, no obvious signs of disturbance.
Excellent	2	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good	3	Vegetation structure altered; obvious signs of disturbance.
Good	4	Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate it.
Degraded	5	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching Very Good condition without intensive management.
Completely Degraded	6	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species.

APPENDIX 3

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.

APPENDIX 4

Conservation Codes for Western Australia Flora

T: Threatened (Declared Rare) Flora - Extant Taxa

Taxa which have been adequately searched for, and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.

1: Priority One - Poorly Known Taxa

Taxa that are known from one or a few collections or sight records (generally less than five), all on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, Shire, Westrail and Main Roads WA road, gravel and soil reserves, and active mineral leases and under threat of habitat destruction or degradation. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes.

2: Priority Two - Poorly Known Taxa

Taxa that are known from one or a few collections or sight records, some of which are on lands not under imminent threat of habitat destruction or degradation, e.g. national parks, conservation parks, nature reserves, State forest, vacant Crown land, water reserves, etc. Taxa may be included if they are comparatively well known from one or more localities but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes.

3: Priority Three - Poorly Known Taxa

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

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

(a) **Rare.** Taxa that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These taxa are usually represented on conservation lands.
(b) **Near Threatened**. Taxa that are considered to have been adequately surveyed and that do not qualify for Conservation Dependent, but that are close to qualifying for Vulnerable.
(c) Taxa that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

5: Priority Five - Conservation Dependent taxa

Taxa that are not threatened but are subject to a specific conservation program, the cessation of which would result in the taxa becoming threatened within five years.

APPENDIX 5

Conservation Codes for Fauna

International Union for Conservation of Nature

Category	Definition
Extinct (EX)	A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Extinct in the Wild (EW)	A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.
Critically Endangered (CE)	A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild.
Endangered (EN)	A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild.
Vulnerable (VU)	A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild.
Near Threatened (NT)	A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future
Data Deficient (DD)	A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

Environment Protection and Biodiversity Conservation Act 1999

Category	Definition
Extinct (EX)	Taxa not definitely located in the wild during the past 50 years.
Extinct in the Wild (EW)	Taxa known to survive only in captivity.
Critically Endangered (CR)	Taxa facing an extremely high risk of extinction in the wild in the immediate future.
Endangered (EN)	Taxa facing a very high risk of extinction in the wild in the near future.
Vulnerable (VU)	Taxa facing a high risk of extinction in the wild in the medium-term future.
Migratory (MG)	Consists of species listed under the following International Conventions: Japan-Australia Migratory Bird Agreement (JAMBA) China-Australia Migratory Bird Agreement (CAMBA) Convention on the Conservation of Migratory Species of Wild animals (Bonn Convention)

Wildlife Conservation Act 1950

Category	Definition
Schedule 1 (S1)	Rare and Likely to become Extinct.
Schedule 2 (S2)	Extinct.
Schedule 3 (S3)	Migratory species listed under international treaties.
Schedule 4 (S4)	Other Specially Protected Fauna.

Department of Environment and Conservation Priority Codes

Category	Definition
Priority 1 (P1)	Taxa with few, poorly known populations on threatened lands.
Priority 2 (P2)	Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands.
Priority 3 (P3)	Taxa with several, poorly known populations, some on conservation lands.
Priority 4 (P4)	Taxa in need of monitoring. Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change.
Priority 5 (P5)	Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

APPENDIX 6

Records for Introduced Weed Species from the Study Area

Waypoint	Genus	Species	Easting_m	Northing_m	MGA Zone
O52	**Acetosa*	*vesicaria*	NA	NA	50
O56	**Bidens*	*bipinnata*	798488.9	7415423	50
O52	**Cenchrus*	*ciliaris*	NA	NA	50
O31	**Cenchrus*	*ciliaris*	NA	NA	50
O24	**Cenchrus*	*ciliaris*	797925.6	7414646	50
O57	**Cenchrus*	*ciliaris*	798487.9	7415372	50
O60	**Cenchrus*	*ciliaris*	798444.4	7415249	50
O5	**Cynadon*	*dactylon*	796590.3	7414575	50
O52	**Malvastrum*	*americanum*	NA	NA	50
O57	**Malvastrum*	*americanum*	798487.9	7415372	50
O52	**Setaria*	*verticillata*	NA	NA	50

