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LandCorp

Broome North: Southern Portion
(Area A)

Preliminary Environmental
Impact Assessment and
Biological Survey

September 2009



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Executive Summary

GHD Pty Ltd (GHD) was commissioned by LandCorp to complete a combined Preliminary Environmental Impact Assessment (PEIA) and Biological Survey for the proposed subdivision and development of a number of lots south of Fairway Drive (Area A) in the town of Broome.

The following is a summary of the findings of the PEIA and Biological Survey:

- » No vegetation types surveyed across the study area are considered to be under-represented;
- » Vegetation condition was considered range from *Very Good* to *Completely Degraded*;
- » The study area is described as having a moderate flora species diversity with 95 taxa from 33 families;
- » No Declared Rare or Priority Flora species were recorded from the survey area;
- » Fifteen weed species were recorded from the survey area. Weed species were most dominant along tracks and roads, within and adjacent to the light industrial area, and amongst rubbish dumped within the study area;
- » Two introduced species recorded within the study area, the Bellyache Bush and Rubber Tree, are listed as Declared Plants under the *Agriculture and Related Resources Protection Act 1976*. Occurrences of these plants should be controlled using the appropriate control methods as recommended by the Western Australian Department of Agriculture and Food;
- » The study area is located within the buffer zones of one 'Vulnerable' Threatened Ecological Community (TEC); 'vine thickets on the coastal sand dunes of Dampier Peninsula'. However, no TECs or PECs were identified as being present on the site during the field survey;
- » One fauna species of national environmental significance was recorded in the study area. The Rainbow Bee-eater (*Merops ornatus*) is a Migratory and Marine species listed under the EPBC Act. The Rainbow Bee-eater is a common and widespread species and is unlikely to be significantly impacted by the proposed project;
- » No wetlands or watercourses are located within the study area. Roebuck Bay, an internationally significant wetland (RAMSAR listed site) is located within 10 km of the study area. This RAMSAR listed site will not be impacted by the proposed project;
- » No Environmentally Sensitive Areas (ESA) are situated within the study area;
- » The study area is not located within a Public Drinking Water Source Area (PDWSA);
- » The study area intersects a number of Aboriginal Heritage sites which are protected under the *Aboriginal Heritage Act (1972)*. A detailed Aboriginal Heritage survey is recommended in order to determine the impact of the proposed project on Aboriginal Heritage Sites. Approval to disturb these sites will be required;



- » The clearing for the proposed project has been assessed to may be at variance to Clearing Principle (g), however with appropriate management plans the potential impacts can be managed;
- » A number of potential impacts have been identified as a result of the proposed project. Where possible these impacts should be avoided and minimised in the design stage but where potential impacts still occur management measures will be required to mitigate these issues;
- » Formal referral of this proposal to the Department of Environment, Water, Heritage and the Arts (DEWHA) under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) is not considered warranted;
- » It is considered unlikely that issues relating to this proposal will trigger a formal assessment by the EPA; and
- » Any clearing of native vegetation will require a permit from the Department of Environment and Conservation (DEC) under Part V of the EP Act, except where exemptions apply under Schedule 6 of the Act or are prescribed in the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*, and not in an Environmentally Sensitive Area (ESA).



1. Introduction

LandCorp has commissioned GHD Pty Ltd (GHD) to complete a combined Preliminary Environmental Impact Assessment (PEIA) and Biological Survey for the proposed subdivision and development of lots south of Fairway Drive (Area A) in the town of Broome. The study area is shown in **Figure 1, Appendix A**.

The purpose of the survey is to provide an appropriate examination and description of the receiving environment to ensure that all aspects of biological/ecological significance are identified and recorded.

This combined PEIA and Biological Survey seeks to determine and assess the potential environmental impacts of the proposed works within the project area. Recommendations to LandCorp on the actions and requirements necessary for completion of this project with legislative guidelines are also provided.

1.1 Background

LandCorp proposes to subdivide and develop two adjacent areas north of the Broome Town Site known as Area A (south of Fairway Drive) and Area B (north of Fairway Drive).

Area A and surrounding areas comprise of approximately 350 hectares. It is bound by Gubinge Road to the south and Broome Road to the east. The area lies adjacent to the 'Blue Haze Industrial Area' and is currently zoned residential. Area A is proposed to be developed for between 600 – 1000 residential dwellings, a primary school, local retail centre and expansion of the existing Blue Haze light industrial subdivision. Civil works will need to commence by the dry season (May) 2009. A town planning scheme amendment to rezone the land from tourism to development zone has been initiated.

Area B and surrounding areas comprises of approximately 365 hectares, and lies north of Area A. It is bound by Fairway Drive to the South and Buckleys Road to the east. This area is proposed to be developed for around 800 dwellings including a primary school and high school site and local retail centre. Area B is currently zoned general rural.

This report focuses on the environmental aspects of Area A. A separate report has been prepared for Area B.

