CLIENTS | PEOPLE | PERFORMANCE

Main Roads Western Australia

Report for Goldfields Highway, SLK 737-748

Biological Survey

May 2011

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Executive Summary

Main Roads Western Australia (Main Roads) is proposing to erect fencing a nominal distance of 100 m either side of the Goldfields Highway from SLK 737 to SLK 748.

Main Roads has commissioned GHD Pty Ltd (GHD) to undertake a biological survey of the project area to provide necessary information to assist in the preparation of environmental impact assessment and environmental management documentation.

Key findings of the survey are as follows:

- Within the vicinity of the project area, the vegetation is considered to be of Least Concern, with approximately 100% of the pre-European extent of native vegetation remaining;
- A total of eight vegetation types were recorded from the study area. These vegetation types can be considered to be comparable to the broad Vegetation Associations 18 and 107 described by Beard (1979);
- No Threatened Ecological Communities (TECs) are known to occur within 50 km of the project area; however, three Priority Ecological Communities (PECs) were recorded during the desktop assessment, two of which intersect the project area. All three PECs are associated with subterranean fauna and are unlikely to be affected by the proposed fencing works. No TECs or PECs were recorded in the project area during the field survey;
- Vegetation condition within the study corridor ranged from *Very Good* (3) to *Completely Degraded* (6) with better condition vegetation generally restricted to the laterite breakaways and stony hills. The most noticeable areas of disturbance were the existing burrow pits, pastoral infrastructure and roadside margins;
- A total of 98 flora taxa from 24 families were recorded from the project area, representing a medium level of diversity;
- No Declared Rare Flora (DRF) or Priority Listed Flora (PLF) taxa were recorded from the project area during the field survey. No taxa recorded from the project area exhibited an extension to their known range;
- A total of two weed species were recorded from the project area, representing 2% of the total number of plant species recorded;
- A total of 19 bird species, four mammal and three reptile species were recorded from the project area;
- Conservation significant fauna species are considered unlikely to occur in the project area. No threatened fauna species were recorded in the project area during the reconnaissance fauna survey. Threatened fauna species known to occur in the general area, as identified in the desktop assessment, are considered unlikely to use the project area for breeding or refuge purposes;
- No protected fauna species were recorded during the field survey;

- A number of *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Marine and Migratory Listed species were recorded from the project area. These species are considered to be common in Western Australia and are not under threat;
- The proposed clearing of approximately 10 ha of native vegetation within the project area is not considered to be significantly at variance against any of the '10 Clearing Principles;
- GHD considers that the clearing remnant native vegetation and minor modifications to the landscape for fencing works may be approved by the Department of Environment and Conservation (DEC) given the outcomes of this assessment against the 'Ten Clearing Principles';
- This project is considered unlikely to require referral to the Environmental Protection Authority (EPA) for any approval to clear vegetation; and
- Management measures should be implemented during construction to minimise impacts to flora and fauna (refer Section 6.2).

1. Introduction

1.1 Background

Main Roads Western Australia (Main Roads) is proposing to erect fencing a nominal distance of 100 m either side of the Goldfields Highway from SLK 737 to SLK 748. Proposed fencing will take into consideration the new proposed road alignment that deviates from the existing road along the eastern end of this section.

Main Roads has commissioned GHD Pty Ltd (GHD) to undertake a biological survey of the project area to provide necessary information to assist in the preparation of environmental impact assessment and environmental management documentation. A key objective of the survey is to assess the possibility of Threatened Flora within the proposed works area.

A Preliminary Environmental Impact Assessment (PEIA) immediately to the west of the project area was undertaken by GHD in 2006. The assessment was associated with road upgrade works completed from SLK 748 to SLK 758.

1.2 Project Area

The project area is located approximately 54 km east of Meekatharra on the Goldfields Highway between SLK 737 and SLK 748. The survey was restricted to a linear corridor 150 m either side of the road centreline, encompassing a total area of approximately 300 ha. The location and extent of the project area is shown in Figure 1, Appendix A.

Environmental aspects outside of the immediate project area that may be impacted by the fencing project were also considered.

1.3 Scope of Work

The scope of work for survey included the following:

- a desktop assessment of the project area;
- a field study of relevant biological aspects and issues including reserves and other relevant land use;
- an assessment of the project against the *Environmental Protection Act WA 1986* (EP Act) 10 Clearing Principles (Schedule 5); and
- an indication and discussion of the requirement for referral to statutory authorities or for other clearances for the project for all surveys.

2. Methodology

2.1 Desktop Assessment

A desktop assessment was carried out prior to the field survey in order to consider biological constraints, which may be in, or adjoining the study area. This included a literature search to identify information pertaining to the study area which may assist in improving an understanding of its biological significance. More specifically, the desktop assessment included:

- a review of existing biological survey information for the area and relevant information on the existing physical environment;
- a search of the Department of Sustainability Environment, Water, Population and Communities (DSEWPaC) database for Threatened Ecological Communities listed under the EPBC Act;
- a search of the Department of Environment and Conservation's (DEC's) Threatened Ecological Community (TEC) and Priority Ecological Communities (PEC) database to determine the potential for any TECs and PECs that could be present in the project area;
- a search of the DEC's Environmentally Sensitive Areas (ESA) database;
- a review of adjoining land use, including conservation reserves;
- a review of broad vegetation types shown in existing mapping (e.g. Beard);
- a search of Declared Rare Flora (DRF) and Priority Listed Flora (PLF) databases;
- a search of the Western Australian Museum (WAM)/DEC *NatureMap* database for threatened or otherwise protected vertebrate fauna; and
- consultation and liaison with the relevant statutory authorities or specialists; and
- a review of remnant vegetation clearing in relation to statutory requirements.

2.2 Field Assessment

The field survey sought to confirm the findings of the desktop assessment and provide a detailed examination of the existing environment in the study area and its relationship to adjoining areas. The field survey was undertaken with regards to Environmental Protection Authority (EPA) Guidance Statement No. 51 and was considered appropriate given the potential significance of the proposed project within the receiving environment. More specifically, the field survey included the following:

- a description and summary of climatic data and how it may affect the outcome of the survey;
- broad soil descriptions and their relationship to topography and plant communities;

- Compiling an inventory of the vascular plant species in the project area;
- Undertaking a review of, and search for, native plant species considered to be rare or potentially endangered.
- Mapping locations of DRF or PLF at a suitable scale;
- Compiling an inventory of dominant exotic plants, including declared noxious plants and environmental weed species;
- Describing and recording locations of plant communities, including GIS mapping and photographs (communities were linked to already known, described where possible);
- Rating the condition of the vegetation communities or areas using a published rating scale (i.e. Keighery, 1994);
- Reviewing of the local and regional significance of the plant communities in terms of their intrinsic value, extent, rarity and condition;
- Determining whether the project area is within an ESA and whether the native vegetation in the area to be cleared is in a *Good* or better condition than the rest;
- Compiling an inventory of vertebrate fauna species observed within the survey area through targeted searches and opportunistic recording of species;
- Reviewing and searching for threatened vertebrate fauna species potentially present within the project area;
- Identifying any habitats of significance; and
- Assessing proposed clearing against the "10 Clearing Principles" as outlined in Schedule 5 of the EP Act.

2.2.1 Vegetation and Flora Survey

GHD's qualified ecologist, Peter Moonie with assistance from GHD's Environmental Scientist, Casey Skalski, completed the flora and vegetation survey during the period 8 – 11 November 2010. The survey was conducted with regards to the EPA's Guidance Statement No. 51, *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004a).

The area studied consisted of a linear corridor centred on the Goldfields Highway. The field survey involved walking a series of transects at approximately 1 km intervals. Transect intervals were adjusted where required to better capture the range of vegetation associations present. Each transect was orientated perpendicular to the Highway and extended 200 m either side of the road corridor. A total of 11 transects were undertaken along the length of the project area (locations are mapped at Figure 1, Appendix A). Data collected provided information on substrate, vegetation condition (including weed status), vascular flora species present and the dominant species within each selected vegetation type.

Targeted searches for significant species were also undertaken. Survey effort was concentrated within habitats identified as potentially having significant flora species present, based on the preferred habitat and known distributions of significant flora

taxa. If suspected significant flora was found, particular attention was paid to the habitat, soil types and vegetation associations at each location. These observations were then used to search for additional populations at likely locations in the project area.

Vehicle traverses were also undertaken where possible to assist in vegetation type and condition mapping.

A list of flora species recorded during the survey was generated for the project area. The presence of significant flora and/or potential TECs within the project area was assessed and aerial photography was used to assist in the delineation of vegetation types.

2.2.2 Fauna

GHD's qualified ecologist, Peter Moonie, with assistance from GHD's Environmental Scientist, Casey Skalski, conducted the fauna investigation in conjunction with the flora investigation during the period 8 – 11 November 2010. The fauna investigation was an opportunistic survey and involved recording sightings of fauna species utilising the study area as well as any fauna signs observed, such as tracks, scats, bones, diggings and feeding signs. Fauna trapping was not undertaken.

2.2.3 Nomenclature

Nomenclature used in this report follows that used by the DEC/WAM *NatureMap* database as it is deemed to contain the most up-to-date species information for Western Australia.

2.2.4 Limitations

Complete flora and fauna surveys can require multiple surveys, at different times of year, and over a period of a number of years, to enable observation of all species present. Some flora species, such as annuals, are only available for collection at certain times of the year, and others are only identifiable at certain times (such as when they are flowering). Additionally, climatic and stochastic events (such as fire) may affect the presence of plant species. Species that have a very low abundance in the area are more difficult to locate, due to above factors. Whilst the flora survey was relatively thorough, there is a possibility that some taxa in the area may have been overlooked, particularly given the dry conditions and level of grazing observed.

The flora survey was also predominantly restricted to flowering plants, with consideration of some other vascular plants such as cycads. Non-vascular plants were not systematically searched for, as the information available on these plants is generally limited.

The fauna survey undertaken was a reconnaissance survey only and thus only sampled those species that can be easily seen, heard or have distinctive signs, such as tracks, scats and diggings. Many cryptic and nocturnal species would not have been identified during a reconnaissance survey. Extensive detailed fauna surveys, involving trapping surveys, are required to obtain a more comprehensive list of fauna

species that may utilise the site. This survey was also aimed at identifying the terrestrial vertebrate fauna of the study area. No sampling of invertebrates or aquatic species occurred.

3. Desktop Assessment

3.1 Surrounding Land Use

The dominant land use surrounding the project area is agricultural grazing, predominately cattle, sheep and to a lesser extent goats (Martinick McNulty, 1999). Mining is also undertaken within the broader region.

3.2 Previous Biological Studies

A number of biological studies have been completed within the broader Meekatharra – Wiluna region. The most relevant to this assessment are outlined below:

- Martinick McNulty Pty Ltd compiled an inventory of flora species observed 500m either side of the Goldfields Highway whilst undertaking an environmental assessment of the proposed road reconstruction from Wiluna to Meekatharra (SLK 611.51 to 793.28) in 1999. One hundred and thirty eight vascular flora taxa were recorded. A targeted flora survey was also undertaken as part of the assessment. No Declared Flora or Priority were recorded within the study corridor at the time of the survey (Martinick McNulty Pty Ltd, 1999).
- A comprehensive biological survey of the broader Meekatharra – Wiluna region was undertaken by Marbutt *et al* in 1958. The objective of the survey was to describe and map land systems present based on recurring patterns of landforms, soils and vegetation. Forty-eight land systems were described for the region, three of which were noted by Martinick McNulty Pty Ltd as occurring within the extent of current study area: the Glengarry, Sherwood and Bullimore Land Systems (Martinick McNulty Pty Ltd, 1999).
- Biological surveys completed by GHD in 2007 along nominated sections of the Goldfields Highway, Wiluna to Meekatharra section. (SLK 614-618, SLK 626-636, SLK 643-647).