APPENDIX 7

Fauna recorded from the study area and immediate vicinity

EPBC Act Protected Matters search with 5 km buffer
DPaW Threatened Species Database search within 5 km buffer

Mammals

Family and Species	Common name	Conservation Status				Surveys								Databases	
		EPBC	WCA	DPaW	IUCN	OB25 Biological Assessment Survey (ecologia, 1995)	OB23 Extension Biological Assessment (ecologia, 1998)	OB 24 Expansion Biological Survey (ecologia, 2004)	Eastern Ophthalmia Range Expansion Biological Survey (ecologia 2004)	OB 24 Flora and Fauna Assessment Phase 2 (ENV, 2006)	Eastern Ridge (OB23/24/25) Vertebrate Fauna Assessment	OB24 Targeted Vertebrate Fauna Survey	Current study	Nature Map	EPBC
TACHYGLOSSIDAE															
Tachyglossus aculeatus	Echidna									●		●			
DASYURIDAE															
Dasycercus blythi	Brush-tailed Mulgara			P4								●			
Dasykaluta rosamondae	Little Red Kaluta							●							
Dasyurus hallucatus	Northern Quoll	EN	S1		EN										●
Ningaui timealeyi	Pilbara Ningaui						●								
Pseudantechinus macdonnellensis	Fat-tailedAntechinus					●									
Sminthopsis macroura	Stripe-faced Dunnart						●								
Sminthopsis youngsoni	Lesser Hairy-footed Dunnart								●						
THYLACOMYIDAE															
Macrotis lagotis	Bilby, Dalgyte	VU	S1		VU										●
MACROPODIDAE															
Macropus robustus	Common Wallaroo					●	●	●	●	●		●			
Macropus rufus	Red Kangaroo, Marlu										●	●			
Petrogale sp.	Rock-wallaby								●						
Petrogale rothschildi	Rothschild's Rock-wallaby											●			
NOTORYCTIDAE															
Notoryctes caurinus	Northern Marsupial Mole	EN													●
MEGADERMATIDAE															
Macroderma gigas	Ghost Bat			P4	VU					●					
HIPPOSIDERIDAE															
Rhinonicteris aurantia	Pilbara Leaf-nosed Bat	VU	S1									●			●
EMBALLONURIDAE															
Saccolaimus flaviventris	Yellow-bellied Sheathtail-bat										●	●		●	
Taphozous georgianus	Common Sheathtail-bat								●		●	●		●	
Taphozous hilli	Hill's Sheathtail-bat						●								
MOLOSSIDAE															
Chaerephon jobensis	Northern Freetail-bat										●	●			
Mormopterus beccarii	Beccari's Freetail-bat						●				●	●			
Tadarida australis	White-striped Freetail-bat										●				
VESPERTILIONIDAE															
Chalinolobus gouldii	Gould's Wattled Bat										●	●		●	
Nyctophilus geoffroyi	Lesser Long-eared Bat											●			
Scotorepens balstoni	Inland Broad-nosed Bat						●								
Scotorepens greyii	Little Broad-nosed Bat						●	●			●	●			
Vespadelus finlaysoni	Finlayson's Cave Bat						●				●	●		●	
MURIDAE															
**Mus musculus*	House Mouse						●	●	●	●					
Notomys alexis	Spinifex Hopping-mouse						●					●			
Pseudomys chapmani	Western Pebble-mound Mouse			P4			●	●	●		●	●			
Pseudomys desertor	Desert Mouse						●		●	●					
Pseudomys hermannsburgensis	Sandy Inland Mouse						●		●	●				●	
Zyzomys argurus	Common Rock-rat						●		●	●		●			