1.2 Scope of the Report

The information in this report is based on existing database records, information provided by LandCorp and literature available in the public domain. This PEIA and Biological Survey have been prepared according to the scope of works requested by LandCorp and include:

- » Description of the environmental attributes of Area A identifying potential opportunities and constraints to development of the proposed site;



- » Potential environmental issues and assess the level of risk that may arise within the process of developing Area A;
- » Detailed Flora and Fauna Survey to provide information to determine opportunities and constraints of the proposed development for residential purposes;
- » Desktop and on-site assessment of the potential for the presence of significant fauna and flora;
- » Desktop and on-site assessment including description of soils, hydrology, hydrogeology, geology and geomorphology;
- » Historical use of the site and surrounding land use;
- » Presence of any applicable land use buffers;
- » Description and significance of any wetlands and watercourses;
- » Description of potential wetland buffers;
- » Department of indigenous affairs aboriginal heritage site register studies;
- » Descriptions and significance of the remnant vegetation and fauna (vegetation and fauna complexes and associations);
- » DEC, Western Australian Museum and Department of Environment, Water, Heritage and the Arts database searches for rare and endangered fauna;
- » Climate; and
- » Topography.



2. Desktop Investigation

2.1 Climate

The project area is located within the Kimberley region of Western Australia. This region has a tropical climate with hot and humid summers and warm winters. There are two distinct seasons: the 'wet' usually from December to March and the 'dry' for the remainder of the year (Bureau of Meteorology, 2008). Tropical cyclones can be experienced during the months from November to April, but are most common in January and February (Bureau of Meteorology, 2008).

The closest weather recording station to the project area is Broome Airport. Recorded historical climate data for the Broome Airport has been summarised below:

- » Mean Annual Maximum Temperature Range: 34.3° C (April) to 28.8° C (July)
- » Mean Annual Minimum Temperature Range: 13.6° C (July) to 26.4° C (December)
- » Mean Annual Rainfall: 602.4 mm
- » Mean Annual Rain days per year: 34.8 days

(Source: Bureau of Meteorology – Climate Averages for Australian Sites: Averages for Broome Airport, 2008)

2.2 Topography, Geology and Soils

The study area is situated on a flat to gently undulating plain on the Dampier Peninsula. The Dampier Peninsula is underlain by the ancient (Pre-Cambrian) rocks of the Canning Basin. The Geological Survey of Western Australia (1982) indicates that the geology of the study area comprises of "Red sand, fine to medium, minor silt: Aeolian".

The principle soil-type of the Dampier Peninsula is the pindan, which developed during the Quaternary period on desert dune sandstone. The soils of the area are red earthy sands, which are of wind-blown origin (Kenneally *et al.*, 1996).

The pindan soils form extensive undulating plains with little or no organised surface drainage; seasonal runoff forms sheets of water behind the coastal dune systems (Kenneally *et al.*, 1996). Within the Broome area the pindan is often overlain by a layer of more recent, coarser and unconsolidated sand, which assists in water penetration, plant establishment and growth (Kenneally *et al.*, 1996).

2.3 Hydrology and Hydrogeology

The study area is located in the Cape Leveque Coast drainage basin (Department of the Environment, Water, Heritage and the Arts, 2008a).

The study area is not located in a proclaimed Surface Water Management Area (Department of Water, 2008a).



The regional groundwater resources of the Broome area (1:250,000 map sheet SE51-6) comprise both confined and unconfined aquifers of significant extent. The hydrogeology of the Broome area is documented by Laws (1991). In Broome, there are three major and two minor aquifers where groundwater occurs (**Table 1**).

Table 1 Summary of the Stratigraphy in Broome (Based on Laws, 1991)

Age	Formation Unit	Estimated Thickness	Lithology	Groundwater Potential
Quaternary	Superficial Deposits	5-20	Sand, silt, clay; minor gravel, black organic clay	Minor perched Aquifer; fresh
	Bossut Formation	20	Sandstone, calcilutite	Minor
Tertiary to Quaternary	Superficial Deposits	2	Pisolitic and massive laterite	None
	Emeriau Sandstone	30	Sandstone; minor conglomerate	None
Early Cretaceous	Melligo Sandstone	30	Thin bedded to laminated sandstone	None
	Broome Sandstone	283	Fine – to coarse-grained sandstone; minor gravel, some mudstone and conglomerate	Major aquifer; fresh - saline
Late Jurassic	Jarlemai Siltstone	259	Siltstone, claystone; minor sandstone	Aquiclude, minor aquifers
	Alexander Formation	46	Fine – to coarse-grained sandstone; minor mudstone	Aquifer, artesian at Broome; brackish
Early to Late Jurassic	Wallal Sandstone	>360	Fine – to coarse-grained sandstone; minor siltstone, lignite	Major aquifer; fresh to saline artesian at Broome

The most utilised aquifer is the Broome Sandstone that comprises fine to coarse grained sandstone with minor beds of pebble conglomerate, grey siltstone and claystone. The Broome Sandstone is unconfined and is separated from the underlying (confined) aquifers, Alexander Formation and the Wallal Sandstone, by an aquiclude, the Jarlemai Siltstone.

The wellfield that supplies Broome (located approximately 12 km to the north east of the Broome town site) is screened in the Broome Sandstone aquifer. According to a report by the Water and Rivers Commission (WRC) (WRC, 2001) (now known as the



Department of Water (DoW)) the depth of the watertable near the wellfield is 25 m to 30 m (WRC, 2001) with the highest groundwater levels being to the north-east of the wellfield. Groundwater in the Broome area moves under the influence of gravity down the hydraulic gradient west toward the ocean and south toward Roebuck Bay (WRC, 2001).