3.3 Climate

The project area is located within the western Murchison region of Western Australia. This region experiences a dry climate with hot dry summers that last on average five to six months and mild winters. The climate of this region is strongly influenced by a band of high pressure known as the sub-tropical ridge, and in the warmer summer months by a trough of low pressure extending southwards from the tropics (Bureau of Meteorology, 2010).

The closest official weather recording station to the project area is located at the Meekatharra Airport. This recording station is approximately 50 km to the west of the project area. Recorded climate data for the Meekatharra Airport has been summarised in Table 1. The project area is considered to exhibit a similar long term climate to that recorded at the Meekatharra Airport.

Table 1 Summary Climatic Statistics for Meekatharra Airport

Statistic Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Mean max. temp(°C)	38.3	36.7	34.3	29.2	23.8	19.6	19	21.3	25.6	29.6	33.2	36.4	28.9
Mean min. temp (°C)	24.4	23.7	21.4	17	12.1	8.8	7.4	8.5	11.5	15.1	18.7	22	15.9
Mean rainfall (mm)	27.1	35.3	28.1	20.7	23.2	30.6	21.7	11.2	4.9	6.3	11.6	12.1	232.7

(Source: Bureau of Meteorology, 2010)

Seasonal variations in temperature are reasonably large. Mean maximum temperatures recorded range from 38.3 °C in January to 19.6 °C in August. Mean minimum temperature range from 24.4 °C in January to 7.4 °C in July.

Meekatharra's mean annual rainfall is 232.7 mm, with monthly averages ranging from 4.9 mm in September to 35.3 mm in February.

3.3.1 Climate 2010

Rainfall recorded for the three-month period (August – October) proceeding the survey (33 mm) was above the long term average of 22.4 mm; however, rainfall recorded since the start of the year (65.4 mm) was well below the long term average of 209.1 mm recorded for the same period (January - October).

3.4 Geology, Topography and Soils

The project area is located largely within the Salinaland Plains soil-landscape zone of the Murchison Province. The zone is characterised by Sandplains (with hardpan wash plains and some mesas, stony plains and salt lakes) on granitic rocks of the Yilgarn Craton (Tille, 2006).

The soils of the Salinaland Plains zone consist of red sandy earths with some red brown hardpan shallow loams, salt lake soils and red shallow sandy duplexes (Tille, 2006).

Landforms present within the project area were typical of the broader Salinaland Plains zone and consisted largely of broad wash plains interspersed with low stony ridges and hills. Soils ranged from red loamy earths on the wash plains to shallow loamy soils and gravels on the low hills and ridges.

3.5 Hydrology

Rainfall within the region is unreliable and drainage lines are predominantly ephemeral. No permanent water courses or natural wetlands occur within the project area. Occasional drainage lines dissect the site, the most prominent of which intersects the road corridor at approximately SLK 740. Such watercourses are only likely to flow following periods of heavy rainfall. Sheetflow will occur on the flat broad wash plains following major rainfall events.

3.6 Phytogeography

The project area lies in the Murchison 1 (East Murchison) biogeographic region of the Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway and Cresswell, 1995). This is a system of some 85 biogeographic regions and 403 subregions covering the whole of Australia (including Tasmania) 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 East Murchison subregion is characterised by elevated red desert sandplains, internal drainage and salt lake systems. Mulga woodlands (often with a rich ephemeral understorey), hummock grasslands, saltbush shrublands and samphire shrublands comprise the dominant vegetation units (Australian Natural Resource Atlas, 2010).

Threatening processes for ecosystems in the region include: grazing pressure, changed hydrology, feral animals (especially goats, foxes and rabbits), changed fire regimes, pollution, pathogens, increased vegetation fragmentation and proximity to mining activities (Australian Natural Resource Atlas, 2010).

3.7 Conservation Areas

No conservation areas occur within the immediate vicinity of the project area. The nearest DEC estate is Mooloogool Station, a former pastoral lease, which lies 20 km to the east of the project area. Mooloogool Station is proposed for conservation but holds no reservation status at this time. The closest conservation reserve is Collier Range National Park which lies 175 km to the north of the project area.

3.8 Environmentally Sensitive Areas

The DEC's online Native Vegetation Viewer provides information on the location of ESAs, as declared by a Notice under section 51B of the EP Act. These databases also indicate areas where low impact mineral and petroleum activities cannot occur without a Native Vegetation Clearing Permit, as defined under Schedule One of the *Environmental Protection (Clearing of native Vegetation) Regulations* 2004.

The DEC's online Native Vegetation Viewer was searched to determine the location of any ESA's or Schedule One areas within the vicinity of the project area. No ESAs or Schedule One areas were recorded. The closest Schedule One area shown was the Meekatharra Water Reserve, 22 km to the west of the project area.

3.9 Acid Sulphate Soils

The classification of Acid Sulphate Soils (ASS) includes both actual acid sulphate soils (AASS) and potential acid sulphate soils (PASS). AASS are those soils that are generating acidity, whereas PASS are those soils that have the potential to generate acidity.

ASS are soils containing naturally-occurring, fine-grained metal sulphides typically pyrite (FeS_2), formed under saturated, anoxic/reducing conditions. They generally

occur in Quaternary (1.8 Ma – Present) marine or estuarine sediments, predominantly confined to coastal lowlands (elevations generally below 5 m AHD). Within these sediments, the majority of soils that present an environmental risk are generally confined to Holocene aged material (<10 000 years). Where these materials have oxidised, they commonly have a mottled appearance (orange and yellow discolouration) due to the presence of oxidised iron minerals.

Although soils described above represent typical conditions where ASS occurs, the presence of ASS materials is not limited to these soil types. In Western Australia, ASS materials have been identified in other soil types such as leached sands and silts. Accordingly, for areas where no data is available, the extent of ASS materials should be established through field investigations.

A search of the Australian Soil Resource Information System (ASRIS) website indicated that ASS have an extremely low probability of occurrence within the general vicinity of the site. Further ASS assessment is not considered necessary.

3.10 Pathogens

Phytophthora cinnamomi ("Dieback") disease is generally restricted to areas in the south west of the State, south of the 26th parallel of latitude, in areas receiving an average annual rainfall of greater than 400 mm.

As the project area is north of this latitude, plant species growing in the area are not considered to be susceptible to the development of the *Phytophthora cinnamomi* pathogen.

3.11 Vegetation

3.11.1 Vegetation Types

The vegetation of the Murchison region was mapped by Beard as part of the Western Australian mapping project conducted from 1964-1981. The vegetation of the project area is identified by Beard (1975) as likely to contain:

- Vegetation Association 18 described as: "Low woodland; mulga (Acacia aneura)"; and
- Vegetation Association 107 described as: "Hummock grasslands, shrub steppe; Eucalyptus kingsmillii over hard spinifex".

3.11.2 Vegetation in a Regional Context

A vegetation type is considered underrepresented if there is less than 30 percent of its original distribution remaining. From a purely biodiversity perspective, and not taking into account any other land degradation issues, there are several key criteria now being applied to vegetation in States where clearing is still occurring (EPA, 2000).

- The “threshold level” below which species loss appears to accelerate exponentially at an ecosystem level is regarded as being at 30% of the pre-European / pre-1750 extent for the vegetation type;
- A level of 10% of the original extent is regarded as being a level representing *Endangered*; and
- Clearing which would put the threat level into the class below should be avoided.

Such status can be delineated into five classes, where:

- *Presumed Extinct*: Probably no longer present in the bioregion
- *Endangered**: <10% of pre-European extent remains
- *Vulnerable**: 10-30% of pre-European extent exists
- *Depleted**: >30% and up to 50% of pre-European extent exists
- *Least Concern*: >50% pre-European extent exists and subject to little or no degradation over a majority of this area.

* or a combination of depletion, loss of quality, current threats and rarity gives a comparable status

The native vegetation association represented in the survey area; its regional extent and reservation status is drawn from Shepherd, *et al*. (2002) and Shepherd *pers. comm.* (2005) (Table 2).

Table 2 Vegetation Extent and Status in the Murchison IBRA Region

Vegetation Association Number	Association Description	Pre-European Extent (ha) in Murchison IBRA region	Current Extent (ha) in Murchison IBRA region	% Remaining	% Pre-European Extent in IUCN Class I-IV Reserves
18	Low woodland; mulga (Acacia aneura)	12403248.477	12403248.477	100	0.4
107	Hummock grasslands, shrub steppe; Eucalyptus kingsmillii over hard spinifex	2792396.685	2792396.685	100	0.7

Vegetation Associations 18 and 107 are considered to be of *Least Concern* in terms of their regional extent with no reduction in area recorded from either of their pre-European extents within the East Murchison IBRA region (Shepherd, 2005). Clearing of this vegetation is not considered contradictory to the EPA’s recommendations stated in Position Statement No. 2.

3.11.3 Threatened Ecological Communities

Ecological communities are defined as 'naturally occurring biological assemblages that occur in a particular type of habitat' (English and Blythe, 1997). Threatened Ecological Communities (TECs) are ecological communities that have been assessed and assigned to one of four categories related to the status of the threat to the community, i.e. *Presumed Totally Destroyed, Critically Endangered, Endangered,* and *Vulnerable*.

Some TECs are protected under the EPBC Act. Although TECs are not formally protected under the State *Wildlife Conservation Act 1950* (WC Act), the loss of, or disturbance to, some TECs may trigger the EPBC Act. The Environmental Protection Authority's (EPA's) position on TECs states that proposals that result in the direct loss of TECs are likely to require formal assessment.

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

The DEC's TEC database was queried for known occurrences of TECs or PECs near the study area. No TECs are known to occur within 50 km of the project area; however three PECs were recorded, two of which occur within the project area. All three PECs are associated with subterranean fauna and are unlikely to be affected by the proposed fencing works. A description of the PECs recorded is provided in Table 3.

Table 3 PECs Recorded within 50 km of the Project Area

Name	Conservation Code	Description
Killara North calcrete groundwater assemblage types on Murchison palaeodrainage on Killara Station	Priority 1	Unique assemblages of invertebrates have been identified in the groundwater calcretes.
Murchison Downs calcrete groundwater assemblage type on Murchison palaeodrainage on Murchison Downs Station	Priority 1	Unique assemblages of invertebrates have been identified in the groundwater calcretes.
Murchison Downs calcrete groundwater assemblage type on Murchison palaeodrainage on Murchison Downs Station	Priority 1	Unique assemblages of invertebrates have been identified in the groundwater calcretes.

3.12 Flora

3.12.1 Threatened and Priority Flora

Flora species considered to be significant are listed under the EPBC Act and the WC Act. The DEC also keeps a list of Priority Flora that are not listed under legislation but for which the DEC feels there is a cause for concern, or for which not enough information is known.

Conservation categories applicable to flora and fauna at the Commonwealth and State levels are listed in Appendix B.

Commonwealth

An EPBC Act Protected Matters Search (DSEWPaC, 2010a) was undertaken for the study area. *Pityrodia augustensis* was the only EPBC Act protected flora species considered to occur or likely to occur within a 15 km buffer of the project area.