Family and Species	Common name	Conservation Status				Surveys								Databases		
		EPBC	WCA	DPaW	IUCN	OB25 Biological Assessment Survey (ecologia, 1995)	OB23 Extension Biological Assessment (ecologia, 1998)	OB 24 Expansion Biological Survey (ecologia, 2004)	Eastern Ophthalmia Range Expansion Biological Survey (ecologia 2004)	OB 24 Flora and Fauna Assessment Phase 2 (ENV, 2006)	Eastern Ridge (OB23/24/25) Vertebrate Fauna Assessment	OB24 Targeted Vertebrate Fauna Survey	Current study	Nature Map	EPBC
BOVIDAE																
**Bos taurus*	European Cattle						●						●			
CANIDAE																
**Canis lupus dingo*	Dingo						●		●							
**Vulpes vulpes*	Red Fox									●						
EQUIDAE																
**Equus caballus*	Horse						●									
FELIDAE																
**Felis catus*	Cat							●		●			●			
LEPORIDAE																
**Oryctolagus cuniculus*	Rabbit						●			●						
CAMELIDAE																
*Camelus dromedarius	Camel												●	●		

Birds

Family and Species	Common name	Conservation Status				Surveys								Database searches	
		EPBC	WCA	DPaW	IUCN	OB25 Biological Assessment Survey (ecologia, 1995)	OB23 Extension Biological Assessment (ecologia, 1998)	OB 24 Expansion Biological Survey (ecologia, 2004)	Eastern Ophthalmia Range Expansion Biological Survey (ecologia 2004)	OB 24 Flora and Fauna Assessment Phase 2 (ENV, 2006)	Eastern Ridge (OB23/24/25) Vertebrate Fauna Assessment	OB24 Targeted Vertebrate Fauna Survey	Current Survey	DPAW	EPBC
CASUARIIDAE															
Dromaius novaehollandiae	Emu													●	
PHASIANIDAE															
Coturnix ypsilophora	Brown Quail								●						
ANATIDAE															
Anas gracilis	Grey Teal												●	●	
Anas superciliosa	Pacific Black Duck													●	
Aythya australis	Hardhead													●	
Cygnus atratus	Black Swan													●	
RALLIDAE															
Fulica atra	Eurasian coot													●	
Porphyrio porphyrio	Purple Swamphen													●	
PODICIPEDIDAE															
Podiceps cristatus	Great Crested Grebe													●	
Tachybaptus novaehollandiae	Australasian Grebe													●	
COLUMBIDAE															
Geophaps plumifera	Spinifex Pigeon					●	●	●	●	●	●	●	●	●	
Geopelia cuneata	Diamond Dove					●		●	●	●		●			
Geopelia striata	Peaceful Dove								●						
Ocyphaps lophotes	Crested Pigeon						●	●	●	●	●	●	●		
Phaps chalcoptera	Common Bronzewing					●	●		●			●			
PODARGIDAE															
Podargus strigoides	Tawny Frogmouth									●		●			
EUROSTOPODIDAE															
Eurostopodus argus	Spotted Nightjar							●	●	●					
AEGOTHELIDAE															
Aegotheles cristatus	Australian Owlet-nightjar						●	●	●			●			
APODIDAE															
Apus pacificus	Fork-tailed Swift	MG	S3						●						●
PHALACROCORACIDAE															
Phalacrocorax carbo	Great Cormorant													●	
Phalacrocorax sulcirostris	Little Black Cormorant													●	
PELECANIDAE															
Pelecanus conspicillatus	Australian Pelican													●	
ARDEIDAE															
Ardea ibis	Cattle Egret	MG	S3												●
Ardea intermedia	Intermediate Egret													●	
Ardea modesta	Eastern Great Egret	MG	S3											●	●
Ardea pacifica	White-necked Heron						●								
THRESKIORNITHIDAE															
Plegadis falcinellus	Glossy Ibis	MG													●
ACCIPITRIDAE															
Aquila audax	Wedge-tailed Eagle							●		●		●		●	
Haliaeetus leucogaster	White-bellied Sea-eagle	MG												●	
Accipiter cirrocephalus	Collared Sparrowhawk					●		●							

