Main Roads Western Australia

Report for Kundana Road Intersection

Environmental Impact Assessment

February 2010

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1. Introduction

1.1 Project Background

Main Roads Goldfields-Esperance Region (Main Roads) has commissioned GHD Pty Ltd (GHD) to complete an Environmental Impact Assessment (EIA) for proposed safety upgrade works at the Kundana Road /Great Eastern Highway (GEH) intersection (H005@SLK 578.13).

The current intersection layout does not allow trucks to enter the GEH without crossing the centreline or to exit the GEH without holding up traffic within the 110 km/hr speed zone. The proposed improvements include widening and smoothing of the intersection apexes to accommodate road trains, installing an island on Kundana Road to guide turning movements, and widening the southern side of the GEH to allow vehicles to pass whilst trucks are turning right into Kundana Road.

Although the existing intersection is situated within the road reserve, some clearing will be required within the adjacent Kurrawang Nature Reserve (No. 35453) to facilitate construction of the improvement works. It is anticipated that up to 0.3 ha of native vegetation will be required to be cleared within the Nature Reserve and an additional 1.44 ha within the road reserve. Main Roads has advised that road building materials will be sourced from existing stockpiles or local suppliers. No clearing for material source areas will be required for this project.

1.2 Study Area

The study area is located approximately 15 km to the southwest of the City of Kalgoorlie-Boulder at SLK 578.13. The boundary of the study area extends 20 m beyond the extent of the proposed area of clearing as provided by Main Roads. The location and extent of the study area is shown in Figure 1, Appendix A. Environmental aspects outside of the immediate study area that may be impacted by the proposed works (up to a 5 km radius) were also considered. The area covered by this broader extent is referred to as the ‘broader study area’.

1.3 Scope of the Report

This document has been prepared according to Main Roads requirements. It describes the significant aspects of the natural, social and cultural environment at the site and examines their significance in regards to the potential impacts of the proposed project.

A biological field survey was completed as part of this assessment in order to verify results of the desktop study and to assess the existing environment and its relationship to adjoining areas. An assessment of proposed clearing against the ‘10 Clearing Principles’ as outlined in Schedule 5 of the *Environmental protection Amendment Act 2003* was also undertaken and results are documented within this report.

2. Existing Environment

2.1 Climate

The Goldfields region experiences an arid to semi-arid climate with hot summers and mild winters with cool nights (Australian Natural Resource Atlas, 2008). Rainfall is unreliable, but mean delivery per month tends to be slightly higher during the winter period. Rainfall patterns are typically associated with cold fronts in winter and thunderstorms and rain bearing depressions in summer (Hall and McKenzie, 1992). Whilst the intense summer rainfalls are efficient for plant growth, the light more regular winter rains are ineffective for growth other than herbs and grasses (Milewski, 1981).

The closest official Bureau of Meteorology (BoM) weather recording station is at the Kalgoorlie Airport where climate data is available for the period from 1939 to 2009. Kalgoorlie's mean annual rainfall is 264.9 mm, with monthly averages ranging from 31.2 mm in February to 14 mm in September (BoM, 2009). The evaporation rate is 2665 mm per annum, which is approximately 10 times the annual rainfall.

Seasonal variations in temperature are reasonably large. Summer temperatures may exceed 40°C and winter frosts within the region are not uncommon. Mean maximum temperatures recorded range from 33.6°C in January to 16.7°C in July. Mean minimum temperatures range from 18.2°C in January to 5°C in July.

Table 1 outlines the mean minimum and mean maximum temperatures as well as the mean rainfall for Kalgoorlie (BoM, 2009).

Table 1 Climate Data for Kalgoorlie (source: BoM, 2009)

Statistic Element	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Mean maximum temperature (ºC)	33.6	32.1	29.5	25.2	20.6	17.5	16.7	18.6	22.3	25.7	28.9	31.9	25.2
Mean minimum temperature (ºC)	18.2	17.8	16.0	12.6	8.7	6.2	5.0	5.5	8.0	11.0	14.0	16.5	11.6
Mean Monthly rainfall (mm)	23.6	31.2	24.0	21.3	26.5	28.9	24.9	21.3	14.0	14.9	17.6	16.4	264.9

Source: (BoM, 2009)

2.2 Regional Geology

The study area is situated within the Kalgoorlie Province, which is on the central eastern portion of the Yilgarn Craton. The underlying geology of the province consists of Achaean greenstone basement rocks with a north-south strike and steep westerly dip.

This is overlaid with granitic rocks and greenstone of the Yilgarn Craton that have been extensively weathered and laterised (Department of Agriculture and Food, 2006). Superficial deposits are typically comprised of colluvial and alluvial sediments.

2.3 Topography and Soils

The study area falls within the Undulating Plain landform habitat unit as mapped by McKenzie and Hall (1992). The unit consists of colluvial flats interspersed with low ridges and hills which have formed from the differential weathering of bedrock.

The study area is situated within a low-lying area of a gently undulating plain characterised by red clay loamy soils typical of such areas within the unit. Surface fragments of quartz alluvium and ironstone pebbles were evident across parts of the site.

2.4 Hydrology

2.4.1 Surface Water

The study area is situated within a low-lying area. Drainage is poorly defined but the site is likely to receive sheet flow following periods of heavy rainfall. A culvert passes under the GEH approximately 30 m northeast of the intersection.

A search of the Western Australian Wetlands Database (*Wetland Base*) did not identify any permanent watercourses or natural wetland areas within the study area. The closest identified wetland was an artificial water body recorded at Lake Douglas Recreation Reserve, located approximately 3 km to the south east.

Drainage lines present within the vicinity of the study area generally drain in a southerly direction, eventually dissipating into a series of salt lakes to the south. These drainage lines are ephemeral and are only likely to flow following major rainfall events. Road infrastructure has resulted in some disruption to natural flow paths.

Provided existing drainage controls are maintained, proposed intersection works are considered unlikely to impact on existing surface water flows.

2.4.2 Groundwater

A description of the main aquifer types in the area is provided below:

» Fractured basement rocks – minor aquifers commonly formed near the mafic/ultramafic contacts.

» Weathered and vuggy siliceous cap rock aquifers – developed over some mafics/ultramafics.

» Tertiary paleochannels - formed where channels are infilled with medium to coarse sediments.

» Quaternary/Recent alluvium and chemical sediments – sands and calcretes/silicates form aquifers in shallow infilled valleys.

Regional groundwater quality varies from fresh to hypersaline, with most aquifer types yielding brackish to saline water.

A search of the geographic data atlas on the Department of Water (DoW) indicates that the project area is not part of a Public Drinking Water Source Area (PDWSA). Given its

general poor quality, groundwater within the Kalgoorlie region is not used for drinking or irrigation purposes

No impact to public drinking water sources is likely to occur as a result of implementing the current proposal.

2.5 Phytogeography

The survey area lies in the Coolgardie biogeographic region of the Interim Biogeographic Regionalisation for Australia (IBRA) (Thackway and Cresswell, 1995). This is a system of some 85 biogeographic regions 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 Coolgardie biogeographic region correlates largely to the Coolgardie Botanical District defined by Beard (1990) and is described broadly as lying within the interzone between mulga/spinifex country and eucalypt environments (Australian Natural Resource Atlas, 2008). The Coolgardie bioregion is summarised as supporting diverse Eucalypt woodlands on low greenstone hills, valley floors, broad plains and salt lake surrounds; samphire shrublands on saline valley floors; and Mallees, Acacia thickets and shrub-heaths on sandplains, playas, laterite areas and granite outcrops (Thackway & Cresswell, 1995).

Dominant environmental constraints for the Coolgardie bioregion include extinction of critical weight range mammals, wildfire, feral animals (in particular cat and fox), weeds, and pastoral and mining activities (Australian Natural Resource Atlas, 2008).

2.6 Reserves and Conservation Areas

A portion of the study area is situated within the 'C Class' Kurrawang Nature Reserve (No 35453). The Reserve was established for the purpose of 'flora and fauna conservation' and covers an area of 621 ha. The Reserve is currently vested with the Conservation Commission Western Australia.

It is anticipated that up to 0.31 ha of native vegetation will be required to be cleared within the Reserve.

2.7 Acid Sulphate Soils

The Western Australian Planning Commission's (WAPC) publication *Planning Bulletin Number 64 Acid Sulphate Soils* states that developers, planners and the community need to be aware of the implication of the presence of Acid Sulphate Soils (ASS) and the management processes required to avoid their potential adverse effects on the environment and infrastructure (WAPC, 2007).

A search of the 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.

2.8 Contaminated Sites

The *Contaminated Sites Act 2003* recognises contaminated sites to be areas that contain background concentrations of substances that present the potential to be a risk to human health or the environment. A search on the DEC Contaminated Sites Database indicated that there no known sites registered within the study area. The closest registered site was approximately 9 km from the study area.

2.9 Environmentally Sensitive Areas (ESA)

The DEC's online Native Vegetation Viewer provides information on the location of ESAs, as declared by a Notice under section 51B of the *Environmental Protection Act 1986* (*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 study area. No ESAs were recorded within the vicinity of the study area; however, five Schedule One areas (Nos. 1630, 1633, 1635, 1636 and 2369) were identified. These Schedule One areas will not impact on the proposed works.

2.10 Pathogens

Phytophthora cinnamomi threatens over 2,300 (40%) of different plant species in Western Australia. Introduced following European settlement, *Phytophthora cinnamomi* is a soil-borne pathogen that kills a wide range of native plant species in the south west of Western Australia by attacking their root system.

Phytophthora cinnamomi can also survive and reproduce on a wide range of native plant species without killing them. It has a widespread but discontinuous range in areas of the south west with an annual rainfall above 400 mm (Dieback Working Group, 2005).

The study area is not considered to occur in an area susceptible to the development of the pathogen.

3. Biological Survey

3.1 Background

Given that proposed works will require vegetation clearing within the Kurrawang Nature Reserve, it was considered appropriate to complete a biological survey as part of this environmental impact assessment. The biological survey included a vegetation and flora survey as well as an opportunistic fauna survey.

A desktop assessment was completed prior to undertaking the fieldwork component. The desktop assessment included the following:

- A review of existing biological survey information for the broader study area and relevant information on the existing physical environment;
- A review of aerial photography to assist in the delineation of vegetation types present in the study area;
- A review of the local and regional significance of plant communities;
- A search of the Department of Environment and Conservation's (DEC) Rare and Priority Flora databases;
- A search of the Western Australian Museum (WAM)/DEC's *NatureMap* database for threatened fauna; and
- A search of the Department of Environment, Water, Heritage and the Arts' (DEWHA) database for areas listed under the *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)*.

