Appendix D
Biological Assessment

BHP BILLITON
IRON ORE

OREBODY 25 BIOLOGICAL REVIEW AND ENVIRONMENTAL IMPACT ASSESSMENT

OCTOBER
2005

ecologia
ENVIRONMENT

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SUMMARY

BHP Billiton Iron Ore Pty Ltd (BHPBIO) manages mining operations at Orebody 25, which is situated on the Eastern Ridge some eight kilometres north-east of Newman within ML 244SA. Open pit hard rock mining methods are used at Orebody 25 at an ore production rate of approximately 7 million tonnes per annum (Mtpa). Current operations take place at two pits, Pit 1 and Pit 3. BHPBIO is proposing to mine approximately 60 million tonnes of ore remaining at Orebody 25 by expanding the existing pits. The proposal also involves increasing production from the current rate of approximately 7 Mtpa to 8 Mtpa. At the proposed production rate, the proposal is expected to have an eight year mining life. The proposal is known as the Orebody 25 Extension Project (the Project).

The proposal to extend mining at Orebody 25 has resulted in the need to review existing flora and fauna survey data within the Project area. A biological survey of the area has been completed previously (*ecologia*, 1995b), and was recently revised (*ecologia*, 2004a). In order to update the existing biological information available for Orebody 25, BHPBIO commissioned *ecologia* Environment (*ecologia*) to update and expand the vegetation mapping of the Eastern Ridge, undertake a review of the conservation status of flora and fauna found specifically at Orebody 25, conduct a desktop review of species that may potentially occur at the site which are now of conservation significance, and prepare a flora and fauna impact assessment report for the Project.

In 1995 the vegetation of the Orebody 25 area was mapped and classified into four major vegetation types (broadly corresponding to the major topographical features of the area) and 11 sub-types. In September/October 2005 additional vegetation mapping was conducted to include all of the proposed project areas. One additional vegetation type and two additional vegetation sub-types were identified as a result of this mapping. The current vegetation classification for the Orebody 25 area is as follows:

- A *Triodia basedowii* steppes with emergents.
  - A1 *Triodia basedowii* steppe with sparse to very sparse *Eucalyptus* emergents.
  - A2 *Triodia basedowii / T. pungens* steppe with open *Acacia rhodophloia / Acacia aneura* shrub overstorey, often with *Eucalyptus gamophylla* mallee.
  - A3 *Triodia basedowii* steppe.
- B *Triodia wiseana* dominated steppes
  - B1 *Triodia wiseana / Triodia basedowii* steppes.
- C Hill Slopes
  - C1 *Acacia hilliana / Corchorus aff. sidoides / Ptilotus rotundifolius / Grevillea wickhamii* sparse low shrubland, over *Aristida spp.* moderately dense tussock grassland on a moderate midslope.
- D Alluvial Plains
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- E Gullies, Valleys and Drainage Lines.
  - E1 Narrow gullies.
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  - E3 Rocky outcroppings and gully faces.

- E4 Minor drainage lines.
- E5 Creeklines and creekbanks.
- E6 Floodplains.

Fauna habitat types within the Orebody 25 area have been classified into Scree Slope, Spinifex Drainage, Ridges / Hills, Gully and Spinifex Steppe.

The field biological survey of the Orebody 25 area (*ecologia*, 1995b), recorded 211 flora taxa, from 41 families (12 of which were represented by a single taxon) and 93 genera. This flora inventory included two weed species, Ruby Dock (**Acetosa vesicaria*) and Common Sowthistle (**Sonchus oleraceus*), neither of which are listed under the *Agriculture and Related Resources Protection Act 1976* (ARRP) Act.

Two species listed by the Department of Conservation and Land Management (CALM) as 'Priority' flora species have been recorded at Orebody 25.

- *Triumfetta leptacantha* – Priority 3

  Triumfetta. leptacantha is a small shrub to one metre, which grows on rocky outcropping along the upper slopes of gorges and gullies throughout the Pilbara. A few small populations of this species were recorded at Orebody 25 during a survey by BHP Iron Ore Pty Ltd in 2000. A later survey in 2004 by *ecologia* did not record this species, however it was subsequently identified by mine personnel in November 2004 at two locations to the east and west of Pit 3. This species was not recorded during the September/October 2005 vegetation mapping by *ecologia*.

- *Eremophila magnifica ms*

  E. magnifica ms is a relatively large, dense shrub that grows to over a metre. This species grows on skeletal ferritic soils along ridgetops, and along the tops of drainage lines stemming from hilltops. This species has two distinct subspecies, which have been categorised as Priority flora:

  1. *E. magnifica subsp. magnifica ms* (Priority 4); and
  2. *E. magnifica subsp. velutina ms* (Priority 3).

  There is some debate as to the actual taxonomic status of this species. Some consider there to be two distinct subspecies, based primarily on variation in hairs on the leaves. However, due to variation in specimens collected, others now regard it as being without subspecies, simply having natural variation in the leaves (M. Trudgen, pers. comm.). *E. magnifica* ms has been recorded widely in the Eastern Ridge area on several occasions (*ecologia*, 1995a and 2004; BHPIO), and was most recently recorded at two sites during the September/October 2005 vegetation mapping.

The 1995 baseline fauna survey of the Orebody 25 area recorded 47 species of bird, six native and one introduced mammal, and 15 reptiles. Species of conservation significance that were recorded included the Peregrine Falcon (*Falco peregrinus*) (Schedule 4) and Western Pebble-mound Mouse (*Pseudomys chapmani*) (Priority 4). A further 42 species have been identified as having the potential to occur in the Project area based on database and literature searches.

When compared to the flora taxa found at other existing and potential mining areas within 35 km (eg. Orebodies 18 and 25, Jimblebar-Wheelarra Hill, Eastern Ophthalmia Range, and East Jimblebar), the number of taxa found at Orebody 25 is relatively limited. However, few species were found at Orebody 25 that had not been found at the other nearby areas, which suggests that the flora of the area is well-represented regionally. Similarly, comparisons of fauna found at Orebody 25 with the findings of previous surveys in the region show fewer species were recorded, particularly in the number of herpetile and mammal observations. However, the recorded fauna species and habitat types were not unique to Orebody 25 which suggests that the area is not of particular conservation value in terms of fauna.

The relatively low number of flora and fauna taxa of conservation significance that have been recorded at Orebody 25 suggest that the area does not have particular regional or local conservation value in the region. Notwithstanding, management measures should be put in place during operations to minimise disturbance to nesting habitat for the two species of conservation significance known to occur in the area (i.e. the Peregrine Falcon and the Western Pebble-mound Mouse).

Disturbance of vegetation through the proposed Orebody 25 extension project raises the following potential issues for the local flora and fauna: loss of natural vegetation and fauna through the proposed clearing of an additional 230 hectares (particularly the ridgeline habitat type where the majority of the clearing would occur); direct loss of fauna from ongoing mining practices (eg. road kill); and predation or competition by feral species.

In order to minimise the potential impacts of the Project on flora and fauna the following environmental management measures are suggested:

- Weed populations to be monitored, particularly Ruby Dock (**Acetosa vescicaria*) and movement of soil and vehicles to be controlled so that the potential for the spread of weeds within the site is minimised.

- Clearing to be minimised to that absolutely necessary in areas known to contain *Eremophila magnifica* ms. Vegetation clearing permits issued for areas supporting this species should identify the level of potential disturbance and an environmental officer should be present at the clearing site to ensure disturbance is minimised.

- Fauna microhabitats of limited distribution of abundance (e.g. large living or dead standing trees or permanent water sources) to be disturbed as little as possible. Any development of large tracts of specialised habitats (such as mature grasslands, or open eucalypt woodlands) should be cited so as to disrupt and fragment these habitats as little as possible, and to limit the impact of fragmentation to fauna reliant upon such habitats.

- All necessary precautions to be taken during mining operations to prevent fires.

- Vehicle movements to be restricted to designated tracks, and off-road activities limited. Speed limits should be placed upon all haul roads to minimise effects of road kills upon the local fauna.

- Disturbance to areas which contain potential nesting habitat for the Peregrine Falcon (*Falco peregrinus*) and the Western Pebble-mound Mouse (*Pseudomys chapmani*) should restricted to the practicable minimum.

- Clearing operations be kept to a minimum to reduce impact upon surrounding ecosystems. Physical disturbance to ecologically significant sites to be minimised.

- Dust suppression techniques to be applied to roads in use to reduce impact to adjacent vegetation.

1.0 INTRODUCTION

1.1 PROJECT SCOPE

BHP Billiton Iron Ore Pty Ltd (BHPBIO) manages mining operations at Orebody 25, which is situated on the Eastern Ridge some eight kilometres north-east of Newman (Figure 1.1) within ML 244SA, in accordance with Department of Environment (DoE) license number 6942. Open pit hard rock mining methods are used at Orebody 25 at an ore production rate of approximately 7 million tonnes per annum (Mtpa). Current operations take place at two pits, Pit 1 and Pit 3. BHPBIO is proposing to mine approximately 60 million tonnes of ore remaining at Orebody 25 by expanding the existing pits. The proposal also involves increasing production from the current rate of approximately 7 Mtpa to 8 Mtpa. At the proposed production rate, the proposal is expected to have an eight year mining life. The proposal is known as the Orebody 25 Extension Project (the Project).

A biological survey of the area was completed previously (*ecologia*, 1995b), and was recently revised (*ecologia*, 2004a). Since these surveys were completed there have been changes in the conservation status of taxa of fauna and flora within the Pilbara. In order to update the existing biological information available for Orebody 25, BHPBIO commissioned *ecologia* Environment (*ecologia*) to update and expand the vegetation mapping of the Eastern Ridge, undertake a review of the conservation status of flora and fauna that had been previously recorded, conduct a desktop review of species of conservation significance that may potentially occur in the Project area, and prepare a flora and fauna impact assessment report for the Project and undertake vegetation mapping of the area.

1.2 CONTENT OF THIS REPORT

This report contains the following:

- A review of the fauna habitats, and an updated map of vegetation communities in the Project area;
- A review of the regional and local conservation value of flora and fauna that have been previously recorded, or are considered likely to be present, in the Project area;
- A description of flora and fauna species of particular conservation value, such as Scheduled or Priority species, known to occur or considered likely to occur in the Project area;
- A discussion of the potential impacts of the proposed mine extensions on flora and fauna; and
- A discussion of environmental management strategies that could be implemented to minimise the potential impacts on the proposed mine extensions on flora and fauna.

PORT HEDLAND

PORT OPERATIONS

PORT HEDLAND YARRIE RAILWAY

NORTH WEST COASTAL HWY

NIMINGARRA

YARRIE

OLD GREAT NORTHERN HWY

PORT HEDLAND

MARBLE BAR

PILBARA REGION

NEWMAN

RAILWAY

GREAT NORTHERN HWY

MARILLANA CREEK

AREA C

OB 23/25

OB 18

Mt WHALEBACK

JIMBLEBAR

OB 29/30/35

NEWMAN

N

0 10 20 30 40 50km

SCALE 1:2000000

BHP Billiton Iron Ore

LOCATION PLAN OF W.A. OPERATIONS

Figure 1.1

2.0 METHODOLOGY

2.1 DESKTOP REVIEW

A desktop assessment of the flora and fauna of the Project area was undertaken by *ecologia* in August 2005. This assessment included a review of the previous field surveys associated with various existing and proposed BHPBIO mining projects within 50 km of Newman (Table 2.1).

The desktop assessment also included a review of literature sourced from *ecologia*'s in-house reference library, the Department of Environment (DoE) library, the Department of Conservation and Land Management's (CALM's) reference library, and BHPBIO's Perth and Newman offices. Species of fauna were compared with the Western Australian Museum's (WAM's) FaunaBase to determine their current taxonomic and conservation status. Species of flora were referenced relative to the WA Herbarium's FloraBase, and compared to the Declared Rare and Priority Flora List for Western Australia (Atkins, 2005). All weed species were cross-referenced with those listed under the *Agriculture and Related Resources Protection Act 1976* (ARRP Act) to determine specific management strategies for each taxon.

Table 2.1: Biological Surveys Conducted in the Region

Site	Year	Type of survey	Company
Orebody 18	1995	Flora & Fauna	*ecologia*
	1998	Western Pebble-mound mouse relocation	Halpern Glick Maunsell
Orebody 23	1998	Flora & Fauna	*ecologia*
	1998	Rare & Priority Flora	*ecologia*
Orebody 25	1995	Flora & Fauna	*ecologia*
	2000	Rare & Priority Flora	BHPIO
	2004	Rare & Priority Flora	*ecologia*
Jimblebar	1994	Flora & Fauna	Endersby
	1999	Flora	*ecologia*
	2004	Flora & Fauna	*ecologia*
	2004	Flora & (desktop) Fauna	Biota
Eastern Ophthalmia Range	2004	Flora & Fauna	*ecologia*
ML244SA West of the Fortescue River	2001	Flora & (predominantly desktop) Fauna	Biota
East Jimblebar Exploration	2005	Flora & Fauna	*ecologia*

2.2 FIELD SURVEYS

The vegetation types at Orebody25 were first mapped and described in 1995 during the baseline field survey (*ecologia*, 1995). Detailed floristic survey sites were chosen by means of aerial photographs and field observations so that the array of vegetation types present was represented. Survey plots were 100 m × 100 m, or, where habitats were not large enough to contain such a plot, survey sites were arranged to encompass 10,000 m^2.

Data recorded for each survey plot included species presence and abundance in terms of percentage cover. In addition, the vegetation type, life-form strata and percentage cover for each stratun was recorded based upon Beard (1975) and Muir (1977) classification systems.

Physiographic characteristics such as topography, aspect, surface soil type, drainage and litter cover were also recorded for each site.

In September 2005 additional mapping was conducted to expand the coverage of the 1995 vegetation map to include the parts of the proposed new project areas which had not been fully covered. An updated vegetation map for the Orebody 25 area was produced and is included in this report.

3.0 REGIONAL OVERVIEW

3.1 FLORA AND VEGETATION

The project area lies in the Pilbara biogeographic region of the Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway & Cresswell, 1995). This is a system of some eighty biogeographic regions covering the whole of Australia and is the result of collaboration between all State Conservation agencies with co-ordination by the Australian Nature Conservation Agency (ANCA). Bioregions are defined on the basis of climate, geology, landforms, vegetation and fauna.

The Pilbara biogeographic region is similar to that commonly recognised as the Pilbara region, and includes four major components; Hamersley, Fortescue Plains, Chichester and Roebourne. Hamersley, the component relevant to this biological assessment, is summarised by Thackway and Cresswell (1995: 69) as follows:

"Mountainous areas of Proterozoic sedimentary ranges and plateaux with Mulga low woodland over bunch grasses on fine textured soils and Snappy Gum over Triodia on skeletal sandy soils of the ranges".

With an area of 179,287 km^2, the Pilbara bioregion is within the largest area class, with other bioregions varying from 2,372 to 423,751 km^2 (Thackway & Cresswell, 1995) and most being between 14,000 and 200,000 km2 in size. However, the size of the Pilbara bioregion is fairly typical of bioregions situated in remote arid and semi-arid areas.

Dominant limiting factors and constraints for the Pilbara bioregion listed by Thackway and Cresswell (1995) include extinction of critical weight range (CWR) mammals, wildfire, feral animals (in particular cat and fox), weeds, and grazing or pastoral activities. The reservation status of the bioregion is 1 - 5 %, which is relatively low (some bioregions have a greater than 10 % reservation status).

3.2 FAUNA AND FAUNA HABITATS

The main habitat types encountered within the Orebody 25 area are common in the Pilbara and include Scree Slope, Spinifex Drainage, Ridges/Hills, Gully and Spinifex Steppe. A description of the typical characteristics of each is provided below.

In the Pilbara region, the Scree Slope habitat consists of sparse eucalypts and fairly dense spinifex, and generally supports only a moderate number of bird species. Ground dwelling birds, such as the Spinifex Pigeon (*Geophaps plumifera*) and the Spinifex bird (*Eremiornis carteri*), are usually common, while the Eucalypt overstorey supports species such as the Weebill (*Smicrornis brevirostris*) and the Grey-headed Honeyeater (*Lichenostomus keartlandi*). Although the thick spinifex appears structurally homogenous, spinifex clumps provide suitable habitat for a diverse array of fauna.

The Ridge/Hill habitat type found in the Pilbara is generally similar to Scree Slope but has less shrub cover, and usually a Eucalypt/*Corymbia* overstorey. A number of bird species, including the Rufous-crowned Emu-wren (*Stipiturus ruficeps*) and the Striated Grasswren (*Amytornis striatus*), occur. However, most species are generally found in other areas with Eucalypt

woodland. The skink (*Egernia depressa*) is also usually confined to such areas, being found in the Pilbara under rocks and in crevices. The loose rocks and small caves on the open slopes may provide roosting spots for several species of bat, as well as provide shelter for species such as the Fat-tailed False Antechinus (*Pseudantechinus macdonnellensis*) and the Common Rock Rat (*Zyzomys argurus*). The smaller crevices of the rocky slopes are utilised by reptile species such as *Gehyra punctata* and the Ridge-tailed Rock monitor (*Varanus acanthurus*) and the endemic varanid Varanus *pilbarensis*. If the habitat is suitably steep and rocky, rock wallabies *Petrogale* spp. are commonly sighted.

The Spinifex Drainage habitat type in the Pilbara generally consists of dense thickets of *Acacia* species with scattered eucalypts over predominantly sandy soils. A high number of bird species occur in this habitat, including the Crested Pigeon (*Ocyphaps lophotes*), Red-backed Kingfisher (*Todiramphus pyrrhopygia*), Black-chinned Honeyeater (*Melithreptus gularis*), Western Bowerbird (*Chlamydera guttata*) and Grey-headed Honeyeater (*Lichenostomus keartlandi*). Spinifex Drainage habitats are particularly rich in reptiles that utilize the dense vegetation, sandy soil and litter layer. Such reptiles include *Lophognathus longirostris, Delma pax* and burrowing or fossorial species, such as *Lerista zietzi*.

In the Pilbara, the Gully habitat generally provides the most structural diversity, with dense thickets of *Acacia aneura*. Such high habitat heterogeneity provides a rich array of ecological niches for exploitation by invertebrate and vertebrate fauna. The litter layer is rich in ground-dwelling insects, which in turn, support a diverse assemblage of insectivorous bird and reptile species, particularly small fossorial skinks, such as *Carlia munda*. *Morethia ruficauda* is a rock dwelling skink frequently captured in this habitat, as is the gecko *Gehyra punctata.* The Pygmy Python (*Antaresia perthensis*) is commonly recorded within the rocks and the dense gully vegetation.

4.0 FLORA AND FAUNA OF OB25

4.1 VEGETATION

Vegetation mapping was undertaken in the June 1995 survey (*ecologia,* 1995b) using a combination of multivariate analysis of the survey sites and ground truthing. A new vegetation map for the Orebody 25 area has been produced due to changes relating to mining activities and to incorporate the planned areas for development that are outside of those previously mapped. The new map has been updated from the maps presented in the June 1995 report (*ecologia,* 1995b) via ground truthing in September 2005 (Figure 4.1a – 4.1c).

The 1995 vegetation mapping identified four major vegetation types which broadly correspond to the major topographical features of the area. These major vegetation types were further classified into 11 subtypes. As a result of the 2005 vegetation mapping an additional vegetation type, Hill Slopes, and an additional two vegetation sub-types were identified. The current vegetation classification for the Orebody 25 area is as follows:

A *Triodia basedowii* steppes with emergents.
This vegetation type is further subdivided into:

A1 *Triodia basedowii* steppe with sparse to very sparse *Eucalyptus* emergents.

This vegetation type was occasionally found with *Triodia pungens* spinifex. It includes trees of *Eucalyptus leucophloia* subsp. *leucophloia* and mallee of *Eucalyptus gamophylla*. Shrubs such as *Acacia pruinocarpa, A. hilliana, A. adoxa* var. *adoxa* and *A. ancistrocarpa* were also present.

A2 *Triodia basedowii* / *T. pungens* steppe with open *Acacia rhodophloia / Acacia aneura* shrub overstorey, often with *Eucalyptus gamophylla* mallee.

This vegetation type also includes trees of *Corymbia hamersleyana*, *Corymbia deserticola* subsp. *deserticola, Eucalyptus leucophloia* subsp. *leucophloia* and *Hakea chordophylla*.

A3 *Triodia basedowii* steppe.

This vegetation type also includes scattered trees of *Acacia inaequilatera* and *Hakea chordophylla*.

B *Triodia wiseana* dominated steppes
This vegetation type is further subdivided into:

B1 *Triodia wiseana / Triodia basedowii* steppes.

This vegetation type was associated with trees of *Eucalyptus leucophloia* subsp. *leucophloia* and *Hakea chordophylla*, as well as shrubs of *Acacia* spp. and *Senna* spp.

B2 *Triodia wiseana* with herbs and very sparse, low emergents.

This vegetation type was recorded within the proposed Pit 3 area during the 1995 vegetation mapping survey. This vegetation type was not recorded in the current survey as Pit 3 has now been developed.

C Hill Slopes

C1 *Acacia hilliana* / *Corchorus* aff. *sidoides* / *Ptilotus rotundifolius* / *Grevillea wickhamii* sparse low shrubland, over *Aristida* spp. moderately dense tussock grassland on a moderate midslope.

D Alluvial Plains

D1 Open to moderately dense *Eucalyptus gamophylla* over dense *Triodia pungens.*

This vegetation type also includes *Triodia basedowii* spinifex, shrubs of *Acacia* spp. and soft tussock grasses.

E Gullies, Valleys and Drainage Lines.

This vegetation type is further subdivided into:

E1 Narrow gullies – dense *Acacia citrinoviridis* and other trees over *Triodia pungens.*

This vegetation type also includes trees of *Acacia aneura* var. *conifera*, *Acacia pruinocapra* and *Grevillea* aff. *berryana.* Shrubs can include the species *Tribulus suberosus* and often *Eremophila* spp.

E2 Broad gullies – sparse mixed overstorey with mixed *Triodia.*

This vegetation type includes mixed trees of *Acacia aneura* var. *pilbarana*, *Acacia citrinoviridis, Eucalyptus leucophloia* subsp. *leucophloia*, *Corymbia hamersleyana* and / or *Corymbia ferriticola* subsp. *ferriticola*. It can also have shrub species such as *Petalostylis labicheoides, Acacia hamersleyensis* (slender form) or *Keraudrenia integrifolia.*

E3 Rocky outcroppings and gully faces – scattered *Eucalyptus leucophloia* over sparse shrubs and mixed *Triodia*.

This vegetation type has medium to low shrubs of *Acacia pachyacra* and *Ptilotus rotundifolius*, as well as soft tussock grasses of *Eriachne mucronata* (typical form) and *Eriachne lanata*, with some *Triodia basedowii* spinifex in parts.