Family and Species	Common name	Conservation Status				Surveys								Database searches	
		EPBC	WCA	DPaW	IUCN	OB25 Biological Assessment Survey (ecologia, 1995)	OB23 Extension Biological Assessment (ecologia, 1998)	OB 24 Expansion Biological Survey (ecologia, 2004)	Eastern Ophthalmia Range Expansion Biological Survey (ecologia 2004)	OB 24 Flora and Fauna Assessment Phase 2 (ENV, 2006)	Eastern Ridge (OB23/24/25) Vertebrate Fauna Assessment	OB24 Targeted Vertebrate Fauna Survey	Current Survey	DPAW	EPBC
Accipiter fasciatus	Brown Goshawk								●			●			
Circus assimilis	Spotted Harrier						●	●	●				●		
Elanus axillaris	Black-shouldered Kite							●					●		
Haliastur sphenurus	Whistling Kite					●	●	●	●	●	●	●	●	●	
Lophoictinia isura	Square-tailed Kite								●						
Milvus migrans	Black Kite												●	●	
Hamirostra melanosternon	Black-breasted Buzzard								●	●				●	
Hieraaetus morphnoides	Little Eagle					●				●	●				
FALCONIDAE															
Falco berigora	Brown Falcon					●	●	●	●	●	●	●			
Falco cenchroides	Nankeen Kestrel					●	●	●	●	●	●	●		●	
Falco longipennis	Australian Hobby							●	●	●	●	●		●	
Falco peregrinus	Peregrine Falcon					●	●					●			
OTIDIDAE															
Ardeotis australis	Australian Bustard			P4	NT						●				
CHARADRIIDAE															
Charadrius ruficapillus	Red-capped Plover	MG												●	●
Charadrius veredus	Oriental Plover	MG	S3												●
Elseyornis melanops	Black-fronted Dotterel												●		
SCOLOPACIDAE															
Calidris acuminata	Sharp-tailed Sandpiper	M	**S3**												●
Calidris ferruginea	Curlew Sandpiper	CE, M	**S3**											●	●
Calidris ruficollis	Red-necked Stint	M	**S3**											●	●
Calidris subminuta	Long-toed Stint	M	**S3**												●
Tringa glareola	Wood Sandpiper	M	**S3**												●
Tringa nebularia	Common Greenshank	M	**S3**												●
Actitis hypoleucos	Common Sandpiper	M	**S3**												●
TURNICIDAE															
Turnix velox	Little Button-quail								●		●			●	
CACATUIDAE															
Eolophus roseicapillus	Galah					●	●		●	●	●	●	●		
Cacatua sanguinea	Little Corella						●		●	●	●	●			
Nymphicus hollandicus	Cockatiel						●	●	●	●	●			●	
PSITTACIDAE															
Barnardius zonarius	Australian Ringneck					●	●	●	●	●	●	●	●	●	
Psephotus varius	Mulga Parrot											●			
Melopsittacus undulatus	Budgerigar					●	●	●	●	●	●		●	●	
CUCULIDAE															
Centropus phasianinus	Pheasant Coucal							●		●					
Chalcites basalis	Horsfield's Bronze-Cuckoo						●	●	●	●			●		
Chalcites osculans	Black-eared Cuckoo						●				●				
Cacomantis pallidus	Pallid Cuckoo					●	●	●	●	●	●		●		
STRIGIDAE															
Ninox novaeseelandiae	Southern Boobook					●	●	●	●	●		●			
TYTONIDAE															
Tyto javanica	Eastern Barn Owl							●							