3.2 Desktop Assessment Results

3.2.1 Previous Studies

A number of biological surveys have been undertaken previously in the Eastern Goldfields region. The most notable being the broad scale mapping of vegetation assemblages conducted by John Beard as part of the Western Australian mapping project (Beard, 1979) and the comprehensive biological survey of the region undertaken by the Biological Surveys Committee during the 1980's (McKenzie and Hall, 1992). The latter study not only described vegetation assemblages present but also recorded vertebrate fauna sampled from all major habitats within the region. Detailed studies of avifauna (Storr, 1984) and herpetofauna (Storr et al., 1981) have also been undertaken within the Eastern Goldfields and a review of the region's biodiversity significance was recently completed by the Wilderness Society (Watson, 2008).

At a local level, the following fauna studies were undertaken within the adjacent Kurrawang Nature Reserve:

- A survey of vertebrate fauna within the Reserve was completed in 1991 as part of a broader biological survey of nature reserves within the local Kalgoorlie area (Chapman et al., 1991). Quantitative trapping data is provided in the survey report.

» A study examining changes to avifauna within the Reserve between 1904 and 1996 was undertaken in 2001 (Chapman and Kealley, 2001).

Relevant findings from the above mentioned studies are referenced within the body of this report.

3.3 Vegetation

3.3.1 Vegetation Description, Extent and Status

The vegetation of the Eastern Goldfields region was mapped by Beard as part of the Western Australian mapping project conducted from 1964-1981. The Vegetation Association recorded for the study area (Association No: 9) is described as 'Medium woodland; coral gum (*Eucalyptus torquata*) & goldfields blackbutt (*E. lesouefii*)'.

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) (refer Table 2).

Table 2 Vegetation Extent and Status in the Coolgardie IBRA Region

Vegetation Association Number	Association Description	Pre-European Extent (ha) in Coolgardie IBRA region	Current Extent (ha) in Coolgardie IBRA region	% Remaining	% Pre-European Extent in IUCN Class I-IV Reserves
9	Medium woodland; coral gum (*Eucalyptus torquata*) & goldfields blackbutt (*E. lesouefii*)	235047.53	234440.27	99.7	1.3

Vegetation within the study area (as mapped by Beard) is considered to be of *Least Concern* in terms of its regional extent with only a slight reduction in area recorded from its pre-European extent.

3.3.2 Threatened Ecological Communities (TECs)

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,* the loss of, or disturbance to, some TECs 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.

There are no known occurrences of TECs or PECs recorded within the vicinity of the study area.

3.4 Flora

3.4.1 Significant Flora

Commonwealth

Species of significant flora are protected under both Commonwealth and State Acts. Any activities that are deemed to have a significant impact on species that are recognised by the *EPBC Act* and the *Wildlife Conservation Act 1950* (*WC Act*) can trigger referral to the DEWHA and/or the EPA.

A description of Conservation Categories delineated under the *EPBC Act* is detailed in Table 3. These are applicable to threatened flora and fauna species.

Table 3 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.

A search of the *EPBC Act* Protected Matters Search Tool was undertaken to identify Commonwealth protected flora species which may be present within 20 km of the study area. *Gastrolobium graniticum* (Granite Poison) was the only species of significance recorded. It is currently listed as 'Endangered'.

State

In addition to the *EPBC Act,* significant flora in Western Australia is protected by the *WC Act*. This *Act*, which is administered by the DEC, protects Declared Rare Flora (DRF) species. The DEC also maintains a list of Priority Listed Flora (PLF) species.

Conservation codes for flora species are assigned by the DEC to define the level of conservation significance. PLF are not currently protected under the *Wildlife Conservation Act 1950*. PLF may be rare or threatened, but cannot be considered for declaration as rare flora until adequate surveys have been undertaken of known sites and the degree of threat to these populations clarified. Special consideration is often given to sites that contain PLF, despite them not having formal legislatory protection. A description of the DEC's Conservation Codes that relate to flora species is provided in Table 4.

Table 4 Conservation Codes and Descriptions for DEC Declared Rare and Priority Flora Species

Conservation Code	Description
X: Declared Rare Flora – 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	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.
P1: Priority One – Poorly Known Taxa	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 Two – Poorly Known Taxa	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 Three – Poorly Known Taxa	Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but are in need of further survey.
P4: Priority Four – Taxa in need of monitoring	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.

A search of the DEC's Rare Flora databases and the Western Australian Herbarium (WAHERB) records was performed. No significant flora species were recorded within the study area; however, 10 PLF species were recorded within 20 km of the study area. The approximate locations of those flora species occurring within the vicinity of study area have been mapped and are shown in Figure 2, Appendix A.

The WAM/DEC's *NatureMap* database was also queried for records of significant flora occurring within 20 km of the study area. No DRF species were recorded. PLF species recorded from combined database searches are listed in Table 5.

Table 5 Significant Flora Present within 20 km of the Study Area

Species	Conservation Code	Description
Alyxia tetanifolia	P3	Erect, rigid, pungent shrub, 1–2 m high, to 2.5 m wide. Fl. white, cream, May–Jun/Nov. Occurs in drainage lines, near lakes.
Arstartea sp. *Bungalbin Hill* (KR Newbey 8989)	P3	Spreading shrub, 0.1–0.4(–0.6) m high, to 0.65 m wide. Fl. white, pink, Sep–Dec/Mar. Deep yellow sand. Sandplains
Elachanthus pusillus	P2	Ascending or decumbent annual, herb, to 0.15 m high. Fl. yellow, green, Aug–Oct.
Eremophila caerulea subsp. *merrallii*	P4	Spreading or sprawling shrub, to 0.35 m high, to 0.8 m wide. Fl. blue, purple, Oct–Dec. Sand, clay or loam. Undulating plains.
Eremophila praecox	P1	Broom-like shrub, 1.5–3 m high. Fl. purple, Oct–Dec. Red/brown sandy loam. Occurs on undulating plains.
Eucalyptus jutsonii	P2	Mallee, 4–8 m high, bark rough, fibrous. Fl. white, Nov or Mar. Occurs in deep yellow to orange to red sands on sandplains & sandhills.
Eucalyptus x brachyphylla	P4	Mallee or tree, to 4 m high, bark rough, flaky. Fl. white, Jun. Sandy loam. Granite outcrops.
Gnephosis intonsa	P1	Prostrate to ascending annual, herb, 0.01–0.04 m high. Fl. yellow, brown, Sep–Oct. Red/brown clay, stony saline loam
Lepidium fasciculatum	P3	Erect annual, herb, (0.1–)0.3–0.6 m high
Melaleuca coccinea	P3	Much branched shrub, 1.5–2.6 m high, leaf blade elliptic to ovate, 1.5-2.2 times as long as wide. Fl. red, Sep–Jan. Sandy loam over granite. Granite outcrops, sandplain, river valleys.
Ptilotus procumbens	P1	Spreading procumbent annual, herb, ca 0.1 m high. Fl. pink, white, Nov. Red clay

[1] Data Source: Department of Environment and Conservation (2009) Florabase accessed on line at http://florabase.calm.wa.gov.au/ in September 2009.

3.5 Fauna

The desktop assessment included a number of database searches as well as a review of findings from fauna studies of the Kurrawang Nature Reserve conducted by Chapman et al. (1991) and Chapman and Kealley (2001).

3.5.1 Potential Fauna Species

A WAM/DEC *NatureMap* online search was conducted for the study area. The search identifies terrestrial vertebrate species recorded in various databases including collections from the WAM. The search identified the potential presence of four amphibian species, 17 mammal, 34 bird and 50 reptile species.

A full list of species recorded from the WAM/DEC *Nature Map* search is presented in Table 16.

It should be noted that some of the records of the Museum are historical and some of the recorded species may now be locally extinct. Additionally these records may include species (particularly bird species) that are vagrants or present in the general area but not present within the study area due to lack of suitable habitat.

Previous Studies

Chapman et al. (1991) recorded the presence of 37 bird, 16 reptile and nine mammal species during a biological survey of the Kurrawang Nature Reserve in 1988. A review by Chapman and Kealley (2001) of historical bird count data recorded from the Kurrawang Nature Reserve revealed that 52 species were recorded in 1904 and 65 in the period 1988-96. Count data indicates that both additions and deletions of species have occurred over the 92 year review period.

3.5.2 Threatened or Otherwise Protected Fauna

The conservation status of fauna species is assessed under both Commonwealth and State Acts, namely the *EPBC Act* and the *WC Act*.

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* is provided in Table 3 and the circumstances under which a project will trigger referral to the DEWHA are described in Appendix C. These categories are applicable to both threatened flora and fauna species.

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 Australia and the Republic of Korea for the protection of migratory shorebirds and their habitat (ROKAMBA); and

» 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).

Listed migratory species also include species identified in other international agreements approved by the Commonwealth Environment Minister.

The *WC Act* uses a set of Schedules but also classifies species using some of the IUCN categories. These categories and schedules are described in Table 6. These may be trigger species in the *EPBC Act*.

Table 6 Western Australian Threatened Fauna Categories

Category	Code	Description
Schedule 1	S1	Fauna which is rare or likely to become extinct.
Schedule 2	S2	Fauna which is presumed extinct.
Schedule 3	S3	Birds which are subject to an agreement between the governments of Australia and Japan (JAMBA) relating to the protection of migratory birds and birds in danger of extinction.
Schedule 4	S4	Fauna that is otherwise in need of special protection.

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. These species have no special legislative protection, but their presence would normally be considered. Such taxa need further survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna. Levels of Priority are described in Table 7.

Table 7 Department of Environment and Conservation Priority Codes

Category	Code	Description
Priority 1	P1	Taxa with few, poorly known populations on threatened lands.
Priority 2	P2	Taxa with few, poorly known populations on conservation lands.
Priority 3	P3	Taxa with several, poorly known populations, some on conservation lands.
Priority 4	P4	Taxa in need of monitoring which are considered not currently threatened or in need of special protection, but could be if present circumstances change. Usually represented on conservation lands.
Priority 5	P5	Taxa in need of monitoring 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.

3.5.3 Threatened Fauna Searches

The DEWHA maintains a database of matters of national environmental significance that are protected under the *EPBC Act*. An *EPBC Act* Protected Matters Report was

generated (from the website of the DEWHA), in September 2009 for the matters of significance that may occur in, or may relate to, the study area. Marine species listed in this search were included in the list. A search of the DEC's *NatureMap* database for any rare and priority species that may occur in the study area was also undertaken at that time.

Protected fauna species identified from DEC and DEWHA databases as potentially occurring within the study area are listed in Table 8.