E4 Minor drainage lines – dense shrubs over *Triodia basedowii*.

This vegetation type includes trees of *Corymbia hamersleyana* and *Eucalyptus leucophloia* subsp. *leucophloia*, and shrubs of *Acacia ancistrocarpa, Grevillea wickhamii* subsp. *hispidula*, *Petalostylis labicheoides* and *Senna* spp. There is usually

spinifex of *Triodia pungens*, sometimes with *Triodia basedowii* and dwarf shrub species.

E5 Creeklines and creekbanks – *Eucalyptus camaldulensis* tall forest and *Acacia citrinoviridis* medium trees, over mixed shrubs, over *Triodia pungens* spinifex and **Cenchrus ciliarus* (Buffel grass) along the banks, with patches of *Typha domingensis* rushes and *Cyperus vaginatus* sedges in the creek channel.

This vegetation type also had other mixed shrubs, and *Stemodia viscosa* along the creek channel.

E6 Floodplains – *Corymbia ferriticola* subsp. *ferriticola* / *Corymbia hamersleyana* tall to medium woodland, *Acacia citrinoviridis* trees, over *Triodia pungens* spinifex and **Cenchrus ciliarus* (Buffel grass).

This vegetation type also has *Acacia aneura* var. *pilbarana* and *Hakea lorea* subsp. *lorea* low trees, as well as *Acacia dictylophleba* and *A. tenuissima* shrubs, also *Themeda triandra* grasses.

The 1995 vegetation mapping identified two subtypes that were not recorded in the 2005 mapping survey. These were:

- *Triodia basedowii* steppe with open juvenile *Eucalyptus leucophloia* / *Acacia pruinocarpa* overstorey. In the 1995 survey this vegetation type was recorded after a small fire or earlier clearing had occurred.
- *Triodia wiseana* with herbs and very sparse, low emergents. This vegetation type was recorded within the proposed Pit 3 area during the 1995 vegetation mapping survey. This vegetation type was not recorded in the current survey as Pit 3 has now been developed.

4.2 FLORA

A biological assessment survey of the Orebody 25 area was carried out in June 1995 (*ecologia,* 1995b). The survey included 27 sites and a total of 211 taxa, from 41 families (12 of which were represented by a single taxon) and 93 genera, were collected from the project area. The most numerously represented families were Amaranthaceae and Mimosaceae (21 taxa each), and Poaceae and Chenopodiaceae (19 taxa each). The most numerously represented genera were *Acacia* (21 taxa), *Ptilotus* (15 taxa), *Senna* (10 taxa), *Maireana* (nine taxa) and *Eremophila* (eight taxa). Of the 211 taxa recorded, 77 were annual taxa. Two weed species, Ruby Dock **Acetosa vesicaria* and **Sonchus oleraceus,* were recorded from the Orebody 25 project area.

No Declared Rare Flora (DRF) species have been recorded within the Orebody 25 area. Two Priority species have been recorded to date: *Eremophila magnifica* ms, and *Triumfetta leptacantha*. A discussion of these two species is provided in Section 5.

4.3 FAUNA

A comprehensive, nine-day field survey was conducted in the Orebody 25 area between June 7th and 15th, 1995 (*ecologia,* 1995b). Four systematic study sites were established to represent the major habitat types within the area, as well as areas with zones of major environmental impacts from the proposed mine development at the time (Figure 4.1a & b). Assessment of the terrestrial vertebrate fauna was carried out using a variety of sampling techniques:

Systematic Sampling: refers to data methodically collected over a fixed period in discrete vegetation community types, using an equal (standardised) sampling effort. Resulting information can be analysed statistically as well as facilitating comparisons within and among sites between seasons.

Systematic surveying was undertaken for mammals, reptiles and amphibians by the use of conventional pit-trap and drift fence techniques and Elliot box traps deployed based upon a CALM Pilbara grid, in conjunction with hand searching and spotlighting. Bird surveys were undertaken at each site for a minimum of 60 minutes across all times of the day.

Bats were surveyed by establishing mist nets over the entrances to caves and flushing bat species out.

Inventory Sampling: includes data collected non-systematically outside fixed sampling sites.

Casual Sampling: refers to data opportunistically collected which is accompanied by little of no detailed habitat descriptions. The data include records of species which were noted while travelling within the project area.

This field survey of the Orebody 25 area recorded 47 species of bird, six native and one introduced mammal, and 15 reptiles (*ecologia*, 1995b). Literature searches, WAM database searches and known habitat preferences suggest that the Orebody 25 area may support approximately 116 bird, 41 mammal, and 107 herpetile species.

Avifauna

The 1995 (*ecologia*) fauna survey of the Orebody 25 area recorded 47 bird species, 17 non-passerines and 30 passerines. The Orebody 25 area is unlikely to support the full complement of bird species at any one time since many species are transitory visitors, especially aerial species such as the raptors. Passerines were the most abundant type of bird, with the Painted Finch (*Emblema pictum*) and the Zebra Finch (*Taeniopygia guttata*) being the most numerous. The Budgerigar (*Melopsittacus undulatus*) and Australian Ringneck (*Barnardius zonarius*) were the most common non-passerine avifauna. The dominance of passerines is typical of an area with little or no permanent water.

Legend

- Disturbance Footprint
- *Triumfetta leptacantha*
- 1995 Flora Survey Site (Position Approximate)
- 1995 Flora and Fauna Survey Site (Position Approximate)

ecologia ENVIRONMENT

Author: C. Slee | Drawn: S. Coleman

Client: BHP BILLITON

Project: ORE BODY 25

OREBODY 25 (WEST) VEGETATION ASSOCIATIONS

A3

Date: 27 October 2005

Scale: 1:10 000

Figure No. 4.1a

Plan No. OB25-004

787000mE
788000mE
789000mE
790000mE
7418000mN
7417000mN

N

SCALE 1 : 10 000

0 500

Metres

AUSTRALIAN MAP GRID
Grid based on Transverse Mercator Projection

R I D G E

Triumfetta leptacantha
Triumfetta leptacantha
OREBODY 25
Triumfetta leptacantha
Triumfetta leptacantha
Triumfetta leptacantha

18
19
17
16
21
15
20
13
12
27

Pit 3
4

Land Farm

Explosive Magazine

Homestead Creek

Legend

- Disturbance Footprint
- *Triumfetta leptacantha*
- 1995 Flora Survey Site (Position Approximate)
- 1995 Flora and Fauna Survey Site (Position Approximate)

ecologia ENVIRONMENT

Author: C. Slee
Drawn: S. Coleman

Client: BHP BILLITON

Project: ORE BODY 25

OREBODY 25 (EAST) VEGETATION ASSOCIATIONS

A3

Date: 27 October 2005
Scale: 1:10 000
Figure No. 4.1b
Plan No. OB25-005

Vegetation Legend

A1 ***Triodia basedowii*** steppe with sparse to very sparse ***Eucalyptus*** emergents.

A2 ***Triodia basedowii / T. pungens*** steppe with open ***Acacia rhodophloia / Acacia aneura*** shrub overstorey, often with ***Eucalyptus gamophylla*** mallee.

A3 ***Triodia basedowii*** steppe.

B1 ***Triodia wiseana / Trodia basedowii*** steppes.

C1 ***Acacia hilliana / Corchorus*** aff. ***sidoides / Ptilotus rotundifolius / Grevillea wickhamii*** sparse low shrubland, over ***Aristida*** spp. moderately dense tussock grassland on a moderate midslope.

D1 Open to moderately dense ***Eucalyptus gamophylla*** over dense ***Triodia pungens.***

E1 Narrow gullies - dense ***Acacia citrinoviridis*** and other trees over ***Triodia pungens.***

E2 Broad gullies - sparse mixed overstorey with mixed ***Triodia.***

E3 Rocky outcroppings and gully faces - scattered ***Eucalyptus leucophloia*** over sparse shrubs and mixed ***Triodia.***

E4 Minor drainage lines - dense shrubs over ***Triodia basedowii.***

E5 Creeklines and creekbanks - ***Eucalyptus camaldulensis*** tall forest and ***Acacia citrinoviridis*** medium trees. over mixed shrubs, over ***Triodia pungens*** spinifex and ****Cenchrus ciliaris*** (Buffel grass) along the banks, with patches of ***Typhus domingensis*** rushes and ***Cyperus vaginatus*** sedges in the creek channel.

E6 Floodplains - ***Corymbia ferriticola*** subsp. ***ferriticola / Corymbia hamersleyana*** tall to medium woodland, ***Acacia citrinoviridis*** trees, over ***Triodia pungens*** spinifex and ****Cenchrus ciliaris*** (Buffel grass).

ecologia ENVIRONMENT

Client: **BHP BILLITON**

Project: **ORE BODY 25**

VEGETATION DESCRIPTIONS

A4

Date: 27 October 2005

Scale: NTS

Author: C.S./ S.C.

Figure No. **4.1c**

Plan No. **OB25-006**

Herpetofauna

The 1995 (*ecologia*) fauna survey of the Orebody 25 area recorded 15 reptile species from seven families (*ecologia*, 1995b). Most of the expected reptilian species have strong affinities with the Eyrean biogeographic region. Some species (*e.g. Strophurus wellingtonae*) are at the northern most part of their range, while others are occurring at the southern most extreme of their range (*e.g. Carlia munda*). Several species, including *Varanus pilbarensis*, *Liasis olivaceus barroni* and *Lerista zeitzi,* have small distributions in the northern/central Pilbara area, encompassing the Orebody 25 area. The most abundant reptile recorded in the area was *Gehyra punctata*, a gecko that typically inhabits rocky micro-habitats.

Mammals

The 1995 (*ecologia*) fauna survey of the Orebody 25 area recorded six native and one introduced species of mammal. The available literature suggests that the area may support up to 34 native species (including 12 species of bats) and seven introduced species. All of the native terrestrial mammals, except the Short-beaked Echidna (*Tachyglossus aculeatus*) and Euro (*Macropus robustus*), have only Eyrean biogeographic affinities. Two Pilbara endemics, the Pebble-Mound Mouse (*Pseudomys chapmani*) and Pilbara Ningaui (*Ningaui timealeyi*) were recorded.

5.0 CONSERVATION SIGNIFICANCE

5.1 FLORA

5.1.1 Conservation Significant Flora Previously Recorded at Orebody 25

Environment Protection and Biodiversity Conservation Act 1999

Flora species are protected at a National level under the Commonwealth *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act). The Act contains a list of species that are considered Critically Endangered, Endangered, Vulnerable, Conservation Dependent, Extinct or Extinct in the Wild (Appendix III).

No species listed under the EPBC Act have been collected at Orebody 25.

Wildlife Conservation Act 1950

Rare Flora species are also protected under the Western Australian Wildlife Conservation (Rare Flora) Notice 2005 of the *Wildlife Conservation Act 1950*. The notice lists protected flora taxa that are extant and considered likely to become extinct or rare. Generally speaking, species of flora are considered as Declared Rare Flora (DRF) or of priority conservation status where their populations are restricted geographically or threatened by local processes. CALM maintains a list of all Declared rare, and Priority Flora within Western Australia (Atkins, 2005). Priority Flora are either poorly known, believed to be uncommon, rare or under threat but have not been designated as DRF and thereby legally protected because the detailed survey work to justify this has not been carried out. Priority species are maintained on a "Reserve List" and assigned to one of four Priority categories (Atkins, 2005) (see Appendix III for definition of categories).

No DRF species listed under the *Wildlife Conservation Act* were located within or in the vicinity of the Orebody 25 area.

Two flora species of Priority conservation status; *Triumfetta leptacantha* and *Eremophila magnifica* ms have been recorded at Orebody 25. A description of each, and where and when they were recorded is provided below.

***Triumfetta leptacantha* – Priority 3**

Triumfetta leptacantha is a small shrub to one metre, which grows on rocky outcropping along the upper slopes of gorges and gullies throughout the Pilbara (Plate 5.1). The spiked fruits of this species tend to be slightly ovate, becoming more so when reaching maturity.

Five small populations (i.e. between 1 and 9 plants) of *Triumfetta leptacantha* were recorded at Orebody 25 in 2000 (BHPBIO, 2000), and are shown on Figure 4.1. It was not recorded during the 2004 rare and priority flora search (*ecologia,* 2004a), despite extensive searches being conducted along the Eastern Ridge (including the areas where it was found in 2000). This may have been due to a number of factors; the largest of the original populations sighted (BHPIO, 2000) consisted of nine plants, it is therefore possible that these populations may not have persisted, or simply that, due to their small size, linked foot traverses over the area did not encounter the populations.

Triumfetta leptacantha was identified by BHPBIO mine personnel in November 2004 at two new locations to the east and west of Pit 3 (Figure 4-1). It was not recorded during the September/October 2005 vegetation mapping.

Potential Impact of the Extension Project

The proposed Orebody 25 Extension Project would involve extensions to the existing pits and OSAs in landform types which generally suit the habitat requirements for *Triumfetta leptacantha* (i.e. rocky upper slopes, gorges and gullies along the Eastern Ridge). All of the locations of *Triumfetta leptacantha* recorded at Orebody 25 in 2000 were located along the crest and slopes of Eastern Ridge. Only two of these populations are located within the proposed project disturbance areas (Figure 4.1), and importantly, subsequent targeted searches in 2004 of the areas where *Triumfetta leptacantha* was found in 2000 failed to find the original populations The two additional populations recorded by BHPBIO near Pit 3 in 2004 are also located outside of the proposed project disturbance areas.

The potential impacts of the proposed project on *Triumfetta leptacantha* is unlikely to be significant because the majority of the previously recorded populations would not be disturbed, and the two previous records that would be affected, appear to no longer contain the species.

Plate 5.1 ***Triumfetta leptacantha***

Eremophila magnifica ms

Eremophila magnifica ms is a relatively large, dense shrub, that may grow over a meter in height, which is known to occur only in the Pilbara region (Plate 5.2). In the Pilbara region this species grows on skeletal ferritic soils along ridgetops, and along the tops of drainage lines stemming from hilltops. *Eremophila magnifica* ms is often regarded as having two distinct subspecies, which have been categorized as priority flora.

- *Eremophila magnifica* subsp. *magnifica* ms. (Priority 4)
- *Eremophila magnifica* subsp. *velutina* ms. (Priority 3)

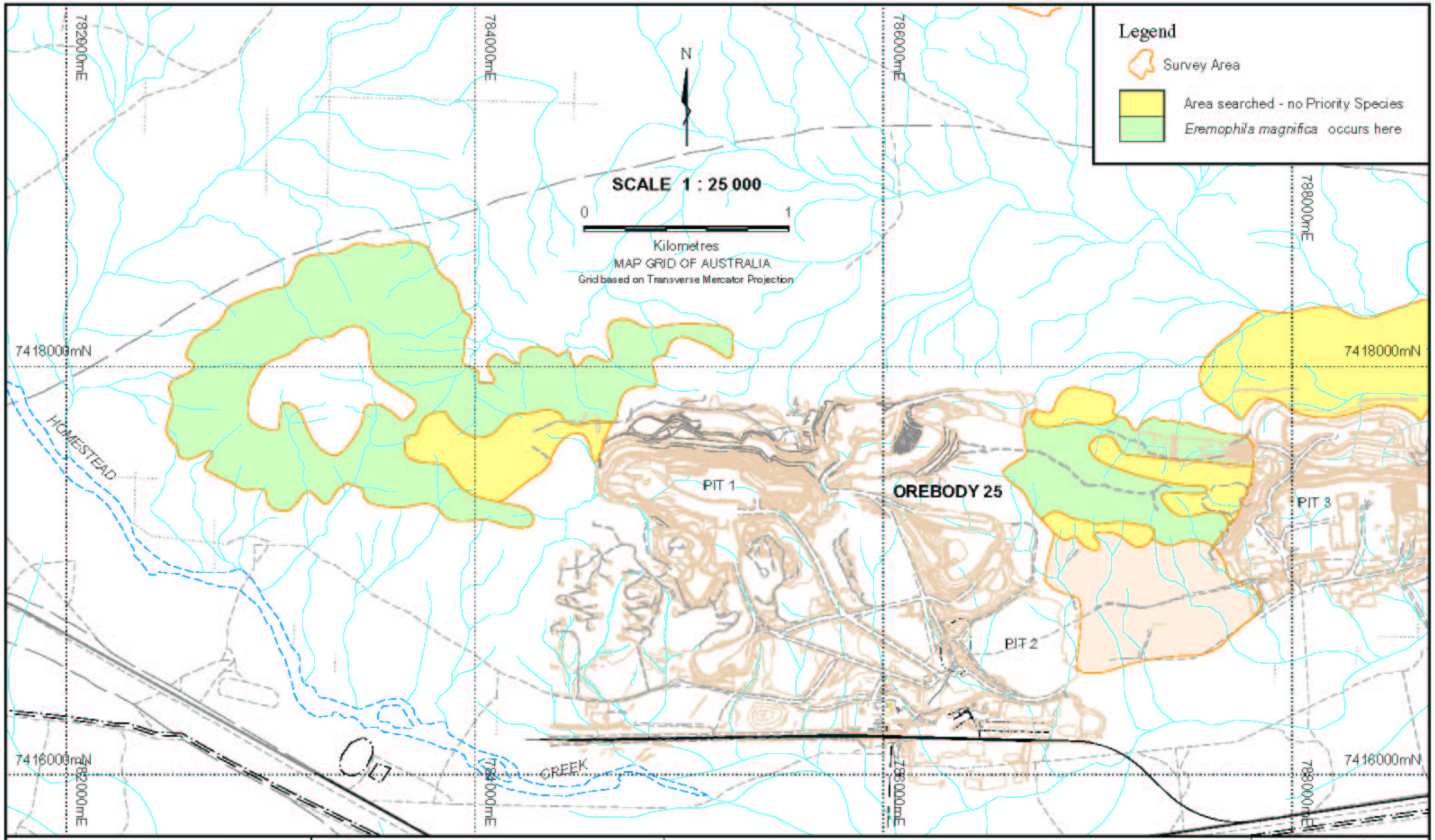
There is some debate as to the actual taxonomic status of this species. Some consider there to be two distinct subspecies, based primarily on variation in hairs on the leaves, however, due to variation in specimens collected, others such as Malcolm Trudgen as well as Andrew Brown (CALM Woodvale Branch) now regard this species to not have variation at a subspecies level, but rather having natural variation in the leaves due to non-linked genes (M. Trudgen, Pers. Comm.).

Eremophila magnifica ms was recorded in 1995 at eight locations (Flora Sites 3, 5, 9, 11, 13, 15, 18, and 25; Figure 4.1)(*ecologia*, 1995). A follow-up survey by *ecologia* in June 2000 found five new populations of *Eremophila magnifica* ms (BHPBIO, 2000). A targeted Rare and Priority flora search conducted by *ecologia* in 2004 recorded *E. magnifica* ms in relatively large numbers along the Eastern Ridge, in particular it was found in the section of ridgeline between Pits 1 and 3, and in large areas to the west of Pit 1 (Figure 5.1). Based on these survey findings *Eremophila magnifica* ms appears to be locally common along the crest and slopes of Eastern Ridge.

Potential Impact of the Extension Project

The proposed Orebody 25 Extension Project would involve additional clearing of areas where *Eremophila magnifica* ms has been recorded, and would be expected to result in the death of some plants. However, the extent of the proposed additional disturbance is relatively small when compared with the area in which the species is known to occur, and as a result the project is unlikely to significantly impact the species or threaten its continued presence at the Eastern Ridge.

Plate 5.2 *Eremophila magnifica* ms at Orebody 25



ecologia ENVIRONMENTAL CONSULTANTS	Client: BHP BILLITON PTY LTD.	DISTRIBUTION OF *Eremophila magnifica* subsp. *magnifica* ms IN THE OB25 PROJECT AREA	Date: 1 September 2005
	Project: EASTERN RIDGE REVIEW		Scale: 1:25 000
			Figure No. 5.1
Author: S.Jarvis	Drawn: S.Coleman	A4	Plan No. OB25-002

5.1.2 Potential Conservation Significant Flora

A search of the CALM Rare and Priority Flora database yielded 24 priority flora species that have been previously recorded within the a 100 km radius of Newman. Details of these species are included in 5.1.

In addition to the CALM database search, a review of Priority flora species recorded during previous flora surveys conducted by *ecologia* in the Newman area was undertaken. This review included three Priority species (*Isotropis winneckei, Rhodanthe frenchii,* and *Sida* sp.Wittenoom – refer to Table 5.2) that had been recorded in nearby areas but were not identified in the CALM database search (Table 5.1). The most likely reason for this is that the *ecologia* surveys reviewed were undertaken after the CALM database search, often by several years. New flora species have been identified as Priorities in the Orebody 25 area subsequent to the original CALM flora database search (*ecologia*, 1995b).

Table 5.1 Priority Flora Previously Recorded within the Newman Area
(Summarised from CALM rare flora search).

SPECIES	PRIORITY	POPULATIONS RECORDED
Dampiera metallorum ms	P3	1
Eremophila caespitosa ms	P3	3
Eremophila magnifica subsp. *magnifica* ms	P4	3
Eremophila pilosa ms	P1	3
Eremophila rigida ms	P1	3
Eremophila spongiocarpa ms	P1	1
Eremophila sp. Ophthalmia Range (D. Brearley s.n. 20/3/2004)	P1	1
Eremophila youngii subsp. *lepidota* ms	P4	7
Eriachne tenuiculmis	P3	2
Fimbristylis sieberiana	P3	1
Gonocarpus ephemerus	P2	1
Goodenia hartiana ms	P2	3
Goodenia lyrata	P1	1
Goodenia modesta	P3	1
Goodenia nuda	P3	3
Goodenia stellata	P4	1
Helichrysum oligochaetum	P1	1
Indigofera gilesii subsp. *gilesii* ms	P3	1
Lepidium catapycnon	DRF	2
Maireana prosthecochaeta	P3	1
Myriocephalus scalpellus	P1	1
Stylidium weeliwolli	P2	4
Tephrosia sp. Cathedral Gorge	P3	1
Triumfetta leptacantha	P3	6

* includes population recorded at Jimblebar by Biota (2004).

Table 5.2 Priority Flora Recorded During Previous Surveys Conducted by *ecologia* Within the Newman Area
(JJunc = Jimblebar Y Junction, WH = Wheelarra Hill, JIM = Jimblebar, OB18 = Orebody 18, OB24 = Orebody 24, OB25 = Orebody 25, EO = East Ophthalmia Range project areas.