Groundwater recharge to the Quaternary aeolian sands is direct from rainfall percolation and is estimated to be 6.5% of rainfall (Hingston and Gailitis, 1976). Recharge to the Broome Sandstone aquifer system is by direct percolation from rainfall and by leakage from the coastal dunes north of Broome. Recharge is estimated to be about 4 to 5 % of the average annual rainfall (Laws, 1987). Groundwater discharges over a saline interface (WRC, 2001). Groundwater salinity ranges from less than 100 to more than 30,000 mg/L TDS, the lower levels being in the inland areas increasing towards discharge areas along the coast and Roebuck Plains above the saltwater wedge (Laws, 1991). Within the study area, groundwater salinity ranges from 1000 – 3000 mg/L TDS in the west to greater than 14,000 mg/L TDS in the east of the study area.

2.4 Wetlands and Watercourses

There are no wetlands or watercourses located within the study area.

Department of the Environment, Water, Heritage and the Arts (2008b) identifies Roebuck Bay, an internationally significant wetland (RAMSAR listed site), within 10 km of the study area. This RAMSAR listed site will not be impacted by the proposed project.

2.5 Public Drinking Water Source Areas

Public Drinking Water Source Areas (PDWSAs) is a collective term used for the description of Water Reserves, Catchment Areas and Underground Pollution Control Areas declared (gazetted) under the provisions of the *Metropolitan Water Supply, Sewage and Drainage (MWSSD) Act 1909* or the *Country Area Water Supply (CAWS) Act 1947*.

The protection of PDWSAs relies on statutory measures available in water resource management and land use planning legislation. The DoW policy for the protection of PDWSAs includes three risk management based priority classification areas and two types of protection zones.

The DoW Geographic Data Atlas indicates that there are no Public Drinking Water Source Areas within the vicinity of the Project area. The nearest PDWSA is approximately 6 km to the north-east of the site.

2.6 Acid Sulphate Soils

Acid Sulphate Soils (ASS) are wetland soils and unconsolidated sediments that contain iron sulphides which, when exposed to atmospheric oxygen in the presence of water, form sulphuric acid. ASS forms in protected low energy environments such as barrier



estuaries, coastal lakes and coastal alluvial valleys, and commonly occurs in low-lying coastal lands such as Holocene marine muds and sands. When disturbed, these soils are prone to produce sulphuric acid and mobilise arsenic, iron, aluminium, manganese and other heavy metals. The release of these reaction products can be detrimental to biota, human health and built infrastructure.

The presence of ASS has been a recognised issue of concern in Western Australia since 2003. The DEC and the WAPC have released guidance notes on ASS covering the requirement for assessment and management of sites where ASS is identified.

Proponents of developments that involve the disturbance of soil or the change of groundwater levels in areas susceptible to ASS are required to conduct desktop and field based investigations. Adequate investigations are required prior to soil disturbance to determine the potential risks and to allow for the formulation of appropriate management strategies.

Mapping of ASS by the Western Australian Planning Commission in the Shire of Broome is very limited with no data available for the majority of the shire. No ASS data is available for the study area however it is located within approximately one kilometre of land designated as high to moderate risk of ASS occurring within 3m of natural soil surface (Western Australian Planning Commission, 2003). Preliminary ASS investigations should be conducted prior to works to determine the potential issues of ASS.

2.7 Land Use

The study area is covered predominantly by native vegetation. Historical land use of the study area is grazing and natural vegetation. Recent land uses include a water tank located in the north-west corner of the study area on a reserve vested to the Water Corporation for water supply purposes. There is also a small built-up area for the purpose of light industrial (Blue Haze Industrial Area) within the eastern boundary of the study area, off Tanami Drive and a poultry farm in the north east of the study area.

An examination of historical aerial photography was undertaken to identify changes in land use over time. **Table 2** provides a description of the land use changes as can be observed from aerial photography sourced from the Department of Land Administration (DOLA).

Table 2 Historical land use changes as observed from DOLA aerial photography

Year	Area A
1967	The eastern section of Area A has a small clearing directly off Broome Road, it is likely to be man made but photography is not clear enough to identify the land use. The remainder of Area A is remnant native vegetation with several roads dissecting the area.
1982	Directly off Broome Road there is a small area of cleared paddocks to the north of the clearing. The clearing contains sheds or market garden



Year	Area A
	facilities. On the western boundary there is a small square clearing that is likely to be connected with the residential area adjacent to Area A.
1989	The small clearing directly off Broome Road has been expanded and shows the initial construction of the Light Industrial Area. The north west corner has a reserve vested to the Water Corporation for water supply purposes and contains a clearly marked track showing the location of the ye to be constructed water tank. Directly south of the reserve is the small square clearing present in 1982, and this area has increased to a larger cleared rectangle area.
2000	The Light Industrial Area has been completed and the paddocks above the area no longer obvious appearing as naturally regenerated vegetation. The Water Corporation tank is now constructed and a poultry farm is present along the north east boundary. The cleared rectangle below the Water Corporation reserve appears largely revegetated but still contains a cleared section with some structures in it at the eastern end.
2007	The rectangular cleared section that was largely revegetated in 1989 still contains a cleared area at its eastern end and is now bordered by tracks and has a structure at its western end at the edge of the site.

Reference to the Broome Town Planning Scheme No. 4 indicates that the study area is zoned for a number of uses including tourism, light and service industry, environmental cultural corridor, a small area for rural and another for public purposes.

The study area is proposed to be developed for residential dwellings, primary school, local retail centre and expansion of the light industrial area. LandCorp have advised that a town planning scheme amendment to rezone the land from tourism to development zone has been initiated.