It should be noted that some species that appear in the *EPBC Act* Protected Matters Search Tool are often not likely to occur within the specified area, as the search provides an approximate guidance to matters of national significance that require further investigation. The records from the DEC search provide more accurate information for the general area; however some records of sightings or trappings can be dated and often misrepresent the current range of threatened species.

Table 8 Listing of Significant, Rare and Priority Fauna Species that Potentially Occur within the Study Area

Genus	Species	Common Name	Listing under *WC Act* or DEC Priority List	Listing under *EPBC Act*	DEC/WAM *NatureMap* Database	EPBC Protected Matters Search Tool
Birds						
Acanthiza	*iredalei iredalei*	Slender-billed Thornbill (western)		Vulnerable		+
Apus	*pacificus*	Fork-tailed Swift		Migratory, Marine		+
Ardea	*alba*	Great Egret, White Egret		Migratory, Marine		+
Ardea	*ibis*	Cattle Egret		Migratory, Marine		+
Hylacola	*cauta* subsp. *whitlocki*	Shy Heathwren (western ssp)	Priority 4		+	
Leipoa	*ocellata*	Malleefowl	Schedule 1	Vulnerable	+	+
Merops	*ornatus*	Rainbow Bee-eater		Migratory, Marine		+
Oreoica	*gutturalis* subsp. *gutturalis*	Crested Bellbird (southern)	*Priority 4*		+	
Pomatostomus	*Superciliosus subsp. ashbyi*	White-browed Babbler (wetern wheatbelt)	Priority 4		+	
Reptiles						
Morelia	*spilota* subsp. *imbricata*	Carpet Python	Schedule 4, Priority 4		+	
Mammals						
Macrotis	*lagotis*	Bilby, Dalgyte	Schedule 1	Vulnerable	+	+
Myrmecobius	*fasciatus*	Numbat, Walpurti	Schedule 1	Vulnerable	+	

3.6 Field Survey Methodology

3.6.1 Vegetation and Flora

GHD's qualified ecologist (Peter Moonie) conducted the field flora survey on 20th January 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), where possible.

Given the relatively small size of the study area, releves were considered to be the most appropriate survey method. Data collected from releves included information on substrate, vegetation condition (including weed status), vascular flora species present and the dominant species within each vegetation type.

Where identification of flora species was uncertain, confirmation was made at the Western Australian State Herbarium (WAHERB). The presence of significant flora and/or potential TECs within the study area was assessed and aerial photography was used to assist in the delineation of vegetation types.

3.6.2 Fauna

GHD's qualified ecologist (Peter Moonie) conducted the fauna investigation in conjunction with the flora survey on 20 January 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. The weather was fine and hot at the time of the survey, reaching a maximum temperature of 45 ^{0}C.

3.6.3 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.

3.6.4 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 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, it was conducted outside of the optimal survey period for the region and there is a possibility that some ephemeral species may not be represented.

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.

3.7 Results of Field Survey – Vegetation and Flora

3.7.1 Vegetation Description

Apart from the roads and associated batters, the landform across the study area was relatively uniform and was considered to comprise a single vegetation type. A description of the vegetation type recorded within the study area is provided below:

» ***Eucalyptus griffithsii* woodland** - Low open woodland of *Eucalyptus griffithsii* with scattered *Casuarina pauper* over *Acacia* sp. (narrow phyllode), *Eremophila alternifolia, Eremophila oldfieldii* subsp. *angustifolia* over *Senna artemisioides* subsp. *artemisioides, Acacia hemiteles, Eremophila scoparia* and *Scaveola spinescens* over mixed chenopods (Refer Plate 1).

A narrow drainage swale was observed running adjacent to the northern edge of Kundana Road. Vegetation was noticeably denser within this swale; however, the species present were similar to those across the remainder of the site. A vegetation map is provided in Figure 3.

Plate 1 ***Eucalyptus griffithsii*** **woodland within the Study Area**

3.7.2 Vegetation Condition

The vegetation condition of the site was rated using the vegetation condition rating scale developed by Keighery (1994), which recognises the intactness of vegetation and is defined by the following:

» Completeness of structural levels;

» Extent of weed invasion;

» Historical disturbance from tracks and other clearing or dumping; and

» The potential for natural or assisted regeneration.

The scale consists of six rating levels from pristine or nearly so to completely degraded. The Vegetation Condition Rating Scale is outlined in below in Table 9.

Table 9 Vegetation Condition Rating Scale (after Keighery, 1994)

Vegetation Condition Rating	Vegetation Condition	Description
1	*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.

Vegetation Condition Rating	Vegetation Condition	Description
4	*Good*	Vegetation structure significantly altered by very obvious signs of multiple disturbances retains basic vegetation structure or ability to regenerate it.
5	*Degraded*	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not in a state approaching good condition without intensive management.
6	*Completely Degraded*	The structure of the vegetation is no longer intact and the area is completely or almost without native species.

Disturbances from road construction, timber extraction and pastoral activities are evident across much of the site. Vegetated areas were generally considered to be in *Good* (4) to *Degraded* (5) condition.

The most noticeable areas of disturbance were the formal roads and the unsealed parking bay/turnaround area. Such areas were considered to be *Completely Degraded* (6).

Minor tracks traverse much of the site. These tracks have not been mapped but were considered to be *Degraded (5).* A high proportion of weeds and disturbance response species were observed on the batters of the GEH and adjacent to the culvert passing beneath it.

General vegetation condition has been mapped in Figure 1, Appendix A.

3.7.3 Threatened Ecological Communities (TECs)

No TECs were recorded during the field survey.

No PECs were recorded during the field survey.

3.7.4 Flora Species

Vegetation within the study area is considered to be moderately diverse. A total of 75 taxa from 21 families were recorded from the study area. Of these, 70 taxa were native plant species. Two collections could not be identified beyond family level due to lack of flowering parts or fruiting bodies, or because they were only found in a juvenile form.

Dominant families recorded included:

- Chenopodiaceae (chenopods): 21 taxa
- Myoporaceae (poverty bushes): 8 taxa
- Poaceae (grasses): 8 taxa
- Mimosaceae (wattles): 6 taxa

Dominant genera recorded from the study area included:

» *Maireana:* 9 taxa

» *Eremophila:* 8 taxa

» *Acacia:* 6 taxa

A full list of flora species present in the study area is provided in Table 15.

3.7.5 Significant Flora

No DRF or PLF species were recorded from the study area during this survey.

3.7.6 Weeds

A total of seven weed species were recorded, comprising approximately 9% of the total number of plant species recorded in the study area. Weed species recorded are listed in Table 10.

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

Table 10 Weed Species Recorded Within the Study Area

Genus	Species	Common Name
Centaurea	*melitensis*	Maltese Cockspur
Conyza	*bonariensis*	Flaxleaf Fleabane
Sonchus	*oleraceus*	Common Sowthistle
Salvia	*verbenaca*	Wild Sage
Carrichtera	*annua*	Ward's Weed
Cynodon	*dactylon*	Couch
Eragrostis	*curvula*	African Lovegrass

3.8 Results of Field Survey - Fauna

3.8.1 Fauna Species

Eleven bird species, one mammal and two reptile species were recorded within the study area during the reconnaissance survey (refer Table 17, Appendix C).

It is considered that the short duration of the survey, the hot conditions and absence of trapping resulted in the low number species recorded.

It should also be noted that surveys such as this provide a brief snapshot of those species present at the time of sampling (daytime), in one season, in one year. Not all

potentially occurring species would be recorded during a single survey due to spatial and temporal variations in fauna population numbers.

3.8.2 Significant Fauna Species

The White-browed Babbler was observed within the study area during the field survey. The White-browed Babbler consists of four subspecies, two of which occur in the local area (*Pomatostomus superciliosus* subsp. *superciliosus* and *Pomatostomus superciliosus* subsp. *ashbyi)*. The two subspecies are indistinguishable in the field. Although unlikely, it is possible that the White-browed Babbler observed in the study area is the Priority 4 *ashbyi* subspecies. Despite taxonomic uncertainty, proposed works are unlikely to impact on family groups observed as both subspecies are likely to move to adjacent areas of intact vegetation if disturbed.

3.8.3 Significant Fauna Assessment

Desktop searches indicate that a number of protected fauna species not recorded during the field survey may also occur within the study area. The habitat requirements of these species and the likelihood of their occurrence in the study area are considered below.

Slender-billed Thornbill – western (*Acanthiza iredalei iredalei*)

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). It is unlikely to occur within the study area given the lack of suitable habitat.

Malleefowl (*Leipoa ocellata*)

Malleefowl build large mounds from soil, leaves, sticks and small stones from the surrounding shrublands and woodlands (Department of Environment and Conservation, 2007). The Malleefowl's habitat can be broadly described as semi-arid areas and remnant vegetation within agricultural zones. The species main danger lies through land clearing, predation and altered fire regimes (Department of Environment and Conservation, 2007). Mallefowl has never been recorded in surveys of the Kurrawang area which date back as far as 1904 (Chapman and Kealley, 2001). It is unlikely to occur within the study area.

Shy Heathwren (*Hylacola Cauta whitlocki*)

This species is reliant on dense shrub and heath undergrowth of mallee communities. Habitat degradation of remnant bushland and land clearing are the major threats to this species. Proposed works are unlikely to impact on the conservation significance of this species.

Crested Bellbird (*Oreoica gutturalis gutturalis*)

The Crested Bellbird lives in the shrub layer of Eucalypt woodlands, mallee and Acacia shrublands, Triodia hummock grasslands, saltbush and heath. Its main threat is from clearing (DEWHA, 2009) and has probably been listed as a result of habitat loss within

the wheatbelt region. This species may occur within the project area but is unlikely to be impacted as it is a vagrant and will readily move to adjacent areas if disturbed.

Carpet Python (*Morelia spilota imbricata*)

Although generally uncommon, this subspecies has a wide distribution within the south west, having been recorded from semi-arid coastal and inland habitats, Banksia woodland, Eucalypt woodlands, and grasslands. It commonly utilises hollow logs for shelter (Wilson and Swan, 2003). Local populations in the south west have suffered due to extensive clearing, changed fire regimes and the removal of habitat for this species (Department of Environment and Conservation, 2008). This species is likely to move to adjacent areas if disturbed. Care should be taken when clearing vegetation and any animals observed within the clearing footprint should be relocated to adjacent bushland areas.

Numbat (*Myrmecobius fasciatus*)

The Numbat is listed as Schedule 1 by DEC and as Vulnerable by EPBC and IUCN. Populations of the Numbat currently occur in habitat types including upland Jarrah forests, open Eucalypt woodlands, Banksia woodlands and tall closed shrublands. This species is found in areas with an abundance of termites, hollow logs and branches for shelter. The severe decline in the population numbers of Numbats is due to predation by foxes, loss of habitat due to clearing for agriculture and changes in fire regimes. This species is presumed extinct in the region.