State

A search was undertaken of the DEC Threatened Flora Database (DEFL), the Declared Rare Flora and Priority Flora Database (Access database) and the Western Australian Herbarium Specimen (WAHERB) database for Threatened and Priority Flora taxa located within 5 km of the project area.

Sixteen Priority Flora species were indicated to occur within the vicinity of the project area from the database searches (refer Table 12, Appendix C).

Assessment

Only two of these Priority Flora taxa are considered likely to occur in the project area, based on known range and preferred habitat (refer Table 12, Appendix C):

- *Drummondita miniata* (Priority 3); and
- *Eremophila micrantha* (Priority 3).

3.12.2 Invasive Flora Species

The EPBC Act Protected Matters Search (DSEWPaC, 2010a) indicates that there are three invasive flora species or species habitat that may occur within the vicinity of the study area:

- **Carrichtera annua* (Ward's Weed);
- **Cenchrus ciliaris* (Buffel Grass); and
- **Prosopis* species (Mesquite).

Buffel Grass is the only species listed above as indicated by *FloraBase* to occur within the vicinity of the project area.

Mesquite is a Weed of National Significance and is also classified as a Declared Plant under the *Agriculture and Related Resources Protection Act 1976* (ARRP Act) with control categories: P1, P2 and P4.

Ward's weed is not listed as a Weed of National Significance or classified as a Declared Plant under the ARRP Act.

3.13 Fauna

3.13.1 Fauna Habitat

Based on the Land Systems and Vegetation Associations mapped for the site (Mabbutt *et al*, 1958; Beard, 1979), the dominant habitat types present are likely to include low mulga shrublands on broad wash plains, spinifex grasslands on sandplains and mixed shrubs on stony plains and breakaways. Such habitats are considered likely to provide shelter for a range of fauna, particularly reptile species.

As the Vegetation Associations are of *Least Concern* (refer to Table 1), it is considered that fauna habitat within the vicinity of the study area will be of similar status.

3.13.2 Existing Fauna Records

A search of DEC/WAM *NatureMap* records was undertaken for the project area, inclusive of a 40 km buffer. A large buffer was applied due to the paucity of records in the area. The *NatureMap* records show that 67 bird and four reptile species have been officially recorded as present within the search area (refer Table 14).

3.13.3 Threatened and Priority Fauna

The conservation of fauna species and their significance status is currently assessed under both Commonwealth and State Acts. The acts include the Commonwealth EPBC Act and the State WC Act.

Commonwealth

The significance levels for fauna used in the EPBC Act are those recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN). A description of Conservation Categories delineated under the EPBC Act and the circumstances under which a project will trigger referral to the DSEWPaC are described in Appendix B.

The EPBC Act also protects migratory species that are listed under the following International Agreements:

- Appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals) for which Australia is a range state under the Convention;
- The Agreement between the Government of Australia and the Government of the Peoples Republic of China for the Protection of Migratory Birds and their Environment (CAMBA);
- The Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA);

- The Agreement between the Government of Australia and the Government of the Republic of Korea on the Protection of Migratory Birds (ROKAMBA); and
- Listed migratory species also include species identified in other international agreements approved by the Commonwealth Environment Minister.

The Act also protects marine species on Commonwealth lands and waters.

State

The WC Act uses a set of Schedules but also classifies species using some of the IUCN categories (refer Appendix B).

In Western Australia, the DEC also produces a supplementary list of Priority Fauna, these being species that are not considered Threatened under the WC Act but for which the Department feels there is a cause for concern.

Database Search Results

Protected fauna species or associated habitat identified from the EPBC Act Protected Matters Search as potentially occurring within the study area are listed in Table 4.

Table 4 Listing of Protected Fauna Species from EPBC Act Protected Matters Search

Genus	Species	Common name	EPBC Status
Birds			
Acanthiza	*iredalei iredalei*	Slender-billed Thornbill	Vulnerable
Apus	*pacificus*	Fork-tailed Swift	Migratory, Marine
Ardea	*alba*	Great Egret, White Egret	Migratory, Marine
Charadruis	*veredus*	Oriental Plover, Oriental Dotterel	Migratory, Marine
Merops	*ornatus*	Rainbow Bee-eater	Migratory, Marine
Mammals			
Rhinoonicteris	*aurantia* (Pilbara form)	Pilbara Leaf-nosed Bat	Vulnerable

One conservation significant fauna species was recorded in the search area from the DEC/WAM *NatureMap* search:

- *Burhinus grallarius* (Bush Stone Curlew*).*

This species is listed as a Priority 4 species by the DEC.

Threatened and Priority Fauna species are assessed for their likelihood of occurrence in the study area in Section 4.3.3.

3.13.4 Invasive Fauna Species

The EPBC Act Protected Matters Search (DSEWPaC, 2010a) indicates that there are four invasive fauna species occurring or likely to occur within or within the vicinity of the project area:

- *Capra hircus* (Feral Goat);
- *Felis catus* (Feral Cat);
- *Oryctolagus cuniculus* (European Rabbit); and
- *Vulpes vulpes* (Red Fox).

4. Field Assessment

4.1 Physical Environment

4.1.1 Influence of Climate

Despite the higher-than-average rainfall recorded at Meekatharra Airport in the three months prior to the field assessment, the soil profile within the project area itself was extremely dry. GHD considers that the rainfall recorded at Meekatharra may not have influenced the project area. Consequently, the collection of annual flora species was lower than anticipated.

Many perennial plants observed were also showing signs of considerable water stress and palatable vegetation was very heavily grazed. A number of specimens collected in the field were in poor condition at the time of the survey and lacked adequate plant material for identification purposes. As a result, some specimens were unable to be identified beyond genus level.

During the field survey, the weather was very hot and windy (site surveyed between 8 - 11 November 2010). The hot windy conditions were considered to account for the reduced number of bird species recorded to that anticipated.

4.1.2 Soils

Soils encountered were typical of those described in literature searches for broadwash plains and stony hills.

4.1.3 Vegetation

4.1.4 Vegetation Description

The vegetation of the survey area was classified into eight vegetation types. These vegetation types have been mapped (Figure 2, Appendix A) and are summarised in Table 5.

Table 5 Project Area Vegetation Type Descriptions

Code	Description
LF 1	**Low open mulga forest on localised area of run-on** Low open forest of *Acacia aneura* var. *macrocarpa, Acacia aneura* var. *aneura, Acacia ramulosa var. linophylla* over *Acacia craspedocarpa* and *Psydrax latifolia* over *Acacia tetragonophylla* on localised run-on zone.
TS1	**Tall mixed Acacia shrubland on low stony hill:** Tall shrubland of *Acacia aneura* var. *conifera, Acacia ?effusifolia, Acacia quadrimarginea, Acacia rhodophloia* and *Grevillea nematophylla* subsp. *supralana* over *Eremophila flabellata* and *E. punctata* over sparse understorey of *Ptilotus schwartzii* and *Sida fibulifera* with occasional *Eucalyptus kingsmillii* subsp. *kingsmillii* and *Acacia pruinocarpa* on low ironstone/quartz stony hills.
TS2	**Tall Acacia shrubland over spinifex with occasional eucalypts on sandy loam plain:** Tall shrubland of *Acacia pruinocarpa,* A. *aneura* var. *conifera, A. ramulosa* var. *linophylla, A. aneura* var. *argentea and A. sibirica* over *Eremophila forrestii, E. flabellata* over *Triodia* sp. and *Ptilotus obovatus* with occasional stands of *Eucalyptus kingsmillii* subsp. *kingsmillii and Eucalyptus striaticalyx* on sandy loam plain.
TS3	**Tall mulga shrubland over sparse understorey on broadwash plain:** Tall shrubland of *Acacia aneura* var. *aneura, A. aneura* var. *argentea, A. ramulosa* var. *linophylla* and *A. tetragonophylla* over *Eremophila flabellata* and mixed *Senna* spp. on broadwash plain.
TS4	**Tall Acacia shrubland over spinifex on sandy loam plain:** Tall shrubland of *Acacia pruinocarpa, Acacia aneura* var. *aneura,* A. *aneura* var. *conifera, A. ramulosa* var. *linophylla, A. aneura* var. *argentea* over *Acacia craspedocarpa* over *Eremophila forrestii* and *E. flabellata* over *Triodia* sp. on sandy loam plain.
LS1	**Low mixed shrubland on laterite breakaway:** Low shrubland of *Acacia effusifolia, A. quadrimarginea* and *A. aneura* var. *aneura* over *Eremophila latrobei* subsp. *latrobei, E. glutinosa* and *Dodonaea viscosa* subsp. *spatulata* over *Stylidium longibracteatum* and mixed grasses.
S1	**Acacia scrub over mixed understorey along drainage channel:** Scrub of *Acacia sibilans*, *A. aneura* var. *conifera* and *A. quadrimarginea* over *Eremophila punctata, E. fraseri, Senna artemisioides* subsp. *helmsii* and *Acacia tetragonophylla* over mixed grasses and herbs.
HD	**Highly Disturbed:** Clearing or other activities have fundamentally altered the composition of native vegetation. Few native species present (primarily disturbance response species).

4.1.5 Vegetation Condition

The vegetation in the project area was given a condition rating based on the Bush Forever Volume 2 vegetation condition ratings scale (after Keighery, 1994).

The ratings in this scale are described in Table 6.

Vegetation condition within the study corridor ranged from *Very Good* (3) to *Completely Degraded* (6) with better condition vegetation generally restricted to the laterite breakaways and stony hills. The most noticeable areas of disturbance were the existing burrow pits, pastoral infrastructure (e.g. dams, access tracks, holding yards) and roadside margins.

Grazing by livestock, native mammals and feral animals has substantially altered vegetation composition across the site, with palatable species being far more heavily grazed. Grazing and trampling impacts were generally more prevalent within drainage lines and adjacent broad sheetwash areas, as well as the margins of artificial water sources. Soils were also extremely dry during the survey and many plants observed were showing signs of considerable water stress.

Weed levels across the site were considered to be at relatively low densities given the proximity to the road and past grazing practices.

Vegetation condition within the project area has been mapped in Figure 3, Appendix A. Given the considerable extent of the project area, mapping of disturbance footprints associated with pastoral infrastructure was not attempted. However, these areas were generally considered to be *Degraded* or *Completely Degraded*.

Table 6 Vegetation Condition Scale (after Keighery, 1994)

Assigned Number	Classification	Description
1	*Pristine*	Pristine or nearly so, no obvious signs of disturbance.
2	*Excellent*	Vegetation structure intact, disturbance affecting individual species, and weeds are non-aggressive species.
3	*Very Good*	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
4	*Good*	Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some aggressive weeds at high density, partial clearing, dieback and grazing.

Assigned Number	Classification	Description
5	*Degraded*	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
6	*Completely Degraded*	The structure of the vegetation is no longer intact and the area is completely or almost without native species. These areas are often described as 'parkland clearing' with flora composing weed or crops species with isolated native trees or shrubs.

4.1.6 Local and Regional Significance of Vegetation

The National Objectives and Targets for Biodiversity Conservation 2001-2005 (Commonwealth of Australia, 2001) recognise that the retention of 30 per cent or more of the pre-clearing extent of each ecological community is necessary if Australia's biological diversity is to be protected.

The vegetation types recorded from the field survey can be considered to be comparable to the Vegetation Associations 18 and 107 described by Beard. These Associations are considered to be of *Least Concern*. As such the vegetation within the project area is not considered to be under threat, locally or regionally.

Vegetation types recorded within the project area are found in better condition in areas beyond the surveyed site which has been impacted by pastoral activities over a substantial period.