Species	Priority	JJunc	WH	JIM	OB18	OB24	OB25	EO
Eremophila magnifica subsp. *magnifica* ms	4						×	
Eremophila sp. Ophthalmia Range (D. Brearley s.n. 20/3/2004)	1							
Goodenia hartiana ms	2		×	×				
Isotropis winneckei	1					×		×
Rhodanthe frenchii	2				×			
Sida sp. Wittenoom	3			×				
Tephrosia sp. Cathedral Gorge (F.H. Mollemans 2420)	3		×			×		
Triumfetta leptacantha	3					×	×	

Eremophila magnifica and *Triumfetta leptacantha* found within the OB25 project area (*ecologia*, 1995b) are discussed in Section 5.1. The following species though not recorded in the OB25 1995 survey have been recorded in areas adjacent to OB25 in other surveys (Table 5.2)

Eremophila sp. Ophthalmia Range (D. Brearley s.n. 20/3/2004) – Priority 1

This taxon was recorded once during a survey of alluvial plain and riverine habitat at the base of OB23, at an area known as Jimblebar Y Junction area to the south east of the Orebody 25 area. Since 2004, this taxon has again been recorded in the same location during a follow-up survey. Recent taxonomic review has suggested that this species, as well as another recorded nearby that has been given the temporary name of *Eremophila* sp. Ophthalmia Dam, are closely related to one another, and these related to *Eremophila margarethae*, to which they probably deserve a position of a subspecies rank (M. Trudgen, Pers. Comm.).

The current uncertainty surrounding these taxa relates to the limited numbers of specimen collection, and the limited number amount of good material for taxonomic review. Most previous collections have been or relatively poor specimen material, but none the less there appears to be differences in hairiness of the flower calyxes.

Potential Impact of the Extension Project

This proposed project involves some additional land disturbance in the alluvial habitat type which occurs adjacent to Homestead Creek. In particular, the proposed extension of the Pit 3 low grade ore stockpile, which is situated to the south of pit 3, and a portion of Pit 3 itself. The total area of additional disturbance required for this stockpile and the portion of Pit 3 is approximately 27.4 ha. *Eremophila* sp. Ophthalmia Range has not been recorded in the proposed disturbance area and is therefore considered unlikely to be significantly affected by the project.

***Goodenia hartiana* ms – Priority 2**

Goodenia hartiana ms is described as a small, multi-stemmed, viscid shrub, which grows on sandy substrates (WA Herbarium, 2005).

This species was recorded at Wheelarra Hill (Jimblebar) by *ecologia* (2004d) on a number of occasions. It was noted that the species occurred in a number of habitats, mainly undulating plains but also on hill slopes, crests, and on one occasion, on the side of a gully (*ecologia*, 2004). Wheelarra Hill is located approximately 35 km to the east of Orebody 25.

Potential Impact of the Extension Project

Goodenia hartiana ms has not been recorded at the Eastern Ridge, despite several priority flora searches and the presence of similar landforms to those found at Wheelarra Hill. It is therefore considered unlikely that *Goodenia hartiana* ms would be significantly affected by the proposed additional clearing of some 230 ha associated with the Orebody 25 extension project.

***Isotropis winneckei* - Priority 1**

Isotropis winneckei (Papilionaceae) is a small perennial herb which produces pink/purple flowers and is usually associated with skeletal soils in sandstone ranges and rocky rises (WA Herbarium, 2005). It has a wide distribution across Western Australia, Northern Territory and Queensland. It has been recorded in the Goldfields at Rawlinson Range (Atkins, 2005), and once at the Eastern Ophthalmia Range in the Pilbara (approximately 10 km to the east of Orebody 25). The Eastern Ophthalmia Range record was within a vegetation type described as scattered *Eucalyptus kingsmillii* low mallee woodland over dwarf scrub and *Triodia* aff. *basedowii* hummock grassland. The site was located on a hillcrest with a moderate slope on red/orange loam soil with coarse, ferrous pebbles.

Potential Impact of the Extension Project

As described above, the only record of *Isotropis winneckei* in the Pilbara region is located some 10 km to the east of Orebody 25 at the Eastern Ophthalmia Range. The vegetation type in which it was found does not occur within the proposed Orebody 25 extension project disturbance areas, and as a result it is considered unlikely that the project would impact this species.

***Rhodanthe frenchii* – Priority 2**

Rhodanthe frenchii has been described as an upright herb to 0.35 m, with yellow flowers, and can be found growing on stony hills, rocky river banks, and outcrops (WA Herbarium, 2005). This species was previously recorded at Orebody 18 by *ecologia* (1995a). Since the initial biological survey of Orebody 18 (*ecologia*, 1995a), this species has been elevated to the conservation status of Priority 2.

Potential Impact of the Extension Project

Rhodanthe frenchii has not been recorded at Orebody 25, despite the presence of similar stoney hills and rocky outcrops to those found at Orebody 18 (where it has been found). It is unlikely that *Rhodanthe frenchii* would be impacted by the proposed Orebody 25 extension project.

Sida sp. Wittenoom(W. R. Barker 1962) – Priority 3

This species is described as being a spreading shrub to 0.6 m tall, with yellow flowers, known to favor disturbed roadsides (WA Herbarium, 2005).

A specimen collected at Wheelarra Hill (Jimblebar) by *ecologia* (2004) was tentatively identified as *Sida* sp. Wittenoom(W.R. Barker 1962). Unfortunately, the specimen was in poor condition, and thus, could not be conclusively identified as *Sida* sp. Wittenoom(W.R. Barker 1962). Searching for this species as part of the Eastern Ridge Review failed to produce any further specimens. Further collection is needed to confirm the identification of this species.

Potential Impact of the Extension Project

Sida sp. Wittenoom(W.R. Barker 1962) has not been recorded at Orebody 25 during the baseline surveys in 1995, priority species surveys in 2000 and 2004 or the additional vegetation mapping of project areas in 2005. The nearest record of this species to the project is at Wheelarra Hill which is some 35 km to the east. It is considered unlikely that this species would be adversely impacted by the proposed Orebody 25 extension project.

Tephrosia sp. Cathedral Gorge (F.H. Mollemans 2420) – Priority 3

Tephrosia sp. Cathedral Gorge (F.H. Mollemans 2420) is a low erect shrub to 25 cm with orange/red pea flowers and found on clay-sand and pebbles. Several populations of *Tephrosia* sp. Cathedral Gorge (F.H. Mollemans 2420) are known from the Pilbara with records from Cathedral Gorge near Newman, and within the Hamersley Range and Fortescue Valley.

During a baseline survey of Orebody 24, *Tephrosia* sp. Cathedral Gorge (F.H. Mollemans 2420) was recorded in a gully base and on a hill slope associated with scattered *Eucalyptus leucophloia* and *Triodia* sp. hummock grasslands (*ecologia* 2004b).

Potential Impact of the Extension Project

As per *Eremophila* sp. Ophthalmia Range (refer to description above), *Tephrosia* sp. Cathedral Gorge (F.H. Mollemans 2420) is considered most likely to occur in the alluvial type. It has not however, been recorded at Orebody 25, and it is therefore considered unlikely that the proposed extension to the Pit 3 low grade ore stockpile and a portion of Pit 3 (i.e. approximately 27.4 ha of additional clearing) would adversely affect this species.

5.1.3 Weeds

Weeds that are, or have the potential to become, pests to agriculture can be formally declared under the *Agriculture and Related Resources Protection Act* (ARRP) 1976. Weeds listed under the Act are listed with a coded definition of the requirements for control. There are five priority groupings and more than one priority may be placed on a weed species. The categories are detailed in Appendix III.

Two introduced species have been recorded at Orebody 25. Neither of these species are listed under the ARRP Act. Although these species are not a threat to agricultural resources (and as

such are not recognised as "weeds" by the ARRP Act), they still represent a threat of degradation to native biodiversity through competition with local endemic flora. Since the aim of this biological assessment is to identify possible affects of mining to the local ecology, introduced species not recognized under the ARRP Act are still of interest under the terms of this survey.

******Acetosa vesicaria* **– Ruby Dock**

Acetosa vesicaria (Ruby Dock) is a highly invasive weed that has become common in disturbed areas from the Pilbara to the Nullabor (Hussey *et al*. 1997). Although this species is not an agricultural weed, and hence is not listed as a declared weed under the ARRP Act, it has been identified by the Environmental Protection Authority (EPA) as a threat to the conservation values of the Pilbara Region. Control of Ruby Dock is made particularly difficult by its strongly developed taproot and prolific seed production. The seeds are dispersed by wind and animals. In addition, it is capable of regenerating from fragments of taproot dispersed by the actions of heavy machinery. Ruby Dock has been recorded at 10 locations within the Orebody 25 area (Site 5, 8, 10, 11, 13, 15, 17, 19, 27, and 28; Figure 4.1). Ruby Dock has also previously been recorded within the Orebody 18, Orebody 23, Orebody 24, and Jimblebar project areas.

******Sonchus oleraceus* **– Common Sowthistle**

Sonchus oleraceus is an annual or short-lived perennial that is widespread in disturbed areas from Wittenoom to the Nullabor (Hussey *et al*. 1997). Sowthistles are spread entirely by seed. The seeds are equipped with a small pappas, which may carry the seed over large distances in strong winds. *Sonchus oleraceus* was recorded in moderately steep valleys at three locations (site 8, 10, and 28; Figure 4.1) within the Orebody 25 area, and has also been previously recorded within the Orebody 18 and Orebody 23 project areas.

5.2 FAUNA

Twenty terrestrial vertebrate species of Scheduled or Priority status have distributions within the Pilbara (WAM, 2005) (Table 5.3). Some of the species listed in Table 5.3, however, are unlikely to occur at Orebody 25 due to habitat restrictions, or geographical distributions that do not extend to any reasonable proximity of Orebody 25. Table 5.4 summarises the species which may occur within the Orebody 25 extension project area.

Bioregional endemic fauna are species which occur only in the Pilbara IBRA Bioregion (Thackway and Cresswell, 1995; updated by Environment Australia, 2000). As such, they represent short-range endemic fauna that are potentially more threatened by development due to their limited geographical range, especially considering the high levels of development and disturbance being undertaken by the resources sector in the Pilbara by comparison to other IBRA regions. Bioregional endemic fauna that may potentially occur within the Orebody 25 extension project area are listed in Table 5.4.

5.2.1 Conservation Significant Fauna Previously Recorded at Orebody 25

- **Peregrine Falcon (*Falco peregrinus*) – Schedule 4**

This species has been previously recorded at Orebody 25 (*ecologia*, 1995b; 2004a). One individual was recorded at Site 5, in a Narrow Gully habitat (*ecologia,* 1995b). The Peregrine Falcon is typically a solitary bird (Ferguson-Lees and Christie, 2001) that is distributed over much of Australia (Debus, 2001), favouring areas with available nesting sites, such as cliffs (Simpson and Day, 2004) and abandoned nests of other raptors in tall, wooded forests (Debus, 2001).

Based on the landforms and mapped vegetation types at Orebody 25 (Section 4.1), habitat potentially suitable for the breeding of this species may occur on the steep rocky slopes and ridge crests which occur along the Eastern Ridge (*ecologia*, 1995b). Similar habitat occurs widely outside the project area along the ridgelines of the Ophthalmia Ranges, however mine developments have resulted in disturbance to these ridgelines in several areas (*i.e.* at Orebodies 18, 24, 25, Eastern Ophthalmia Range, and Jimblebar).

Potential Impact of the Extension Project

The proposed Orebody 25 Extension Project would involve deepening and some widening of the existing pits, which are located along the crest and southern slopes of the Eastern Ridge. It is this rock slope and ridge habitat type which has potential to provide breeding habitat for the Peregrine Falcon. The proposed OSA and low grade ore stockpile extensions are located on the lower slopes of the Ridge and alluvial plain of Homestead Creek, which may be used for foraging but is not regarded as suitable habitat for breeding.

The additional disturbance along the crest of the Eastern Ridge itself would be restricted to a relatively small area less than 500 m either side of the existing pits. Given the proximity to existing mining activities, and the fact that there has been only one record of the Peregrine Falcon at Orebody 25, it is considered unlikely that the proposed additional disturbance associated with the pit extensions would adversely affect the breeding or foraging potential for

this species. It is probable that once mining ceases the residual pit walls would provide more breeding habitat opportunities than were available prior to the commencement of mining at Orebody 25.

- **Pebble-mound Mouse (*Pseudomys chapmani*) – Priority 4**

The Western Pebble-mound Mouse, *Pseudomys chapmani*, was described in 1980. In the past, it was confused with the Sandy Inland Mouse *P. hermannsburgensis*. The Pebble Mound Mouse averages 135 mm in length (including 75 mm tail) and 10 g in weight. It is virtually identical to the Sandy Inland Mouse, being buff brown above and on the sides, with a blackish-brown head and buff/white underbody. The only differences are a slightly shorter tail, ears and feet.

The Western Pebble-mound Mouse inhabits hummock grassland areas of *Triodia*, *Cassia*, *Acacia* and *Ptilotus* on skeletal soils containing an abundance of small (~5 g) pebbles (Start and Kitchener, 1995). These conditions are most common on spurs and the lower slopes of ridges. The Western Pebble-mound Mouse uses the pebbles to construct its mound, the purpose of which is unknown. It has been speculated that the mound is used by the mouse to escape from the heat of the day.

When first described, it was thought that the range of the Western Pebble-mound Mouse had decreased substantially due to the occurrence of unused mounds in the Murchison and Gascoyne. This decline was attributed to foxes, cats and cattle. As such, it was classified as 'fauna that is likely to become extinct or is rare' (Start *et al.,* 2000). Since then, it has been found on many sites associated with development projects, particularly iron ore mining in the Pilbara and is possibly the most abundant small mammal in the region. Its status has subsequently been downgraded to Priority 4 by CALM. The biology of the Western Pebble-mound Mouse enables it to accommodate energetic constraints and a 'boom-bust' life-mode, such that in times of plentiful resources, it is abundant (Start *et al*., 2000).

Since the initial surveys undertaken in the region in the late 1990s, the status of *Pseudomys chapmani* has subsequently been downgraded from CALM Schedule 1 to CALM Priority 4. This is the result of further study confirming that this species is more widespread than initially thought. However, as it is on the Priority list, it still remains a conservation significant species.

This species was recorded during the initial survey (*ecologia*, 1995b), based upon the observation of five mounds in Spinifex Steppe habitat, four of which were old abandoned mounds and one was noted to be visibly active (23 ° 19.543 ′S, 119 ° 47.981 ′S).

Potential Impact of the Extension Project

The additional 230 ha of land disturbance associated with the proposed Orebody 25 Extension Project could potentially impact the Western Pebble-mound mouse as it has been recorded as occurring on the slopes and rocky habitats found at the Eastern Ridge (i.e. one active and four abandoned mounds). It is considered unlikely however, that the additional land clearing would significantly affect the species as large areas of the Eastern Ridge with similar habitat would not be disturbed (e.g. the southern and northern slopes to the west of Pit 1). Notwithstanding, BHPBIO should continue to monitor the conservation status of this species and consult with CALM as necessary with regard to appropriate management measures to minimise impacts.

Table 5.3: Scheduled and Priority Fauna with Distributions in the Pilbara

Class	Species	Common Name	Conservation Status		Habitat	Comment
Mammalia	*Macrotis lagotis*	Bilby, Dalgyte, Ninu	VU	Schedule 1	Occur in *Acacia* shrubland and hummock grassland.	May potentially occur in lowland areas.
Mammalia	*Petrogale lateralis lateralis*	Black-footed Rock Wallaby or Warru	VU	Schedule 1	Rocky ranges. Shelters in crevices and caves.	Habitat suitable. Likely to be present.
Mammalia	*Rhinonicteris aurantius*	Pilbara Leaf-nosed Bat	VU	Schedule 1	Requires deep, warm, humid caves in dry season. May not require caves during wet season.	Habitat suitable.
Mammalia	*Zyzomys pedunculatus*	Antina, Central Rock-rat	CR	Schedule 1	Unknown.	Only recent record is from the MacDonnell Ranges (1996).
Mammalia	*Sminthopsis longicaudata*	Long-tailed Dunnart		Priority 4	Rocky screes with hummock grasses and shrubs.	Habitat suitable, potentially occurs.
Mammalia	*Lagorchestes conspicillatus leichardti* (mainland)	Spectacled Hare-wallaby		Priority 3	Hummock grassland with mid-dense or sparse tree and shrub cover.	Habitat is potentially suitable.
Mammalia	*Macroderma gigas*	Ghost Bat		Priority 4	Requires undisturbed roost caves or mineshafts, usually with several openings.	Habitat suitable.
Mammalia	*Pseudomys chapmani*	Ngadji or Western Pebble-mound Mouse		Priority 4	Stony hillsides with hummock grassland.	Habitat suitable. Recorded in area.
Mammalia	*Leggadina lakedownensis*	Kerakenga or Lakeland Downs Mouse		Priority 4	Stony hummock grassland in the Pilbara.	Habitat suitable.
Mammalia	*Dasyurus hallucatus*	Northern Quoll	EN		Rocky eucalypt woodlands	Habitat suitable
Aves	*Falco peregrinus*	Peregrine Falcon		Schedule 4	Occurs in most land types, but favours cliffs and rocky outcrops.	Habitat suitable. Recorded in area.
Aves	*Falco hypoleucos*	Grey Falcon		Priority 4	Inland drainage systems, frequenting timbered lowland plains (especially *Acacia* shrublands), tussock grassland and open woodland.	May potentially occur in nearby riverine areas.
Aves	*Ardeotis australis*	Australian Bustard		Priority 4	Open grassland, grassy woodland, pastoral land and crops.	Habitat suitable, particularly in the lower areas.
Aves	*Burhinus grallarius*	Bush Stone-curlew		Priority 4	Require sparsely grassed, lightly timbered, open forest or woodland.	Likely to be present in lowland areas.

Class	Species	Common Name	Conservation Status		Habitat	Comment
Aves	*Phaps histrionica*	Flock Bronzewing		Priority 4	Most common in grasslands on black soil plains, but also frequent saltbush, bluebush and hummock grasslands, grassy woodlands and recently burnt areas, roadsides and agricultural land.	Potentially occurs within lowland areas.
Aves	*Tyto novaehollandiae novaehollandiae*	Masked Owl		Priority 3	Forests, woodlands and caves.	Suitable habitat, especially in lowlands. Limited records in the Pilbara.
Aves	*Neochmia ruficauda subclarescens*	Star Finch (western)		Priority 4	Occur in grasslands and eucalypt woodlands close to water. Occurs in low density in the Pilbara.	Suitable habitat in lowlands.
Reptilia	*Liasis olivaceus barroni*	Pilbara Olive Python	VU	Schedule 1	Found in a variety of habitats from monsoon forest to savannah woodland. Especially abundant in rocky hills and ranges.	Habitat suitable, likely to be present.
Reptilia	*Lerista macropisthopus remota*			Priority 2	Leaf litter beneath a wide variety of shrubs and trees.	Only known from Robertson Range and Mundiwindi.
Reptilia	*Ramphotyphlops ganei*			Priority 1		Has been recorded near Newman. Potentially occurs within review areas.

Table 5.4: Species of Conservation Significance that Occur, or Potentially Occur, within the Orebody 25 Project Area

Species	EPBC Act	CALM Priority	WA Wildlife Cons. Act	IUCN Red List	Other	Obs	Pot
Diplodactylus savagei					Bioregional Endemic		+
Diplodactylus wombeyi					Bioregional Endemic		+
Delma elegans					Bioregional Endemic		+
Delma pax					Bioregional Endemic		+
Ctenotus rubicundus					Bioregional Endemic		+
Ctenotus aff. robustus					Bioregional Endemic		+
Egernia pilbarensis					Bioregional Endemic		+
Lerista zietzi					Bioregional Endemic		+
Lerista flammicauda					Bioregional Endemic		+
Lerista neander					Bioregional Endemic		+
Lerista muelleri (undescribed taxa)					Bioregional Endemic		+
Notoscincus butleri					Bioregional Endemic		+
Varanus pilbarensis					Bioregional Endemic		+
Liasis olivaceus barroni	Vulnerable		Schedule 1		Bioregional Endemic		+
Ramphotyphlops ganei		Priority 1			Bioregional Endemic		+
Ramphotyphlops pilbarensis					Bioregional Endemic		+
Acanthophis wellsi					Bioregional Endemic		+
Demansia rufescens					Bioregional Endemic		+
Ardeotis australis		Priority 4		LR/NT			+
Burhinus grallarius		Priority 4		LR/NT			+
Falco hypoleucos		Priority 4		LR/NT			+
Falco peregrinus			Schedule 4			×	
Cacatua leadbeateri			Schedule 4				+
Apus pacificus					CAMBA/JAMBA		+
Ardea alba					CAMBA/JAMBA		+
Merops ornatus	Migratory						+
Neochmia ruficauda subclarescens		Priority 4		LR/NT			+
Phaps histrionica		Priority 4					+
Tyto novaehollandiae		Priority 3					+
Dasyurus hallucatus	Endangered			LR/NT			+
Dasykaluta rosamondae					Bioregional Endemic		+
Pseudantechinus roryi					Bioregional Endemic		+
Ningaui timealeyi					Bioregional Endemic		+

Species	EPBC Act	CALM Priority	WA Wildlife Cons. Act	IUCN Red List	Other	Obs	Pot
Lagorchestes conspicillatus leichardti		Priority 3		LR/NT			+
Leggadina lakedownensis		Priority 4		LR/NT			+
Macroderma gigas		Priority 4		VU A2c			+
Petrogale l. lateralis	Vulnerable		Schedule 1				+
Petrogale rothschildi					Local		+
Pseudomys chapmani		Priority 4			Bioregional Endemic		+
Pseudomys desertor				LR/NT	Local	×	
Sminthopsis longicaudata		Priority 4					+
Saccolaimus flaviventris				LR/NT			+
Tadarida australis				LR/NT			+
Rhinonicteris aurantius	Vulnerable		Schedule 1	VU A1c			+
Macrotis lagotis	Vulnerable		Schedule 1	VU C2a			+

5.2.2 International Union for the Conservation of Nature (ICUN) Listed Species

Thirteen species listed by the IUCN potentially occur in the project area, but have not been recorded to date during the baseline surveys. The majority of these are listed as Low Risk / Near Threatened (LR/NT) (Table 5.4)

- **Desert Mouse (*Pseudomys desertor*) – IUCN Red List LR/NT**

The Desert Mouse (*Pseudomys desertor*) grows to ~ 90 mm long with a ~ 85 mm tail. It weighs, on average, 25 g and is chestnut-brown in colour. The Desert Mouse has a white upper lip and chin and an orange eye ring. Prolonged drought conditions during the 1950s and 1960s explain why this rodent was once considered to be rare. Today it is known that its populations fluctuate significantly in response to rain (Kerle, 1995) and, despite its name, the Desert Mouse may primarily be an inhabitant of wetter micro-habitats. Populations are often associated with water sources such as bores, where permanently moist soils support sedge and grass habitats (Kerle, 1995). The Desert Mouse forms runways through these sedges and is thus protected from extremes of external climate. The Desert Mouse is most common in areas of dense grassland / spinifex throughout central Australia. *Pseudomys desertor* is primarily herbivorous, feeding on the shoots, flowers and seeds of the grasses and sedges that comprise its microhabitat. The Desert Mouse breeds throughout the year if favourable conditions prevail. Gestation is approximately four weeks, with the young mice reaching sexual maturity at ten weeks. The mean litter size is three, such that populations of the Desert Mouse can explode under the right conditions.