Bilby (*Macrotis lagotis*)

The Bilby usually spends the daytime in burrows. After dark they leave their burrows to feed and populations are known to move long distances when current habitat ranges become unsuitable. Bilbies are largely solitary, widely dispersed and found in low numbers. This species is presumed extinct in the region.

Rainbow Bee-eater (*Merops ornatus)*

The Rainbow Bee-eater (Migratory, *EPBC Act*) 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. 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 (*Apus pacificus)*

May utilise the study area but is an aerial species, and as such is unlikely to be affected by proposed development activities.

Great Egret (*Ardea alba)* and Cattle Egret (*Ardea ibis)*

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

3.8.4 Introduced Species

No introduced fauna were recorded from the study area.

4. Social Environment

4.1 Surrounding Land Use

The study area encompasses three different zones under the Shire of Coolgardie's Strategic Planning Scheme. They include: rural/mining; road reserve and public purposes (recreation). The Kurrawang townsite immediately to the north of the Kurrawang Nature Reserve is reserved for public purposes (townsite). A broader area surrounding the townsite is reserved for public purposes (public utility). The Kurrawang Native Mission (Yamatji Ngura Community) is located within this zoned area.

The Department of Mines and Petroleum (DMP) 'Tengraph' database was also accessed to determine any mining tenements present in the study area. The search revealed that the study area is located within Mining Tenement M15/1394. It is recommended that Main Roads liaise with the relevant tenement holder prior to the commencement of works.

The proposed works are considered unlikely to impact on adjacent land uses.

4.2 Aboriginal Heritage

A search of the Department of Indigenous Affairs (DIA) Register of Aboriginal Sites was conducted as part of the EIA, to determine the likelihood of the project impacting on any Aboriginal sites listed under the *Aboriginal Heritage Act 1972*. The search indicated that no known Aboriginal Heritage sites occur within the study area. Details of Aboriginal sites within the vicinity of the study area are provided in Table 11 and sites are mapped in Figure 2, Appendix A.

Table 11 Aboriginal Heritage Sites within Vicinity of the Study Area

Site ID	Site Name	Site Type	MGA East	MGA North
26174	Yamatji Ngurra Burial	Skeletal material/Burial	341098	6588681
20649	Seven Sisters Ceremonial	Ceremonial, Mythological, Man-made Structure	Closed site - not available	Closed site - not available
17025	Lake Douglas Gnamma Hole	Water Source	346137	6587157

4.3 European Heritage

The assessment of European Heritage issues for the Project included a review of the Department of Environment, Water, Heritage and the Arts (DEWHA) on-line database, Australian Heritage Places Inventory on-line database, and the Western Australian Heritage Council Places Database.

No heritage sites were identified within the study area. The closest recorded site is the historic Kurrawang settlement (Heritage Council of Western Australia Place No. 07385). Kurrawang settlement was the centre of one of the region's woodline operations which provided timber for the mining industry. The settlement was dismantled in 1937 and later became a mission for Aboriginal people.

Proposed works are considered unlikely to impact on any listed European heritage sites.

5. Clearing of Native Vegetation

5.1 Assessment against Clearing Principles

The proposed intersection works will require clearing of native vegetation within both the existing road reserve as well as the Kurrawang Nature Reserve.

Whilst clearing within the road reserve may be assessed and authorised under the Main Roads State-wide Purpose Clearing Permit (CPS 818/4), it is understood that clearing within the Nature Reserve will be required to be assessed separately and submitted to the DEC Goldfields Regional Office for approval.

Proposed clearing within each area has therefore been assessed separately against each of the '10 Clearing Principles' as outlined in Schedule 5 of the *Environmental Protection Amendment Act 2003.*

In accordance with Condition 13 of CPS 818/4, given that the proposed clearing within the road reserve is not for temporary works, extraction sites, camps, project surveys or preconstruction activities, a revegetation plan is not considered necessary for the proposed works.

5.1.1 Clearing within the Road Reserve

Table 12 provides an assessment of the proposed clearing within the road reserve against the '10 Clearing Principles'. Proposed clearing is considered unlikely to be at variance against any of the '10 Clearing Principles'.

5.1.2 Clearing within the Kurrawang Nature Reserve

Table 13 provides an assessment of the proposed clearing within the Kurrawang Nature Reserve against the '10 Clearing Principles'. Proposed clearing is considered unlikely to be at variance against any of the '10 Clearing Principles'.

Table 12 Assessment of Clearing within the Road Reserve against the 10 Clearing Principles

Principle Number	Principle	Assessment	Outcome
(a)	Native vegetation should not be cleared if it comprises a high level of biological diversity.	Vegetation within the study area is considered to be moderately diverse. The study area is not considered to be of higher biodiversity than the broader surrounding area and the proposed clearing is unlikely to have any significant impact on the biodiversity of the region. No Priority Flora or other significant flora were recorded within the study area. No PECs were recorded within the study area.	The proposal is not considered to be at variance with the 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.	No specific habitat was noted within the study area that was not present in the local area. The vegetation and associated fauna habitat within the study area is considered to be minimal in a regional perspective. Fauna species present in the study area are likely to find similar habitat adjacent to the study area. The area required to be cleared for the intersection works is not likely to impact on significant fauna or required habitat.	The proposal is not considered to be at variance with the Principle.
(c)	Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.	No DRF species have been recorded previously within the study area. No DRF species were recorded during the field survey.	The proposal is not considered to be at variance with the Principle.

Principle Number	Principle	Assessment	Outcome
(d)	Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a TEC.	No TECs or PECs or associated native vegetation will be impacted by the proposed works.	The proposal is not considered to be at variance with the 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.	Clearing native vegetation within the study area will not significantly reduce the known extent from pre-European extents.	The proposal is not considered to be at variance with the 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.	There are no permanent watercourses or wetlands within the study area, nor is the vegetation wetland dependent. A culvert exists under the GEH within a low lying area of the site. Appropriate mitigation measures should be implemented to minimise runoff and sedimentation to this area.	The proposal is not considered to be at variance with the Principle.
(g)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	Given the minimal amount clearing required and the location (adjacent to an existing road), it is unlikely that the project will cause appreciable land degradation. Erosion and weed spread can be mitigated by the use of appropriate management regimes.	The proposal is unlikely to be at variance with the Principle.

Principle Number	Principle	Assessment	Outcome
(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.	The proposed area of clearing within the road reserve on the northern side of the GEH lies immediately adjacent to the Kurrawang Nature Reserve. Although the vegetation provides a buffer between the road and the nature reserve, it is small narrow area with a high proportion of weeds and its contribution to the functioning and viability of the reserve is negligible. The removal of vegetation within the road reserve is unlikely to impact significantly on the environmental values of the Kurrawang Nature Reserve.	The proposal is unlikely to be at variance with this 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.	The clearing of native vegetation is not considered likely to alter the quality of surface or ground waters within the study area. Erosion may occur following any potential clearing. Erosion can be mitigated by the use of appropriate design and management regimes.	The proposal is not considered to be at variance with the Principle.
(j)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.	The clearing of native vegetation is not considered likely to cause or exacerbate the incidence or intensity of flooding.	The proposal is not considered to be at variance with the Principle.

Table 13 Assessment of Clearing within the Kurrawang Nature Reserve against the 10 Clearing Principles

Principle Number	Principle	Assessment	Outcome
(a)	Native vegetation should not be cleared if it comprises a high level of biological diversity.	Vegetation within the study area is considered to be moderately diverse. The study area is not considered to be of higher biodiversity than the broader surrounding area and the proposed clearing is unlikely to have any significant impact on the biodiversity of the region. No Priority Flora or other significant flora were recorded within the study area. No PECs were recorded within the study area.	The proposal is not considered to be at variance with the 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.	No specific habitat was noted within the study area that was not present in the local area. The vegetation and associated fauna habitat within the study area is considered to be minimal in a regional perspective. Fauna species present in the study area are likely to find similar habitat adjacent to the study area. The area required to be cleared for the intersection works is not likely to impact on significant fauna or required habitat.	The proposal is not considered to be at variance with the Principle.
(c)	Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.	No DRF species have been recorded previously within the study area. No DRF species were recorded during the field survey.	The proposal is not considered to be at variance with the Principle.

Principle Number	Principle	Assessment	Outcome
(d)	Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a TEC.	No TECs or PECs or associated native vegetation will be impacted by the proposed works.	The proposal is not considered to be at variance with the 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.	Clearing native vegetation within the study area will not significantly reduce the known extent from pre-European extents.	The proposal is not considered to be at variance with the 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.	There are no permanent watercourses or wetlands within the study area, nor is the vegetation wetland dependent.	The proposal is not considered to be at variance with the Principle.
(g)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	Given the minimal amount clearing required and the location (adjacent to an existing road), it is unlikely that the project will cause appreciable land degradation. Erosion and weed spread can be mitigated by the use of appropriate management regimes.	The proposal is unlikely to be at variance with the 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.	The proposed intersection works will require clearing of up to 0.3 ha of native vegetation within the Kurrawang Nature Reserve. The contribution of this small area to the functioning and viability of the reserve is considered to be negligible. The proposed clearing is unlikely to impact significantly on the environmental values of the Kurrawang Nature Reserve.	The proposal is unlikely to be at variance with this Principle.

Principle Number	Principle	Assessment	Outcome
(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.	The clearing of native vegetation is not considered likely to alter the quality of surface or ground waters within the study area. Erosion may occur following any potential clearing. Erosion can be mitigated by the use of appropriate design and management regimes.	The proposal is not considered to be at variance with the Principle.
(j)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.	The clearing of native vegetation is not considered likely to cause or exacerbate the incidence or intensity of flooding.	The proposal is not considered to be at variance with the Principle.

6. Environmental Aspects and Potential Impacts Assessment

Table 14 lists all of the environmental aspects assessed and evaluates their potential impacts relevant to the project. This section includes recommendations where applicable. A map showing the environmental and heritage constraints over the broader study area is shown at Figure 2, Appendix A with site photos at Appendix E.