Family and Species	Common name	Conservation Status				Surveys								Database searches	
		EPBC	WCA	DPaW	IUCN	OB25 Biological Assessment Survey (ecologia, 1995)	OB23 Extension Biological Assessment (ecologia, 1998)	OB 24 Expansion Biological Survey (ecologia, 2004)	Eastern Ophthalmia Range Expansion Biological Survey (ecologia 2004)	OB 24 Flora and Fauna Assessment Phase 2 (ENV, 2006)	Eastern Ridge (OB23/24/25) Vertebrate Fauna Assessment	OB24 Targeted Vertebrate Fauna Survey	Current Survey	DPAW	EPBC
HALCYONIDAE															
Dacelo leachii	Blue-winged Kookaburra						●	●		●	●	●	●	●	
Todiramphus pyrrhopygius	Red-backed Kingfisher					●	●	●		●	●		●		
Todiramphus sanctus	Sacred Kingfisher								●	●				●	
MEROPIDAE															
Merops ornatus	Rainbow Bee-eater	MG	S3					●	●		●	●	●	●	●
PTILINORHYNCHIDAE															
Ptilonorhynchus guttatus	Western Bowerbird					●	●	●	●	●	●	●			
MALURIDAE															
Amytornis striatus whitei	Striated Grasswren					●		●	●	●		●			
Malurus lamberti	Variegated Fairy-wren					●	●	●	●	●	●	●	●	●	
Malurus leucopterus	White-winged Fairy-wren					●	●	●	●	●	●		●		
Malurus splendens	Splendid Fairy-wren							●							
ACANTHIZIDAE															
Pyrrholaemus brunneus	Redthroat					●	●								
Smicrornis brevirostris	Weebill						●	●	●	●	●	●	●	●	
Gerygone fusca	Western Gerygone						●	●		●	●		●	●	
Acanthiza apicalis	Inland Thornbill							●							
Acanthiza robustirostris	Slaty-backed Thornbill						●								
Acanthiza uropygialis	Chestnut-rumped Thornbill					●	●			●	●			●	
PARDALOTIDAE															
Pardalotus rubricatus	Red-browed Pardalote						●	●		●			●	●	
Pardalotus striatus	Striated Pardalote					●	●	●	●	●			●	●	
MELIPHAGIDAE															
Acanthagenys rufogularis	Spiny-cheeked Honeyeater						●	●	●	●			●	●	
Certhionyx niger	Black Honeyeater												●		
Certhionyx variegatus	Pied Honeyeater												●		
Conopophila whitei	Grey Honeyeater						●								
Lichenostomus keartlandi	Grey-headed Honeyeater					●	●	●	●	●	●	●			
Lichenostomus penicillatus	White-plumed Honeyeater						●	●		●	●		●		
Lichenostomus plumulus	Grey-fronted Honeyeater						●								
Lichenostomus virescens	Singing Honeyeater					●	●	●	●	●	●	●			
Lichmera indistincta	Brown Honeyeater					●	●	●	●	●	●			●	
Melithreptus gularis	Black-chinned Honeyeater						●	●		●					
Purnella albifrons	White-fronted Honeyeater					●		●							
Sugomel niger	Black Honeyeater					●					●				
Manorina flavigula	Yellow-throated Miner						●	●	●	●	●	●	●	●	
Epthianura tricolor	Crimson Chat					●						●			
POMATOSTOMIDAE															
Pomatostomus superciliosus	White-browed Babbler						●					●			
Pomatostomus temporalis	Grey-crowned Babbler						●	●	●	●	●	●	●	●	
CAMPEPHAGIDAE															
Coracina maxima	Ground Cuckoo-shrike							●				●			
Coracina novaehollandiae	Black-faced Cuckoo-shrike					●	●	●	●	●		●	●	●	
Lalage tricolor	White-winged Triller					●		●		●			●	●	
PACHYCEPHALIDAE															