This species is considered on the IUCN Red List as being Lower Risk/near threatened. Habitat known to be important for this species potentially exist in the gully habitats described by *ecologia* (1995b). Due to the paucity of habitat descriptions, it is currently uncertain whether these habitats support wet enough microhabitats for this species. Threats to this species can be minimised by not disturbing creeklines that support permanent water sources.

Potential Impact of the Extension Project

The Desert Mouse (*Pseudomys desertor*) has not been recorded at Orebody 25, however potentially suitable habitat for this species occurs along the alluvial floodplain areas adjacent to Homestead Creek. A relatively small proportion of the proposed project disturbance area (i.e. some 27.4 ha of the total 230 ha) would occur in this habitat type (i.e. extension to the Pit 3 low grade ore stockpile and a portion of Pit 3). This amount of clearing is not however, considered likely to significantly affect this species, given it has not been recorded in the area, and the same habitat type occurs extensively along Homestead Creek.

- **Pilbara Leaf-nosed Bat (*Rhinonicteris aurantius*) – VU A1c**

This species weighs 8 – 10 g, and has golden-orange fur (hence its previous common name of Orange Leaf-nosed Bat), and complex nose leaves (Jolly and Hand, 1995). Very little is known of its biology, and most work has focussed dispersal, roost preferences and physiology of the species (Armstrong, 2000; 2001; 2002).

This bat species has a largely Torresian distribution but isolated populations occur in the Pilbara (Jolly and Hand, 1995). It is known to prefer deep, humid caves for roosting although foraging occurs over a wider range of habitats. Mist netting at the entrances to potentially suitable caves and rocky overhangs was conducted during the 1995 baseline fauna survey (*ecologia*, 1995b), however the Pilbara Leaf-nosed bat was not record.

Potential Impact of the Extension Project

As part of the vegetation mapping conducted in September/October 2005 an evaluation was conducted of potential caves and overhangs along the mapped areas of the Eastern Ridge. No deep caves or overhangs were observed that were considered likely to provide suitable roosting or maternity habitat for the Pilbara Leaf-nosed bat (*Rhinonicteris aurantius*). It is therefore considered unlikely that the project would have a significant impact on this species.

- **Ghost Bat (*Macroderma gigas*) – VU A2c**

The Ghost Bat (*Macroderma gigas*) is the largest Microchiropteran bat in Australia. Ghost Bats occur in a variety of habitats, from arid spinifex hillsides, to open tall forest and tropical rainforest (Churchill 1998). Their distribution is determined by the availability of suitable roosting sites. The preferred roosting habitats of Ghost Bats in the Pilbara are caves beneath bluffs of low rounded hills composed of Marra Mamba geology and granite rockpiles. They have also been known to roost in large colonies in sandstone caves, under boulder piles and in abandoned mines (Churchill 1998).

The Ghost Bat is classed as VU A2c by the IUCN, meaning this species is considered to be Vulnerable based on an observed, estimated, inferred or suspected population size reduction of 30 % over the last 10 years or three generations, whichever is longer, where the reduction or its causes may not have ceased or may not be understood or may not be reversible, based on a decline in area of occupancy, extent of occurrence and/or quality of habitat.

Potential Impact of the Extension Project

The Ghost Bat (*Macroderma gigas*) has not been recorded at Orebody 25. As for Pilbara Leaf-nosed Bat (*Rhinonicteris aurantius*), no deep caves or overhangs considered likely to provide suitable roosting or breeding habitat for the Ghost Bat were observed in the proposed disturbance areas during the September/October 2005 vegetation mapping. It is therefore considered unlikely that the project would have a significant impact on this species.

- **Bilby (*Macrotis lagotis*) – VU C2a**

The Bilby is a critical weight-range mammal, and as such is at risk of predation by feral predators such as the cat and the fox. It builds burrow systems that may be up to 3 m long and 1.8 m deep (Johnson, 1995). They shelter in this burrow during the day, only emerging well after dark.

The Bilby was common and widespread throughout much of Australia until the early 20th century when there was a sudden and widespread reduction in both its range and abundance. It is now limited to the central deserts of Australia, and populations appear to still be fragmenting (Johnson, 1995). This reduction is most likely due to a combination of altered fire regimes and the presence of rabbits, livestock and feral predators.

Based upon descriptions of the local vegetation types (Section 4.1), habitats known to be important to this species potentially occur on the sand plains. Depending upon the maturity and quality of the local vegetation, this species may well be present, however the risk to the species can be minimised by reducing disturbance to mature sand-plain ecosystems, and by not heavily dissecting extensive areas of this habitat.

Potential Impact of the Extension Project

The Bilby has not been recorded at Orebody 25, and is considered unlikely to be present in the area due to the lack of suitable habitat and the level of existing human activity (i.e. mining, roads, railways and the nearby township of Newman). The alluvial plains found adjacent to Homestead Creek may represent marginal habitat potential for the Bilby, however it is considered unlikely that the proposed project activities in this habitat type (i.e. clearing of some 27.4 ha associated with the Pit 3 low grade ore stockpile and a portion of Pit 3) would have a significant impact on the species.

- **Australian Bustard (*Ardeotis australis*) – LR/NT**

The Australian Bustard, *Ardeotis australis*, is a large ground-dwelling (although not flightless) bird known to occur in open or lightly-wooded country in Australia and southern New Guinea, but is now extinct in south-eastern Australia. Males grow up to 1.2 m in height and have a wingspan of 2.3 m. Females are slightly smaller. It is unmistakeable in the field, being the only bird of its size and shape. It generally has a brown wings bordered with black and white patches, a grey neck and black crown.

The Australian Bustard is usually encountered either singly, or in small single-sex groups, but it occasionally occurs in flocks of more than 30 in remote areas (Blakers *et al.,* 1984). It is nomadic and may range over very large areas, largely dependent on rainfall and hence food availability. At night it roosts in trees, or on the ground in treeless areas. During the day, they fly out onto the plains for food. *Ardeotis australis* has a varied diet, feeding on grasses, seeds, fruit, insects and small vertebrates. It is commonly seen in areas affected by locust or mouse plagues.

The Australian Bustard breeds when conditions are favourable. In northern Australia, this is generally late in the wet season, or early in the dry (*i.e.* January-March). It does not make a nest, but instead lays one or two light-olive-brown eggs directly onto the ground. The flightless young use camouflage to avoid predators.

Alteration of its grassland habitat by sheep and rabbits, predation by foxes and cats and illegal shooting have caused a great decline in the Bustard's numbers and range in the last century (Frith, 1976). Consequently, it has been listed as Priority 4 by CALM. This means that the Australian Bustard has been adequately surveyed, and is not considered to be currently threatened, but could be if present circumstances change.

Potential Impact of the Extension Project

This species is not particularly habitat-specific and has not been recorded at Orebody 25 to date. However, elsewhere in the Pilbara it is known to use vegetation types (Section 4.1) similar to those found at Orebody 25. Breeding habitats for this species tend to be associated

with low aspect areas, such as grasslands and shrublands. Potentially suitable habitats for the species do exist within the proposed project disturbance areas, but these habitats are well-represented outside the project area, and the species is not likely to be seriously adversely affected by the proposed additional clearing.

- **Bush Stone-curlew (*Burhinus grallarius*) – LR/NT**

The Bush Stone-curlew has a distribution covering the majority of the continent and also occurs on offshore islands. They are most common in areas where land disturbance is minimal, and hence have become rare or extinct near human settlements. Preferred habitat is grassy woodland, and they are almost absent in rainforest and bare deserts (Frith, 1976).

Bush Stone-curlews are usually seen singly or in pairs, however during the breeding season between August and January small flocks gather. The species is non-migratory and ground-dwelling, feeding on invertebrates (Frith, 1976). As such, they are quite susceptible to disturbance in the local area, and unlikely to move away from their established home ranges.

Potential Impact of the Extension Project

The Bush Stone-curlew (*Burhinis grallarius*) has not been recorded at Orebody 25 to date, however potentially suitable habitat for the species occurs in the alluvial plains adjacent to Homestead Creek. It is considered unlikely that the proposed project activities in this habitat type (i.e. clearing of some 27.4 ha associated with the Pit 3 low grade ore stockpile and a portion of Pit 3) would have a significant impact on the species.

- **Grey Falcon (*Falco hypoleucos*) – LR/NT**

The Grey Falcon is an infrequently observed, uncommon bird of prey, which inhabits Australia's arid zone. Preferred habitat includes shrubland, grassland and wooded watercourses (Debus, 2001; Ferguson-Lees and Christie, 2001; Slater *et al.*, 2003; Simpson and Day, 2004). This species is known to nest in disused stick nests of other birds, particularly corvids and other raptors (Debus, 2001; Ferguson-Lees and Christie, 2001; Slater *et al.*, 2003). Diet consists mainly of other birds (Aumann, 2001; Debus, 2001), but may include other prey, such as small mammals, reptiles and insects (Debus, 2001; Ferguson-Lees and Christie, 2001).

Potential Impact of the Extension Project

This species has not been recorded at Orebody 25 to date. It is not particularly habitat-specific, and may use several of the local vegetation types (Section 4.1). Breeding habitats for this species tend to be associated with woodlands, especially wooded watercourses like Homestead Creek and the Fortescue River. As such, potentially important habitats for the species exist near to (but outside of) the proposed project disturbance areas. The species is, however not likely to be seriously adversely affected by the proposed Orebody 25 extension project.

- **Star Finch (*Neochmia ruficauda subclarescens*) – LR/NT**

The Western race of the Star Finch (*Neochmia ruficauda subclarescens*) is generally found in and around grassland near water (Slater *et al.,* 2003; Simpson and Day, 2004). They feed

exclusively upon grass seeds, however during the breeding season are known to take termites and flying ants as well (Frith, 1976). Presumably this is due to a high protein or fat requirement associated with breeding. Habitat known to be important for this species potentially exist in the gully habitats described by *ecologia* (1995b).

Potential Impact of the Extension Project

The proposed project would require some clearing of the gully habitat type which has the potential to be used by the Star Finch (*Neochmia ruficauda subclarescens*). However, the species has not been recorded at Orebody 25 during the baseline surveys, and similar habitat occurs elsewhere on Eastern Ridge in areas that will not be disturbed. As a result no significant adverse affects on this species are expected as a result of the proposed project.

- **Northern Quoll (*Dasyurus hallucatus*) – LR/NT**

The Northern Quoll is the least well-known of all quolls, due to the paucity of survey work undertaken in northern Australia (Braithwaite and Begg, 1995). It formerly occurred across northern Australia from the Pilbara to south-east Queensland. It is now restricted to several highly disjunct areas within its former range. It is found in wooded habitats, and is most abundant in rocky and broken country in open Eucalypt forest. It is arboreal and quite aggressive. They have suffered substantial range reduction following European settlement, but unlike the other quolls, this is a recent development, occurring within living memory in some areas. Reasons for its population decline may be predation by introduced animals such as dogs, foxes, cats and poisoning by cane toads, or it may be in competition with introduced carnivores. Also, the Northern Quoll may be a victim of habitat loss, as much of its former range is now used for rangelands agriculture and grazing.

The Northern Quoll has not been recorded at Orebody 25, however based upon descriptions of the local vegetation types (Section 4.1), habitats potentially used by this species occur on steep rocky slopes and ridge crests.

Potential Impact of the Extension Project

It is considered unlikely that the additional land clearing associated with the project would significantly affect the Northern Quoll as it has not been recorded during the previous surveys.

- **Spectacled Hare-wallaby (*Lagorchestes conspicillatus*) – LR/NT**

This species is noted for its reliance upon specialised habitat of hummock grasses at a suitable seral stage (Burbidge and Johnson, 1995). The species is abundant on Barrow Island; however the mainland population has declined drastically since European settlement. It has been suggested that this decline may be in part due to frequent burning of the spinifex grasslands, preventing the development of hummocks large enough to provide the wallabies with shelter (Burbidge and Johnson, 1995).

The Spectacled Hare-wallaby has not been recorded at Orebody 25.

Potential Impact of the Extension Project

Potentially suitable habitat for the Spectacled Hare-wallaby may occur in the alluvial plains adjacent to Homestead Creek. However, it has not been recorded at Orebody 25 and it is considered unlikely that the proposed project activities in this habitat type (i.e. clearing of some 27.4 ha associated with the Pit 3 low grade ore stockpile and a portion of Pit 3) would have a significant impact on the species.

- **Lakeland Downs Mouse (*Leggadina lakedownensis*) – LR/NT**

Covacevich (1995) notes that this species is secretive and apparently rare, yet the only two known voucher collections were made at sites where the mice were common enough to be hand-captured. This in itself suggests that the species persists in a "boom-bust" life cycle. Although virtually nothing is known about the mouse's biology, in captivity it thrives on a diet of seeds, is nocturnal, and breeds readily with a gestation period of 30 days. It is a moderately sized (15 – 20 g) mouse that is distinguished from other species of *Leggadina* by skull morphology (Covacevich, 1995), and was first identified in 1976. Covacevich (1995) suggests that the western populations (i.e. those in the Pilbara) may represent a unique and undescribed species of *Leggadina*. Habitat potentially important for this species potentially exist in the gully habitats described by *ecologia* (1995b).

Potential Impact of the Extension Project

The proposed project would require some clearing of the gully habitat type which has the potential to be used by the Lakeland Downs Mouse. However, the species has not been recorded at Orebody 25, and similar habitat occurs elsewhere on Eastern Ridge in areas that will not be disturbed. As a result no significant adverse affects on this species are expected as a result of the proposed project.

- **Yellow-bellied Sheathtail Bat (*Saccolaimus flaviventris*) – LR/NT**

The Yellow-bellied Sheathtail Bat is widespread in Australia, and is the only emballonurid to extend far into the temperate regions of Australia. They roost in tree hollows, and tend to be solitary for much of the year. The species has been found in all habitats in Australia, from deserts to wet sclerophyll forest (Churchill, 1998; Richards, 1995a).

Based upon descriptions of the local vegetation types (Section 4.1), potential habitats for this species occur on the alluvial plains adjacent to Homestead Creek. This species roosts in the hollows of large standing trees (Richards, 1995a).

Potential Impact of the Extension Project

Potentially suitable habitat for the Yellow-bellied Sheathtail Bat may occur in the alluvial plains adjacent to Homestead Creek. However, it has not been recorded at Orebody 25 and it is considered unlikely that the proposed project activities in this habitat type (i.e. clearing of some 27.4 ha associated with the Pit 3 low grade ore stockpile and a portion of Pit 3) would have a significant impact on the species.

- **White-striped Mastiff Bat (*Tadarida australis*) – LR/NT**

The White-striped Mastiff Bat *Tadarida* (then *Nyctinomus*) *australis* is noted by Richards (1995b) as the largest of the Australian free-tailed bats, averaging 36 g. It is distinctly coloured, with stripes of white fur along its flanks and underside of the wings. This species exploits food resources that are not targeted by many other species. It flies fast and high above the tree canopy, often favouring dry creeklines of inland Australia. It has been known, however, to hunt on the ground where it is surprisingly agile in the search of terrestrial insects (Richards, 1995b), and unlike other bats it can launch directly into the air following such activities. They roost in small groups in tree hollows, dead stumps, under loose bark and in the ceilings of buildings. Little is known about their breeding biology, except that pregnant females have been recorded in spring and early summer. Habitats potentially important to this species may occur on the alluvial plains adjacent to Homestead creek.

Potential Impact of the Extension Project

As for the Yellow-bellied Sheathtail Bat, no significant impacts on this species are expected since it has not been recorded in the area, and because the proposed disturbance area in the alluvial plain habitat type is relatively small (i.e. some 27.4 ha of a total of 230 ha).

5.2.3 Species Protected by International Agreements

Two international agreements exist to protect migratory birds: the Japan Australia Migratory Birds Agreement (JAMBA) and the China Australia Migratory Birds Agreement (CAMBA). No species protected under these international agreements have been recorded at Orebody 25, however two potentially occur there (Table 5.4):

- **Fork-tailed Swift (*Apus pacificus*) – JAMBA / CAMBA**

This species is a relatively common trans-equatorial migrant in October to April throughout mainland Australia (Slater *et al*., 1991). They usually come into Australia following the hot winds generated by low pressure storm systems (Frith, 1976). They feed exclusively on insects, and are aerial foragers, with no reliable reports of them coming to land (Frith, 1976).

Potential Impact of the Extension Project

The species does not breed in Australia. Due to their high-altitude lifestyle, and the low impact of mining activities upon their food sources, they are unlikely to be affected by the proposed Orebody 25 extension project.

- **Great Egret (*Ardea alba*) – JAMBA / CAMBA**

The diet of this species consists of a range of small, aquatic invertebrates (Frith, 1976). As such, it is restricted to lakes, swamps and other watercourses. None of the habitats that would be affected by the Orebody 25 extension project contain permanent water sources.

Potential Impact of the Extension Project

The Great Egret has not been recorded at Orebody 25, and is considered unlikely to be significantly affected by the proposed project.

5.2.4 Environmental Protection and Biodiversity Conservation Act 1999

No species listed under the EPBC Act have been recorded within the site; however, six species potentially occur (Table 5.4).

- **Pilbara Olive Python (*Liasis olivaceus barroni*) – Vulnerable**

Distinguished as a separate subspecies, *Liasis olivaceus barroni* can grow up to 4.5 m long and weigh more than 15 kg. It is pale fawn to brown or olive-brown above, merging with a white or cream ventral surface. It has smooth scales, in 55-80 rows at midbody (Cogger, 2000).

The Pilbara subspecies of Olive Python is geographically distinct from the Kimberley subspecies *Liasis olivaceus olivaceus*, and its apparent rarity has caused it to be listed by the IUCN as vulnerable and by state legislation as Schedule 1. Despite this, considerable numbers are killed on Pilbara roads each year due to its tendency to freeze in response to oncoming vehicles. Furthermore, a recent study (Pearson, 2003) indicates that *Liasis olivaceus olivaceus* is widespread across the Pilbara and that there are a number of sizeable populations.

A nocturnal ambush predator, *Liasis olivaceus barroni* is generally, although not exclusively associated with permanent water, such as riverine woodland areas, large rock holes and swamps. This association is due to the permanent water being an important lure for suitably sized prey. *Liasis olivaceus barroni* has been known to make long excursions into rocky flat-topped hills neighbouring water sources. Large specimens have been seen to feed on a variety of birds (corellas, pigeons, ducks) and mammals (fruit bats, small euros, rock wallabies), with smaller snakes probably feeding mainly on reptiles and frogs (Pearson, 2003).

Liasis olivaceus barroni breeds during June to August. Males track females by scent and when they have found one, they usually retire to a cave for up to three weeks, during which time they probably mate numerous times. The male then leaves the female, who lays her eggs during October. Nothing is known of the number of eggs laid, although the young hatch and disperse in January.

Liasis olivaceus barroni has not been recorded at Orebody 25, however habitat potentially suitable for this species exist in the gully habitats described by *ecologia* (1995b).

Potential Impact of the Extension Project

The proposed project would require some clearing of the gully habitat type which has the potential to be used by the Pilbara Olive Python (*Liasis olivaceus barroni*). However, the species has not been recorded at Orebody 25, and similar habitat occurs elsewhere on Eastern Ridge in areas that will not be disturbed. As a result no significant adverse affects on this species are expected as a result of the proposed project.

- **Black-footed Rock Wallaby (*Petrogale lateralis*) – Vulnerable**

Petrogale lateralis is a diverse species, with three subspecies and two chromosomal races:

P. lateralis lateralis	Black-footed Rock Wallaby
P. lateralis hacketti	Recherché Rock Wallaby
P. lateralis pearsoni	Pearson Island Rock Wallaby
P. lateralis MacDonnell Ranges race	Black-footed (MacDonnell Ranges race)
P. lateralis West Kimberley race	Black-footed (West Kimberley race)

Taxonomic identities of many populations have not yet been determined (Pearson and Kinnear, 1997).

Petrogale lateralis lateralis has declined throughout its mainland range, with extant populations known from six localities in the Wheatbelt, Cape Range, the Calvert Range, and Barrow and Sailsbury Islands (Pearson and Kinnear, 1997). Local and regional extinctions are still occurring (Pearson and Kinnear, 1997). The conservation status of the species is of immediate concern, as one of its subspecies and one chromosomal race have suffered drastic declines in distribution and abundance (Pearson and Kinnear, 1997). Male *P. l. lateralis* weigh 4.1-5.0 (4.5) kg, and females, 3.1-3.8 (3.5) kg (Eldridge and Close, 1997).

The cliffs identified by *ecologia* (1995b) as a part of the Narrow Gorge habitats, and the steep rock habitats described in section 4.1 may support *Petrogale* species.

Potential Impact of the Extension Project

The proposed Orebody 25 Extension Project would involve deepening and some widening of the existing pits, which are located along the crest and southern slopes of the Eastern Ridge. It is this rock slope, gorge and ridge habitat type which has potential to provide habitat suitable for the *Petrogale lateralis*. The proposed OSA and low grade ore stockpile extensions are located on the lower slopes of the Ridge and alluvial plain of Homestead Creek, which are less likely to be suitable habitat for this species.

The additional disturbance along the crest of the Eastern Ridge itself would be restricted to a relatively small area less than 500 m either side of the existing pits. Given the proximity to existing mining activities, and the fact that there has been no records of *Petrogale lateralis*.at Orebody 25, it is considered unlikely that the proposed additional disturbance associated with the pit extensions would adversely affect the species.

- **Rainbow Bee-eater (*Merops ornatus*) – Migratory**

This species lives almost anywhere suitable for hawking insects. It migrates between Australia and Japan, breeding in New Guinea and Australia. This species was not observed in the project area, which may be unusual, since Blakers *et al* (1984) note that some populations overwinter in areas north of 26 °S.

Potential Impact of the Extension Project

Although habitats for this species occur in the project area, the species is not particularly habitat specific, feeding over almost every habitat available. This species constructs nesting

burrows in sand banks, however the species is also known to migrate to the southern half of the state to breed (Blakers *et al*., 1984). It has not been recorded at Orebody 25 to date and no significant impacts on the species are expected as a result of the project.