Table 14 Assessment of Environmental Impacts

Aspect	Potential Impact	Recommendations
Surface water	No permanent wetlands or major drainage lines occur within the Project Area. The impact on natural surface flows is expected to be minimal.	Existing surface water flows will be maintained by replacing and / or extending existing crossroad culverts.
Groundwater	Proposed works are not expected to impact on groundwater resources.	Not considered to be an issue.
Vegetation	The project will require clearing of up to 1.44 ha of native vegetation within the road reserve and up to 0.3 ha within the Kurrawang Nature Reserve. Vegetation condition ranges from good to degraded.	Following assessment against the '10 Clearing Principles', it is considered that clearing within the road reserve may proceed under the Main Roads state-wide Purpose Permit (CPS 818/4). Approval for clearing vegetation within the Kurrawang Nature Reserve should be processed through the DEC Goldfields Regional Office. Clearing should not proceed within the Nature Reserve without DEC approval. The limits of clearing should be clearly marked on site prior to works commencing and all project activities contained within them. Clearing should be minimised where possible.
Vegetation – threatened species and communities	No TECs or PECs or associated native vegetation will be impacted by the proposed works. No DRF of Priority Flora species were identified within the study area.	Not considered to be an issue.
Vegetation - Dieback	The available climatic and hydrological data suggests that the Project Area is not vulnerable to impacts caused by Phytophthora cinnamomi (Dieback).	Not considered to be an issue.
Flora	No Declared Flora, Priority Listed Flora or other significant flora were identified within the study area during the field assessment.	Not considered to be an issue.

Aspect	Potential Impact	Recommendations
Fauna	Vegetated areas within the study area are considered to provide low to medium habitat value for fauna. Construction works may directly impact on individual animals; however, the project is unlikely to significantly impact on the long-term survival of conservation significant species or required habitat.	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 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. 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.
Weeds	A high proportion of weed species were observed along the margins of formed roads within the study area. Weed spread may occur from disturbed areas to less disturbed areas via vehicles, machinery and soil movement if not appropriately managed during construction.	It is recommended that weed management strategies be incorporated within the Main Roads contract documentation to minimise the spread of weed species during construction.
Public safety and risk	The construction phase of the project may create some public safety and risk issues. Applying traffic management and signage to Main Roads standards will be necessary to manage these risks throughout the implementation of the project.	Plan and apply traffic management and signage to Main Roads standards.
Air quality	Local air quality may be affected during construction by the generation of machinery exhaust and dust, however these impacts are not considered to be significant. Long term air quality impacts are not considered to be significant.	An air quality impact assessment is not required for this project.
Dust	Dust may be a potential nuisance issue during construction works, especially in summer where construction can generate wind-borne dust. Excessive dust may impact on adjacent vegetation.	Apply standard dust management measures during construction.

Aspect	Potential Impact	Recommendations
Salinity	Groundwater within the region can be hypersaline.	If hypersaline water is used for dust suppression, spray drift should be minimised and contact with surrounding vegetation should be avoided.
Noise and Vibration	Given that the project area not in close proximity to residential dwellings or other sensitive receptors, the potential for construction noise and vibration to cause significant impacts is considered minimal.	Apply standard noise and vibration management measures during construction.
Acid Sulphate Soils	Acid Sulphate Soils have an extremely low probability of occurrence within the study area.	Not considered to be an issue.
Contaminated Sites	A search of the DEC's Contaminated Sites Database indicated there were no known contaminated sites registered within the Project Area under the Contaminated Sites Act 2003.	Not considered to be an issue
Heritage (non-indigenous)	A search of relevant online databases indicated there are no World Heritage Properties or European heritage sites of significance present in the Project Area.	Not considered to be an issue.
Heritage (Aboriginal)	The results of an on-line search of the Department of Indigenous Affairs (DIA) sites database show that no registered Aboriginal heritage sites occur within the study area.	In the event that objects of Aboriginal origin are uncovered during construction activities, comply with obligations under the Aboriginal Heritage Act 1972.
Visual Amenity	The site is surrounded by natural bushland. Clearing will have minimal impact due to the remote location of the site and the fact that an intersection already exists at the site.	Not considered to be an issue.
Construction phase impacts – public safety and risk, dust, fire management, fuel and chemical storage and waste disposal.	Construction phase impacts are considered minor based on the lack of sensitive receptors within the area.	It is recommended that Main Roads develops and implements a Construction Environmental Management Plan with measures to address relevant environmental, social and cultural issues during construction.

7. Environmental Approvals

7.1 Commonwealth Approvals

The *EPBC Act* is the Australian Government's key piece of environmental legislation which provides for the protection of the environment, especially matters of national environmental significance and provides a streamlined national environmental assessment and approvals process. Approval by the DEWHA under the *EPBC Act* may be required if a project is likely to have a significant impact on the environment in general (for actions by Commonwealth agencies of actions on Commonwealth land) or is likely to have a significant impact on a matter of national significance. The seven matters of national significance protected under the *Act* are:

- World Heritage properties;
- National Heritage places;
- Wetland of international importance;
- Listed threatened species and ecological communities;
- Migratory species;
- Commonwealth marine areas;
- Nuclear actions (including uranium mines).

The proposed roadworks are unlikely to require referral to the DEWHA under the provisions of the *Environmental Protection* and *Biodiversity Conservation Act (1999)* as no significant impacts are likely to occur on Matters of National Environmental Significance.

7.2 Government of Western Australia

The Department of Environment and Conservation (DEC) are responsible for administering the *Environmental Protection* Act *(1986).* 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.

This EIA indicates that environmental and social impacts are minimal and formal assessment by the EPA is considered unnecessary.

7.2.1 Clearing Regulations

The *Environmental Protection (Clearing of Native Vegetation) Regulations 2004* stipulate that a permit is required to clear native vegetation.

Following an assessment against the 10 Clearing Principles (refer Table 12), it is considered that clearing within the road reserve may proceed under the Main Roads State-wide Purpose Clearing Permit (CPS 818/4)

Clearing within the Kurrawang Reserve will require approval from the DEC Goldfields Regional Office.

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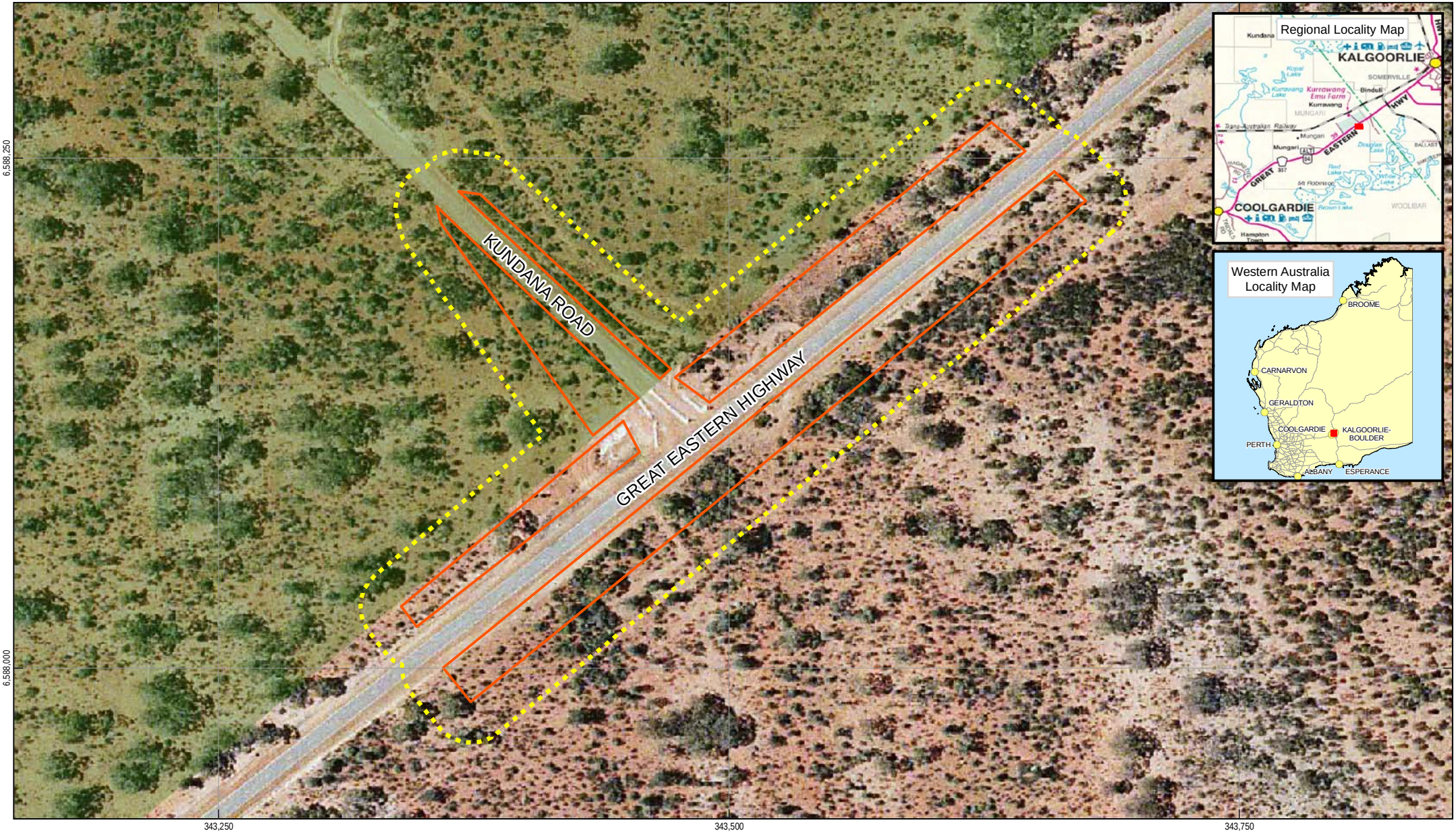
Appendix A

Figures



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0 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 51