4.1.7 Threatened Ecological Communities

No Threatened Ecological Communities or Priority Ecological Communities were recorded from the field assessment. The PECs indicated to occur within 50 km of the study area (refer Section 3.11.3) will not be impacted by the proposed project.

4.2 Flora

4.2.1 Results of Field Survey

Species richness within the project area was considered reduced due to the lack of ephemeral species present. This deficiency is likely to be consequence of grazing pressures and dry conditions observed within the project area.

Results from the field survey revealed a total of 98 taxa from 24 families, of which 96 taxa are considered native. Seven collections could not be identified beyond genus level due to lack of flowering parts or fruiting bodies, or because they were only found in a juvenile form.

Dominant families recorded included:

- Fabaceae (wattles, peas, cassias): 29 taxa;
- Scrophulariaceae (poverty bushes): 8 taxa; and
- Poaceae (grasses): 7 taxa.

Dominant genera recorded included:

- *Acacia:* 19 taxa;
- *Eremophila:* 8 taxa; and
- *Senna:* 8 taxa.

A full list of flora identified in the study area is provided in Table 13, Appendix C.

4.2.2 Conservation Significant Flora

No DRF or PLF taxa were recorded from the project area during this survey. No taxa recorded from the project area exhibited an extension to their known range.

4.2.3 Weeds

The study area contains a low proportion of introduced flora. A total of two weed species were recorded from the project area, representing 2% of the total number of plant species recorded. Weed species recorded are listed in Table 7.

No Weeds of National Significance (WONS) or Declared Plants under the *Agriculture and Related Resources Protection Act 1976* (ARRP Act) were recorded within the project area.

Table 7 Weed Species Recorded within the Study Area

Genus	Species	Common Name
**Citrillus*	*lanatus*	Pie Melon
**Cyperus*	*hamulosus*	

Weed Spread

Weed species within the project area are not considered have an impact on the status of weeds in the local area. **Citrillus lanatus* is common within disturbed areas (particularly roadsides and pastoral areas) and is considered to be widespread in the local and regional area. **Cyperus hamulosus* is only known from six collections in Western Australia (DEC, 2010). The DEC plant prioritisation assessment (DEC, 2010b) indicates that although *Cyperus hamulosus* has a limited potential distribution, it has the capacity to cause acute disruption to ecological processes and dominate and/or significantly alter vegetation structure and composition.

4.3 Vertebrate Fauna

4.3.1 Fauna Records

The Level 1 reconnaissance fauna survey was conducted over a period of two days, in conjunction with the vegetation and flora survey. The fauna survey examined terrestrial vertebrate fauna species only, and was limited to diurnal searches.

Fauna records from the project area were considered to be reasonable, given the disturbed nature of the site, the absence of trapping and the hot, dry conditions during the survey period. The survey recorded 19 bird species, four mammal and three reptile species. No amphibian species were recorded from the project area. Three of the four mammal taxa recorded are exotic species (refer Table 14, Appendix D).

4.3.2 Significant Fauna Records

No threatened fauna species were recorded during the field survey.

Three EPBC Act Listed Marine and/or Migratory birds were recorded within the project area. Many of these migratory and marine species are considered common in Western Australia and do not have special protection under the Western Australian WC Act.

4.3.3 Threatened and Priority Fauna Assessment

The desktop assessment indicated that a number of protected fauna species not recorded during the field survey may also occur within the project area (refer to 3.13.3). The habitat requirements of these species and the likelihood of their occurrence in the project area are considered below.

Pilbara Leaf-nosed Bat (EPBC Act Status: *Vulnerable*; WC Act Status: Schedule 1)

The Pilbara Leaf-nosed Bat has bright orange fur and is a high energy flyer. It will often take flight before encountered by humans. This species is restricted to the Pilbara region of Western Australia. It roosts in deep caves and mines and forages nearby. Populations are localised and scattered (DSEWPaC, 2010b).

Assessment: Proposed development activities are unlikely to impact on the conservation significance of this species. The project area is south west of the known range for this species and there were no suitable roosting areas observed within the project area. This species is unlikely to occur in the project area.

Slender-billed Thornbill – western (EPBC Act Status: *Vulnerable*; WC Act Status: Schedule 1)

The Slender-billed Thornbill is listed as *Vulnerable* under the EPBC Act. This species preferred habitat is chenopod shrublands and sandplain heath, expected along shores of salt lakes and other saline-clay pans (DEWHA, 2004).

Assessment: The potential impact on this species is considered to be low given the lack of preferred habitat within the study area. It is also likely to move to adjacent areas if disturbed.

Rainbow Bee-eater (EPBC Act Status: Migratory, Marine*)*

The Rainbow Bee-eater is a migratory species listed under the EPBC Act, migrating to south-western Australia to breed during spring and summer. The Rainbow Bee-eater nests in burrows excavated in sandy ground or banks (Australian Museum, 2008). The Rainbow Bee-eater is a common and widespread species.

Assessment: Proposed development activities are unlikely to impact on the conservation significance of the species as it will move its foraging (and breeding) to adjacent areas of undisturbed habitat.

Fork-tailed Swift (EPBC Act Status: Migratory, Marine*)*

The Fork-tailed Swift is characterised by a long and deeply forked tail and is a non-breeding visitor to all states and territories of Australia. Inland records from Western Australia are generally sparse and scattered (DSEWPaC, 2010b).

Assessment: This species may utilise the project area but is an aerial species, and as such is unlikely to be affected by proposed development activities.

Great Egret and Cattle Egret (EPBC Act Status: Migratory, Marine*)*

The Great Egret is a moderately large bird with a widespread distribution. The Cattle Egret is smaller member of the Ardeidae family (length 70 cm) and is common across much of Australia.

Assessment: Both species are migratory and are unlikely to be affected by proposed development activities.

Oriental Plover, Oriental Dotterel (EPBC Act Status: Migratory, Marine*)*

The Oriental Plover is a non-breeding visitor to Australia and has been recorded at numerous sites, both in coastal and inland areas.

Assessment: This species is migratory and is unlikely to be affected by proposed development activities.

4.4 Fauna Habitat

No habitats were recorded that are considered to be exclusive to the project area. The broad habitat types identified within the project area included:

- Mulga woodlands on wash plains;
- Mixed shrubland on stony hills and breakaways; and
- Cleared areas.

Habitat Value

The mulga woodland habitat was considered to provide a low to medium level of habitat value to fauna. The understorey was severely impacted by grazing and structural diversity was generally considered to be poor. Although limited within the project area, hummock grasses present on the coarser soils would provide an additional ecological niche for a number of species, particularly ground dwelling reptile species.

The mixed shrubland habitat was generally in better condition than the mulga woodlands and was considered to provide a medium level of habitat to fauna.

The cleared areas (tracks, road margins, burrow pits, etc) are highly disturbed, devoid of vegetation and offer little habitat value for fauna. The species diversity for all taxonomic groups is likely to be very limited in this habitat type.

Habitat Linkages

Habitat linkages are important to allow animals to move between areas of resource availability. Habitat linkage is important for ground and aerial fauna, providing cover, resources, and linking areas suitable for rest and reproduction.

Fragmentation of habitat limits the resources available to species, particularly sedentary species, which means they may be more vulnerable to natural disasters or habitat changes over time. Fragmentation of habitat can also lead to edge effects, leading to degradation of the habitat. Where the distance between habitat fragments is small, species may still be able to move between these habitats areas, but may be more exposed to predation pressures in the cleared areas.

The project area is surrounded by relatively intact vegetation and is not considered to constitute a significant corridor or habitat linkage for fauna.

5. Requirement for Referral

5.1 Vegetation Clearing

Clearing applications are assessed against ten principles outlined in Schedule 5 of the *Environmental Protection Amendment Act 2003*. These principles aim to ensure that all potential impacts resulting from removal of native vegetation can be assessed in an integrated way. The principles address three main environmental areas:

- Biodiversity significance;
- Land degradation; and
- Ground and surface water quality.

These principles apply to all lands throughout Western Australia. If the project involves significant impacts other than on native vegetation, or the clearing is exempt under Section 51C but is considered likely to have a significant impact, it should be referred to the EPA for consideration.

Any clearing of native vegetation requires a permit under Part V of the *Environmental Protection Act 1986* except where exemptions apply under Schedule 6 of the *Act* or are prescribed in the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. These exemptions do not apply in Environmentally Sensitive Areas (ESAs).

5.1.1 Assessment against the 'Ten Clearing Principles'

This project has been assessed against the '10 Clearing Principles' (refer Appendix E), and is not considered to be significantly at variance against any of the principles.

GHD considers that the clearing of 10 ha of remnant native vegetation and minor modifications to the landscape for fencing works may be approved by the DEC given the outcomes of this assessment against the '10 Clearing Principles'.

5.2 Requirement for Referral

Projects may require referral to the EPA under Part IV of the *Environmental Protection Act, 1986*, if the project will have significant impacts on any of the following matters:

- Native remnant vegetation;
- Rare flora and fauna species and threatened communities;
- Wetlands;
- Watercourses and rivers;
- Estuaries and inlets;
- Coastlines and near shore marine areas;
- Catchments with special requirements;
- Contaminated soils;
- Noise and vibration;

- Public Drinking Water Source Areas - groundwater and surface water;
- Aboriginal heritage;
- European cultural heritage; or
- Adjacent land uses.

The results of this biological survey indicate that the project is considered unlikely to require referral to the EPA, based on the clearing of the vegetation, flora and fauna habitat within the project area.

6. Conclusions and Recommendations

6.1 Conclusions

The following conclusions are made based on the findings of this survey:

- Within the vicinity of the project area, the vegetation is considered to be of Least Concern, with approximately 100% of the pre-European extent of native vegetation remaining;
- A total of eight vegetation types were recorded from the project area. These vegetation types can be considered to be comparable to the broad Vegetation Associations 18 and 107 described by Beard (1979);
- No Threatened Ecological Communities (TECs) are known to occur within 50 km of the project area; however, three Priority Ecological Communities (PECs) were recorded during the desktop assessment, two of which intersect the project area. All three PECs are associated with subterranean fauna and are unlikely to be affected by the proposed fencing works. No TECs or PECs were recorded in the project area during the field survey;
- Vegetation condition within the study corridor ranged from *Very Good* (3) to *Completely Degraded* (6) with better condition vegetation generally restricted to the laterite breakaways and stony hills. The most noticeable areas of disturbance were the existing burrow pits, pastoral infrastructure and roadside margins;
- A total of 98 flora taxa from 24 families were recorded from the project area, representing a medium level of diversity;
- No DRF or PLF taxa were recorded from the project area during the field survey. No taxa recorded from the project area exhibited an extension to their known range;
- A total of two weed species were recorded from the project area, representing 2% of the total number of plant species recorded;
- A total of 19 bird species, four mammal and three reptile species were recorded from the project area;
- Conservation significant fauna species are considered unlikely to occur in the project area. No threatened fauna species were recorded in the project area during the reconnaissance fauna survey. Threatened fauna species known to occur in the general area, as identified in the desktop assessment, are considered unlikely to use the project area for breeding or refuge purposes;
- No protected fauna species were recorded during the field survey;
- A number of EPBC Act Marine and Migratory Listed species were recorded from the project area. These species are considered to be common in Western Australia and are not under threat;
- The proposed clearing of 10 ha of native vegetation within the project area is not considered to be significantly at variance against any of the '10 Clearing Principles;

- GHD considers that the clearing remnant native vegetation and minor modifications to the landscape for fencing works may be approved by the DEC given the outcomes of this assessment against the 'Ten Clearing Principles'; and
- This Project is considered unlikely to require referral to the Environmental Protection Authority for any approval to clear vegetation.