2.8 Contaminated Sites

A search of DEC's Contaminated Sites Database indicates no contaminated sites within or in close proximity to the Study area. This database only identifies known contaminated sites which are related to existing or historical land uses. Although no sites are listed in the database, there is still potential for contamination to occur, depending upon the previous land uses. Where past or present land use activities have involved the storage, handling or disposal of chemicals, there is an increased risk of contamination. Potential contaminating activities may include service stations, landfills, power stations, gasworks, and market gardens.

Based on previous and current land-uses in the Area A study area, the risk of contaminated sites is low.

2.9 Aboriginal Heritage

The Aboriginal Site Register is held under Section 38 of the State *Aboriginal Heritage Act 1972*. It protects places and objects customarily used by, or traditional to, the original inhabitants of Australia.



A search of the Department of Indigenous Affairs (DIA) database identified six Registered Aboriginal sites within the vicinity of the study area. The details of these sites are summarised in **Table 3**.

Table 3 Aboriginal heritage sites within the study area

Site ID	Site Name	Site Type	Additional Info
12839	Billingurru	Ceremonial, Mythological	Camp
12841	Marnalakun	Skeletal material/Burial	Camp
12886	Illangarami	Mythological	-
12917	Cable Beach 6	Midden/Scatter	Meeting Place, Camp, Water Source
13351	Ngilirirrbanjjin	Ceremonial	-
21408	Broome Crocodile Farm	Ceremonial, Mythological	Camp

Figure 1 (Appendix A) identifies the location of registered Aboriginal heritage sites within the vicinity of the study area.

A search of the DIA database does not comprise of a full assessment under the *Aboriginal Heritage Act (1972)*. This would require consultation with Aboriginal people with knowledge of the area, and an archaeological survey to ascertain whether any previously unrecorded archaeological sites are within the proposed works area.

Under the *Aboriginal Heritage Act (1972)*, it is an offence to disturb an Aboriginal heritage site whether it is registered or not. Where an activity disturbs an Aboriginal site or object an application for permission to disturb those sites will need to be submitted under Section 18 of the *Aboriginal Heritage Act 1972*. Where an area of previously unknown Aboriginal heritage is to be disturbed, it is advised that a detailed anthropological and archeological heritage survey is undertaken to find if there any sites or objects of significance in that area.

2.10 Environmentally Sensitive Areas

The DEC's online Native Vegetation Viewer was searched to determine the location of any Environmentally Sensitive Areas (ESAs) within the vicinity of the project area, as declared by a Notice under Section 51B of the *Environmental Protection Act 1986*.

The search confirmed that there are no ESAs situated within the Study area. There is one ESA situated east of the study area, east of Broome Road. This ESA is associated with Dampier Creek and will not be impacted as a result of the proposed project.



2.11 Reserves and Conservation Areas

The preliminary desktop investigation did not identify any reserves or conservation areas within or in close proximity to the study area.

2.12 Vegetation

2.12.1 Vegetation Description

The study area falls within the Dampier Botanical District, which is broadly characterised by Pindan formation on sandplains (Beard, 1979). Vegetation can be classified as Pindan or Pindan Woodland, with both vegetation types dominated by Acacia species. Pindan is a shrubland with areas of Acacia thickets; while Pindan woodland also has an emergent tree layer, specifically of Eucalyptus and Grevillea species, *Gyrocarpus americanus*, *Erythrophloeum chlorostachys*, *Bauhinia cunninghamii*, *Adansonia gregorii*, *Buchanania obovata* and *Terminalia canescens* (Wheeler et al., 1992). The Dampier District also has areas of Low Tree Savanna in which the grass layer is dominated by Chrysopogon species and the tree layer by *Adansonia gregorii*, *Bauhinia cunninghamii*, and species of Eucalyptus, Grevillea, Hakea and Acacia (Wheeler et al., 1992).

The majority of the Dampier Peninsula contains a relatively uniform environment of low relief undulating red sandplains with few creeks or hills. The vegetation is predominantly Pindan, a grassland wooded by scattered trees, particularly Eucalypts, with a middle layer of Acacias (Kenneally et al., 1996). Fire is the controlling agent of the Pindan with the variety in the vegetation, particularly the Acacias, relating directly to a fire regeneration cycle (Kenneally *et al.*, 1996).

2.12.2 Vegetation Extent and Status

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 (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;
- » 10% of the pre-European / pre-1750 extent for the vegetation type 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 (5) 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

Native vegetation types represented in the survey area; their regional extent and reservation status are drawn from Shepherd, *et al.* (2002), and Shepherd pers. comm. These are shown in **Table 4**.

Table 4 Vegetation extent and status in the Dampierland IBRA region

Vegetation Association Number	Association Description	Pre-European Extent (ha) in Dampierland IBRA region	Current Extent (ha) in Dampierland IBRA region	% Remaining	% Pre-European Extent in IUCN Class I-IV Reserves
750	Shrublands, pindan; Acacia tumida shrubland with grey box & cabbage gum medium woodland over ribbon grass & curly spinifex	1229175.94	1227005.04	99.8	2.3

The extent of the vegetation in the survey area is considered of *Least Concern*, i.e. intact, with nearly 100% of the pre-European extent remaining.

2.12.3 Threatened Ecological Communities

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

Some TECs are protected under the *Environment Protection and Biodiversity Conservation (EPBC) Act*. Although TECs are not formally protected under the *State Wildlife Conservation Act 1950*, the loss of, or disturbance to, some TECs triggers 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 Department of Environment and Conservation’s (DEC) 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.