N

LEGEND

- Study Area
- Proposed Clearing Areas
- Kurrawang Nature Reserve

GHD

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mainroads WESTERN AUSTRALIA

Main Roads Western Australia
Kundana Road Environmental Impact Assessment

Job Number	61-25040
Revision	0
Date	15 FEB 2010

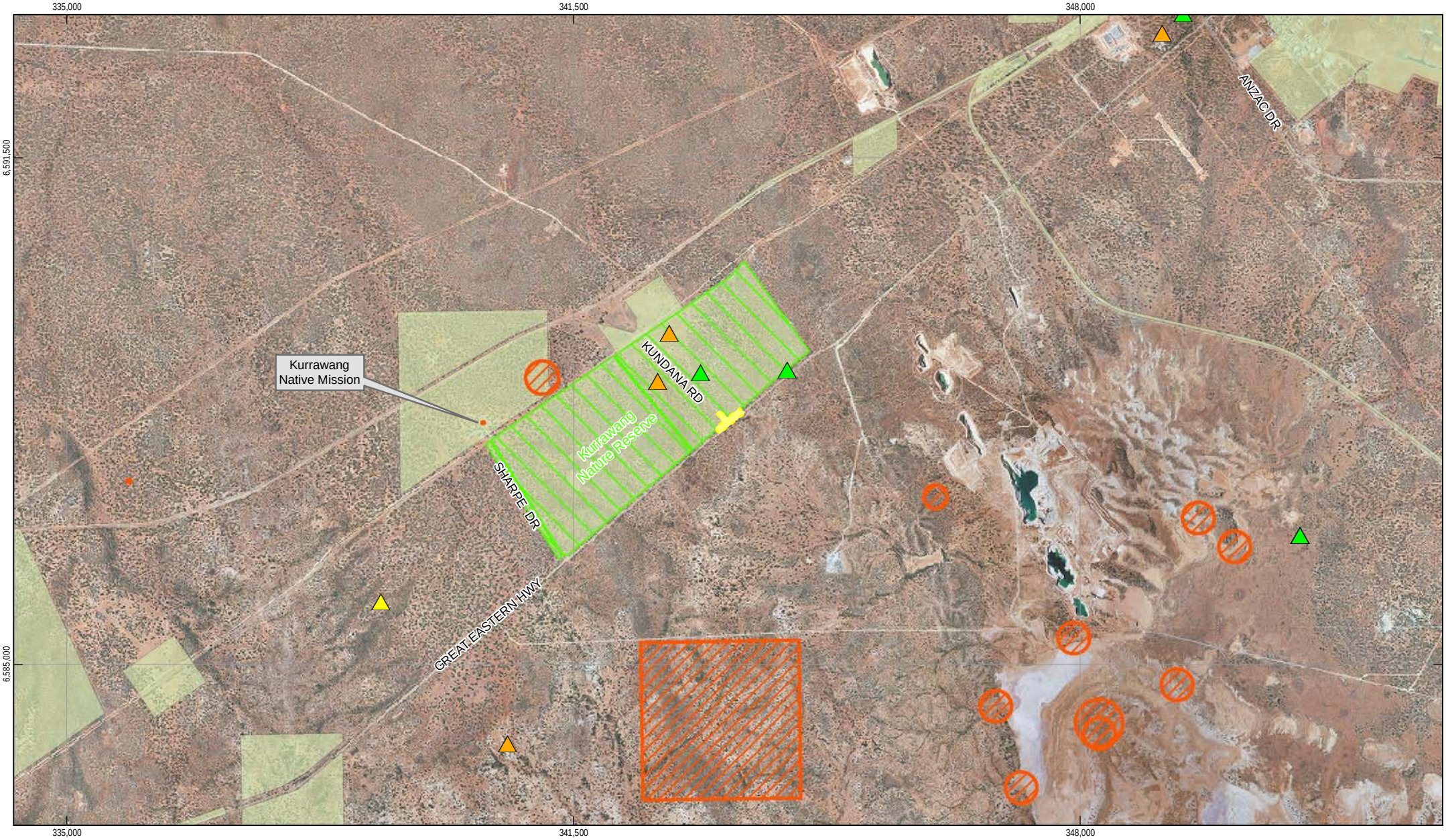
Study Area & Locality

Figure 1

G:\61\25040\GIS\Maps\MXD\61_25040_StudyArea_Location_E001_rev0.mxd

76 Forrest Street Geraldton WA 6530 **T** 61 8 9964 3677 **F** 61 8 9921 7997 **E** getmail@ghd.com.au **W** www.ghd.com.au

Data Source: GHD: Study Area - 20100127; Geodetic Australia: Travellers Atlas - 2004. Created by: ageiger, mludovico



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 51

N

LEGEND

- Study Area
- Aboriginal Heritage Site
- DEC Estate
- Schedule One Area

Declared Rare & Priority Species*

- Priority 1 - Poorly Known Taxa
- Priority 2 - Poorly Known Taxa
- Priority 3 - Poorly Known Taxa

*WAHerb and DEFL Database Search Ref. 24-0110

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Main Roads Western Australia
Kundana Road Environmental
Impact Assessment

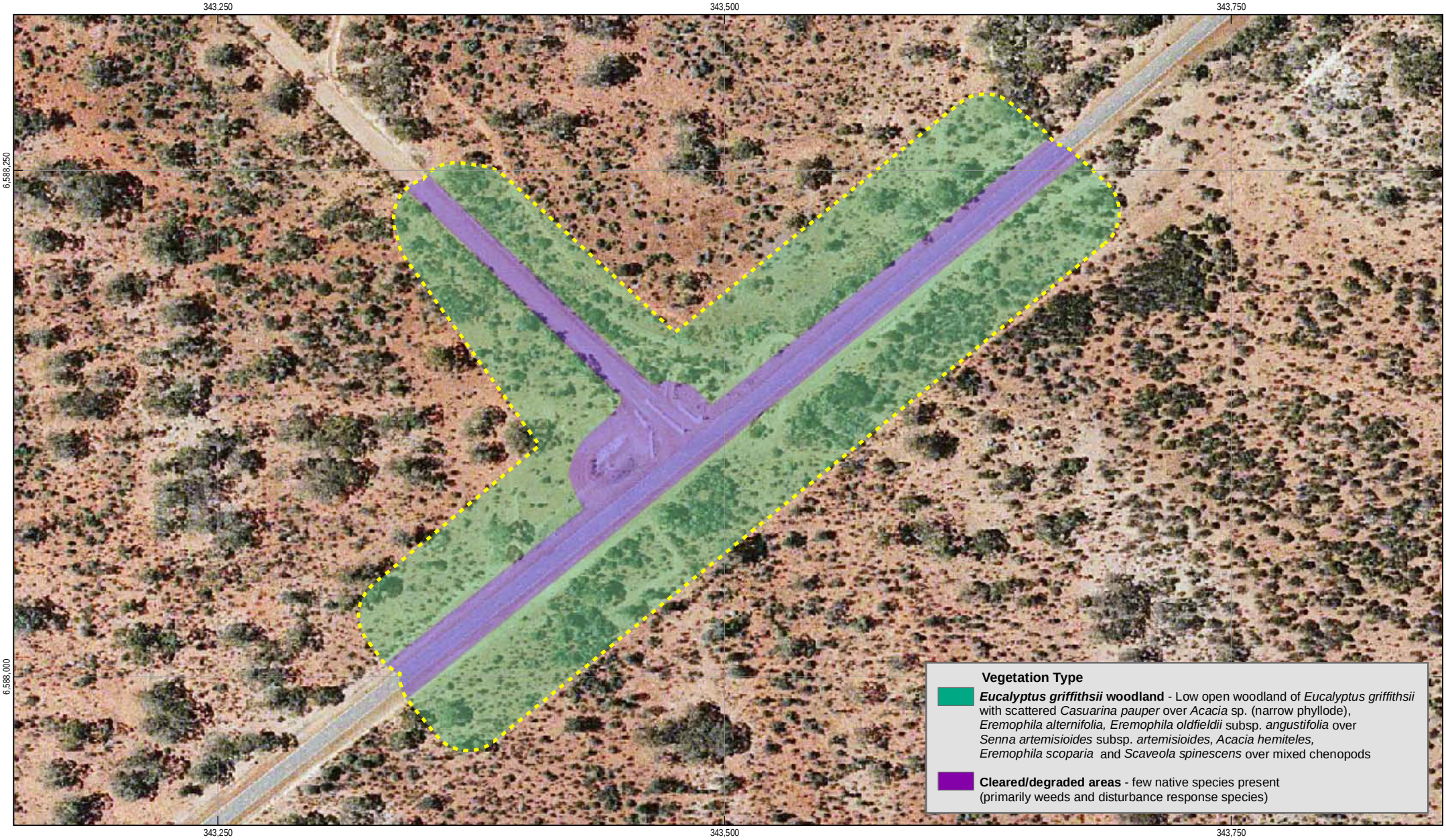
Job Number	61-25040
Revision	0
Date	15 FEB 2010

Environmental Constraints Figure 2

G:\61\25040\GIS\Maps\MXD\61_25040_Environmental-Constraints_E002_rev0.mxd

76 Forrest Street Geraldton WA 6530 **T** 61 8 9964 3677 **F** 61 8 9921 7997 **E** getmail@ghd.com.au **W** www.ghd.com.au

Data Source: DEC: Declared Rare & Priority Species - 20100118, DEC Estate - 20090812, Schedule One Area - 20071126; DIA: Aboriginal Heritage Site - 20100115; GHD: Study Area - 20100127. Created by: ageiger, mludovico



1:2,500 (at A4)

0 12.5 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 51

N

LEGEND

Study Area

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Main Roads Western Australia
Kundana Road Environmental Impact Assessment