- **Pilbara Leaf-nosed Bat (*Rhinonicteris aurantius*) – Vulnerable**
- **Bilby (*Macrotis lagotis*) – Vulnerable**
- **Northern Quoll (*Dasyurus hallucatus*) – Endangered**

These species have been previously discussed in Section 5.2.2.

5.2.5 WA Wildlife Conservation Act 1950

One Schedule 4 species, the Peregrine Falcon (*Falco peregrinus*), has been opportunistically recorded within Orebody 25 (*ecologia*, 1995b) (Table 5.4). Five additional species have the potential to occur in the area:

- **Pilbara Olive Python (*Liasis olivaceus barroni*) – Schedule 1**
- **Black-footed Rock Wallaby (*Petrogale lateralis*) – Schedule 1**
- **Pilbara Leaf-nosed Bat (*Rhinonicteris aurantius*) – Schedule 1**
- **Bilby (*Macrotis lagotis*) – Schedule 1**

These species have been previously discussed in Section 5.2.2.

5.2.6 CALM Priority Fauna

Only one CALM Priority Fauna were recorded within the Orebody 25 area, the Pilbara Pebble-mound Mouse (*Pseudomys chapmani*) (Priority 4), however 11 additional species may occur in the area:

- ***Ramphotyphlops ganei* – Priority 1**

Only described as a new species in 1998 (Aplin, 1998), virtually nothing of the ecology or biology of *Ramphotyphlops ganei* is known. Like all *Ramphotyphlops* species, it is a small, worm-like burrowing snake, which probably feeds primarily on ants and termites. *Ramphotyphlops* species often inhabit termite mounds. This species is known only from a small number of specimens collected near Port Hedland and a specimen collected by *ecologia* (2005) on the Roy Hill Exploration survey. As such, it is classified as Priority 1 by CALM.

Potential Impact of the Extension Project

This species is not particularly habitat-specific, and is expected to utilise several of the local vegetation types (Section 4.1). Potentially important habitats for this species are likely to be associated with low aspect areas, such as grasslands, shrublands and woodlands which support large populations of termites. As such, important habitats for the species exist within the proposed disturbance areas (particularly the OSA and low grade stockpile extensions), but are likely to be well-represented outside the project area, and the species is not likely to be seriously adversely affected by the loss of these habitats at Orebody 25.

- **Masked Owl (*Tyto novaehollandiae*) – Priority 3**

This species is nominally associated with open forest and woodland, but also occurs in treeless country, where it shelters in caves (Frith, 1976). Based upon descriptions of the local vegetation types (Section 4.1), habitats known to be important to this species potentially occur on the base plains adjacent to Homestead Creek.

Potential Impact of the Extension Project

Very little is known about the species, including its breeding habits. As a result, it is unclear just how much disruption presents a threat to it. However, given the proposed disturbance to the alluvial habitat type is relatively small, and it is an extension to an existing mining operation, it is unlikely that the project would significantly affect this species.

- **Flock Bronzewing (*Phaps histrionica*) – Priority 4**

Frith (1976) notes that this is one of the most gregarious of pigeons, living and breeding in loose groups of several hundreds of birds. Much in the manner of the North American Passenger Pigeon (*Ectopistes migratorius*, now extinct), the Flock Bronzewing was noted at the time of European settlement as occurring in flocks of thousands. This startling population decline is attributed to agricultural destruction of native grasslands. They fly for several kilometres each day in search of water.

Potential Impact of the Extension Project

Potentially suitable habitat for the Flock Bronzewing may occur in the alluvial plains adjacent to Homestead Creek. However, it has not been recorded at Orebody 25 and it is considered unlikely that the proposed project activities in this habitat type (i.e. clearing of some 27.4 ha associated with the Pit 3 low grade ore stockpile and a portion of Pit 3) would have a significant impact on the species.

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

This species occupies rocky hills and mesas. Little is known of the biology of this species (Burbidge *et al*, 1995). A total of four specimens from the Pilbara region, all from areas to the south have been lodged with the WA Museum. Based upon descriptions of the local vegetation types (Section 4.1), habitats potentially important to this species may occur on steep rocky slopes and ridge crests.

Potential Impact of the Extension Project

The additional disturbance along the crest of the Eastern Ridge itself would be restricted to a relatively small area less than 500 m either side of the existing pits. Given the proximity to existing mining activities, and the fact that there has been no records of the Long-tailed Dunnart at Orebody 25, it is considered unlikely that the proposed additional disturbance associated with the pit extensions would adversely affect the species.

- **Spectacled Hare-wallaby (*Lagorchestes conspicillatus*) – Priority 3**
- **Australian Bustard (*Ardeotis australis*) – Priority 4**
- **Bush Stone-curlew (*Burhinus grallarius*) – Priority 4**

- **Star Finch (*Neochmia ruficauda subclarescens*) – Priority 4**
- **Grey Falcon (*Falco hypoleucos*) – Priority 4**
- **Lakeland Downs Mouse (*Leggadina lakedownensis*) – Priority 4**
- **Ghost Bat (*Macroderma gigas*) – Priority 4**

These species have been discussed in Section 5.2.2.

5.2.7 Other Specially Protected Fauna

Bioregional Endemic Species

Very little is known about bioregional endemic invertebrates in the Pilbara (Kendrick and McKenzie, 2001), however 22 bioregionally endemic vertebrates are listed (Table 5.4). Most of these are relatively common within the Pilbara, and do not require highly specialised habitats. Due to their low mobility, the majority of these species are reptiles (18 species). Unfortunately, the majority of the endemic vertebrates are associated with rock habitats that are often also target for mining development, such as that at Orebody 25. Due to their low mobility, mining activities are likely to fall heavily upon the species, both directly by fatalities associated with mining, and indirectly by localised habitat destruction. They may even result in local extinctions of some species. Such habitats are, however, quite widespread across the Pilbara, as are the majority of endemic species, and mining activity at Orebody 25 probably does not represent a huge threat to these species at large, with the exception of noted conservation significant species, the Pilbara Olive Python (*Liasis olivaceus barroni*), *Ramphotyphlops ganei* and the Pilbara Pebble-mound Mouse (*Pseudomys chapmani*).

In regional terms, Orebody 25 encompasses landforms and vegetation associations that are widespread throughout the Pilbara. The project areas do not contain any particular habitat that supports high biodiversity or site-specific fauna. There appear to be no areas of ecological significance within the Orebody 25 project area.

6.0 BIODIVERSITY

Australia has an international obligation to maintain biodiversity. The Commonwealth government has initiated the National Strategy for the Conservation of Biological Diversity, which incorporates elements of the National Strategy for Ecologically Sustainable Development (NSESD). Biological diversity (biodiversity) relates to the richness of the biota at a local, regional, state, national or even global level, and includes all components of the environment, from bacteria to insects, plants, and vertebrate fauna. Biodiversity can be thought of as existing at several levels, including genetic, population and species (or taxon) diversity. This study examines biodiversity at the species and population level, and places it within a local, regional and national context.

6.1 FLORA

A number of surveys have been conducted by *ecologia* within 35 km of Orebody 25 as detailed in Table 2.1. As a result, the extant flora of the region, including Priority and DRF, are relatively well known (Appendix I). A total of 211 taxa (including subspecies, varieties and affinities) were recorded during the baseline Orebody 25 survey (*ecologia,* 1995) including two conservation significant species, and two introduced species.

Table 6.1 indicates the total number of taxa found at Orebody 25 compared with the total number of taxa recorded from all previous surveys by ecologia in the region (i.e. within 35 km of Orebody 25). The table shows that the number of taxa found during the Orebody 25 baseline survey was limited in general (approximately 36% of the total number of species previously recorded in the region). Further from this, the relatively low number of flora species unique to Orebody 25, suggest that these flora are quite well-represented outside the Orebody 25 area.

Few introduced flora species (weeds) were recorded at Orebody 25, and those that were, have been recorded elsewhere in the region (i.e. none are found exclusively at Orebody 25.

Conservation significant flora recorded at Orebody 25 and the other surveyed areas in the region may be locally common (i.e. *Eremophila magnifica* ms), but appear to be associated with individual survey areas, with few taxa being found in multiple survey areas (Appendix I).

Table 6.1 Flora Biodiversity Recorded Within or Adjacent to Orebody 25

	Taxa	Conservation Significant	Introduced
Total species recorded	560*	6	6
Species recorded at OB 25	211	2	2
Number unique to OB 25	26	2	0

* Totals for this dataset extracted from surveys assessed in Appendix I (OB 18, OB25, Jimblebar, Eastern Ophthalmia Range, Wheelarra Hill and East Jimblebar)

6.2 FAUNA

A large number of fauna surveys have also been conducted by *ecologia* within 35 km of Orebody 25, and the extant vertebrate fauna of the area has been described in detail (see references contributing to Appendix II). A total of 69 vertebrate fauna species was recorded during the baseline survey of the Orebody 25 area (*ecologia,* 1995), including six native and one introduced mammals, 47 birds, and 15 reptiles. This is not likely represent all of the vertebrate fauna species inhabiting the area but, nevertheless, this inventory suggests that a diverse array of fauna species utilise the area. Based on known species distributions and other information pertaining to the fauna of the area, additional species expected to occur in the project area would include several species of Microchiropteran bats, marsupials, birds of prey, several additional species of elapid, skinks and frogs.

Table 6.2 indicates the total number of fauna taxa found at Orebody 25 compared with the total number of fauna taxa recorded from all previous surveys in the region. The table shows that collections made during the Orebody 25 field survey were limited in general (approximately 35% of the total number of species previously recorded in the region), and particularly limited in herpetile and mammal observations. However, the table does clearly show that the extent of survey work in the adjacent area, in very similar fauna habitats, has resulted the collections of almost all of the species expected to occur in the region.

From a biodiversity perspective, one of the major issues is whether individual species would be restricted to the particular habitat of the project area. It is important to note is that there was only one species collected at Orebody 25 that has not been collected elsewhere (the Fairy Martin [*Petrochelidon ariel*]). The Fairy Martin is not listed as specially protected fauna, and is common across a large distribution, however, it would seem that individuals are difficult to locate. Disscused nests are often recorded during biological surveys along ridgelines, as the species prefers to nest in rock overhangs. However, individuals forage in and around water bodies. This may be why they are not often recorded during biological surveys that are focused on impact areas along the ridges and screes. Whatever, the case the proposed OB25 extension will result in some localised impacts on potential nest sites, but it is expected that the local populations will likely find alternative sites to nest and no significant impacts on the species would occur as a result of the proposed project.

Generally, the habitats within the project area are well represented within the region and furthermore, few Pilbara endemics were identified as occurring. Therefore, loss or modification of habitat within the project area is unlikely to reduce regional biodiversity.

Table 6.2 Fauna Biodiversity Recorded Within or Adjacent to Orebody 25

	Herpetiles	Aves	Mammals
Number expected	107	117	41
Number previously recorded	89*	114	40
Species recorded at OB 25	15	47	6
Number unique to OB 25	0	1	0

* Totals for this dataset extracted from surveys assessed in Appendix II (OB 18, OB24, OB25, Jimblebar, Wheelarra Hill , Eastern Ophthalmia Range, East Jimblebar, West Angelas Pipeline Corridor, Mining Area C, Packsaddle Range, East Angeles)

Part of the purpose of the biogeographic regionalisation of Australia (Thackway and Cresswell, 1995; updated by Environment Australia, 2000) was to examine the representation of ecosystems within conservation reserves at a bioregional level to ensure that the biodiversity of each bioregion was maintained. Within close proximity to the project area, and within the same biotopes, occur Karijini National Park (the second largest national park in Western Australia at 627,444 ha) and Chichester Range National Park. The habitat type present in the project area is well represented in these reserves.

Issues that have been identified as important to conservation planning and management in the future include the extinction of critical weight range mammals, wildfire, grazing and feral animals. All of these issues are considered in the management strategies proposed for the project area.

6.3 CONSERVATION SIGNIFICANCE OF OB25 BIODIVERSITY

The number of conservation significant taxa, both flora and fauna, recorded for the Orebody 25 area suggest that it is not of particular conservation value, from a regional perspective, and the biota of the region are, by and large, quite widespread, with the majority being found at multiple survey areas in the region. As such, they are probably well-represented outside proposed disturbance areas.

Nevertheless the presence of Priority Fauna (Peregrine Falcon, and Western Pebble-mound Mouse) and Priority Flora (*Triumfetta leptacantha* and *Eremophila magnifica* ms) is significant at the State Level.

Appropriate environmental management measures should be undertaken to minimise disturbance to these species.

7.0 IMPACT ASSESSMENT

Disturbance of vegetation through mining practices raises potential issues for the local flora and fauna. These issues include:

- Loss of natural vegetation and fauna through clearing;
- Direct loss of fauna from ongoing mining practices;
- Indirect loss of fauna and fauna habitat from ongoing mining practices; and
- Predation or competition by feral species

1. *Clearing: Loss of Flora, Fauna and Fauna Habitat*

The proposed project would result in the clearing of approximately 230 ha of native vegetation and consequent loss of fauna and habitat. All flora in the proposed disturbance footprint will be lost. Birds are generally highly mobile, and only a few relatively sedentary species (*e.g.* Fairy-wrens) and nocturnal roosting species (*e.g.* Australian Owlet-nightjar) may suffer mortality during initial clearing. With the exception of macropods and goannas, the majority of mammals, reptiles and amphibians will be lost in areas of direct impact. Daytime tree hollow dwellers, such as bats, may also be lost.

Individuals, and potentially, groups of resident Western Pebble-mound mice may be lost if they occur within the proposed disturbance areas. However, this taxon is relatively common and mainly occupies the lower slopes of the hills along the Ophthalmia Range and other ranges in the Pilbara. It has been located during nine other baseline biological surveys within a 150 km radius. These lower slopes are generally cleared for overburden storage areas, and infrastructure associated with ore processing and handling.

The OB25 extension project may have an impact on the Peregrine Falcon, *Falco peregrinus,* which has been recorded at the mine (one individual in 1995). The Peregrine Falcon forages widely over a range of habitat, favouring woodlands along water courses, such as those occurring at nearby Homestead Creek. However, the impact will come in the form of loss of potential nest sites if the individual observed during the field survey is nesting in the impact area. The Peregrine does not build a nest, preferring to lay eggs in the recesses of cliffs, which occur along the Eastern Ridge (including the relatively small section of the ridge that is within the disturbance footprint).

With respect to the Priority Flora species, *Triumfetta leptacantha* and *Eremophila magnifica* ms, disturbance associated with the mine extension may have an effect on local populations of these species. *T. leptacantha* was located between the active mines at OB25 and OB23 during a survey undertaken by BHPIO in 2000. However, this species was not located again during a ground survey undertaken in the same area by ecologia in 2004, and has not been located since.

Eremophila magnifica ms was located in several different locations during the *ecologia* (1995) and the BHPIO (2000) surveys. During the *ecologia* (2004) survey, this species was described as occurring broadly across the study area (OB23 – 25 ridgeline). Figure 5.1 shows the distribution of the species in the proposed impact area and Section 5.1.1 describes the vegetation types that this species was observed growing in during the 2005 vegetation mapping survey for the current report. If areas outside of the proposed impact area were

surveyed it is highly likely more populations of this species would be located. Nevertheless, disturbance to the local populations should be avoided where practicable.

2. Mining Operations: Direct Loss of Fauna

Several species of native animal are highly susceptible to direct losses from anthropogenic causes such as road-kill. Some species of nocturnal birds, such as nightjars, have a tendency to roost on roads at night and are most often killed due to their reluctance to move away from oncoming vehicles once they are in the lights. Other species have a tendency to cross roads at night, especially if the roads dissect large areas of good habitat for the species. Other instances were fauna may die involve accidental deaths associated with infrastructure. For example, Ghost Bats are prone to entanglement in barbed wire fencing.

The Orebody 25 extension project is a continuation of an existing operation, and would use the existing access and haul roads, railway line, power and water supply infrastructure, and ore crushing and screening plant. As a result the potential impacts on local fauna through road and rail traffic is not expected to increase from the existing operation.

3. Mining Operations: Indirect Loss of Flora, Fauna and Fauna Habitat

The displacement of fauna due to the proposed mine extension would be expected to result in a migration of some mobile species into adjacent habitat, and may cause the carrying capacity of the local area to be exceeded. This, in turn, may result in a reduction of available resources (*e.g.* microhabitat and prey) for all of the animals in the local area, and death of surplus individuals that cannot re-establish a niche, or maintain the niche they presently occupy. It is likely that over time the same species assemblage would re-establish a new equilibrium based on the original carrying capacity of the area, or that the excess pressure of local clearing would disrupt the interactions of all species, resulting in the displacement of less robust species groups, or even trophic levels. As a result, some loss of fauna may continue beyond the initial period of clearing until a new equilibrium is established.

Introduced plant species have the potential to rapidly invade areas cleared of native vegetation or areas otherwise disturbed by humans. Weeds that propagate in newly cleared land may spread to adjacent areas of habitat not disturbed by clearing. If weeds become established in these areas they may cause two types of impacts: they may out compete native plants (including conservation significant taxa), and subsequently the habitat value for native fauna may be reduced. This secondary impact often takes the form of reducing the available resources for fauna (be these food or shelter).

Dust generated by the proposed project extensions may affect the health of vegetation adjacent to the mine operation over extended period due to covering of leaves and loss of vigour in plant growth. Significant dust deposition on vegetation may result in the immediate death of smaller less robust herb species, and over the longer term, the death of more dominant and larger species.

A third aspect to indirect losses of fauna takes place at a regional level. Secondary impacts can fall upon the functional value of remaining habitats. As such, if the functionality of a habitat is reduced (e.g. increase in habitat fragmentation), the populations of fauna can suffer due to reduced mobility. Species that characteristically migrate over short distances may decline due to inability to migrate, isolated populations may suffer inbreeding depression and

genetic drift, or important resources required for reproduction may be denied to the population, resulting in a slow population decline.

4. Predation or Competition by Feral Species

An increase in human activity is often associated with an increase in the abundance of introduced species such as the Feral Cat (*Felis catus*) or weed species such as Buffel Grass (**Cenchrus ciliaris*) or Ruby Dock (**Acetosa vescicaria*). Introduced plants, as suggested above, can quickly fill an ecological niche, out competing native species and leading to their local extinction. This is turn has the flow-on effects to fauna described above. Feral fauna fall into two categories: feral predators, which increase the predation pressure on small critical-weight-range mammals, small reptiles and birds (Kinnear, 1993; Bamford, 1995), and feral herbivores (*e.g.* the rabbit, *Oryctolagus cuniculus*) which may drastically out-compete native herbivores.

8.0 MANAGEMENT AND MONITORING

In order to minimise the potential impacts of the Project on flora and fauna the following environmental management measures are suggested:

- Weed populations should be monitored, and movement of soil and vehicles to be controlled so that the potential for the spread of weeds within the site is minimised.

- Clearing in areas where *Eremophila magnifica* ms. has been observed to be minimised to that which is absolutely necessary. Vegetation clearing permits issued for areas supporting this species should identify the level of potential disturbance and an environmental officer should be present at the clearing site to ensure disturbance is minimised.

- Limited fauna microhabitats (e.g. large living or dead standing trees or permanent water sources) should disturbed as little as possible. Any development of large tracts of specialised habitats (such as mature grasslands, or open eucalypt woodlands) to be located so as to limit disruption and fragmentation of these habitats as little as possible, and to limit the effect of these impacts on fauna reliant upon such habitats.

- All necessary precautions to be taken during mining operations to prevent fires.

- Vehicle movements to be restricted to designated tracks, and off-road activities limited. Speed limits should be placed upon all haul roads to minimise effects of road kills upon the local fauna.

- Disturbance to areas which contain potential nesting habitat for the Peregrine Falcon (*Falco peregrinus*) and the Western Pebble-mound Mouse (*Pseudomys chapmani*) should restricted to the practicable minimum.

- Clearing operations to be minimised to reduce impact upon surrounding ecosystems. Physical disturbance to ecologically significant sites to be minimised.

- Dust suppression techniques to be applied to roads in use to reduce impact to adjacent vegetation.

9.0 STUDY TEAM

The BHPBIO Orebody 25 Life Of Mine Environmental Impact Review described in this document was planned, coordinated and executed by:

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LICENCES

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C. Slee, *ecologia* Environment
"Licence to take flora for scientific purposes"
Licence Number: SL007.75, valid until the 28th January 2006.

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Fauna Protection Acts and Agreements Cited in the Text:

China Australia Migratory Bird Agreement (CAMBA):

> Agreement between the Government of Australia and the Government of the People's Republic of China for the Protection of Migratory Birds and their Environment

Japan Australia Migratory Bird Agreement (JAMBA):

> Agreement between the Government of Australia and the Government of Japan for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment

Commonwealth Environment Protection and Biodiversity Conservation Act 1999

Western Australian *Wildlife Conservation Act 1950*

Western Australian *Wildlife Conservation (Rare Flora) Notice 2003*

Western Australian *Wildlife Conservation (Specially Protected Fauna) Notice 2003*

APPENDIX I: Flora Taxa Previously Observed or Expected to Occur in the Vicinity of Orebody 25.