6.2 Recommendations

Impacts on flora and fauna can be minimised and managed by a number of measures which are outlined below:

- All clearing operations should be kept to a minimum and designated clearing areas should be clearly defined and contractors should be adequately briefed to ensure accidental clearing does not occur. Clearing should occur from the most disturbed areas towards undisturbed areas, thereby directing fleeing species away from the disturbance zone.
- Management measures should be implemented to ensure clearing does not cause appreciable land degradation, including minimising runoff from the cleared areas.
- Management measures should be implemented to minimise the introduction and spread of weeds, such as avoiding movement of soils containing weedy species.
- Management measures should be implemented to maintain natural surface water flow paths where practicable.
- Management measures should be implemented to ensure fauna species are not adversely impacted during construction. This may include keeping pits and trenches open for minimal periods, providing exit ramps, regularly inspecting excavations and liaising with the DEC as necessary regarding the relocation of fauna species. Staff and contractors should also be educated during inductions on significant fauna species which may potentially be present in the area.
- Destruction of fauna habitat should be minimised during clearing. Dead, standing or fallen timber should be retained as habitat, wherever possible. Where micro-habitats, such as rocks, logs and other debris, must be disturbed for construction, these should be retained and used in rehabilitation.
- Avoid driving vehicles at dusk and dawn where possible, to minimise the potential for collisions with nocturnal animals.
- Management measures should be implemented to prevent impacts on adjacent flora and fauna from pollution, such as litter and oil spills.

Disturbed areas not required for the operation or ongoing maintenance of the fenceline should be rehabilitated where possible. Topsoil and vegetation should be stockpiled for later use in rehabilitation works.

7. Limitations

7.1 Survey Limitations

The GHD field survey was carried out during only one season, and in one year. Complete surveys require multiple surveys, at different times of year, and over a period of a number of years, to enable full survey of all species present. Some flora species, such as annuals, are only available for collection at certain times of the year, and others are only identifiable at certain times (such as when they are flowering). Additionally, climatic and stochastic events (such as fire) may affect the presence of plant species. Species that have a very low abundance in the area are more difficult to locate, due to above factors.

7.2 Report Limitations

This report presents the results of a Level 1 flora and reconnaissance fauna survey, and desktop findings, prepared for the purpose of this commission. The fauna survey was limited to a Level 1 reconnaissance fauna survey. The data and advice provided herein relate only to the project described herein and must be reviewed by a competent scientist before being used for any other purpose. GHD accepts no responsibility for other use of the data.

Where reports, searches, any third party information and similar work have been performed and recorded by others the data is included and used in the form provided by others. The responsibility for the accuracy of such data remains with the issuing authority, not with GHD.

For these investigations GHD has conducted desktop data searches and a field survey. The conclusions of this report were based on the information gathered during these investigations and thus reflect the environment of the survey area at the time of survey. GHD accepts no responsibility for any variation in the flora present in the survey area due to natural and seasonal variability.

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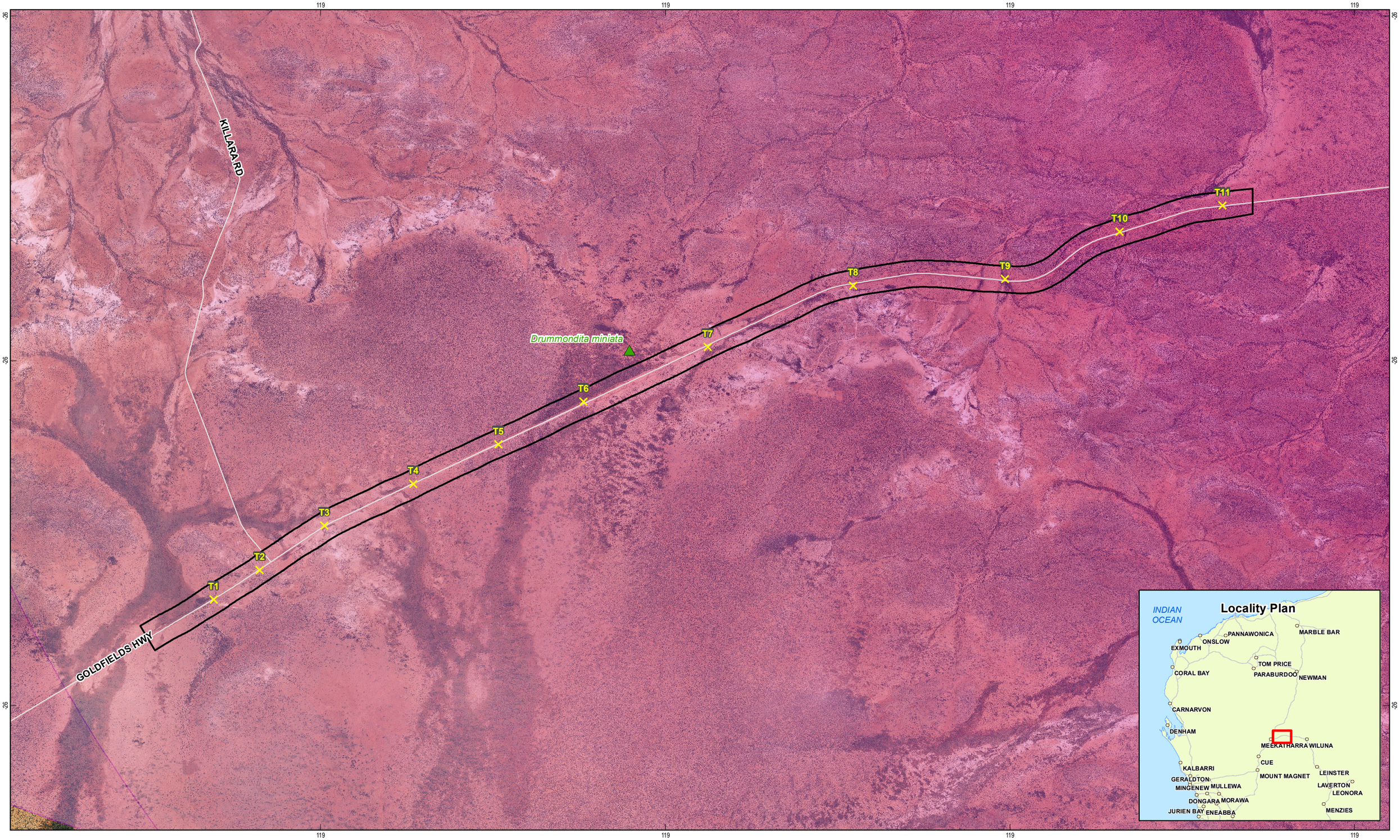
Appendix A

Figures



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LEGEND

Declared Rare & Priority Species

- (R) Declared Rare Flora - Extant Taxa
- Priority 1 - Poorly Known Taxa
- Priority 2 - Poorly Known Taxa
- Priority 3 - Poorly Known Taxa
- Priority 4 - Rare Taxa
- Road
- Transect Locations
- Prioritised Ecological Communities
- Study Area

CLIENTS | PEOPLE | PERFORMANCE

Main Roads
Goldfields Highway SLK 737-748

Job Number	61- 26248
Revision	A
Date	07 Feb 2011

Locality Plan and Environmental Constraints

Figure 1

G:\61\26248\GIS\Maps\MXD\61_26248_G001_RevA_Figure 1_Locality Plan.mxd

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Data source: GHD: Study Area - 20101102; GHD: Transect Locations - 20110202; DEC: Declared Rare & Priority Species - 20101104; SLIP: Minerie 2006 Mosaic - 20101103; Commonwealth of Australia : NatMap Geodata Topo 250K Series3_GA - 2006. Created by: td, jhchen

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KILLARA RD

GOLDFIELDS HWY

HD TS2 TS3 TS1 LF1 LS1 S1 TS4

Code	Description
	Low open mulga forest on localised area of run-on
LF 1	Low open forest of *Acacia aneura* var. *macrocarpa, Acacia aneura* var. *aneura, Acacia ramulosa var. linophylla* over *Acacia craspedocarpa* and *Psydrax latifolia* over *Acacia tetragonophylla* on localised run-on zone.
	Tall mixed Acacia shrubland on low stony hill:
TS1	Tall shrubland of *Acacia aneura* var. *conifera, Acacia effusifolia, Acacia quadrimarginea, Acacia rhodophloia* and *Grevillea nematophylla* subsp. *supralana* over *Eremophila flabellata* and *E. punctata* over sparse understorey of *Ptilotus schwartzii* and *Sida fibulifera* with occasional *Eucalyptus kingsmillii* subsp. *kingsmillii* and *Acacia pruinocarpa* on low ironstone/quartz stony hills.
	Tall Acacia shrubland over spinifex with occasional eucalypts on sandy loam plain:
TS2	Tall shrubland of *Acacia pruinocarpa*, A. *aneura* var. *conifera, A. ramulosa* var. *linophylla, A. aneura* var. *argentea and A. sibirica* over *Eremophila forrestii, E. flabellata* over *Triodia* sp. and *Ptilotus obovatus* with occasional stands of *Eucalyptus kingsmillii* subsp. *kingsmillii and Eucalyptus striaticalyx* on sandy loam plain.
	Tall mulga shrubland over sparse understorey on broadwash plain:
TS3	Tall shrubland of *Acacia aneura* var. *aneura*, *A. aneura* var. *argentea, A. ramulosa* var. *linophylla* and *A. tetragonophylla* over *Eremophila flabellata* and mixed *Senna* spp. on broadwash plain.
	Tall Acacia shrubland over spinifex on sandy loam plain:
TS4	Tall shrubland of *Acacia pruinocarpa, Acacia aneura* var. *aneura,* A. *aneura* var. *conifera, A. ramulosa* var. *linophylla, A. aneura* var. *argentea* over *Acacia craspedocarpa* over *Eremophila forrestii* and *E. flabellata* over *Triodia* sp. on sandy loam plain.
	Low mixed shrubland on laterite breakaway:
LS1	Low shrubland of *Acacia effusifolia, A. quadrimarginea* and *A. aneura* var. *aneura* over *Eremophila latrobei* subsp. *latrobei, E. glutinosa* and *Dodonaea viscosa* subsp. *spatulata* over *Stylidium longibracteatum* and mixed grasses.
	Acacia scrub over mixed understorey along drainage channel:
S1	Scrub of *Acacia sibilans*, *A. aneura* var. *conifera* and *A. quadrimarginea* over *Eremophila punctata, E. fraseri, Senna artemisioides* subsp. *helmsii* and *Acacia tetragonophylla* over mixed grasses and herbs.
	Highly Disturbed:
HD	Clearing or other activities have fundamentally altered the composition of native vegetation. Few native species present (primarily disturbance response species).