Job Number	61-25040
Revision	0
Date	15 FEB 2010

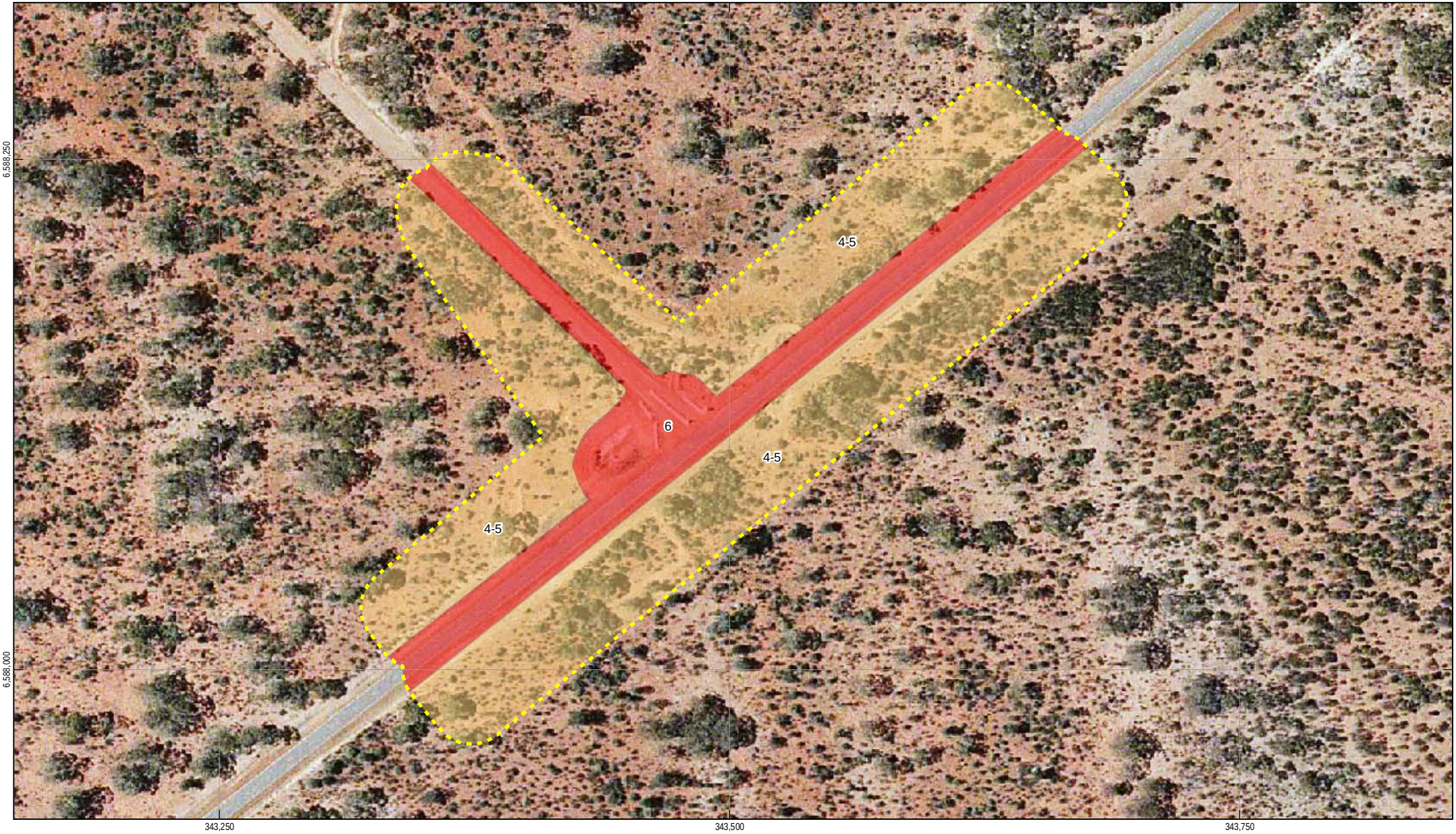
Vegetation Type

Figure 3

G:\61\25040\GIS\Maps\MXD\61_25040_VegetationType_E003_rev0.mxd

76 Forrest Street Geraldton WA 6530 **T** 61 8 9964 3677 **F** 61 8 9921 7997 **E** getmail@ghd.com.au **W** www.ghd.com.au

Data Source: Landgate: Kalgoorlie 2006 Mosaic - 20100119; GHD: Study Area - 20100127, Vegetation Type - 20100127. Created by: ageiger, mludovico



1:2,500 (at A4)

0 12.5 25 50 75 100

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 51

N

LEGEND

Study Area

Vegetation Condition
1 - Pristine
2 - Excellent
3 - Very Good
4 - Good
5 - Degraded
6 - Completely Degraded

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mainroads WESTERN AUSTRALIA

Main Roads Western Australia
Kundana Road Environmental
Impact Assessment

Job Number	61-25040
Revision	0
Date	15 FEB 2010

Vegetation Condition

Figure 4

76 Forrest Street Geraldton WA 6530 **T** 61 8 9964 3677 **F** 61 8 9921 7997 **E** getmail@ghd.com.au **W** www.ghd.com.au

G:\61\25040\GIS\Maps\MXD\61_25040_VegetationCondition_E004_rev0.mxd

Data Source: Landgate: Kalgoorlie 2006 Mosaic - 20100119; GHD: Study Area - 20100127, Vegetation Condition - 20100127. Created by: ageiger, mludovico

Appendix B

Flora

Flora Species Recorded during the Field Survey of the Study Area – January 2010

Table 15 Flora Species Recorded During Field Survey of the Study Area – January 2010

Family	Genus	Species	Common Name	Status
Amaranthaceae	*Ptilotus*	*exaltatus*	Tall Mulla Mulla	
Amaranthaceae	*Ptilotus*	*obovatus*	Cotton Bush	
Asclepiadaceae	*Marsdenia*	*australis*	Cogla	
Asteraceae	*Vittadina*	*? humerata*		
Asteraceae	*Centaurea*	*melitensis*	Maltese Cockspur	*
Asteraceae	*Conyza*	*bonariensis*	Flaxleaf Fleabane	*
Asteraceae	*Olearia*	*muelleri*	Goldfields Daisy	
Asteraceae	*Sonchus*	*oleraceus*	Common Sowthistle	*
Brassicaceae	*Carrichtera*	*annua*	Ward's Weed	*
Caesalpiniaceae	*Senna*	*artemisioides* subsp. *artemisoides*		
Caesalpiniaceae	*Senna*	*artemisioides* subsp. *filifolia*		
Caesalpiniaceae	*Senna*	*stowardii*		
Casuarinaceae	*Casuarina*	*pauper*	Black Oak	
Chenopodiaceae	*Atriplex*	*acutibractea* subsp. *karoniensis*		
Chenopodiaceae	*Atriplex*	*nummularia*	Old Man Saltbush	
Chenopodiaceae	*Atriplex*	*stipitata*	Bitter Saltbush	
Chenopodiaceae	*Atriplex*	*vesicaria*	Bladder Saltbush	
Chenopodiaceae	*Chenopodium*	*curvispicatum*		
Chenopodiaceae	*Dissocarpus*	*paradoxus*	Curious Saltbush	
Chenopodiaceae	*Enchylaena*	*tomentosa*	Barrier Saltbush	
Chenopodiaceae	*Maireana*	*brevifolia*	Small Leaf Bluebush	
Chenopodiaceae	*Maireana*	*georgei*	Satiny Bluebush	
Chenopodiaceae	*Maireana*	*glomerifolia*	Ball Leaf Bluebush	
Chenopodiaceae	*Maireana*	*pentatropis*		

Family	Genus	Species	Common Name	Status
Chenopodiaceae	*Maireana*	*sedifolia*	Pearl Bluebush	
Chenopodiaceae	*Maireana*	*tomentosa*	Felty Bluebush	
Chenopodiaceae	*Maireana*	*trichoptera*	Downy Bluebush	
Chenopodiaceae	*Maireana*	*triptera*	Threewinged Bluebush	
Chenopodiaceae	*Maireana*	*turbinata*		
Chenopodiaceae	*Rhagodia*	*drummondii*		
Chenopodiaceae	*Salsola*	*tragus*	Roly Poly	
Chenopodiaceae	*Sclerolaena*	*diacantha*	Grey Copperburr	
Chenopodiaceae	*Sclerolaena*	*obliquicuspis*	Limestone Bindii	
Chenopodiaceae	*Tecticornia*	*undulata*		
Goodeniaceae	*Scaevola*	*spinescens*	Currant Bush	
Iridaceae	sp. (insufficient material)			
Lamiaceae	*Salvia*	*verbenaca*	Wild Sage	*
Lamiaceae	*Westringia*	*rigida*	Stiff Westringia	
Malvaceae	*Sida*	*calxhymenia*	Tall Sida	
Mimosaceae	*Acacia*	*duriuscula*		
Mimosaceae	*Acacia*	*erinacea*	Hedgehog Acacia	
Mimosaceae	*Acacia*	*hemiteles*	Tan Wattle	
Mimosaceae	*Acacia*	*jennerae*		
Mimosaceae	*Acacia*	sp. narrow phyllode (B.R. Maslin 7831)		
Mimosaceae	*Acacia*	*tetragonophylla*	Kurara	
Myoporaceae	*Eremophila*	*alternifolia*	Poverty Bush	
Myoporaceae	*Eremophila*	*decipens* subsp. *decipiens*		
Myoporaceae	*Eremophila*	*glabra*	Tar Bush	
Myoporaceae	*Eremophila*	*granitica*	Thin-leaved Poverty Bush	

Family	Genus	Species	Common Name	Status
Myoporaceae	*Eremophila*	*interstans* subsp. *interstans*		
Myoporaceae	*Eremophila*	*oldfieldii* subsp. *angustifolia*	Pixie Bush	
Myoporaceae	*Eremophila*	*parvifolia* subsp. *auricampa*	Small-leaved Eremophila	
Myoporaceae	*Eremophila*	*scoparia*	Broom Bush	
Myrtaceae	*Eucalyptus*	*griffithsii*	Griffith's Grey Gum	
Myrtaceae	*Eucalyptus*	*lesouefii*	Goldfields Blackbutt	
Myrtaceae	*Eucalyptus*	*oleosa* subsp. *oleosa*		
Pittosporaceae	*Pittosporum*	*angustifolium*		
Plantaginaceae	*Plantago*	sp. Mt Magnet (A.S. George 6793)		
Poaceae	*Austrodanthonia*	*caespitosa*		
Poaceae	*Austrostipa*	*nitida*		
Poaceae	*Chloris*	*truncata*	Windmill Grass	
Poaceae	*Cynodon*	*dactylon*	Couch	*
Poaceae	*Enneapogon*	*avenaceus*	Bottle Washers	
Poaceae	*Enteropogon*	*ramosus*	Windmill Grass	
Poaceae	*Eragrostis*	*curvula*	African Lovegrass	*
Poaceae	sp. (insufficient material)			
Santalaceae	*Exocarpos*	*aphyllus*	Leafless Ballart	
Santalaceae	*Santalum*	*spicatum*	Sandalwood	
Sapindaceae	*Dodonaea*	*lobulata*	Bead Hopbush	
Sapindaceae	*Dodonaea*	*viscosa*	Stick Hopbush	
Solanaceae	*Solanum*	*lasiophyllum*	Flannel Bush	
Zygophyllaceae	*Zygophyllum*	*eremaeum*		

Appendix C

Fauna

Triggers for Referral to DEWHA

WAM/DEC *NatureMap* Records within 20 km of the Study Area

Fauna Species Observed within Study Area

***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.

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

- critically endangered, or
- endangered.

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
- introduce disease that may cause the species to decline, 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
- introduce disease that may cause the species to decline, 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 behaviour) of an ecologically significant proportion of the population of the species.

An area of important habitat is:

» 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

» habitat utilised by a migratory species which is at the limit of the species range, or

» 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.

The Commonwealth marine environment

An action will require approval from the Environment Minister if:

» the action is taken in a Commonwealth marine area and the action has, will have, or is likely to have a significant effect on the environment, or

» the action is taken outside a Commonwealth marine area and the action has, will have, or is likely to have a significant effect on the environment in a Commonwealth marine area.

An action has, will have or is likely to have a significant impact on the environment in a Commonwealth marine area if it does, will, or is likely to:

» result in a known or potential pest species becoming established in the Commonwealth marine area*, or

» modify, destroy, fragment, isolate or disturb an important or substantial area of habitat such that an adverse impact on marine ecosystem functioning or integrity in a Commonwealth marine area results, or

» have a substantial adverse effect on a population of a marine species or cetacean including its life cycle (eg breeding, feeding, migration behaviour, and life expectancy) and spatial distribution, or

» result in a substantial change in air quality** or water quality (including temperature) which may adversely impact on biodiversity, ecological integrity, social amenity or human health, or

» result in persistent organic chemicals, heavy metals, or other potentially harmful chemicals accumulating in the marine environment such that biodiversity, ecological integrity, social amenity or human health may be adversely affected.