Key to Abbreviations

JIM: Recorded during the Jimblebar Mine Site Survey (Endersby, 1994)

OB18: Recorded in the Orebody 18 Survey (*ecologia* 1995b)

EOR: Recorded during the East Ophthalmia Range Survey (*ecologia,* 2004)

WH: Recorded during the Wheelarra Hill Project Survey (*ecologia*, 2004)

OB25: Recorded at Orebody 25 (*ecologia*, 2004)

EJ: Recorded during the East Jimblebar Exploration Survey (*ecologia,* 2005)

APPENDIX I: Flora taxa recorded on surveys proximal to Orebody 25, presented alphabetically. (⚐ = Conservation Significant species; * = introduced species)

Taxa Identification	OB18	OB25	JIM	EOR	WH	EJ
**Acetosa vesicaria*	×	×	×			
**Bidens bipinnata*	×			×		
**Cenchrus ciliaris*			×	×	×	×
**Cenchrus echinatus*						
**Malvastrum americanum*						
**Sonchus oleraceus*	×	×				
⚐*Eremophila magnifica* ms		×				
⚐*Goodenia hartiana* ms			×			
⚐*Isotropis winneckei*				×		
⚐*Rhodanthe frenchii*	×					
⚐*Sida* ?sp. Wittenoom (W.R.Barker 1962)			×			
⚐*Triumfetta leptacantha*		×				
Abutilon cunninghamii			×	×	×	
Abutilon dioicum ms	×			×		
Abutilon fraseri				×		
Abutilon lepidum				×		
Abutilon leucopetalum						×
Abutilon otocarpum	×	×		×		
Acacia adoxa	×		×	×		
Acacia adoxa var. *adoxa*		×	×	×	×	
Acacia adsurgens	×		×	×		×
Acacia aff. *adsurgens*			×		×	
Acacia aff. *catenulata*			×		×	×
Acacia aff. *inaequilatera*			×	×	×	
Acacia aff. *inaequilatera* (MET 15,011)						×
Acacia aff. *stowardii*			×		×	
Acacia aff. *tumida*		×				

Taxa Identification	OB18	OB25	JIM	EOR	WH	EJ
Acacia ancistrocarpa	×		×	×	×	×
Acacia ancistrophylla			×			
Acacia aneura	×	×	×	×	×	
Acacia aneura (forma)	×					
Acacia aneura aff. var. *longicarpa*			×		×	
Acacia aneura var. *aneura*			×		×	
Acacia atkinsiana			×			
Acacia ayersiana			×			×
Acacia bivenosa	×	×	×	×	×	
Acacia citrinoviridis	×	×	×	×	×	
Acacia colei var. *colei*			×		×	
Acacia coriacea	×	×		×		
Acacia coriacea subsp. *pendens*			×		×	
Acacia coriacea subsp. *sericophylla*	×					×
Acacia dictyophleba	×	×	×	×	×	×
Acacia elachantha			×	×		×
Acacia eriopoda x ?			×		×	
Acacia hamersleyensis	×	×	×	×	×	
Acacia hilliana	×	×	×	×	×	
Acacia inaequilatera	×	×	×	×	×	
Acacia kempeana		×	×			
Acacia maitlandii	×	×	×	×	×	
Acacia marramamba			×	×	×	
Acacia melleodora			×			
Acacia monticola	×	×	×	×	×	
Acacia pachyacra	×	×	×	×	×	×
Acacia paraneura			×			×
Acacia pruinocarpa	×	×	×	×	×	×
Acacia pyrifolia	×		×	×	×	
Acacia rhodophloia	×	×	×	×	×	
Acacia sclerosperma			×			
Acacia sclerosperma subsp. *sclerosperma*		×		×		

Taxa Identification	OB18	OB25	JIM	EOR	WH	EJ
Acacia stowardii	×	×	×	×		
Acacia stowardii (linear form)					×	
Acacia synchronicia			×			
Acacia tenuissima	×	×	×	×	×	
Acacia tetragonophylla	×	×	×	×	×	×
Acacia trachycarpa			×	×	×	
Acacia trachycarpa x ancistrocarpa			×		×	
Acacia tumida			×			
Acacia victoriae	×	×	×	×		
Acacia wanyu			×			
Aenictophyton reconditum	×					
Aenictophyton aff. *reconditum*				×		
?*Alyogyne* sp.		×				
Alternanthera nodiflora		×				
Amaranthus ?interruptus			×			
Amaranthus mitchellii	×	×				
Amaranthus pallidiflorus		×				
Ammannia baccifera			×		×	
Amphipogon caricinus	×		×	×	×	
Amphipogon caricinus var. *sericeus*			×		×	
Amphipogon sericeus (Newman form BR2-21)						×
Amyema ?hilliana			×			
Amyema bifurcata			×			
Amyema fitzgeraldii			×		×	×
Amyema gibberula	×					
Amyema gibberula var. *gibberula*			×			
Amyema hilliana			×			
Amyema linophylla						
Amyema maidenii			×			
Amyema miquelii	×					
Amyema preissii	×					
Anthobolus leptomerioides	×		×	×	×	×

Taxa Identification	OB18	OB25	JIM	EOR	WH	EJ
Aristida contorta	×		×	×	×	×
Aristida holathera	×	×		×		
Aristida holathera var. *holathera*			×	×	×	×
Aristida hygrometrica						
Aristida inaequiglumis			×			×
Aristida ingrata						×
Aristida latifolia			×	×		
Astrotricha hamptonii	×		×	×	×	
Boerhavia burbidgeana		×				
Boerhavia coccinea				×		
Bonamia media var. *villosa*		×	×	×	×	
Bonamia rosea	×	×	×	×	×	×
Brachyachne prostrata			×			
Brachyscome ciliaris		×				
Brachyscome ciliocarpa	×					
Brunonia australis	×	×	×	×	×	×
Bulbostylis barbata	×		×	×		
Calandrinia ptychosperma	×					
Calandrinia schistorhiza		×				
Calocephalus sp. Pilbara-Desert (M.E.Trudgen 11454)	×					
Calotis hispidula	×	×				
Calotis multicaulis	×					
Calytrix carinata	×	×	×	×	×	×
Cassia sp. West Angelas (MET 16,115)						×
Cassytha capillaris			×	×	×	
Cassytha filiformis			×			
Centipeda minima	×					
Centipeda minima subsp. *macrocephala*			×		×	
Cheilanthes ?sieberi			×			
Cheilanthes austrotenuifolia	×					
Cheilanthes brownii			×	×		
Cheilanthes lasiophylla	×	×	×	×	×	

Taxa Identification	OB18	OB25	JIM	EOR	WH	EJ
Cheilanthes sieberi					×	
Cheilanthes sieberi subsp. *sieberi*				×		×
Chenopodium melanocarpum	×		×			
Chenopodium pumilio		×				
Chrysocephalum aff. *apiculatum*	×					×
Chrysocephalum apiculatum	×		×	×	×	
Chrysocephalum eremaeum						
Chrysocephalum pterochaetum		×	×	×		
Chrysopogon fallax	×			×		
Cleome oxalidea						×
Cleome viscosa	×	×	×		×	×
Clerodendrum floribundum	×	×	×			
Clerodendrum floribundum var. ?*angustifolium*			×	×	×	
Clerodendrum floribundum var. *ovatum*				×		
Clerodendrum tomentosum		×				
Codonocarpus cotinifolius			×	×	×	×
Corchorus aff. *lasiocarpus* (ms) (AA. Mitchell PRP 943)			×		×	
Corchorus aff. *sidoides*	×					
Corchorus aff. *walcottii*	×					
Corchorus laniflorus						
Corchorus lasiocarpus subsp. *lasiocarpus*				×		
Corchorus lasiocarpus subsp. *parvus* ms				×		
Corchorus lithophilus			×			
Corchorus parviflorus			×		×	
Corchorus sidoides			×		×	
Corchorus sidoides subsp. *sidoides*	×	×	×	×		
Corchorus sidoides subsp. *sidoides* (sens.lat.)						×
Corymbia aspera	×		×		×	
Corymbia deserticola	×	×	×	×	×	
Corymbia deserticola subsp. *deserticola*	×		×	×	×	×
Corymbia ferriticola	×	×	×			
Corymbia ferriticola subsp. *ferriticola*			×	×	×	×

Taxa Identification	OB18	OB25	JIM	EOR	WH	EJ
Corymbia haematoxylon				×		
Corymbia hamersleyana	×		×	×	×	×
Corymbia semiclara			×			
Crotalaria medicaginea			×			
Cryptandra monticola	×		×	×	×	
?*Cullen* sp.			×			
Cullen lachnostachys			×			
Cullen leucochaites				×		
Cullen patens						
Cymbopogon ambiguus	×	×	×		×	
Cymbopogon obtectus			×	×	×	×
Cymbopogon procerus			×	×	×	
Cynanchum floribundum		×			×	
Cyperus cunninghamii		×	×			
Cyperus cunninghamii subsp. *cunninghamii*				×		
Cyperus ixiocarpus			×			
Cyperus squarrosus	×					
Dactyloctenium radulans				×		
Dampiera candicans	×	×	×	×	×	×
Dicrastylis cordifolia			×	×		
Dicrastylis cordifolia var. *barnettii*	×	×			×	
Dicrastylis cordifolia var. *cordifolia*			×			
Dicrastylis georgei	×		×	×		×
Digitaria brownii	×		×	×	×	
Dodonaea coriacea	×	×	×	×	×	×
Dodonaea pachyneura	×	×	×	×	×	
Dodonaea petiolaris			×	×	×	×
Dodonaea viscosa subsp. *angustissima*			×			
Dysphania kalpari	×	×	×			×
Dysphania plantaginella			×			
Dysphania rhadinostachya	×	×	×			
Enchylaena tomentosa	×	×	×	×		×

Taxa Identification	OB18	OB25	JIM	EOR	WH	EJ
Enneapogon ?*oblongus/lindleyanus*			×			
Enneapogon caerulescens	×	×	×			
Enneapogon caerulescens var. *occidentalis*				×		
Enneapogon intermedius	×	×	×	×		×
Enneapogon polyphyllus						×
Enneapogon purpurascens		×				
Eragrostis cumingii			×	×		
Eragrostis dielsii	×					
Eragrostis eriopoda	×	×	×	×	×	×
Eragrostis kennedyae				×		
Eragrostis lanipes				×		
Eragrostis pergracilis						×
Eragrostis tenellula			×		×	×
Eremophila cuneifolia	×		×	×	×	
Eremophila exilifolia	×	×	×	×	×	
Eremophila forrestii	×	×				
Eremophila forrestii subsp. forrestii	×		×		×	×
Eremophila forrestii x *latrobei*						×
Eremophila fraseri	×	×	×			
Eremophila fraseri subsp. *fraseri*			×		×	×
Eremophila gilesii ?subsp. *variabilis* ms	×					
Eremophila jucunda subsp. *pulcherrima* ms				×		
Eremophila lanceolata						×
Eremophila latrobei	×	×	×	×		
Eremophila latrobei subsp. aff. *filiformis* ms				×	×	×
Eremophila latrobei subsp. *filiformis*			×			
Eremophila latrobei subsp. *glabra* ms			×	×		
Eremophila latrobei var. *glabra*					×	
Eremophila longifolia	×		×	×	×	
Eremophila macmillaniana		×				
Eremophila maitlandii		×				
Eremophila margarethae				×		

Taxa Identification	OB18	OB25	JIM	EOR	WH	EJ
Eremophila oppositifolia			×			
†*Eremophila* sp. Ophthalmia Range(D.Brearley s.n.20/3/2004)				×		
Eriachne aff. *ciliata*	×					
Eriachne aristidea	×	×	×	×		×
Eriachne flaccida			×		×	×
Eriachne helmsii	×	×	×		×	×
Eriachne lanata	×	×	×	×	×	
Eriachne meliacea		×	×			
Eriachne mucronata	×		×	×		×
Eriachne mucronata (arid form) (MET 12 736)					×	×
Eriachne mucronata (typical form)					×	
Eriachne pulchella	×	×	×	×		
Eriachne pulchella subsp. *dominii*				×		
Eucalyptus gamophylla	×	×	×	×	×	×
Eucalyptus kingsmillii	×	×	×		×	
Eucalyptus kingsmillii subsp. *kingsmillii*			×			
Eucalyptus leucophloia	×	×	×	×	×	
Eucalyptus leucophloia subsp. *leucophloia*			×	×	×	
Eucalyptus terminalis	×	×				
Eucalyptus trivalvis	×					
Eucalyptus victrix			×	×	×	
Eulalia aurea	×		×		×	×
Euphorbia aff. *australis*	×					
Euphorbia aff. *schultzii*			×			
Euphorbia australis	×	×		×		
Euphorbia biconvexa			×			
Euphorbia boophthona	×	×				×
Euphorbia tannensis	×					
Euphorbia tannensis subsp. *eremophila*			×		×	
Euphorbia wheeleri	×					
Evolvulus alsinoides	×	×				
Evolvulus alsinoides var. ?			×		×	

Taxa Identification	OB18	OB25	JIM	EOR	WH	EJ
Evolvulus alsinoides var. *decumbens*				×		
Evolvulus alsinoides var. *villosicalyx*		×	×	×		×
Ficus brachypoda	×		×	×	×	
Ficus platypoda	×			×		
Fimbristylis ?rara	×					
Fimbristylis depauperata		×				
Fimbristylis dichotoma	×	×		×		
Fimbristylis simulans	×	×	×	×		
Glycine canescens			×			
Gompholobium karijini						×
Gompholobium polyzygum	×	×	×	×	×	
Gomphrena canescens		×		×		
Gomphrena canescens subsp. *canescens*	×					×
Gomphrena cunninghamii	×	×	×	×		
Goodenia ?forrestii		×				
Goodenia aff. *vilmoriniae*		×				
Goodenia azurea	×		×			×
Goodenia hartiana					×	
Goodenia microptera	×	×				×
Goodenia muelleriana	×	×	×			
Goodenia prostrata	×					
Goodenia stobbsiana	×	×	×		×	
Goodenia tenuiloba	×	×	×			
Goodenia trichophylla						×
Goodenia triodiophila	×	×	×		×	
Goodenia vilmoriniae		×	×			
Gossypium robinsonii	×	×	×	×	×	
Grevillea aff. *berryana*		×				
Grevillea berryana			×	×	×	
Grevillea juncifolia subsp. *juncifolia*			×			
Grevillea stenobotrya	×	×	×			
Grevillea striata			×	×		

Taxa Identification	OB18	OB25	JIM	EOR	WH	EJ
Grevillea wickhamii	×	×	×	×	×	
Grevillea wickhamii subsp. ?*hispidula*	×					
Grevillea wickhamii subsp. *aprica*			×	×	×	
Grevillea wickhamii subsp. *hispidula*			x			×
Hakea chordophylla	×	×	×	×	×	×
Hakea lorea			×	×		
Hakea lorea subsp. *lorea*	×	×	×	×	×	×
Hakea preissii			×		×	
Hakea suberea					×	
Halgania aff. *solanacea*	×					
Halgania gustafsenii var. *compactus* ms	×			×		
Halgania solanacea					×	
Halgania solanacea aff. var. *hirsuta* ms	×		×		×	
Halgania solanacea var. *hirsuta*			×			×
†*Halgania* sp. A				×		
Haloragis gossei	×	×	×			
Haloragis odontocarpa		×				
Helichrysum gilesii						×
Heliotropium ?*ovalifolium*			×		×	
Heliotropium cunninghamii	×					
Heliotropium tenuifolium	×					
Heteropogon contortus			×		×	
Hibiscus aff. *coatesii*	×			×		
Hibiscus aff. *haynaldii*			×	×	×	
Hibiscus burtonii	×	×		×		×
Hibiscus coatesii	×	×	×		×	
Hibiscus leptocladus				×		
Hibiscus platychlamys						×
Hibiscus sturtii	×					
Hibiscus sturtii aff. var. *campylochlamys*			×	×	×	
Hibiscus sturtii var. aff. *truncatus* (site 1 016)						×
Hibiscus sturtii var. *platychlamys*				×		

Taxa Identification	OB18	OB25	JIM	EOR	WH	EJ
Hibiscus sturtii var. *truncatus*			×	×		
Hybanthus aurantiacus	×	×	×	×	×	×
Indigofera ?brevidens			×			
Indigofera georgei	×					×
Indigofera monophylla	×	×	×		×	×
Ipomoea muelleri	×					
Iseilema membranaceum	×					
Isotropis atropurpurea	×			×		×
Isotropis forrestii	×			×		
Jasminum didymum	×					
Jasminum didymum subsp. *lineare*		×	×	×	×	
Kennedia prorepens	×	×	×	×	×	×
Keraudrenia integrifolia	×					
Keraudrenia nephrosperma	×	×	×	×		×
Keraudrenia velutina subsp. elliptica	×		×	×	×	×
Lamarchea sulcata	×		×	×	×	
Leiocarpa ?tomentosa		×				
Leiocarpa semicalva	×					
Lepidium muelleri-ferdinandii		×				
Lepidium oxytrichum	×	×	×			
Lepidium pedicellosum	×		×	×	×	
Lepidium phlebopetalum	×	×	×			
Lepidium pholidogynum	×	×				
Lepidium platypetalum		×				
Leptosema chambersii	×					
Macgregoria racemigera	×					
Maireana ?tomentosa			×			
Maireana appressa		×				
Maireana georgei	×	×	×	×	×	
Maireana melanocoma	×		×			
Maireana planifolia		×	×	×		
Maireana planifolia x *villosa*						×

Taxa Identification	OB18	OB25	JIM	EOR	WH	EJ
Maireana tomentosa	×	×				
Maireana villosa	×	×	×	×	×	×
Melaleuca glomerata			×	×	×	
Mirbelia viminalis	×	×	×	×	×	
Monachather paradoxus						×
Mukia maderaspatana		×	×	×		×
Myoporum acuminatum		×				
Nicotiana benthamiana	×	×	×	×		
Nicotiana rosulata		×				
Nicotiana rosulata subsp. *rosulata*						×
Nicotiana simulans	×	×				
Oldenlandia crouchiana	×	×	×	×		
Panicum effusum						×
Paraceterach muelleri						×
Paraneurachne muelleri	×	×	×	×	×	
Paspalidium clementii	×	×	×			
Perotis rara	×			×		×
Petalostylis cassioides						×
Petalostylis labicheoides	×	×	×	×	×	
Phyllanthus erwinii	×	×	×			
Phyllanthus maderaspatensis	×					
Pluchea dentex			×	×		
Pluchea dunlopii	×		×		×	
Pluchea tetranthera						×
Podolepis capillaris	×	×	×	×		
Podolepis sp. Great Victoria Desert(A.S.George 8219)	×		×			
Polycarpaea corymbosa	×		×			
Polycarpaea corymbosa var. *corymbosa*						×
Polycarpaea involucrata	×					
Polycarpaea longiflora		×				
Polygala isingii	×	×				
Porana commixta			×	×	×	×

Taxa Identification	OB18	OB25	JIM	EOR	WH	EJ
Porana sericea	×	×	×			
Portulaca intraterranea		×				
Portulaca oleracea	×	×	×	×		
Psydrax latifolia	×	×	×	×	×	×
Psydrax suaveolens	×		×	×	×	×
Pterocaulon ?sphacelatum x sphaeranthoides			×	×	×	
Pterocaulon sphacelatum	×	×	×			×
Pterocaulon sphaeranthoides	×		×	×	×	×
Ptilotus ?helipteroides			×			
Ptilotus aervoides	×	×				
Ptilotus astrolasius	×	×	×	×	×	
Ptilotus astrolasius var. *astrolasius*	×	×	×			×
Ptilotus auriculifolius	×	×	×			
Ptilotus calostachyus	×		×	×		
Ptilotus calostachyus var. *calostachyus*		×	×	×	×	×
Ptilotus clementii	×	×	×	×		
Ptilotus drummondii			×			
Ptilotus exaltatus	×	×	×	×		×
Ptilotus fusiformis var. *fusiformis*	×	×				
Ptilotus gaudichaudii var. *gaudichaudii*	×	×				
Ptilotus helichrysoides				×		
Ptilotus helipteroides	×	×				
Ptilotus incanus var. *incanus*						×
Ptilotus macrocephalus		×				
Ptilotus obovatus	×		×	×		×
Ptilotus obovatus var. *obovatus*		×	×	×	×	×
Ptilotus polystachyus	×		×			
Ptilotus polystachyus var. *polystachyus*	×	×				×
Ptilotus roei		×				×
Ptilotus rotundifolius	×	×	×	×	×	
Ptilotus schwartzii			×			
†*Ptilotus* sp. nov.			×		×	

Taxa Identification	OB18	OB25	JIM	EOR	WH	EJ
Rhagodia eremaea	×	×	×	×	×	×
Rhagodia sp. Hamersley (M. Trudgen 17794)						×
Rhodanthe charsleyae	×					
Rhodanthe margarethae			×	×		
Rhodanthe sterilescens		×				
Rhyncharrhena linearis	×			×		×
Rhynchosia minima	×		×			
Rulingia kempeana			×			
Rulingia loxophylla	×	×		×		×
Rulingia luteiflora			×	×	×	
Rutidosis helichrysoides	×					
Rutidosis helichrysoides subsp. *helichrysoides*			×			
Salsola kali	×	×	×			
Salsola tragus			×	×		×
Santalum acuminatum			×	×	×	
Santalum lanceolatum	×	×	×	×	×	×
Santalum spicatum			×			
Sarcostemma viminale subsp. *australe*			×			×
Scaevola acacioides						
Scaevola aff. *browniana*						×
Scaevola aff. *browniana* subsp. *browniana*	×					
Scaevola amblyanthera		×				
Scaevola browniana	×					
Scaevola browniana subsp. *browniana*			×			
Scaevola parvifolia	×	×				
Scaevola parvifolia subsp. *pilbarae*			×		×	×
Scaevola sp. 1			×			
Scaevola sp. A.					×	
Scaevola spinescens		×	×		×	
Schizachyrium fragile			×			
Sclerolaena cornishiana		×	×	×	×	
Sclerolaena cuneata				×		

Taxa Identification	OB18	OB25	JIM	EOR	WH	EJ
Sclerolaena densiflora		×				
Sclerolaena eriacantha	×	×	×			
Senna artemisioides hybrid *(?oligophylla x helmsii)*			×			
Senna artemisioides subsp. ?*oligophylla x glaucifolia* (HD 13-14)						×
Senna artemisioides subsp. *glaucifolia*					×	
Senna artemisioides subsp. *glaucifolia* (atypical)						×
Senna artemisioides subsp. *glaucifolia* x? (EJB 26.03)						×
Senna artemisioides subsp. *glaucifolia* x? (Site 626)						×
Senna artemisioides subsp. *helmsii*	×	×	×	×	×	×
Senna artemisioides subsp. *helmsii* x? (EJB 27.07)						×
Senna artemisioides subsp. *oligophylla*	×	×	×	×	×	×
Senna artemisioides subsp. *oligophylla x helmsii*				×		
Senna artemisioides subsp. *oligophylla x?*					×	
Senna artemisioides subsp. *stricta*					×	
Senna artemisioides subsp. *x artemisioides*			×			
Senna artemisioides subsp. *x oligophylla*	×		×			
Senna artemisioides subsp. *x sturtii*		×	×			
Senna ferraria	×	×	×	×		
Senna glaucifolia			×			
Senna glaucifolia x glutinosa subsp. *glutinosa*				×		
Senna glutinosa				×		
Senna glutinosa subsp. ?*chatelainiana*	×					
Senna glutinosa subsp. *glutinosa*	×	×	×	×	×	×
Senna glutinosa subsp. *luerssenii*						×
Senna glutinosa subsp. *pruinosa*	×	×	×	×	×	
Senna glutinosa subsp. *x luerssenii*	×	×	×	×	×	
Senna glutinosa subsp. *x luerssenii x Senna stricta*				×		
Senna hamersleyensis			×			
Senna notabilis	×	×	×	×	×	×
Senna sericea			×	×		
Senna sp. Meekatharra(E.Bailey 1-26)			×			
Senna stricta	×		×	×		