A search of the DEC’s Threatened Ecological Communities (TEC) database was undertaken for known occurrences of TECs and/or PECs within the study area. No TECs or PECs were located within the boundaries of the Area A study area.



However, the site is located within the buffer zones of one vulnerable community:

- » 'Vulnerable' ecological community – 'Vulnerable vine thickets on the coastal sand dunes of Dampier Peninsula'.

The *EPBC Act* Protected Matters Search Tool (Department of the Environment, Water, Heritage and the Arts, 2008b) also does not identify any TEC's within the search area conducted for the Area A.

No TECs or PECs were identified as being present on the site during the field survey.

2.13 Flora

2.13.1 Significant Flora

Commonwealth

Species of significant flora are protected under both State and Commonwealth 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* can trigger referral to the Department of the Environment, Water, Heritage and the Arts (DEWHA) and/or the EPA.

A description of Conservation Categories delineated under the *EPBC Act* is detailed in **Table 8, Appendix B**. These are applicable to threatened flora and fauna species.

A search of the *EPBC Act* Protected Matters Search Tool did not identify any Commonwealth protected flora species within 10 km of the survey area.

State

In addition to the *EPBC Act*, significant flora in Western Australia is protected by the *Wildlife Conservation Act 1950*. 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 legislative protection. A description of the DEC's Conservation Codes that relate to flora species is provided in

Table 9, Appendix B.

A search of the DEC's Rare Flora Databases and the Western Australian Herbarium (WAHERB) records was undertaken. Records indicate that two DRF and seven PLF species are known to exist in the general Broome area (**Table 5**).

Table 5 Significant flora species known to occur in the vicinity of the study area (Source: DEC and WAHERB databases)

Family	Genus	Species	Conservation Code
Sterculiaceae	<i>Keraudrenia</i>	<i>exastia</i>	R
Pandanaceae	<i>Pandanus</i>	<i>spiralis</i> var. <i>flammeus</i>	R
Papilionaceae	<i>Aphyllodium</i>	<i>parvifolium</i>	P1
Papilionaceae	<i>Glycine</i>	<i>pindanica</i>	P1
Solanaceae	<i>Nicotiana</i>	<i>heterantha</i>	P1
Papilionaceae	<i>Tephrosia</i>	<i>andrewii</i>	P1
Asteraceae	<i>Pterocaulon</i>	sp. A Kimberley Flora (B.J. carter 599)	P2
Amaranthaceae	<i>Gomphrena</i>	<i>pusilla</i>	P2
Euphorbiaceae	<i>Phyllanthus</i>	<i>aridus</i>	P3
Sterculiaceae	<i>Keraudrenia</i>	<i>katatona</i>	P3
Pittosporaceae	<i>Pittosporum</i>	<i>moluccanum</i>	P4

There are no known records of DRF or PLF species within the study area. The nearest known record is the Priority 1 species, *Glycine pindanica*, located approximately 500 m north east of the study area.

2.14 Fauna

2.14.1 Significant Fauna Species

The conservation of fauna species and their significance status is currently assessed under both State and Commonwealth Acts. The acts include the *Western Australian Wildlife Conservation Act 1950*; *Wildlife Conservation (Specially Protected Fauna) Notice 2003*, and the *EPBC 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 detailed in **Table 8, Appendix B** and the circumstances under which a project will trigger referral to the DEWHA are described in **Appendix C**. The *WA Wildlife Conservation Act 1950* uses a set of Schedules but also classifies species using some of the IUCN categories. These Schedules are described in **Table 12, Appendix C**. 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); 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 Act also protects marine species on Commonwealth lands and waters.

In Western Australia, the DEC also produces a supplementary list of Priority Fauna, these being species that are not considered Threatened under the Western Australian *Wildlife Conservation Act 1950* 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 13, Appendix C**.

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), for the matters of significance that may occur in, or may relate to, the survey area.

A search of the DEC's Threatened Fauna database for any rare and priority species that may occur in the survey area was undertaken.

From the DEC and DEWHA databases and the records of the Western Australian Museum (WAM), a number of protected fauna species were identified as potentially occurring within the survey area (**Table 14, Appendix C**).

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 searches of threatened fauna 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.



3. Field Assessment

3.1 Field Survey Methodology

3.1.1 Vegetation and Flora

The flora assessment included desktop investigations and field surveys, conducted with regard to the EPA's Guidance Statement No. 51, where possible. GHD's qualified ecologists conducted the field flora survey from the 3rd to the 6th of June 2008.

The flora and vegetation survey was conducted by undertaking walking transects across the study area. The walking transects included recording of flora species and mapping of vegetation types and condition class (including weed status). The transects were up to 300 m long, covered an area 25 m wide, and were positioned at right angles to existing tracks within the study area (locations are mapped at **Figure 2, Appendix A**). Flora species recorded within the study area are presented in **Table 11, Appendix B**.

In addition to the walking transects a slow driving transect was undertaken along the entire perimeter of the study area as well as the existing tracks within the study area. This survey assisted in vegetation type and condition mapping.

A list of flora species collated from the walking transects was generated for the study area. Where identification of flora species was uncertain, confirmation was made at the Western Australian State Herbarium. The presence of DRF or Priority Flora was assessed. Vegetation was also assessed to determine the presence of TECs within the study area. Aerial photography was used to assist in the delineation of vegetation types present in the study area.