Translocating or introducing a pest species may result in that species becoming established.

**The Commonwealth marine area includes any airspace over Commonwealth waters.*

(Department of Environment and Heritage, 2006)

Table 16 WAM/DEC *NatureMap* Records within 20 km of the Study Area

Family	*Species*	Common Name	*EPBC Act*	DEC
Mammals				
Burramyidae	*Cercartetus concinnus*	Western Pygmy-possum, Mundarda		
Canidae	*Canis lupus subsp. dingo*	Dingo		
Dasyuridae	*Ningaui yvonneae*	Southern Ningaui		
Dasyuridae	*Sminthopsis crassicaudata*	Fat-tailed Dunnart		
Dasyuridae	*Sminthopsis dolichura*	Little long-tailed Dunnart		
Dasyuridae	*Sminthopsis gilberti*	Gilbert's Dunnart		
Felidae	*Felis catus*	Cat		
Leporidae	*Oryctolagus cuniculus*	Rabbit		
Muridae	*Mus musculus*	House Mouse		
Muridae	*Pseudomys hermannsburgensis*	Sandy Inland Mouse		
Myrmecobiidae	*Myrmecobius fasciatus*	Numbat, Walpurti	Vulnerable	Schedule 1
Tachyglossidae	*Tachyglossus aculeatus*	Echidna		
Thylacomyidae	*Macrotis lagotis*	Bilby, Dalgyte	Vulnerable	Schedule 1
Vespertilionidae	*Chalinolobus morio*	Chocolate Wattled Bat		
Vespertilionidae	*Nyctophilus geoffroyi*	Lesser Long-eared Bat		
Vespertilionidae	*Vespadelus baverstocki*	Inland Forest Bat		
Vespertilionidae	*Vespadelus regulus*	Southern Forest Bat		
Birds				
Acanthizidae	*Acanthiza apicalis*	Broad-tailed Thornbill (Inland Thornbill)		
Acanthizidae	*Acanthiza chrysorrhoa*	Yellow-rumped Thornbill		
Acanthizidae	*Acanthiza uropygialis*	Chestnut-rumped Thornbill		
Acanthizidae	*Aphelocephala leucopsis subsp. castaneiventris*			
Acanthizidae	*Hylacola cauta subsp. whitlock*	Shy Heathwren (western ssp)		Priority 4
Accipitridae	*Elanus caeruleus*	Black-shouldered Kite	Migratory	

Family	*Species*	Common Name	*EPBC Act*	DEC
Accipitridae	*Elanus caeruleus subsp. axillaris*	Australian Black-shouldered Kite	Migratory	
Ardeidae	*Ixobrychus sinensis*	Yellow Bittern (Chinese Little Bittern)	Migratory, Marine	
Casuariidae	*Dromaius novaehollandiae*	Emu		
Cracticidae	*Cracticus tibicen*	Australian Magpie		
Cuculidae	*Chrysococcyx basalis*	Horsfield's Bronze Cuckoo	Marine	
Cuculidae	*Chrysococcyx osculans*	Black-eared Cuckoo	Marine	
Falconidae	*Falco berigora*	Brown Falcon	Migratory	
Megapodiidae	*Leipoa ocellata*	Malleefowl	Vunerable, Migratory	Schedule 1
Meliphagidae	*Epthianura albifrons*	White-fronted Chat		
Meliphagidae	*Epthianura tricolor*	Crimson Chat		
Meliphagidae	*Lichenostomus leucotis subsp. novaenorciae*			
Meliphagidae	*Lichenostomus ornatus*	Yellow-plumed Honeyeater		
Meliphagidae	*Lichenostomus plumulus*	Grey-fronted Honeyeater		
Meliphagidae	*Manorina flavigula*	Yellow-throated Miner		
Motacillidae	*Anthus australis subsp. australis*			
Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush		
Pachycephalidae	*Oreoica gutturalis*	Crested Bellbird		
Pachycephalidae	*Oreoica gutturalis subsp. gutturalis*	Crested Bellbird (southern)		Priority 4
Pardalotidae	*Pardalotus striatus subsp. westraliensis*			
Petroicidae	*Microeca fascinans subsp. assimilis*			
Petroicidae	*Petroica cucullata*	Hooded Robin		
Petroicidae	*Petroica goodenovii*	Red-capped Robin		
Pomatostomidae	*Pomatostomus superciliosus* (subsp. *ashbyi*) or subsp. *superciliosus*			(Priority 4)

Family	*Species*	Common Name	*EPBC Act*	DEC
Psittacidae	*Nymphicus hollandicus*	Cockatiel		
Psittacidae	*Platycercus varius*	Mulga Parrot		
Psittacidae	*Platycercus zonarius subsp. zonarius*			
Tytonidae	*Tyto alba subsp. delicatula*			
Reptiles				
Agamidae	*Ctenophorus cristatus*	Bicycle Dragon		
Agamidae	*Ctenophorus reticulatus*	Western Netted Dragon		
Agamidae	*Ctenophorus salinarum*	Clay Pan Dragon		
Agamidae	*Ctenophorus scutulatus*			
Agamidae	*Moloch horridus*	Thorny Devil		
Agamidae	*Pogona minor subsp. minor*			
Agamidae	*Tympanocryptis cephalus*	Pebble Dragon		
Agamidae				
Boidae	*Morelia spilota subsp. imbricata*	Carpet Python		Schedule 4, Priority 4
Carphodactylidae	*Nephrurus milii*	Barking Gecko		
Diplodactylidae	*Diplodactylus granariensis subsp. granariensis*			
Diplodactylidae	*Diplodactylus pulcher*			
Diplodactylidae	*Oedura reticulata*			
Diplodactylidae	*Strophurus assimilis*	Goldfields Spiny-tailed Gecko		
Elapidae	*Acanthophis pyrrhus*	Desert Death Adder		
Elapidae	*Brachyurophis fasciolata subsp. fasciolata*			
Elapidae	*Brachyurophis semifasciata*			
Elapidae	*Furina ornata*	Moon Snake		
Elapidae	*Neelaps bimaculatus*	Black-naped Snake		
Elapidae	*Parasuta gouldii*			

Family	*Species*	Common Name	*EPBC Act*	DEC
Elapidae	*Parasuta monachus*			
Elapidae	*Pseudechis australis*	Mulga Snake		
Elapidae	*Pseudonaja modesta*	Ringed Brown Snake		
Elapidae	*Pseudonaja mengdeni*	Gwardar		
Elapidae	*Simoselaps bertholdi*	Jan's Banded Snake		
Elapidae	*Suta fasciata*	Rosen's Snake		
Gekkonidae	*Gehyra variegata*			
Gekkonidae	*Hemidactylus frenatus*	Asian House Gecko		
Gekkonidae	*Heteronotia binoei*	Bynoe's Gecko		
Pygopodidae	*Delma australis*			
Pygopodidae	*Pygopus lepidopodus*	Common Scaly Foot		
Pygopodidae	*Pygopus nigriceps*			
Scincidae	*Cryptoblepharus buchananii*			
Scincidae	*Ctenotus atlas*			
Scincidae	*Ctenotus schomburgkii*			
Scincidae	*Egernia depressa*	Pygmy Spiny-tailed Skink		
Scincidae	*Eremiascincus richardsonii*	Broad-banded Sand Swimmer		
Scincidae	*Hemiergis initialis subsp. initialis*			
Scincidae	*Lerista picturata*			
Scincidae	*Menetia greyii*			
Scincidae	*Morethia adelaidensis*			
Scincidae	*Tiliqua occipitalis*	Western Bluetongue		
Scincidae	*Tiliqua rugosa subsp. rugosa*			
Typhlopidae	*Ramphotyphlops australis*			
Typhlopidae	*Ramphotyphlops bicolor*			
Typhlopidae	*Ramphotyphlops bituberculatus*			

Family	*Species*	Common Name	*EPBC Act*	DEC
Typhlopidae	*Ramphotyphlops hamatus*			
Typhlopidae	*Ramphotyphlops waitii*			
Varanidae	*Varanus caudolineatus*			
Varanidae	*Varanus gouldii*	Bungarra or Sand Monitor		
Varanidae	*Varanus tristis subsp. tristis*	Racehorse Monitor		
Amphibian				
Hylidae	*Litoria moorei*	Motorbike Frog		
Limnodynastidae	*Neobatrachus kunapalari*	Kunapalari Frog		
Limnodynastidae	*Neobatrachus sutor*	Shoemaker Frog		
Myobatrachidae	*Pseudophryne occidentalis*	Western Toadlet		

Table 17 Fauna Species Observed within the Study Area - January 2010

Family	Genus	Species	Common Name	Conservation listing	Introduced Fauna
Birds					
Acanthizinae	*Acanthiza*	*apicalis apicalis*	Inland Thornbill		
Acanthizinae	*Smicrornis*	*brevirostris occidentalis*	Weebill		
Corvidae	*Corvus*	*coronoides perplexus*	Australian Raven		
Cracticidae	*Cracticus*	*tibicen*	Australian Magpie		
Dricruridae	*Rhipidura*	*leucophrys*	Willie Wagtail		
Meliphagidae	*Acanthagenys*	*rufogularis*	Spiny-cheeked Honeyeater		
Meliphagidae	*Anthochaera*	*carunculata*	Red Wattlebird		
Meliphagidae	*Lichmera*	*indistincta*	Brown Honeyeater		
Meliphagidae	*Lichenostomus*	*leucotis*	White-eared Honeyeater		
Pomatostomidae	*Pomatostomus*	*Pomatostomus superciliosus (subsp. ashbyi) or subsp. superciliosus*	White-browed Babbler	(Priority 4)	
Psittacidae	*Platycercus*	*zonarius zonarius*	Australian Ringneck		
Reptiles					
Agamidae	*Ctenophorus*	*scutalatus*	Lozenge-marked Dragon		
Scincidae	*Ctenotus*	*uber uber*			
Mammals					
Macropodidae	*Macropus*	*fuliginosus*	Western Grey Kangaroo		

Appendix D

Site Photos

Plate 2 **Photo of Kundana Road/CEH intersection looking northwest along Kundana Road.** (Photo supplied by Main Roads.)

Plate 3 **Photo of the northern corner of the intersection (looking to the south east). Note the degraded margin and culvert passing under the GEH.**

Plate 4 **Parking bay/turnaround area immediately to the west of the intersection.**

Plate 5 **Vegetation within the road reserve directly to the south east of the intersection.**

Plate 6 **Photo of the proposed clearing area within the Kurrawang Nature Reserve, immediately to the west of Kundana Road**

Plate 7 **Lozenge-marked Dragon observed within the study area**

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