119 119 119 119

1:40,000 (at A3)

0 0.25 0.5 1 1.5 2

Kilometres

Horizontal Datum: GDA 1994
Grid: GCS GDA 1994

N

LEGEND

Vegetation Type

HD LS1 TS1 TS3 Study Area

LF1 S1 TS2 TS4

CLIENTS | PEOPLE | PERFORMANCE

Main Roads
Goldfields Highway SLK 737-748

Job Number	61- 26248
Revision	A
Date	07 Feb 2011

Vegetation Type

Figure 2

G:\61\26248\GIS\Maps\MXD\61_26248_G002_RevA_Figure 2_Vegetation Types.mxd

180 Lonsdale Street Melbourne VIC 3000 Australia **T** 61 3 8687 8000 **F** 61 3 8687 8111 **E** melmail@ghd.com.au **W** www.ghd.com.au

Data source: GHD: Study Area - 20101102; GHD: Vegetation Type - 20110202; DEC: Declared Rare & Priority Species - 20101104; SLIP: Minerie 2006 Mosaic - 20101103. Created by: td, jhchen

119 119 119 119

-26 -26 -26 -26

KILLARA RD

GOLDFIELDS HWY

3 - 4 4 - 5 4 - 5 3 - 4 3 - 4 4 - 5 4 - 5 5 - 6 6 6 6 4 4 4 - 5 4 - 5

119 119 119 119

1:40,000 (at A3)

0 0.25 0.5 1 1.5 2

Kilometres

Horizontal Datum: GDA 1994
Grid: GCS GDA 1994

N

LEGEND

Vegetation Condition

3 - 4 | 4 - 5 | 6 | Study Area

4 | 5 - 6

Condition Code

1. Pristine or nearly so
2. Excellent
3. Very Good
4. Good
5. Degraded.
6. Completely Degraded

GHD

CLIENTS | PEOPLE | PERFORMANCE

mainroads WESTERN AUSTRALIA

Main Roads
Goldfields Highway SLK 737-748

Job Number	61- 26248
Revision	A
Date	07 Feb 2011

Vegetation Condition

Figure 3

G:\61\26248\GIS\Maps\MXD\61_26248_G003_RevA_Figure 3_Vegetation Condition.mxd

180 Lonsdale Street Melbourne VIC 3000 Australia **T** 61 3 8687 8000 **F** 61 3 8687 8111 **E** melmail@ghd.com.au **W** www.ghd.com.au

Data source: GHD: Study Area - 20101102; GHD: Vegetation Condition - 20110202; DEC: Declared Rare & Priority Species - 20101104; SLIP: Minerie 2006 Mosaic - 20101103. Created by: td, jhchen

Appendix B

Conservation Categories

Environmental Protection (Biodiversity) Conservation Act 1999

Wildlife Conservation Act 1950

Department of Environment and Conservation

EPBC Act Fauna Conservation Categories

Listed threatened species and ecological communities

An action will require approval from the Environment Minister if the action has, will have, or is likely to have a significant impact on a species listed in any of the following categories:

- Extinct in the wild,
- Critically Endangered,
- Endangered, or
- Vulnerable.

See Table 8.

Critically endangered and endangered species

An action has, will have, or is likely to have a significant impact on a critically endangered or endangered species if it does, will, or is likely to:

- lead to a long-term decrease in the size of a population, or
- reduce the area of occupancy of the species, or
- fragment an existing population into two or more populations, or
- adversely affect habitat critical to the survival of a species, or
- disrupt the breeding cycle of a population, or
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or
- result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat*, or
- interfere with the recovery of the species.

**Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a critically endangered or endangered species by direct competition, modification of habitat, or predation.*

Vulnerable species

An action has, will have, or is likely to have a significant impact on a vulnerable species if it does, will, or is likely to:

- lead to a long-term decrease in the size of an important population of a species, or
- reduce the area of occupancy of an important population, or
- fragment an existing important population into two or more populations, or
- adversely affect habitat critical to the survival of a species, or
- disrupt the breeding cycle of an important population, or
- modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or

- result in invasive species that are harmful a vulnerable species becoming established in the vulnerable species' habitat*, or
- interferes substantially with the recovery of the species.

An important population is one that is necessary for a species' long-term survival and recovery. This may include populations that are:

- key source populations either for breeding or dispersal,
- populations that are necessary for maintaining genetic diversity, and/or
- populations that are near the limit of the species range.

**Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a vulnerable species by direct competition, modification of habitat, or predation.*

Listed Migratory species

An action will require approval from the Environment Minister if the action has, will have, or is likely to have a significant impact on a listed migratory species. Note that some migratory species are also listed as threatened species. The criteria below are relevant to migratory species that are not threatened.

An action has, will have, or is likely to have a significant impact on a migratory species if it does, will, or is likely to:

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat of the migratory species, or
- result in invasive species that is harmful to the migratory species becoming established* in an area of important habitat of the migratory species, or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behavior) of an ecologically significant proportion of the population of the species.

An area of important habitat is:

1. habitat utilised by a migratory species occasionally or periodically within a region that supports an ecologically significant proportion of the population of the species, or
2. habitat utilised by a migratory species which is at the limit of the species range, or
3. habitat within an area where the species is declining.

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an ecologically significant proportion of the population varies with the species (each circumstance will need to be evaluated).

**Introducing an invasive species into the habitat may result in that species becoming established. An invasive species may harm a migratory species by direct competition, modification of habitat, or predation*.

Table 8 Conservation Categories and Definitions for EPBC Act Listed Flora and Fauna Species.

Conservation Category	Definition
Extinct	Taxa not definitely located in the wild during the past 50 years
Extinct in the Wild	Taxa known to survive only in captivity
Critically Endangered	Taxa facing an extremely high risk of extinction in the wild in the immediate future
Endangered	Taxa facing a very high risk of extinction in the wild in the near future
Vulnerable	Taxa facing a high risk of extinction in the wild in the medium-term
Near Threatened	Taxa that risk becoming Vulnerable in the wild
Conservation Dependent	Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classified as Vulnerable or more severely threatened.
Data Deficient (Insufficiently Known)	Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
Least Concern	Taxa that are not considered Threatened

Table 9 Conservation Categories and Definitions for the WC Act Listed Flora and DEC Listed Priority Flora species

Code	Conservation Category	Definition
X	Declared Rare Flora – Presumed Extinct	Presumed Extinct: taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Endangered Flora Consultative Committee.
R	Declared Rare Flora – Extant	Taxa which have been adequately searched for, and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such, following approval by the Minister for the Environment, after recommendation by the State's Endangered Flora Consultative Committee. *(= Threatened Flora = Endangered + Vulnerable*)
P1	Priority 1 – Poorly Known	Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
P2	Priority 2 – Poorly Known	Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
P3	Priority 3 – Poorly Known	Taxa which are known from several populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in need of further survey.
P4	Priority 4 – Rare	taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5–10 years

Table 10 *Western Australia Wildlife Conservation Act* (1950) Conservation Codes

Conservation Code	Description
Schedule 1	"…fauna that is rare or likely to become extinct, are declared to be fauna that is in need of special protection."
Schedule 2	"…fauna that is presumed to be extinct, are declared to be fauna that is in need of special protection."
Schedule 3	"…birds that 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	"…fauna that is in need of special protection, otherwise than for the reasons mentioned [in Schedule 1 – 3]"

Table 11 DEC Priority Fauna Codes

(Species not listed under the *Wildlife Conservation Act (*1950), but for which there is some concern).

Conservation Code	Description
Priority 1	Taxa with few, poorly known populations on threatened lands.
Priority 2	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.
Priority 3	Taxa which are known from few specimens or sight records, some of which are on lands not under immediate threat of habitat destruction or degradation.
Priority 4	Rare taxa. Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5 – 10 years.
Priority 5	Taxa in need of monitoring. Taxa which are not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years.

Appendix C

Flora

Results of Threatened Flora Database Searches

Study Area Flora List

Table 12 Conservation Significant Flora from Database Records from DEC searches

Taxon	Conservation Category	Description (from *FloraBase*)	Preferred Habitat	Likelihood of Occurrence
Acacia speckii	P3	Bushy, rounded shrub or tree, 1.5–3 m high.	Rocky soils over granite, basalt or dolerite. Rocky hills or rises.	Possible, but unlikely. Preferred habitat is limited within the project area. Known range is 50 km to the west of the project area.
Baeckea sp. Sandstone (C.A Gardner s.n. 26 Oct. 1963)	P3	Upright shrub, ca 1 m high. Flowers white, October.	Orange sand. Flats.	Considered unlikely. Preferred habitat not present within project area.
Dicrastylis mitchellii	P1	Shrub to about 0.3 m high. Flowers white, October.	Sand or clay soils. Around dunes.	Unlikely. Dune formations not present in project area.
Calytrix erosipetala	P3	Shrub, 0.3–0.7 m high. Flowers white, pink, September – October.	Rocky sandstone or granite breakaways.	Possible, but unlikely. Preferred habitat is limited within the project area. Known range is 40 km to the south of the project area.
Calytrix uncinata	P3	Shrub, 0.3–1 m high. Flowers white, August–November.	White or red sand, sandy clay. Granite or sandstone breakaways, rocky	Possible but unlikely. Preferred habitat limited. Closest known population 50km to the west of the project area.
Calytrix verruculosa	P3	Shrub, 0.4–0.75 m high. Flowers pink, white, August – October.	Sandy clay soils.	Possible but unlikely. Suitable habitat present within the project corridor but known range is 50 km to the west of the project area.

Taxon	Conservation Category	Description (from *FloraBase*)	Preferred Habitat	Likelihood of Occurrence
Drummondita miniata	P3	Divaricately branched shrub, 0.5–2 m high. Flowers orange, red, July–August/November. Laterite. Breakaways	Laterite. Breakaways	Possible. Recorded adjacent to project area and suitable habitat present within the project corridor.
Eremophila fasciata	P3	Erect shrub, 0.6–0.9 m high. Flowers blue, violet, August.	Stony hills.	Possible but unlikely. Preferred habitat limited. Closest known population 50 km to the west of the project area.
Eremophila micrantha	P3	Upright, spreading shrub or tree (small), to 2.5 m high. Flowers white, October–November.	Red-brown sand or sandy clay soils. Quartz, ironstone, laterite, sandstone. Flats, slopes, hillsides.	Possible. Suitable habitat present within project corridor. Known to occur in vicinity of Killara Homestead on red sandy clay flats.
Eremophila retrophila	P1	Spreading shrub, 0.7–1.7 m high, to 4.2 m wide. Flowers purple, red, white, August–September.	Gravelly loam. Stony flats.	Possible, but unlikely. Preferred habitat is limited within the project area. Known range is 50 km to the west of the project area.
Goodenia berringbinensis	P4	Ascending annual, herb, 0.1–0.3 m high. Flowers yellow, October. Red sandy loam. Along watercourses.	Red sandy loam. Along watercourses.	Considered unlikely. Preferred habitat is very limited within the project area. Known range is 40 km to the north west of the project area.
Grevillea inconspicua	P4	Intricately branched, spreading shrub, 0.6–2 m high. Flowers white, pink, June–August.	Loam, gravel. Along drainage lines on rocky outcrops, creeklines. Amongst tall trees.	Possible, but unlikely. Preferred habitat is limited within the project area. Known range is 50 km to the west of the project area.

Taxon	Conservation Category	Description (from *FloraBase*)	Preferred Habitat	Likelihood of Occurrence
Homalocalyx echinulatus	P3	Shrub, 0.45–1 m high. Flowers pink, June–September.	Laterite. Breakaways, sandstone hills.	Possible but unlikely. Preferred habitat limited. Closest known population 50 km to the west of the project area.
Maireana prosthecochaet	P3	Open, densely-leaved shrub, 0.3–0.6 m high.	Laterite. Hills, salty places.	Possible but unlikely. Preferred habitat limited in project area. No saline areas present.
Menkea draboides	P3	Prostrate, spreading annual, herb, to 0.6 m wide. Flowers white, cream, August–September.	Red sand or clay soils, granite.	Considered unlikely. Preferred habitat not present. Known range is 50 west from project area
Ptilotus luteolus	P3	Erect, compact shrub, 0.3m high by 0.3m wide. Flowers Green. August – September.	Stony hills, banded iron, basalt. Brown sand clay, red loams.	Possible but unlikely. Preferred habitat limited. Closest known population 50km to the west of the project area.