Taxa Identification	OB18	OB25	JIM	EOR	WH	EJ
Senna symonii		×		×		
Senna venusta	×	×	×			
Sida aff. *cardiophylla*	×			×		
Sida aff. *cardiophylla* (site 1215)						×
Sida aff. *echinocarpa*				×		
Sida aff. *fibulifera*			×	x	×	
Sida aff. *fibulifera* (FMG 125-20)						×
Sida arenicola			×	×	×	×
Sida calyxhymenia	×					
Sida cardiophylla	×		×	×	×	
Sida clementii	×		×			
Sida clementii?					×	
Sida echinocarpa		×	×			
Sida excedentifolia	×	×	×	×	×	
Sida filiformis	×					
Sida pilbarensis			×			
Sida platycalyx						×
Sida rohlenae subsp. *rohlenae*				×		
Sida sp. Shovelanna Hill(S. van Leeuwen 3842)	×		×	×	×	
Sida sp. unisexual (N.H.Speck 574)						×
Sida sp. Wittenoom?					×	
Solanum centrale	×	×	×	×	×	×
Solanum cf. *cleistogamum*	×					
Solanum cleistogamum	×	×	×	×		×
Solanum gabrielae	×					
Solanum horridum	×		×	×	×	×
Solanum lasiophyllum	×	×	×	×	×	×
Solanum phlomoides			×	×	×	×
Solanum sturtianum	×	×		×		
Spermacoce brachystema	×					
Sporobolus australasicus	×	×	×			
Stackhousia ?megaloptera		×				

Taxa Identification	OB18	OB25	JIM	EOR	WH	EJ
Stackhousia intermedia	×	×	×	×	×	×
Stemodia grossa			×	×		
Stenopetalum anfractum	×	×				
Streptoglossa ?liatroides	×					
Streptoglossa adscendens						×
Streptoglossa bubakii	×					
Streptoglossa decurrens	×	×	×			
Streptoglossa macrocephala			×		×	×
Stylobasium spathulatum				×		
Swainsona pterostylis		×				
Synaptantha tillaeacea	×					
Synaptantha tillaeacea var. *tillaeacea*			×			
Tephrosia aff. *clementii* (12) (HD1-32)						×
Tephrosia aff. *densa*				×		
Tephrosia bidwillii		×				
Tephrosia densa	×					
Tephrosia rosea	×	×	×			
Tephrosia rosea var. *glabrior*			×		×	
Tephrosia sp. Bungaroo Creek (M.E.Trudgen 11601)			×	×		×
Tephrosia sp. Pilbara Ranges(S.van Leeuwen 4246)			×			
Tephrosia supina				×		
Themeda triandra	×	×	×	×	×	×
Trachymene oleracea	×	×	×		×	
Tragus australianus	×					
Trianthema glossostigma	×	×	×	×	×	
Trianthema pilosa	×			×		
Trianthema triquetra				×		
Tribulus astrocarpus	×					
Tribulus hirsutus		×		×		
Tribulus macrocarpus	×					
Tribulus platypterus	×	×	×	×		
Tribulus suberosus			×	×	×	

Taxa Identification	OB18	OB25	JIM	EOR	WH	EJ
Trichodesma zeylanicum	×	×	×		×	
Trichodesma zeylanicum var. *zeylanicum*	×		×		×	×
Triodia aff. *basedowii*			×	×		
Triodia aff. *wiseana*	×					
Triodia angusta				×		
Triodia basedowii	×	×		×	×	×
Triodia bitextura			×			
Triodia brizoides			×			
Triodia lanigera		×				×
Triodia melvillei	×					
Triodia pungens	×	×	×	×	×	
Triodia schinzii	×		×	×		×
Triodia wiseana		×		×		
Triumfetta appendiculata		×				
Triumfetta maconochiena	×	×	×	×		
Velleia connata	×					
Vittadinia eremaea	×					
Vittadinia virgata	×		×		×	
Wahlenbergia tumidifructa	×					
Waltheria virgata	×		×	×	×	

APPENDIX II: Fauna Species Previously Observed or Expected to Occur in the Vicinity of the Orebody 25 Area.

A – Herpetofauna
B - Avifauna
C - Mammals

Key to Abbreviations

A: Recorded during the Jimblebar Mine Site Survey (BHP, 1994)

B: Recorded during the West Angelas Pipeline Corridor Survey (*ecologia,* 1998)

C: Recorded during the Mining Area C Biological Survey (*ecologia,* 1998)

D: Recorded in the OreBody 18 Survey (*ecologia* 1995a)

E: Recorded during the OreBody 24 Survey (*ecologia,*2004)

F: Recorded during the East Ophthalmia Range Survey (*ecologia,* 2004)

G: Recorded during the Wheelarra Hill Project Survey (*ecologia*, 2004)

H: Recorded during the Area C Deposits D, E & F Survey (*ecologia,* 2004)

I: Recorded during the Packsaddle Range Biological Survey (*ecologia,* 2004)

J: Recorded during the East Jimblebar Exploration Survey (*ecologia,* 2005)

K: Recorded during the East Angeles Biological Survey (*ecologia,* 2005)

L: Recorded during the Orebody 25 Biological Assessment Survey (*ecologia*, 1995b)

X: Expected based on WAM Faunabase

APPENDIX II - A: Herpetofauna species previously observed or expected in the Orebody 25 area, presented as family groups alphabetically.

SPECIES	COMMON NAME	PRESENCE
AMPHIBIA		
HYLIDAE		
Cyclorana maini	Main's Frog	B, C, K
Litoria rubella	Desert Tree Frog	B, G, J, C
MYBATRACHIDAE		
Limnodynastes spenceri	Spencer's Frog	B, G
Neobatrachus centralis	Desert Trilling Frog	G
Notaden nichollsi	Desert Spadefoot	B, G
Uperoleia russelli	Russell's Toadlet	B, G
Uperoleia sp.		X
REPTILIA		
CHELUIDAE		
Chelodina steindachneri	Flat-shelled Turtle	G
AGAMIDAE		
Caimanops amphiboluroides	Mulga Dragon	C, K
Ctenophorus caudicinctus	Ring-tailed Dragon	B, H, I, J, C, E, G, D, K, L
Ctenophorus i. gularis	Military Dragon	B, J
Ctenophorus i. isolepis	Military Dragon	B, H, C, D
Ctenophorus nuchalis	Central Netted Dragon	B, D
Ctenophorus reticulatus	Western Netted Dragon	B
Diporiphora valens		H
Lophognathus longirostris	Long-nosed Water Dragon	G, H, I, J, C
Pogona minor	Dwarf Bearded Dragon	B, D, H, I, C, K, L
Tympanocryptis cephala	Earless Pebble Dragon	X
BOIDAE		
Antaresia perthensis	Pygmy Python	B, D, E, G, C, L
Anteresia s. stimsoni	Stimson's Python	X
Aspidites melanocephalus	Black-headed python	B, C
Liasis olivaceus barroni	Pilbara Olive Python	X
ELAPIDAE		
Acanthophis wellsi	Death-Adder	B, H
Brachyurophis approximans	North-western Shovel-nosed Snake	B, H
Demansia psammophis cupreiceps	Yellow-faced Whipsnake	B, J
Demansia rufescens	Rufous Whipsnake	H, I
Furina ornata	Moon Snake	X
Parasuta monachus	Hooded Snake	B
Pseudechis australis	Mulga Snake	G, L
Pseudonaja modesta	Ringed Brown Snake	X
Pseudonaja nuchalis	Gwardar	B, E, K

SPECIES	COMMON NAME	PRESENCE
Suta fasciata	Rosen's Snake	C
GEKKONIDAE		
Diplodactylus conspicillatus	Fat-tailed Gecko	D, J, E
Diplodactylus mitchelli		X
Diplodactylus pulcher	Beautiful Gecko	B
Diplodactylus savagei		C, E
Diplodactylus stenodactylus	Pale-snouted Ground Gecko	B, E, G, H, J
Diplodactylus wombeyi		E, G, C
Gehyra pilbara	Pilbara Dtella	C
Gehyra punctata	Spotted Dtella	B, D, H, I, C, A, K, L
Gehyra purpurascens	Purple Arid Dtella	X
Gehyra variegata	Tree Dtella	D, G, H, J, C, A, K, L
Heteronotia binoei	Bynoe's Gecko	B, D, G, H, J, C, K, L
Heteronotia spelea	Desert Cave Gecko	B, G, H
Nephrurus wheeleri cinctus	Banded Knob-tailed Gecko	B, E
Oedura marmorata	Marbled Velvet Gecko	B, H, I, C, L
Rhynchoedura ornata	Beaked Gecko	D, J, E
Strophurus ciliaris aberrans	Northern Spiny-tailed Gecko	J
Strophurus elderi	Jewelled Gecko	B, G, J
Strophurus jeanae		J
Strophurus wellingtonae		B, I, J, K
Underwoodisaurus milii	Barking Gecko	I
PYGOPODIDAE		
Delma butleri	Un-banded Delma	C
Delma elegans		B
Delma haroldi		H, K
Delma nasuta	Long-nosed Delma	B, D, G, H, E, K
Delma pax		D, G, H, C, E
Delma tincta		B, C
Lialis burtonis	Burton's Snake Lizard	B, G, K, L
Pygopus nigriceps	Hooded Scaly-foot	B
SCINCIDAE		
Carlia munda		B, H, I, C, E, K
Carlia triacantha	Rainbow Skink	B, G
Cryptoblepharus carnabyi		H, K
Cryptoblepharus plagiocephalus	Fence Skink	D, C, K
Ctenotus ariadnae		X
Ctenotus duricola		B, G, H, I, C, E
Ctenotus g. grandis		B, E
Ctenotus g. titan		X
Ctenotus hanloni		C
Ctenotus helenae		B, D, G, H, E, K
Ctenotus leonhardii		D, G, J, C, A, L
Ctenotus pantherinus ocellifer	Leopard Skink	B, D, G, H, I, C, E, K, L

SPECIES	COMMON NAME	PRESENCE
Ctenotus piankai		B, C
Ctenotus rubicundus		B, H, I, C, E
Ctenotus rutilans		B, C, K
Ctenotus saxatilis		B, D, G, H, I, C, E, K
Ctenotus schomburgkii		B, H, C
Ctenotus serventyi		X
Ctenotus uber		B
Cyclodomorphus m. melanops	Gunther's Skink	B, D, C, K, L
Egernia depressa	Pygmy Spiny-tailed Skink	B, H, I, C, E, K
Egernia formosa	Goldfields Crevice Skink	C, E
Eremiascincus fasciolatus	Narrow-banded Sand-swimmer	C,
Eremiascincus richardsonii	Banded Skink	G, J
Lerista bipes		X
Lerista labialis		X
Lerista muelleri		B, D, C
Lerista neander		B, D, G, C, K
Lerista zietzi		B, D, G, H, I, C, K
Menetia greyii	Common Dwarf Skink	B, D, H, C, K
Menetia s. surda		B, K
Morethia ruficauda exquisita	Three Striped Fire-tail	B, D, G, H, I, C, A, K
Tiliqua multifasciata	Central Blue-tongue Lizard	B, G, I, J, C
TYPHLOPIDAE		
Ramphotyphlops ammodytes		X
Ramphotyphlops ganei		X
Ramphotyphlops grypus		D, G, K
Ramphotyphlops hamatus		B
Ramphotyphlops waitii		X
VARANIDAE		
Varanus acanthurus	Ridge-tailed Monitor	B, D, G, H, I, C, E, K, L
Varanus brevicauda	Short-tailed Monitor	B
Varanus caudolineatus	Stripe-tailed Monitor	B
Varanus gilleni	Pygmy Mulga Monitor	H, C, K
Varanus giganteus	Perentie	B, D, C, L
Varanus gouldii	Gould's Monitor or Bungarra	A
Varanus panoptes rubidus		G, H, I, J, C
Varanus pilbarensis	Pilbara Rock Monitor	D, C, L
Varanus tristis	Black-headed Monitor	A, B, D, E, G, H, K
Total Species Expected		**107**
Total Species Recorded in the Region		**89**
Total Species Recorded for Orebody 25		**15**
Species Recorded Exclusively at Orebody 25		**0**

APPENDIX II - B: Bird species previously observed or expected in the Orebody 25 area.

SPECIES	COMMON NAME	PRESENCE
ARDEIDAE		
Ardea novaehollandiae	White-faced Heron	G, C
ANATIDAE		
Cygnus atratus	Black Swan	G
DROMAIIDAE		
Dromaius novaehollandiae	Emu	D, C, A
PHASIANIDAE		
Coturnix pectoralis	Brown Quail	J
ACCIPITRIDAE		
Aquila audax	Wedge-Tailed Eagle	B, G, H, I, C, E, K
Circus assimilis	Spotted Harrier	B, D, C, E
Haliastur sphenurus	Whistling Kite	I, D, C, E, K, L
Elanus axillaris	Black-shouldered Kite	D, E
Accipiter cirrhocephalus	Collared Sparrowhawk	C, E, K, L
Accipiter fasciatus	Brown Goshawk	C, G, K
Lophoictinia isura	Square-tailed Kite	E
Milvus migrans	Black Kite	E
Hamirostra melanosternon	Black-breasted Buzzard	J, K
Hieraaetus morphnoides	Little Eagle	J, K, L
FALCONIDAE		
Falco b. berigora	Brown Falcon	B, D, G, H, I, J, C, E, K, L
Falco c. cenchroides	Australian Kestrel	B, D, A, G, H, J, C, E, K, L
Falco peregrinus	Peregrine Falcon	C, L
Falco l. longipennis	Australian Hobby	B, G, J, C, E
Falco hypoleucos	Grey Falcon	I
BURHINIDAE		
Burhinus grallarius	Bush Stone-curlew	G
TURNICIDAE		
Turnix velox	Little Button-Quail	B, D, H, I, C, E, L
OTIDIDAE		
Ardeotis australis	Australian Bustard	B, D, J, C
CHARADRIIDAE		
Peltohyas australis	Inland Dotterel	X
Elseyornis melanops	Black-fronted Plover	C

SPECIES	COMMON NAME	PRESENCE
COLUMBIDAE		
Geopelia striata placida	Peaceful Dove	B, C
Phaps chalcoptera	Common Bronzewing	B, G, J, C, A, K, L
Geopelia cuneata	Diamond Dove	A, G, D, J, C, E, K, L
Geophaps plumifera	Spinifex Pigeon	A, G, D, I, C, E, K, L
Ocyphaps lophotes	Crested Pigeon	G, I, H, J, C, E, K
CACATUIDAE		
Cacatua roseicapilla assimilis	Galah	B, D, G, H, I, J, C, A, L
Cacatua sanguinea	Little Corella	G, C, D
Nymphicus hollandicus	Cockatiel	E
PSITTACIDAE		
Melopsittacus undulatus	Budgerigar	B, D, A, H, I, J, C, E, L
Neopsephotus bourkii	Bourke's Parrot	I, C
Psephotus varius	Mulga Parrot	B, K
Barnardius z. zonarius	Australian Ringneck	G, D, H, I, J, C, E, K, L
CENTROPIDAE		
Centropus phasianus	Pheasant Coucal	E
CUCULIDAE		
Chrysococcyx basalis	Horsfield's Bronze-Cuckoo	B, D, G, H, I, C, E
Cuculus pallidus	Pallid Cuckoo	C, D, E, H, I, L
Chrysococcyx osculans	Black-eared Cuckoo	C
TYTONIDAE		
Tyto alba	Barn Owl	G, H, I, E
PODARGIDAE		
Podargus strigoides	Tawny Frogmouth	G, I, H, C, J, K
STRIGIDAE		
Ninox c. connivens	Barking Owl	X
Ninox novaeseelandiae boobook	Southern Boobook	B, A, H, C, E, K, L
CAPRIMULGIDAE		
Eurostopodus argus	Spotted Nightjar	B, D, H, I, J, C, E
AEGOTHELIDAE		
Aegotheles cristatus	Australian Owlet-Nightjar	A, D, H, I, J, C, E, K
HALCYONIDAE		
Dacelo leachii	Blue-winged Kookaburra	E
Todiramphus pyrrhopygia	Red-backed Kingfisher	G, D, H, I, E, L

SPECIES	COMMON NAME	PRESENCE
Todiramphus sanctus	Sacred Kingfisher	J
MEROPIDAE		
Merops ornatus	Rainbow Bee-eater	G, J, C, E, K
HIRUNDINIDAE		
Cheramoeca leucosternus	White-backed Swallow	A, G, E, L
Petrochelidon ariel	Fairy Martin	L
Petrochelidon nigricans	Tree Martin	C, L
PARDALOTIDAE		
Acanthiza apicalis	Inland Thornbill	C, K, H, J, E,
Acanthiza robustirostris	Slaty-backed Thornbill	C, H, K
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	B, C
Acanthiza uropygialis	Chestnut-rumped Thornbill	B, G, C, A, K, L
Gerygone fusca	Western Gerygone	B, H, C, E
Smicrornis brevirostris	Weebill	A, G, H, I, C, E, K, L
Pardalotus rubricatus	Red-browed Pardalote	B, G, C, E
Pardalotus striatus murchisoni	Striated Pardalote	B, D, G, H, I, C, E, K, L
Pyrrholaemus brunneus	Redthroat	K
CLIMACTERIDAE		
Climacteris melanura wellsi	Black-tailed Treecreeper	B, I, C
MALURIDAE		
Amytornis striatus whitei	Striated Grasswren	B, D, A, G, H, I, C, E, L
Malurus lamberti assimilis	Variegated Fairy-Wren	B, D, A, G, H, I, J, C, E, K, L
Malurus leucopterus leuconotus	White-winged Fairy-Wren	B, G, H, I, J, C, E, K, L
Malurus splendens splendens	Splendid Fairy-Wren	K
Stipiturus ruficeps	Rufous-crowned Emu-wren	C, H, I
MELIPHAGIDAE		
Acanthagenys rufogularis	Spiny-cheeked Honeyeater	A, G, H, I, J, C, E, K
Epthianura aurifrons	Orange Chat	X
Epthianura tricolor	Crimson Chat	B, D, L
Conopophila whitei	Grey Honeyeater	B
Lichenostomus keartlandi	Grey-headed Honeyeater	B, D, A, G, H, I, C, E, K, L
Lichenostomus penicillatus	White-plumed Honeyeater	B, A, G, J, C, E, K
Lichenostomus plumulus	Grey-fronted Honeyeater	A
Lichenostomus virescens	Singing Honeyeater	B, D, A, G, H, I, J, K, C, E, L
Manorina flavigula	Yellow-throated Miner	A, G, H, I, J, C, E, K
Melithreptus gularis laetior	Black-chinned Honeyeater	G, H, I, C, E, K
Phylidonyris albifrons	White-fronted Honeyeater	B, D, A, E, K, L
Lichmera indistincta	Brown Honeyeater	A, D, G, H, I, J, C, E, K, L

SPECIES	COMMON NAME	PRESENCE
Certhionyx niger	Black Honeyeater	D, L
Certhionyx variegatus	Pied Honeyeater	D, K
PETROICIDAE		
Melanodryas cucullata	Hooded Robin	B, D, A, G, H, I, C, E, K, L
Petroica goodenovii	Red-capped Robin	J, C, A
CINCLOSOMATIDAE		
Cinclosoma castaneothorax marginatum	Chestnut-breasted Quail-Thrush	B
Psophodes occidentalis	Chiming Wedgebill	J
Cinclosoma castanotus	Chestnut Quail-thrush	J
POMATOSTOMIDAE		
Pomatostomus temporalis rubeculus	Grey-crowned Babbler	B, G, H, C, E
Pomatostomus superciliosus	White-browed Babbler	C, K
NEOSITTIDAE		
Daphoenositta chrysoptera pileata	Varied Sitella	B, C
PACHYCEPHALIDAE		
Oreoica gutturalis	Crested Bellbird	B, D, A, G, H, I, C, E, K
Pachycephala rufiventris	Rufous Whistler	B, D, G, H, I, J, C, E, K, L
Colluricincla harmonica	Grey Shrike-Thrush	A, D,G, H, I, J, C, E, K, L
DICRURIDAE		
Rhipidura leucophrys	Willie Wagtail	G, D, A, H, I, J, C, E, K, L
Grallina cyanoleuca	Magpie Lark	G, H, I, J, C, E, K
Rhipidura albiscapa	Grey Fantail	C, K, H
CAMPEPHAGIDAE		
Coracina novaehollandiae subpallida	Black-faced Cuckoo-shrike	B, D, A, G, H, I, J, C, E, K, L
Coracina maxima	Ground Cuckoo-shrike	G, C, E, K
Lalage tricolor	White-winged Triller	G, D, H, I, C, E, L
ARTAMIDAE		
Artamus cinereus	Black-faced Woodswallow	A, G, H, I, J, C, E, K, L
Artamus personatus	Masked Woodswallow	C
Artamus minor	Little Woodswallow	G, D, A, H, I, C, E, L
Cracticus nigrogularis	Pied Butcherbird	G, D, A, H, I, J, C, E, K, L
Cracticus torquatus	Grey Butcherbird	G, H, I, J, C, A, K
Gymnorhina tibicen	Australian Magpie	A, G, H, I, C, E, K, L
CORVIDAE		
Corvus orru cecilae	Torresian Crow	A, G, H, I, J, C, E, K, L
Corvus coronoides	Australian Raven	J

SPECIES	COMMON NAME	PRESENCE
PTILONORHYNCHIDAE		
Chlamydera guttata	Western Bowerbird	G, H, I, C, E, K, L
MOTACILLIDAE		
Anthus novaeseelandiae	Richard's Pipit	G, D, A, J, E, L
ESTRILLIDAE		
Emblema pictum	Painted Firetail	G, D, H, I, C, E, L
Taeniopygia guttata	Zebra Finch	G, D, A, H, I, J, C, E, K, L
Neochmia ruficauda subclarescens	Star Finch	H, I
DICAEIDAE		
Dicaeum hirundinaceum	Mistletoe Bird	G, D, H, I, C, E, K
SYLVIIDAE		
Eremiornis carteri	Spinifexbird	B, D, A, G, H, I, C, E, L
ALAUIDAE		
Cincloramphus cruralis	Brown Songlark	G
Cincloramphus mathewsi	Rufous Songlark	G, C, I
Mirafra javanica	Singing Bushlark	I
Total Species Expected		**117**
Total Species Recorded in the Region		**114**
Total Species Recorded for the Orebody 25 Project		**47**
Species Recorded Exclusively at Orebody 25		**1**

APPENDIX II - C: Mammal species previously observed or expected in the Orebody 25 area.