3.1.2 Fauna

GHD's qualified ecologists conducted the fauna investigation in conjunction with the flora investigation. The fauna survey included desktop investigations and field surveys, conducted with regard to the EPA's Guidance Statement No. 56, where possible.

The fauna survey was an opportunistic survey and did not involve any fauna trapping. The survey involved visual and aural surveys for any fauna species utilising the study area. The study area was also searched for any fauna signs, such as tracks, scats, bones, diggings and feeding signs.

Surveys also included systematic searching across all habitat types, which is an effective method of surveying for many reptile species. This involved searching through microhabitats where reptiles are known to frequent, including turning over logs or rocks, turning over leaf litter and examining hollow logs. Reptiles were also sighted as they basked during the day.

Species – specific search strategies were used to identify any protected species in the area or evidence that they utilise the study area.



3.1.3 Nomenclature

Nomenclature used in this report follows that used by the DEC's *FloraBase* program and Western Australian Museum *FaunaBase* program as they are deemed to contain the most up-to-date species information for Western Australia.

3.1.4 Limitations

Complete flora and fauna surveys can require multiple surveys, at different times of year, and over a period of a number of years, to enable observation of all species present.

Some flora species, such as annuals, are only available for collection at certain times of the year, and others are only identifiable at certain times (such as when they are flowering). Additionally, climatic and stochastic events (such as fire) may affect the presence of plant species. Species that have a very low abundance in the area are more difficult to locate, due to the above factors. Therefore, while this flora survey was relatively exhaustive, and was conducted at a time of year when the majority of the flora species would be able to be identified, there is the possibility that some species with low abundance in the area have been overlooked.

The flora surveys were also restricted to predominantly 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, diggings etc. 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 aimed at identifying the terrestrial vertebrate fauna of the study area; no sampling for invertebrates occurred. The information available on the identification, distribution and conservation status of invertebrates is generally less extensive than that of vertebrate species.

This survey was carried out during only one season, and in one year. Complete faunal surveys often require multiple surveys, at different times of year, and over a period of a number of years, to enable full survey of all species present.

3.2 Vegetation and Flora

3.2.1 Vegetation Description

The Area A survey area contained a very uniform vegetation type; Mixed Acacia low woodland.

In general the vegetation of the study area is dominated by the following species: *Acacia eriopoda*, *A. tumida*, *A. coleii* with scattered *Corymbia polycarpa*, *C. zygophylla*,



C. greeniana, *Bauhinia cunninghamii* over *Hakea arborescens*, *H. macrocarpa*, *Persoonia falcata*, over *Acacia adoxa*, *Distichostemon hispidulus*, *Gossypium australe*, **Sida acuta*, *Solanum cunninghamii*, **Calotropis procera*, *Waltheria indica* over herbs and grasses, including: *Trichodesma zeylanicum*, *Heliotropium tenuifolium*, *Ptilotus* sp., *Triodia* sp., **Cenchrus ciliaris*, **Aerva javanica*, *Cymbopogon ambiguus*, *Eragrostis eriopoda*, *Chrysopogon pallidus*, *Aristida holathera*.

The vegetation in disturbed areas, such as areas previously cleared, along tracks, rubbish dumping (household and garden waste), along powerlines and within the light industrial area, shows some variation, with a dominance of disturbance response species and increase in introduced species such as *Trichodesma zeylanicum*, **Aerva javanica*, **Citrullus lanatus*, **Hyptis suaveolens*, **Ocimum basilicum* and **Cenchrus ciliaris*.

Localised variation across the study area in terms of species and structural composition of the vegetation can largely be attributed to fire impacts on the vegetation.

The vegetation types, as classified in the field survey, have been mapped at **Figure 3, Appendix A**.

3.2.2 Vegetation Condition

Developed for Bush Forever, the vegetation Condition Rating is a scale that recognises the intactness of vegetation, which is defined by the following (Government of WA, 2000):

- » 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 therefore consists of six (6) rating levels from *Pristine* or nearly so to *Completely Degraded*. The Vegetation Condition Rating Scale is outlined in **Table 7, Appendix B**.

The vegetation condition of the study area was rated during the field survey using the Vegetation Condition Rating Scale.

The majority of the study area shows some evidence of disturbance however was generally in good condition and was rated Condition 3 - 4 (*Very Good – Good*). Areas of disturbance were most evident along roads and tracks, within and adjacent to the light industrial area, and other previous cleared areas. These areas were rated Condition 4 to 6 (*Good to Completely Degraded*). Small localised areas of disturbance occur in areas where cars, household and garden waste have been dumped.

The study area shows evidence of frequent use by local people for various purposes such as using the tracks as a short cut, recreation (four wheel driving and BMX), and illegal rubbish dumping, given its close proximity to the Broome town site and Cable Beach.



There has been a long history of fire in the Broome area as a result of wildfires and controlled fires. The variable appearance and density of the vegetation, in particular the Acacia's, relates directly to the history and intensity of fire and their re-generation cycles. There was little evidence of recent fires observed within the study area.

3.2.3 Threatened Ecological Communities

No TECs were recorded during the field survey.

No PECs were recorded during the field survey.

3.2.4 Flora Species

Vegetation within the survey areas is considered to be moderately diverse. A total of 95 taxa from 33 families were recorded from the survey area. Of these, 80 taxa were native plant species. Two collections could not be identified beyond genus level due to lack of flowering parts or fruiting bodies.