Family and Species	Common name	Conservation Status				Surveys								Database searches	
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Pachycephala rufiventris	Rufous Whistler					●	●	●	●	●	●		●	●	
Colluricincla harmonica	Grey Shrike-thrush					●	●	●	●	●	●	●		●	
Oreoica gutturalis	Crested Bellbird						●	●	●	●	●		●	●	
ARTAMIDAE															
Artamus cinereus	Black-faced Woodswallow					●	●		●	●	●	●	●	●	
Artamus minor	Little Woodswallow					●	●	●	●	●		●		●	
Cracticus nigrogularis	Pied Butcherbird					●	●	●	●	●	●	●	●	●	
Cracticus tibicen	Australian Magpie					●	●	●	●	●	●	●		●	
Cracticus torquatus	Grey Butcherbird									●	●				
RHIPIDURIDAE															
Rhipidura albiscapa	Grey Fantail						●								
Rhipidura leucophrys	Willie Wagtail					●	●	●	●	●	●	●	●	●	
CORVIDAE															
Corvus bennetti	Little Crow											●		●	
Corvus orru	Torresian Crow					●	●	●	●	●	●			●	
MONARCHIDAE															
Grallina cyanoleuca	Magpie-lark						●	●	●	●	●	●	●	●	
PETROICIDAE															
Petroica goodenovii	Red-capped Robin						●		●			●	●	●	
Melanodryas cucullata	Hooded Robin					●	●	●	●	●	●				
ALAUDIDAE															
Mirafra javanica	Horsfield's Bushlark									●					
ACROCEPHALIDAE															
Acrocephalus australis	Australian Reed-Warbler													●	
MEGALURIDAE															
Cincloramphus cruralis	Brown Songlark										●				
Cincloramphus mathewsi	Rufous Songlark									●			●	●	
Eremiornis carteri	Spinifexbird					●	●	●	●	●		●			
HIRUNDINIDAE															
Cheramoeca leucosterna	White-backed Swallow					●		●						●	
Hirundo neoxena	Welcome Swallow													●	
Petrochelidon ariel	Fairy Martin					●							●		
Petrochelidon nigricans	Tree Martin					●	●		●	●			●		
NECTARINIIDAE															
Dicaeum hirundinaceum	Mistletoebird						●	●	●	●					
ESTRILDIDAE															
Emblema pictum	Painted Finch					●	●	●	●	●	●	●			
Neochmia ruficauda subclarescens	Star Finch			P4						●			●		
Taeniopygia guttata	Zebra Finch					●	●	●	●	●	●	●		●	
MOTACILLIDAE															
Anthus novaeseelandiae	Richard's Pipit					●	●	●	●						
GLAROLIDAE															
Stiltia isabella	Australian Pratincole													●	

Reptiles

Family and Species	Common name	Conservation Status			Surveys								Database searches	
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AGAMIDAE														
Ctenophorus caudicinctus	Ring-tailed Dragon				●	●	●	●	●	●	●		●	
Ctenophorus isolepis	Crested Dragon					●				●	●			
Ctenophorus reticulatus	Western Netted Dragon													
Lophognathus longirostris						●			●	●	●		●	
Pogona minor					●	●								
DIPLODACTYLIDAE														
Diplodactylus conspicillatus	Fat-tailed Gecko						●	●					●	
Diplodactylus savagei	Yellow-spotted Pilbara Gecko						●						●	
Lucasium stenodactylum	Pale-snouted Ground Gecko						●	●	●					
Lucasium wombeyi							●	●						
Oedura marmorata	Marbled Velvet Gecko				●			●	●					
Rhynchoedura ornata	Beaked Gecko						●							
Strophurus wellingtonae									●					
CARPHODACTYLIDAE														
Nephrurus wheeleri	Banded Knob-tailed Gecko						●		●					
GEKKONIDAE														
Gehyra punctata	Spotted Rock Dtella				●	●		●	●				●	
Gehyra variegata	Tree Dtella				●	●				●			●	
Heteronotia binoei	Bynoe's Gecko				●			●	●				●	
Heteronotia spelea	Desert Cave Gecko							●	●					
PYGOPODIDAE														
Delma borea						●								
Delma haroldi								●						
Delma nasuta							●							
Delma pax						●	●	●			●		●	
Lialis burtonis	Burton's legless lizard				●				●	●				
Pygopus nigriceps	Hooded Scaly foot								●					
SCINCIDAE														
Carlia munda							●		●	●	●		●	
Carlia triacantha	Desert Rainbow Skink									●			●	
Cryptoblepharus carnabyi								●						
Cryptoblepharus ustulatus											●			
Ctenotus ariadnae								●						
Ctenotus duricola							●	●						
Ctenotus grandis							●	●					●	
Ctenotus helenae						●	●	●	●					
Ctenotus leonhardii					●									
Ctenotus pantherinus	Leopard Ctenotus				●	●	●			●	●		●	
Ctenotus quattuordecimlineatus	Fourteen-lined Ctenotus							●						
Ctenotus rubicundus							●							
Ctenotus rutilans	Pilbara Rusty Ctenotus							●			●			
Ctenotus saxatilis	Rock Ctenotus					●	●	●	●	●	●		●	