SPECIES	COMMON NAME	PRESENCE
TACHYGLOSSIDAE		
Tachyglossus aculeatus	Echidna	B, D, C
DASYURIDAE		
Dasykaluta rosamondae	Little Red Kaluta	B, A, G, H, C, E, K
Dasyurus hallucatus	Northern Quoll	X
Ningaui timealeyi	Pilbara Ningaui	B, D, G, H, C
Planigale sp		D, H, E, K
Planigale maculata	Common Planigale	C, K
Pseudantechinus macdonnellensis	Fat-tailed Antechinus	A, L
Sminthopsis macroura	Stripe-faced Dunnart	B, H, C, K
Sminthopsis ooldea	Ooldea Dunnart	B, C
EMBALLONURIDAE		
Saccolaimus flaviventris	Yellow-bellied Sheath-tail Bat	B, H, I, E, J
Taphozous georgianus	Common Sheath-tail Bat	B, H, I, E
Taphozous hilli	Hill's Sheath-tail Bat	B, C, L
FELIDAE		
**Felis catus*	Cat	A, J, C, H, K
LEPORIDAE		
**Oryctolagus cuniculus*	Rabbit	D, A
MACROPODIDAE		
Macropus robustus erubescens	Euro	B, D, A, G, H, I, J, C, E, K, L
Macropus rufus	Red Kangaroo	B, J
Macropus sp.		X
Petrogale rothschildi	Rothschild's Rock-wallaby	D, C
Petrogale sp.	Rock-wallaby Species	G, I, E
MEGADERMATIDAE		
Macroderma gigas	Ghost Bat	B
MOLOSSIDAE		
Chaerophon jobensis	Northern Mastiff-bat	B, J
Mormopterus beccarii	Beccari's Freetail-bat	B, I
Mormopterus planiceps	Little Mastiff-bat	C
Tadarida australis	White-striped Mastiff-bat	B, E
MURIDAE		
**Mus musculus*	House Mouse	B, D, A, G, E, K
Notomys alexis	Spinifex Hopping-mouse	E
Pseudomys chapmani	Western Pebble-mound Mouse	B, D, G, H, I, C, A, K, L

SPECIES	COMMON NAME	PRESENCE
Pseudomys desertor	Desert Mouse	B, G, E
Pseudomys hermannsburgensis	Sandy Inland Mouse	B, D, A, G, H, C, E, K
Zyzomys argurus	Common Rock-rat	B, D, G, H, C, A, K
THYLACOMYIDAE		
Macrotis lagotis	Bilby	B
VESPERTILIONIDAE		
Chalinolobus gouldii	Gould's Wattled Bat	B, H, I, E, C, J
Nyctophilus bifax daedalus	Eastern Long-eared Bat	B
Nyctophilus geoffroyi	Lesser Long-eared Bat	B, I, J
Scotorepens balstoni	Inland Broad-nosed Bat	H, I, C, E
Scotorepens greyii	Inland Broad-nosed Bat	B, H, I, E, C, J
Vespadelus finlaysoni	Western Cave Eptesicus	B, H, I, E, C, J, K
CANIDAE		
**Canis lupus familiaris*	Dingo	A, H, I, J, C, E, L
**Vulpes vulpes*	Fox	A
EQUIDAE		
**Equus caballus*	Horse	A
BOVIDAE		
**Bos taurus*	Cow	C, A, L
Total Species Expected		**41**
Total Species Recorded in the Region		**40**
Total Species Recorded for the Orebody 25 Project		**6**
Species Recorded Exclusively at Orebody 25		**0**

APPENDIX III: Explanation of Conservation Codes

III – a: Vascular Flora
III – b: Declared Weeds
III – c: Fauna

Environment Protection and Biodiversity Conservation Act 1999

At a National level, flora and fauna are protected under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The Act contains a list of species that are considered Critically Endangered, Endangered, Vulnerable, Conservation Dependent, Extinct or Extinct in the Wild (Table C.1.1).

Definition of categories described under the EPBC Act.

CONSERVATION CATEGORY	DEFINITION
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 CULTIVATION, 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 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.

Wildlife Conservation Act 1950

Rare Flora is also protected under the *Western Australian Wildlife Conservation (Rare Flora) Notice 2003* of the *Wildlife Conservation Act 1950*. The notice lists protected flora taxa that are extant and considered likely to become extinct or rare. Generally speaking, species of flora are considered as being of Declared Rare Flora (DRF) or Priority conservation status where their populations are restricted geographically or threatened by local processes. CALM maintains a list of all DRF and Priority Flora taxa within Western Australia (Atkins, 2003). Definitions of categories of DRF and Priority Flora are provided in Table C1.2. Priority Flora are either poorly known, believed to be uncommon, rare or under threat but have not been designated as DRF and thereby legally protected because the detailed survey work to justify this has not been carried out. Priority species are maintained on a "Reserve List" and assigned to one of four Priority categories (Atkins, 2003).

Definition of Declared Rare and Priority Flora Categories.

CODE	DEFINITION
DRF	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.
P1: PRIORITY ONE	POORLY KNOWN TAXA. TAXA WHICH ARE KNOWN FROM ONE OR A FEW (GENERALLY <5) POPULATIONS WHICH ARE UNDER THREAT.
P2: PRIORITY TWO	POORLY KNOWN TAXA. TAXA WHICH ARE KNOWN FROM ONE OR A FEW (GENERALLY <5) POPULATION, AT LEAST SOME OF WHICH ARE NOT BELIEVED TO BE UNDER IMMEDIATE THREAT.
P3: PRIORITY THREE	POORLY KNOWN TAXA. TAXA WHICH ARE KNOWN FROM SEVERAL POPULATIONS, AT LEAST SOME OF WHICH ARE NOT BELIEVED TO BE UNDER IMMEDIATE THREAT.
P4: PRIORITY FOUR	RARE TAXA. TAXA WHICH ARE CONSIDERED TO HAVE BEEN ADEQUATELY SURVEYED AND WHICH WHILST BEING RARE, ARE NOT CURRENTLY THREATENED BY ANY IDENTIFIABLE FACTORS.

(From Atkins, K.J., Declared Rare and Priority Flora List April 2003, Dept CALM)

Explanation of Codes for Declared Weeds in Western Australia.

PRIORITY	REQUIREMENTS
P1 PROHIBITS MOVEMENT	THE MOVEMENT OF PLANTS OR THEIR SEEDS IS PROHIBITED WITHIN THE STATE. THIS PROHIBITS THE MOVEMENT OF CONTAMINATED MACHINERY AND PRODUCE INCLUDING LIVESTOCK AND FODDER.
P2 AIM IS TO ERADICATE INFESTATION	TREAT ALL PLANTS TO DESTROY AND PREVENT PROPAGATION EACH YEAR UNTIL NO PLANTS REMAIN. THE INFESTED AREA MUST BE MANAGED IN SUCH A WAY THAT PREVENTS THE SPREAD OF SEED OR PLANT PARTS ON OR IN LIVESTOCK, FODDER, GRAIN, VEHICLES AND/OR MACHINERY.
P3 AIMS TO CONTROL INFESTATION BY REDUCING AREA AND/OR DENSITY OF INFESTATION	THE INFESTED AREA MUST BE MANAGED IN SUCH A WAY THAT PREVENTS THE SPREAD OF SEED OR PLANT PARTS WITHIN AND FROM THE PROPERTY ON OR IN LIVESTOCK, FODDER, GRAIN, VEHICLES AND/OR MACHINERY. TREAT TO DESTROY AND PREVENT SEED SET FOR ALL PLANTS: • WITHIN 100 METRES INSIDE OF THE BOUNDARIES OF THE INFESTATION. • WITHIN 50 METRES OF ROADS AND HIGH-WATER MARK ON WATERWAYS. • WITHIN 50 METRES OF SHEDS, STOCK YARDS AND HOUSES. • TREATMENT MUST BE DONE PRIOR TO SEED SET EACH YEAR. OF THE REMAINING INFESTED AREA: • WHERE PLANT DENSITY IS 1-10 PER HECTARE TREAT 100% OF INFESTATION. • WHERE PLANT DENSITY IS 11-100 PER HECTARE TREAT 50% OF INFESTATION. • WHERE PLANT DENSITY IS 101-1000 PER HECTARE TREAT 10% OF INFESTATION. PROPERTIES WITH LESS THAN 2 HECTARES OF INFESTATION MUST TREAT THE ENTIRE INFESTATION. ADDITIONAL AREAS MAY BE ORDERED TO BE TREATED.

PRIORITY	REQUIREMENTS
P4 AIMS TO PREVENT INFESTATION SPREADING BEYOND EXISTING BOUNDARIES OF INFESTATION	THE INFESTED AREA MUST BE MANAGED IN SUCH A WAY THAT PREVENTS THE SPREAD OF SEED OR PLANT PARTS WITHIN AND FROM THE PROPERTY ON OR IN LIVESTOCK, FODDER, GRAIN, VEHICLES AND/OR MACHINERY. TREAT TO DESTROY AND PREVENT SEED SET ALL PLANTS: • WITHIN 100 METRES INSIDE OF THE BOUNDARIES OF THE INFESTED PROPERTY • WITHIN 50 METRES OF ROADS AND HIGH-WATER MARK ON WATERWAYS • WITHIN 50 METRES OF SHEDS, STOCK YARDS AND HOUSES • TREATMENT MUST BE DONE PRIOR TO SEED SET EACH YEAR. PROPERTIES WITH LESS THAN 2 HECTARES OF INFESTATION MUST TREAT THE ENTIRE INFESTATION. ADDITIONAL AREAS MAY BE ORDERED TO BE TREATED. SPECIAL CONSIDERATIONS IN THE CASE OF P4 INFESTATIONS WHERE THEY CONTINUE ACROSS PROPERTY BOUNDARIES THERE IS NO REQUIREMENT TO TREAT THE RELEVANT PART OF THE PROPERTY BOUNDARIES AS LONG AS THE BOUNDARIES OF THE INFESTATION AS A WHOLE ARE TREATED. THERE MUST BE AGREEMENT BETWEEN NEIGHBOURS IN RELATION TO THE TREATMENT OF THESE AREAS.
P5	INFESTATIONS ON PUBLIC LANDS MUST BE CONTROLLED

Commonwealth EPBC Act

Schedule 1 of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* contains a list of species that are considered Critically Endangered, Endangered, Vulnerable, Extinct, Extinct in the wild and Conservation Dependent.

Explanation of codes for fauna under the Commonwealth EPBC Act

CONSERVATION CATEGORY	DEFINITION
CRITICALLY ENDANGERED	THE SPECIES IS FACING AN EXTREMELY HIGH RISK OF EXTINCTION IN THE WILD 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.
EXTINCT	A SPECIES IS PRESUMED EXTINCT IF IT HAS NOT BEEN LOCATED IN THE LAST 50 YEARS, OR IT HAS NOT BEEN LOCATED IN THE LAST 10 YEARS DESPITE THOROUGH SEARCHING.
EXTINCT IN THE WILD	THE SPECIES IS ONLY KNOWN TO SURVIVE IN CULTIVATION, IN CAPTIVITY OR AS A NATURALISED POPULATION WELL OUTSIDE ITS PAST RANGE OR IT HAS NOT BEEN RECORDED IN ITS KNOWN AND/OR EXPECTED HABITAT, AT APPROPRIATE SEASONS, ANYWHERE IN ITS PAST RANGE, DESPITE EXHAUSTIVE SURVEYS OVER A TIMEFRAME APPROPRIATE TO ITS LIFE CYCLE AND FORM.
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.

WA *Wildlife Conservation Act 1950 (Specially Protected Fauna) Notice*

Classification of rare and endangered fauna under the WA *Wildlife Conservation (Specially Protected Fauna) Notice 2003*, recognises four distinct schedules.

Explanation of codes under the WA *Wildlife Conservation Act 1950 (Specially Protected Fauna) Notice*

CODE	DEFINITION
SCHEDULE 1	"FAUNA WHICH ARE RARE OR LIKELY TO BECOME EXTINCT, ARE DECLARED TO BE FAUNA THAT IS IN NEED OF SPECIAL PROTECTION"
SCHEDULE 2	"FAUNA WHICH ARE PRESUMED TO BE EXTINCT, ARE DECLARED TO BE FAUNA THAT IS IN NEED OF SPECIAL PROTECTION"
SCHEDULE 3	"BIRDS WHICH ARE SUBJECT TO AN AGREEMENT BETWEEN THE GOVERNMENTS OF AUSTRALIA AND JAPAN RELATING TO THE PROTECTION OF MIGRATORY BIRDS AND BIRDS IN DANGER OF EXTINCTION, ARE DECLARED TO BE FAUNA THAT IS IN NEED OF SPECIAL PROTECTION"
SCHEDULE 4	"DECLARED TO BE FAUNA THAT IS IN NEED OF SPECIAL PROTECTION, OTHERWISE THAN FOR THE REASONS MENTIONED IN PARAGRAPHS (A), (B) AND (C)."

CALM Priority Fauna

Species on the CALM Priority Fauna list include those removed from the Scheduled fauna list and other species known from only a few populations or in need of monitoring. Four Priority Codes are recognised.

Explanation of CALM Priority Fauna categories.

PRIORITY CATEGORY	DEFINITION
PRIORITY ONE TAXA WITH FEW, POORLY KNOWN POPULATIONS ON THREATENED LANDS.	TAXA WHICH ARE KNOWN FROM FEW SPECIMENS OR SIGHT RECORDS FROM ONE OR A FEW LOCALITIES, ON LANDS NOT MANAGED FOR CONSERVATION, *E.G.* AGRICULTURAL OR PASTORAL LANDS, URBAN AREAS, ACTIVE MINERAL LEASES. THE TAXON NEEDS URGENT SURVEY AND EVALUATION OF CONSERVATION STATUS BEFORE CONSIDERATION CAN BE GIVEN TO DECLARATION AS THREATENED FAUNA.
PRIORITY TWO TAXA WITH FEW, POORLY KNOWN POPULATIONS ON CONSERVATION LANDS.	TAXA WHICH ARE KNOWN FROM FEW SPECIMENS OR SIGHT RECORDS FROM ONE OR A FEW LOCALITIES, ON LANDS NOT UNDER IMMEDIATE THREAT OF HABITAT DESTRUCTION OR DEGRADATION, *E.G.* NATIONAL PARKS, CONSERVATION PARKS, NATURE RESERVES, STATE FOREST, VACANT CROWN LAND, WATER RESERVES, ETC. THE TAXON NEEDS URGENT SURVEY AND EVALUATION OF CONSERVATION STATUS BEFORE CONSIDERATION CAN BE GIVEN TO DECLARATION AS THREATENED FAUNA
PRIORITY THREE TAXA WITH SEVERAL, POORLY KNOWN POPULATIONS, SOME ON CONSERVATION LANDS.	TAXA WHICH ARE KNOWN FROM FEW SPECIMENS OR SIGHT RECORDS FROM SEVERAL LOCALITIES, SOME OF WHICH ARE ON LANDS NOT UNDER IMMEDIATE THREAT OF HABITAT DESTRUCTION OR DEGRADATION. THE TAXON NEEDS URGENT SURVEY AND EVALUATION OF CONSERVATION STATUS BEFORE CONSIDERATION CAN BE GIVEN TO DECLARATION AS THREATENED FAUNA.
PRIORITY FOUR 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 IF PRESENT CIRCUMSTANCES CHANGE. THESE TAXA ARE USUALLY REPRESENTED ON CONSERVATION LANDS.
PRIORITY FIVE TAXA IN NEED OF MONITORINS	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.

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Explanation of IUCN Fauna Categories.

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 (CR)	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, 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.
LEAST CONCERN (LC)	A TAXON IS LEAST CONCERN WHEN IT HAS BEEN EVALUATED AGAINST THE CRITERIA AND DOES NOT QUALIFY FOR CRITICALLY ENDANGERED, ENDANGERED, VULNERABLE OR NEAR THREATENED. WIDESPREAD AND ABUNDANT TAXA ARE INCLUDED IN THIS CATEGORY.
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

CATEGORY	DEFINITION
	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.
NOT EVALUATED (NE)	A TAXON IS NOT EVALUATED WHEN IT IS HAS NOT YET BEEN EVALUATED AGAINST THE CRITERIA.

IUCN categories are further classified based on the following criteria:

CRITICALLY ENDANGERED (CR)

A taxon is Critically Endangered when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing an extremely high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of 90% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:

a. direct observation
b. an index of abundance appropriate to the taxon
c. a decline in area of occupancy, extent of occurrence and/or quality of habitat
d. actual or potential levels of exploitation
e. the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of 80% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of a-e under A1.

3. A population size reduction of 80%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of b-e under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of 80% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where

the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of a-e under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 100 km², and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at only a single location.

b. Continuing decline, observed, inferred or projected, in any of the following:
(i) extent of occurrence
(ii) area of occupancy
(iii) area, extent and/or quality of habitat
(iv) number of locations or subpopulations
(v) number of mature individuals.

c. Extreme fluctuations in any of the following:
(i) extent of occurrence
(ii) area of occupancy
(iii) number of locations or subpopulations
(iv) number of mature individuals.

2. Area of occupancy estimated to be less than 10 km², and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at only a single location.

b. Continuing decline, observed, inferred or projected, in any of the following:
(i) extent of occurrence
(ii) area of occupancy
(iii) area, extent and/or quality of habitat
(iv) number of locations or subpopulations
(v) number of mature individuals.

c. Extreme fluctuations in any of the following:
(i) extent of occurrence
(ii) area of occupancy
(iii) number of locations or subpopulations
(iv) number of mature individuals.

C. Population size estimated to number fewer than 250 mature individuals and either:

1. An estimated continuing decline of at least 25% within three years or one generation, whichever is longer, (up to a maximum of 100 years in the future) OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a-b):

a. Population structure in the form of one of the following:
(i) no subpopulation estimated to contain more than 50 mature individuals, OR
(ii) at least 90% of mature individuals in one subpopulation.

b. Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 50 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or three generations, whichever is the longer (up to a maximum of 100 years).

ENDANGERED (EN)

A taxon is Endangered when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing a very high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of 70% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are clearly reversible AND understood AND ceased, based on (and specifying) any of the following:

a. direct observation
b. an index of abundance appropriate to the taxon
c. a decline in area of occupancy, extent of occurrence and/or quality of habitat
d. actual or potential levels of exploitation
e. the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of 50% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of a-e under A1.

3. A population size reduction of 50%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of b-e under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of 50% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of a-e under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 5000 km², and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at no more than five locations.

b. Continuing decline, observed, inferred or projected, in any of the following:
(i) extent of occurrence
(ii) area of occupancy
(iii) area, extent and/or quality of habitat
(iv) number of locations or subpopulations
(v) number of mature individuals.

c. Extreme fluctuations in any of the following:
(i) extent of occurrence
(ii) area of occupancy
(iii) number of locations or subpopulations
(iv) number of mature individuals.

2. Area of occupancy estimated to be less than 500 km², and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at no more than five locations.

b. Continuing decline, observed, inferred or projected, in any of the following:
(i) extent of occurrence
(ii) area of occupancy
(iii) area, extent and/or quality of habitat
(iv) number of locations or subpopulations
(v) number of mature individuals.

c. Extreme fluctuations in any of the following:
(i) extent of occurrence
(ii) area of occupancy
(iii) number of locations or subpopulations
(iv) number of mature individuals.

C. Population size estimated to number fewer than 2500 mature individuals and either:

1. An estimated continuing decline of at least 20% within five years or two generations, whichever is longer, (up to a maximum of 100 years in the future) OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a-b):

a. Population structure in the form of one of the following:
(i) no subpopulation estimated to contain more than 250 mature individuals, OR
(ii) at least 95% of mature individuals in one subpopulation.

b. Extreme fluctuations in number of mature individuals.

D. Population size estimated to number fewer than 250 mature individuals.

E. Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or five generations, whichever is the longer (up to a maximum of 100 years).

VULNERABLE (VU)

A taxon is Vulnerable when the best available evidence indicates that it meets any of the following criteria (A to E), and it is therefore considered to be facing a high risk of extinction in the wild:

A. Reduction in population size based on any of the following:

1. An observed, estimated, inferred or suspected population size reduction of 50% over the last 10 years or three generations, whichever is the longer, where the causes of the reduction are: clearly reversible AND understood AND ceased, based on (and specifying) any of the following:

a. direct observation
b. an index of abundance appropriate to the taxon
c. a decline in area of occupancy, extent of occurrence and/or quality of habitat
d. actual or potential levels of exploitation
e. the effects of introduced taxa, hybridization, pathogens, pollutants, competitors or parasites.

2. An observed, estimated, inferred or suspected population size reduction of 30% over the last 10 years or three generations, whichever is the longer, where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of a-e under A1.

3. A population size reduction of 30%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer (up to a maximum of 100 years), based on (and specifying) any of b-e under A1.

4. An observed, estimated, inferred, projected or suspected population size reduction of 30% over any 10 year or three generation period, whichever is longer (up to a maximum of 100 years in the future), where the time period must include both the past and the future, and where the reduction or its causes may not have ceased OR may not be understood OR may not be reversible, based on (and specifying) any of a-e under A1.

B. Geographic range in the form of either B1 (extent of occurrence) OR B2 (area of occupancy) OR both:

1. Extent of occurrence estimated to be less than 20,000 km², and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at no more than 10 locations.

b. Continuing decline, observed, inferred or projected, in any of the following:
(i) extent of occurrence
(ii) area of occupancy
(iii) area, extent and/or quality of habitat

(iv) number of locations or subpopulations
(v) number of mature individuals.

c. Extreme fluctuations in any of the following:
(i) extent of occurrence
(ii) area of occupancy
(iii) number of locations or subpopulations
(iv) number of mature individuals.

2. Area of occupancy estimated to be less than 2000 km², and estimates indicating at least two of a-c:

a. Severely fragmented or known to exist at no more than 10 locations.

b. Continuing decline, observed, inferred or projected, in any of the following:
(i) extent of occurrence
(ii) area of occupancy
(iii) area, extent and/or quality of habitat
(iv) number of locations or subpopulations
(v) number of mature individuals.

c. Extreme fluctuations in any of the following:
(i) extent of occurrence
(ii) area of occupancy
(iii) number of locations or subpopulations
(iv) number of mature individuals.

C. Population size estimated to number fewer than 10,000 mature individuals and either:

1. An estimated continuing decline of at least 10% within 10 years or three generations, whichever is longer, (up to a maximum of 100 years in the future) OR

2. A continuing decline, observed, projected, or inferred, in numbers of mature individuals AND at least one of the following (a-b):

a. Population structure in the form of one of the following:
(i) no subpopulation estimated to contain more than 1000 mature individuals, OR
(ii) all mature individuals are in one subpopulation.

b. Extreme fluctuations in number of mature individuals.

D. Population is very small or restricted in the form of either of the following:

1. Population size estimated to number fewer than 1000 mature individuals.

2. Population with a very restricted area of occupancy (typically less than 20 km²) or number of locations (typically five or fewer) such that it is prone to the effects of human activities or stochastic events within a very short time period in an uncertain future, and is thus capable of becoming Critically Endangered or even Extinct in a very short time period.

E. Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years.