Dominant families recorded included:

» Poaceae (grasses)	13 taxa
» Malvaceae (mallows)	8 taxa
» Mimosaceae (wattles)	7 taxa
» Papilionaceae (peas)	7 taxa
» Amaranthaceae (mulla-mullas)	6 taxa
» Myrtaceae (myrtles)	6 taxa

Dominant genera recorded from the survey area included:

» <i>Acacia</i>	6 taxa
» <i>Senna</i>	4 taxa
» <i>Sida</i>	3 taxa
» <i>Corymbia</i>	3 taxa

A full list of flora species present in the survey area is provided in **Table 11, Appendix B**.

3.2.5 Significant Flora Species

No DRF or Priority Flora species were recorded from the Area A study area during this survey.

3.2.6 Introduced Species

Fifteen introduced species were recorded from the study area. Most of these species are weedy species that are naturalised and/or widespread throughout the Kimberley



region. Weeds found in the study area included Kapok (**Aerva javanica*), Buffel Grass (**Cenchrus ciliaris*), Rubber Tree/Calotropis (**Calotropis procera*), Noogoora Burr (*Xanthium strumarium*), Curry Bush (**Senna occidentalis*), Bellyache Bush (**Jatropha gossypifolia*), Rosella (**Hibiscus sabdariffa*), Verano Stylo (**Stylosanthes hamata*), Wild Passionfruit (**Passiflora foetida* var. *hispida*), Zornia (**Ziziphus mauritiana*), Pie Melon (**Citrullus lanatus*), Basil Bush (**Ocimum basilicum*), Mint Bush (**Hyptis suaveolens*) **Triumfetta petandra*, and **Sida acuta*.

The presence of a number of these weedy species reflects the extent of disturbances across the study area as a result of human activities such as clearing, rubbish dumping, roads and tracks, and infrastructure such as the light industrial area and water tank. Weed species were most dominant along the tracks and roads, within and adjacent to the light industrial area, and amongst rubbish dumped within the study area.

Declared Plants

Weeds that are, or may, become, a problem to agriculture or the environment can be formally classified as Declared Plants under the *Agriculture and Related Resources Protection Act, 1976*. The Department of Agriculture and Food Western Australia (DAFWA) and the Agriculture Protection Board maintains a list of Declared Plants for Western Australia. If a plant is declared for the whole of the State or for particular Local Government Areas, all landholders are obliged to control that plant on their properties. Declarations specify a category, or categories, for each plant according to the control strategies or objectives which the Agriculture Protection Board believes are appropriate in a particular place.

Among the factors considered in categorising declared plants are:

- » The impact of the plant on individuals, agricultural production and the
- » Community in general,
- » Whether it is already established in the area, and
- » The feasibility and cost of possible control measures.

These Declared Plants are divided into 5 classes, which are detailed in **Table 10, Appendix B**.

Three introduced species recorded within the study area are listed as Declared Plants; the Bellyache Bush, Rubber Tree/Calotropis and the Noogoora burr.

The Bellyache Bush is listed as P1 for the whole of the State and P4 for all the municipal districts in that portion of the State north of the 26th parallel.

The Rubber Tree/Calotropis is listed as P1 for all municipal districts in that portion of the State North of the 26th parallel of latitude, except the municipal districts of Ashburton, Broome, Halls Creek, Derby-West Kimberley and Wyndham-East Kimberley and as P2 for the municipal districts of Ashburton, East Pilbara, Port Hedland and Roebourne. Therefore, there is no control category assigned for the municipal district of Broome.



The Noogoora burr is listed as P1 for the whole of the State and P4 for the municipal districts of Broome.

Occurrences of Declared Plants should be controlled using recommended methods outlined by the Western Australian Department of Agriculture and Food (**Appendix D**).

3.2.7 Plant Pathogens

No known plant pathogens were observed in the survey area.

3.3 Fauna

3.3.1 Fauna Species

A total of nineteen bird species, two mammal species, and one reptile species were recorded during the reconnaissance survey within the Area A survey area (**Table 15, Appendix C**).

This survey only provides 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.

A number of small mammal diggings were located across the study area. A fauna-trapping program would be required to accurately identify these mammal species.

3.3.2 Significant Fauna Species

The desktop surveys indicated that a number of protected fauna may occur within the study area. The habitat requirements of these species and the likelihood of their occurrence in the site (with information from the field surveys) are considered below.

Princess Parrot (*Polytelis alexandrae*) Priority 4

The Princess Parrot occurs in the arid regions of Western Australia, Northern Territory and South Australia. This species has been recorded in low densities in the Great Sandy, Gibson, Tanami and Great Victoria Deserts. The Princess Parrot is typically found in shrublands and savannah woodlands amongst sand dunes, with occupied sites typically consisting of spinifex and shrubs. It also occurs and breeds in vegetation riverine and littoral areas. Princess Parrots mainly feeds on the ground on seeds of spinifex and native grasses and also in flowering shrubs and trees.

Assessment: The study area is outside the current known range of the Princess Parrot. This species would be highly unlikely to occur in the study area.

Eastern Curlew (*Numenius madagascariensis*) Priority 4

The Eastern Curlew is a migratory species and is the largest wader that visits Australia. It is widespread in coastal regions in the north-east and south of Australia, including Tasmania, and scattered in other coastal areas and is rarely seen inland. The Eastern Curlew is found on intertidal mudflats and sandflats, often with beds of



seagrass, on sheltered coasts, especially estuaries, mangrove swamps, bays, harbours and lagoons. It feeds mainly on small crabs and molluscs.