Family and Species	Common name	Conservation Status			Surveys								Database searches	
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Ctenotus schomburgkii	Barred wedge-tailed Ctenotus									●				
Ctenotus serventyi											●			
Ctenotus uber									●					
Cyclodomorphus branchialis	Gunther's Skink				●									
Cyclodomorphus melanops	Slender Blue-tongue					●		●					●	
Egernia depressa	Pygmy Spiny-tailed Skink					●	●	●		●			●	
Egernia formosa	Crevice Skink						●		●		●			
Eremiascincus richardsonii	Broad-banded Sand Swimmer							●						
Lerista muelleri						●							●	
Lerista neander						●							●	
Lerista zietzi								●	●				●	
Menetia greyii	Dwarf Skink							●					●	
Morethia ruficauda	Fire-tailed Skink							●	●	●	●		●	
Proablepharus reginae										●				
Tiliqua occipitalis	Western Blue-tongue								●					
VARANIDAE														
Varanus acanthurus	Spiny-tailed Monitor				●	●	●	●	●		●		●	
Varanus giganteus	Perentie				●				●		●			
Varanus gouldii	Bungarra or Sand Monitor							●						
Varanus pilbarensis	Pilbara Rock Monitor				●				●		●		●	
Varanus tristis	Black-headed Monitor						●	●	●		●		●	
TYPHLOPIDAE														
Ramphotyphlops ganei				**P1**										
Ramphotyphlops grypus								●						
BOIDAE														
Antaresia perthensis	Pygmy Python				●		●	●	●					
Antaresia stimsoni	Stimson's Python								●				●	
Liasis olivaceus barroni	Pilbara Olive Python	**VU**	**S1**								●			●
ELAPIDAE														
Acanthophis wellsi	Pilbara Death Adder								●					
Brachyurophis approximans	Shovel-nosed snake								●					
Demansia psammophis	Yellow-faced Whipsnake												●	
Furina ornata	Moon Snake								●					
Pseudechis australis	Mulga Snake				●				●		●			
Pseudonaja mengdeni	Western Brown Snake						●		●				●	
Pseudonaja modesta	Ringed Brown Snake								●					

Amphibians

Family and Species	Common name	Conservation Status			Surveys								Database searches	
		EPBC	WCA	DPaW	OB25 Biological Assessment Survey (ecologia, 1995)	OB23 Extension Biological Assessment (ecologia, 1998)	OB 24 Expansion Biological Survey (ecologia, 2004)	Eastern Ophthalmia Range Expansion Biological Survey (ecologia 2004)	OB 24 Flora and Fauna Assessment Phase 2 (ENV, 2006)	Eastern Ridge (OB23/24/25) Vertebrate Fauna Assessment	OB24 Targeted Vertebrate Fauna Survey	Current Survey	Nature Map	EPBC
HYLIDAE														
Cyclorana maini	Main's Frog							●	●					
Cyclorana platycephala	Water-Holding Frog								●					
Litoria rubella	Desert Tree Frog							●	●		●			
MYOBATRACHIDAE														
Uperoleia russelli	Russell's Toadlet							●						
LIMNODYNASTIDAE														
Platyplectrum spenceri	Centralian Burrowing Frog							●						