Table 13 SLK 737-748 project area Flora List

Family	Genus	Species	Common Name	Status
Acanthaceae	*Harnieria*	*kempeana* subsp. *muelleri*		
Amaranthaceae	*Alternanthera*	*denticulata*	Lesser Joyweed	
Amaranthaceae	*Ptilotus*	*obovatus*	Cotton Bush	
Amaranthaceae	*Ptilotus*	*rotundifolius*	Royal Mulla Mulla	
Amaranthaceae	*Ptilotus*	*schwartzii*		
Apocynaceae	*Marsdenia*	*australis*		
Asteraceae	*Angianthus*	*tomentosus*	Camel Grass	
Asteraceae	*Calotis*	*plumulifera*		
Asteraceae	*Centipeda*	*thespidioides*	Desert Sneezewood	
Asteraceae	*Helipterum*	*craspedioides*	Yellow Billy Buttons	
Asteraceae	*Pluchea*	*dentex*		
Asteraceae	*Podolepis*	*capillaris*		
Campanulaceae	*Wahlenbergia*	*tumidifructa*		
Chenopodiaceae	*Chenopodium*	*gaudichaudianum*		
Chenopodiaceae	*Dysphania*	*rhadinostachya*		
Chenopodiaceae	*Maireana*	*georgei*	Satiny Bluebush	
Chenopodiaceae	*Maireana*	sp. (insufficient material)		
Cucurbitaceae	*Citrillus*	*lanatus*	Pie Melon	*
Cyperaceae	*Cyperus*	*hamulosus*		*
Cyperaceae	*Fimbristylis*	*depauperata*	Eight Day Grass	
Euphorbiaceae	*Euphorbia*	*drumondii*	Namana	
Fabaceae	*?Glycine*	*canescens*	Silky Glycine	
Fabaceae	*Acacia*	*grasbyi*		
Fabaceae	*Acacia*	*aneura* var. *aneura*	Mulga	
Fabaceae	*Acacia*	*aneura* var. *argentea*	Mulga	
Fabaceae	*Acacia*	*aneura* var. *conifera*	Mulga	
Fabaceae	*Acacia*	*aneura* var. *microcarpa*	Mulga	
Fabaceae	*Acacia*	*ayersiana*		

Fabaceae	*Acacia*	*craspedocarpa*	Hop Mulga	
Fabaceae	*Acacia*	*effusifolia*		
Fabaceae	*Acacia*	*kempeana*	Witchetty Bush	
Fabaceae	*Acacia*	*pachyacra*		
Fabaceae	*Acacia*	*pruinocarpa*	Gidgee	
Fabaceae	*Acacia*	*quadrimarginea*		
Fabaceae	*Acacia*	*ramulosa* var. *linophylla*	Horse Mulga	
Fabaceae	*Acacia*	*ramulosa* var. *ramulosa*	Horse Mulga	
Fabaceae	*Acacia*	*sclerosperma*	Limestone Wattle	
Fabaceae	*Acacia*	*rhodophloia*		
Fabaceae	*Acacia*	*sibilans*	Whispering Myall	
Fabaceae	*Acacia*	*sibirica*	Bastard Mulga	
Fabaceae	*Acacia*	*tetragonophylla*	Kurara	
Fabaceae	*Indigofera*	*gilesii*		*ms*
Fabaceae	*Senna*	*artemisioides* subsp. *filifolia*		
Fabaceae	*Senna*	*artemisioides* subsp. *helmsii*		
Fabaceae	*Senna*	*artemisioides* subsp. *oligophylla*		
Fabaceae	*Senna*	*artemisioides* subsp. *petiolaris*		
Fabaceae	*Senna*	*artemisioides* subsp. *x sturtii*		
Fabaceae	*Senna*	*charlesiana*		
Fabaceae	*Senna*	*pleurocarpa*		
Fabaceae	*Senna*	sp. Meekatharra (E. Bailey 1-26)		
Goodeniaceae	*Goodenia*	*berardiana*		
Goodeniaceae	*Goodenia*	sp. (insufficient material)		
Goodeniaceae	*Scaveola*	*spinescens*	Currant Bush	
Haloragaceae	*Haloragaceae*	sp. (insufficient material)		
Lamiaceae	*?Prostanthera*	sp. (insufficient material)		

Lamiaceae	*?Prosthanthera*	sp. (insufficient material)	
Lamiaceae	*Prostanthera*	*albiflora*	
Lamiaceae	*Spartothamnella*	*teucriiflora*	
Malvaceae	*Brachchiton*	*gregorii*	Desert Kurrajong
Malvaceae	*Malvaceae*	sp. (insufficient material)	
Malvaceae	*Sida*	*fibulifera*	Silver Sida
Myrtaceae	*Calytrix*	sp. (insufficient material)	
Myrtaceae	*Eucalyptus*	*camaldulensis*	River Gum
Myrtaceae	*Eucalyptus*	*kingsmillii* subsp. *kingsmillii*	Kingsmill's Mallee
Myrtaceae	*Eucalyptus*	*striaticalyx*	Cue York Gum
Myrtaceae	*Micromyrtus*	*sulphurea*	
Poaceae	*Aristida*	*holathera*	Kerosine Grass
Poaceae	*Cymbopogon*	*ambiguus*	Scentgrass
Poaceae	*Eragrostis*	*dielsii*	Mallee Lovegrass
Poaceae	*Eriachne*	*mucronata*	Mountain Wanderrie Grass
Poaceae	*Eriachne*	*pulchella*	Pretty Wanderrie
Poaceae	*Tragus*	*australianus*	Small Burrgrass
Poaceae	*Triodia*	*?basedowii*	Lobed Spinifex
Poaceae	*Yakirra*	*australiensis*	
Portulacaceae	*Calandrinia*	*pumila*	
Proteaceae	*Grevillea*	*berryana*	
Proteaceae	*Grevillea*	*nematophylla* subsp. *supraplana*	
Proteaceae	*Grevillea*	*striata*	Beefwood
Proteaceae	*Hakea*	*lorea*	Wtinti
Proteaceae	*Hakea*	*recurva* subsp. *arida*	Djarnokmurd
Rubiaceae	*Psydrax*	*latifolia*	
Rubiaceae	*Psydrax*	*suaveolens*	
Sapindaceae	*Dodonaea*	*petiolaris*	
Sapindaceae	*Dodonaea*	*viscosa* subsp. *spatulata*	

Scrophulariaceae	*Eremophila*	*glutinosa*	
Scrophulariaceae	*Eremophila*	*flabellata*	
Scrophulariaceae	*Eremophila*	*forrestii*	Wilcox Bush
Scrophulariaceae	*Eremophila*	*fraseri*	Baderi
Scrophulariaceae	*Eremophila*	*oppositifolia* subsp. *angustifolia*	
Scrophulariaceae	*Eremophila*	*punctata*	
Scrophulariaceae	*Eremophila*	*forrestii*	Wilcox Bush
Scrophulariaceae	*Eremophila*	*latrobei* subsp. *latrobei*	Warty Fuchsia Bush
Solanaceae	*Nicotiana*	*simulans*	
Solanaceae	*Solanum*	*lasiophyllum*	Flannel Bush
Stylidiaceae	*Stylidium*	*longibracteatum*	Long-bracted Triggerplant
Zygophyllaceae	*Tribulus*	*astrocarpus*	

Where: * = introduced / weed species; DP = Declared Plant (noxious); WONS = Weed of National Significance; N = at northern margin of known range; RI = an infill of known range; RE = an extension to known range; P2 = Priority 2; P3 = Priority 3; + = planted ornamental.

Appendix D

Fauna

Threatened Fauna Database Searches

Project Area Fauna List

Table 14 Results of Fauna Database Searches and Project Area Fauna List

				Status				
Family	Genus	Species	Common Name	EPBC	WC	DEC	Exotic	Observed
Birds								
Acanthizidae	*Acanthiza*	*apicalis*	Broad-tailed Thornbill (Inland Thornbill)					
Acanthizidae	*Acanthiza*	*chrysorrhoa*	Yellow-rumped Thornbill					
Acanthizidae	*Acanthiza*	*Iredalei iredalei*	Slender-billed Thornbill	V				
Acanthizidae	*Acanthiza*	*robustirostris*	Slaty-backed Thornbill					X
Acanthizidae	*Acanthiza*	*uropygialis*	Chestnut-rumped Thornbill					
Acanthizidae	*Aphelocephala*	*leucopsis*	Southern Whiteface					
Acanthizidae	*Pyrrholaemus*	*brunneus*	Redthroat					
Accipitridae	*Accipiter*	*cirrocephalus* subsp. *cirrocephalus*	Collared Sparrowhawk	Mi				
Accipitridae	*Accipiter*	*fasciatus*	Brown Goshawk					
Accipitridae	*Aquila*	*audax*	Wedge-tailed Eagle	Mi				X
Accipitridae	*Haliastur*	*sphenurus*	Whistling Kite					
Aegothelidae	*Aegotheles*	*cristatus*	Australian Owlet-nightjar					
Anatidae	*Anas*	*gracilis*	Grey Teal	Mi				
Anatidae	*Anas*	*superciliosa*	Pacific Black Duck					

Anatidae	*Chenonetta*	*jubata*	Australian Wood Duck (Wood Duck)	Mi		
Anatidae	*Tadorna*	*tadornoides*	Australian Shelduck (Mountain Duck)	Mi		
Apodidae	*Apus*	*pacificus*	Fork-tailed Swift	Mi, Ma		
Ardeidae	*Ardea*	*alba*	Great Egret, White Egret	Mi, Ma		
Ardeidae	*Ardea*	*pacifica*	White-necked Heron			
Artamidae	*Artamus*	*cinereus*	Black-faced Woodswallow			
Burhinidae	*Burhinus*	*grallarius*	Bush Stone-curlew		P4	
Cacatuidae	*Eolophus*	*roseicapilla*	Galah			
Campephagidae	*Coracina*	*novaehollandiae*	Black-faced Cuckoo-shrike	Ma		
Casuariidae	*Dromaius*	*novaehollandiae*	Emu			X
Charadriidae	*Charadrius*	*melanops*	Black-fronted Dotterel	Mi		
Charadriidae	*Charadruis*	*veredus*	Oriental Plover, Oriental Dotterel	Mi, Ma		
Cinclosomatidae	*Cinclosoma*	*castaneothorax*	Chestnut-breasted Quail-thrush			X
Columbidae	*Ocyphaps*	*lophotes*	Crested Pigeon			X
Columbidae	*Phaps*	*chalcoptera*	Common Bronzewing			X
Corvidae	*Corvus*	*bennetti*	Little Crow			
Corivdae	*Corvus*	*coronoides*	Australian Raven			X
Corvidae	*Corvus*	*orru*	Torresian Crow			
Corvidae	*Corvus*	sp.				

Cracticidae	*Cracticus*	*nigrogularis*	Pied Butcherbird		
Cracticidae	*Cracticus*	*tibicen*	Australian Magpie		
Cracticidae	*Cracticus*	*torquatus*	Grey Butcherbird		
Cuculidae	*Chrysococcyx*	*osculans*	Black-eared Cuckoo		
Dicaeidae	*Dicaeum*	*hirundinaceum*	Mistletoebird		
Dicruridae	*Grallina*	*cyanoleuca*	Magpie-lark		X
Dicruridae	*Rhipidura*	*leucophrys*	Willie Wagtail		X
Estrilidae	*Taeniopygia*	*guttata*	Zebra Finch		
Falconidae	*Falco*	*berigora*	Brown Falcon	Mi	X
Falconidae	*Falco*	*cenchroides*	Australian Kestrel	Mi, Ma	
Halcyonidae	*Todiramphus*	*pyrrhopygia*	Red-backed Kingfisher		
Hirundinidae	*Hirundo*	*neoxena*	Welcome Swallow	Ma	X
Hirundinidae	*Hirundo*	*nigricans*	Tree Martin	Ma	
Maluridae	*Malurus*	*lamberti*	Variegated Fairy-wren		
Maluridae	*Malurus*	*splendens*	Splendid Fairy-wren		X
Meliphagidae	*Acanthagenys*	*rufogularis*	Spiny-cheeked Honeyeater		
Meliphagidae	*Epthianura*	*aurifrons*	Orange Chat		
Meliphagidae	*Lichenostomus*	*penicillatus*	White-plumed Honeyeater		
Meliphagidae	*Lichenostomus*	*virescens*	Singing Honeyeater		
Meliphagidae	*Manorina*	*flavigula*	Yellow-throated Miner		X

Meliphagidae	*Phylidonyris*	*albifrons*	White-fronted Honeyeater		
Meropidae	*Merops*	*ornatus*	Rainbow Bee-eater	Mi, Ma	
Motacillidae	*Anthus*	*novaeseelandiae*	Richard's Pipit	Ma	
Pachycephalidae	*Colluricincla*	*harmonica*	Grey Shrike-thrush		
Pachycephalidae	*Oreoica*	*gutturalis*	Crested Bellbird		X
Pachycephalidae	*Pachycephala*	*rufiventris*	Rufous Whistler		X
Pardalotidae	*Pardalotus*	*rubricatus*	Red-browed Pardalote		
Petroicidae	*Petroica*	*cucullata*	Hooded Robin		
Petroicidae	*Petroica*	*goodenovii*	Red-capped Robin		
Podicipedidae	*Poliocephalus*	*poliocephalus*	Hoary-headed Grebe		
Podicipedidae	*Tachybaptus*	*novaehollandiae*	Australasian Grebe (Black-throated Grebe)		
Pomatostomidae	*Pomatostomus*	*superciliosus*	White-browed Babbler		X
Pomatostomidae	*Pomatostomus*	*temporalis*	Grey-crowned Babbler		
Psittacidae	*Platycercus*	*zonarius*	Australian Ringneck		X
Psittacidae	*Cacatua*	*roseicapilla*	Galah		
Psittacidae	*Melopsittacus*	*undulatus*	Budgerigar		
Psittacidae	*Nymphicus*	*hollandicus*	Cockatiel		
Psittacidae	*Platycercus*	*varius*	Mulga Parrot		X
Ptilonorhynchidae	*Ptilonorhynchus*	*maculatus guttatus*	Western Bowerbird		
Strigidae	*Ninox*	*novaeseelandiae*	Boobook Owl		

Mammals						
Canidae	*Canis*	*sp.*	Dog		*	X
Bovidae	*Bos*	*taurus*	Cattle		*	X
Hipposideridae	*Rhinoonicteris*	*aurantia* (Pilbara form)	Pilbara Leaf-nosed Bat	V		
Macropodidae	*Macropus*	*fuliginosus*	Western Grey Kangaroo			X
Muridae	*Oryctolagus*	*cuniculus*	European Rabbit		*	X
Reptiles						
Agamidae	Ctenophorus	*scutulatus*				X
Gekkonidae	*Gehyra*	*punctata*				X
Gekkonidae	*Heteronotia*	*binoei*	Bynoe's Gecko			
Scincidae	*Egernia*	*depressa*	Pygmy Spiny-tailed Skink			
Scincidae	*Menetia*	*greyii*	Common Dwarf Skink			
Varanidae	*Varanus*	*caudolineatus*	Stripe-tailed Monitor			X

KEY

Conservation Codes:

Mi Migratory

V Vulnerable

S Schedule

P Priority

E Endangered

Ma Marine

Appendix E

Assessment against ‘10 Clearing Principles’

(a) Native vegetation should not be cleared if it comprises a high level of biological diversity.

Methodology Desktop assessment of available information and field survey results

Survey Results

Plant Species

- Total Vascular Plant Taxa
  - A total of 98 flora taxa from 24 families (including two weed species) were recorded from the Project area. This total is considered to be low, primarily due to the lack of ephemeral species present. This deficiency is likely to be consequence of grazing pressures and dry conditions observed within the Project area.
- Vascular Plant Taxa Diversity
  - Diversity in the Project area is considered to be comparable to that of similarly disturbed habitat in the local area.
- Priority Flora, Significant Flora
  - No Priority flora species were recorded from the Project area.

Fauna Species

- Total Fauna Taxa
  - The reconnaissance fauna survey recorded 19 bird species, four mammal species and three reptile species. No amphibian species were recorded from the Project area.

Ecosystem Diversity

- Number of Ecological Communities (Plant, Fauna)
  - Eight vegetation types and three fauna habitats were recorded from the Project area. This includes a cleared/degraded vegetation type/habitat. These communities are also present in the local area in similar or better condition.
- Habitat Diversity
  - Habitats (macro- and microhabitats) found in the Project area are also present in the local area in similar condition.
- Variety of Soil Types / Geological Formations
  - Soil types or geological formations in the Project area are also present in the local and regional area.

Assessment Not considered to be at variance with clearing principle.

(b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.

Methodology Desktop assessment of available information and field survey results

Survey Results

Significant Fauna

- Threatened Fauna
    - The desktop assessment indicated that threatened fauna may utilise the Project area. Habitat for threatened fauna was not recorded within the project area, and no threatened fauna were recorded during the survey. Habitat is considered to be common in the local and regional area.
- Priority Fauna
    - No DEC listed Priority Fauna were recorded during the field survey.
- Other Significant Fauna
    - The desktop assessment indicated that significant fauna may occur in the Project area. Two EPBC Act Marine and/or Migratory Listed species were recorded from the project area. These species are considered common in Western Australia and are not under threat.

Habitat

- Significant Habitat / Habitats of Significance
    - No habitat deemed to be significant occurs in the Project area. Habitat in the Project area also occurs in the local area in similar condition. The habitat in the Project area is heavily disturbed by pastoral activities.
- Habitat Extent and Retention
    - Habitats recorded in the Project area are also found in the local area in similar condition. The proposed Project will not significantly diminish the extent of these habitats.
- Ecological Corridors
    - The habitat in the project area occurs in a region with relatively undisturbed ecological corridors. Existing corridors are not considered to be significantly modified by the proposed project.

Assessment Not considered to be at variance with clearing principle.

(c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.

Methodology Desktop assessment of available information and field survey results

Survey Results

Rare Flora

- Presence
  - No Declared Rare Flora (DRF) taxon were indicated to occur within the vicinity of the of the Project area as a result of database searches. No Declare Rare Flora taxa were recorded in the Project area during the field survey.
- Habitat
  - No habitat considered to be required for the continued existence of DRF is considered to be present in the Project area.

Assessment Not considered to be at variance with clearing principle.

(d) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community.

Methodology Desktop assessment of available information and field survey results

Survey Results

Vegetation

- Extent and Status
  - Vegetation Associations within the vicinity of the project area are considered to be of Least Concern with approximately 100% remaining.
  - Vegetation types recorded in the project area are broadly considered to be equivalent to the Vegetation Associations indicated by Beard.
- Communities
  - Three PECs were recorded within 50 km of the Project area. All three PECs are associated with subterranean fauna and are unlikely to be affected by the proposed fencing works.
- Areas
  - No Environmentally Sensitive Areas occur within or adjacent to the Project area.

Assessment The Project is considered unlikely to be at variance with this clearing principle.

(e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.

Methodology	Desktop assessment of available information and field survey results
Survey Results	**Vegetation** ◗ Extent and Status o Vegetation within and adjacent to the Project area is considered to be of *Least Concern*, with approximately 100% remaining of the known Vegetation Associations in the Murchison IBRA region. The Project area is not considered to contain fragmented vegetation. ◗ Regionally Significant Areas o Vegetation within the Project area is not considered to contain communities required to maintain ecosystem services (e.g. hydrological processes).
Assessment	Not considered to be at variance with clearing principle.

(f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.

Methodology	Desktop assessment of available information and field survey results
Survey Results	**Watercourses and Wetlands** ◗ Vegetation o No defined wetlands or permanent watercourses occur in the Project area. Ephemeral drainage lines occasionally intersect the Project corridor. Vegetation present was not riparian in nature nor confined to the drainage lines. ◗ Groundwater Dependent Ecosystems o No groundwater dependent ecosystems occur within or adjacent to the Project area.
Assessment	Considered unlikely to be at variance with clearing principle.

(g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.

Methodology Desktop assessment of available information and field survey results

Survey Results

Land Degradation

- Land Capability
  - The Project proposes to clear vegetation to allow for the construction of a fence line either side of the Goldfields Highway from SLK 737-748. Some degradation will occur at the site during construction, but this is not expected to alter the land capability of the surrounding area, particularly given the previous level of disturbance within the project corridor.
- Soil Erosion
  - Erosion from wind or water is considered to be extremely low. The clearing of native vegetation is not expected to alter the quality or quantity of water run-off in or adjacent to the Project area. Waterlogging and changes to nutrient levels are not expected to be altered by the clearing of vegetation in the Project area.
- Soil Acidity
  - The clearing of vegetation is not considered to alter soil acidity in or adjacent to the Project area.
- Salinity
  - The clearing of vegetation is not considered to significantly alter the hydrological balance and cause a change in the salinity either on- site or off-site.

Assessment Not considered to be at variance with clearing principle.

(h) Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.

Methodology Desktop assessment of available information and field survey results

Survey Results

Conservation Areas

- Protected Areas
  - The Project area is not adjacent to, or in the vicinity of a conservation reserve or protected area.
- Fragmentation
  - The Project area occurs in an area where the vegetation is relatively un-fragmented.
- Ecological Linkages
  - The Project area occurs in a region where the vegetation has not been significantly altered. The Project area does not provide a buffer or outlier to a conservation area. Ecological linkages and corridors are not considered to be significantly altered by any proposed clearing activities in the Project area.

Assessment Not considered to be at variance with clearing principle.

(i) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.

Methodology Desktop assessment of available information and field survey results

Survey Results

Water Quality

- Catchment Areas
  - The Project area does not occur within a proclaimed Public Drinking Water Supply Catchment.
- Groundwater
  - The clearing of vegetation is not considered to cause an alteration to the quality of groundwater in or adjacent to the Project area.
  - No groundwater dependent ecosystems occur in or adjacent to the Project area.
- Surface Water
  - The clearing of vegetation is not considered to cause an alteration to the quality of surface waters in or adjacent to the Project area.

Assessment Not considered to be at variance with clearing principle.

(j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.

Methodology	Desktop assessment of available information and field survey results
Survey Results	**Water Quantity** ◗ Flooding o The clearing of vegetation in the Project area is not considered to alter the frequency or intensity of flood events. Runoff coefficients in the Project area are not likely to be significantly altered as the majority of the soil within and surrounding the Project area is covered in continuous vegetation.
Assessment	Not considered to be at variance with clearing principle.

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