Assessment: The Eastern Curlew is a widespread species that has the potential to occur in the general vicinity of the study area. However, the site does not contain suitable habitat for this species and is unlikely to occur in the study area.

Bush Stone-curlew (*Burhinus grallarius*) Priority 4

The Bush Stone-curlew occurs in any habitat with ground litter from rainforest to open woodland and paddocks. This species occurs across much of Australia and occurs in higher numbers in the northern areas.

Assessment: This species occurs within the general region and there is the potential of it to occur within the study area. This species is widespread and the site is not considered to contain significant habitat for this species.

Grey Falcon (*Falco hypoleucos*) Priority 4

The Grey Falcon occurs over much of arid and semi-arid Australia, particularly on lightly wooded plains, acacia shrublands and grassland. It often occurs on inland drainage systems.

Assessment: The Grey Falcon is a widespread species that has the potential to occur in the study area; however, the site does not contain significant habitat for this species.

Gouldian Finch (*Erythrura gouldiae*) Schedule 1, Endangered

The Gouldian Finch is a small granivorous bird endemic to the savanna woodlands of northern Australia (NTG, 2006a). During the dry season, Gouldian Finches inhabit wooded hills where they can breed in tree hollows of smooth barked eucalypts, eating native seeds that have fallen on the ground. At the end of the dry season they fly to lowland drainage areas where they can feed on native grasses such as Sorghum. They collect seeds by climbing between the vertical grasses (Australian Museum, 2003).

The Gouldian Finch was once amongst the most common finches of the northern savannas, but has declined throughout this century. Its distribution is now patchy through tropical northern subcoastal areas from Derby, WA, to the Gulf of Carpentaria and thinly to central Cape York Peninsula. In the north and northwestern parts of its range, birds are locally common (Australian Museum, 2003).

Assessment: The study area is outside the current known range of the Gouldian Finch, which generally occurs east of Derby. This species would be highly unlikely to occur in the study area.

Australian Painted Snipe (*Rostratula australis*) Schedule 1, Vulnerable

The Australian Painted Snipe is a migratory wetland bird that utilises the temporary or infrequently filled freshwater wetlands of the northwest. The Australian Painted Snipe nests on the ground amongst tall reed-like vegetation near water, and feeds near the



water's edge and on mudflats, taking invertebrates, such as insects and worms, and seeds. Decline in species numbers has been attributed to wetland alteration and loss.

Assessment: There are no wetlands within the study area and the Snipe would be highly unlikely to occur in the study area.

Masked Owl (Northern) (*Tyto novaehollandiae*) Priority 1, Vulnerable

The known range of the Masked Owl is the wet tropics of Australia, and it is found from the Kimberley Region of Western Australia to northeast Queensland, including the Cape York Peninsula. All records of the species are within 300 km of the coast (Garnett & Crowley, 2000).

The masked owl occurs mainly in eucalypt tall open forests (especially those dominated by Darwin woollybutt (*Eucalyptus miniata*) and Darwin stringybark (*E. tetradonta*), but also roosts in monsoon rainforests, and forages in more open vegetation types, including grasslands. Although it may roost in dense foliage, it more typically roosts, and nests, in tree hollows (NTG, 2006b).

There are only very few, and widely separated records of the owl within the tropics of Australia.

Assessment: This species may occur in the general vicinity of the study area but is expected to be uncommon in this area.

Mulgara (*Dasyercus cristicauda*) Schedule 1, Vulnerable

The Mulgara was formally a widespread species in sandy desert areas, but is now rare and patchily distributed in Western Australia in the Pilbara, Gascoyne, Murchison, the north eastern Goldfields, the Central Ranges and the Carnarvon Basin. The Mulgara is found principally within mature hummock grasslands (spinifex) (Burbidge, 2004; Wildlife Australia, 1996).

The cause for decline in Mulgara populations is unknown, but it is likely that decline is related to the process of environmental degradation and habitat homogenization that has occurred throughout arid Australia following European settlement (NTG, 2006c; Wildlife Australia, 1996).

Assessment: The study area is outside the current range of this species and it would be highly unlikely to be found within the study area.

Scaly-tailed Possum (*Wyulda squamicaudata*) Priority 3

The Scaly-tailed Possum is endemic to the Kimberley region of Western Australia where it inhabits very rugged, rocky country. The habitat of the Scaly-tailed Possum includes open woodland and closed forest, sometimes with rainforest vegetation elements. The Scaly-tailed Possum is nocturnal and rests in rock piles, under rock slabs and in underground crevices during the day. It forages mainly in trees but sometimes ventures into open areas to feed on the flowers, seeds and other parts of plants.



Assessment: The study area is outside the current range of this species, which generally occurs further north of Broome. In addition, the site does not contain suitable habitat for this species and is therefore unlikely to occur in the study area.

Greater Bilby (*Macrotis lagotis*) Schedule 1, Vulnerable

The Bilby distribution in Western Australia is restricted to the northern parts of Western Australia. They are found within the Gibson and Great Sandy deserts, eastern Pilbara and the southern edge of the Kimberley. The Bilby usually spend the daytime in burrows, often built against termite mounds spinifex hummock or shrub. 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.

Assessment: Bilbies are known to occur in the general area around Broome and the study area contains suitable habitat for this species. A number of mammal diggings and tracks were observed within the study area during the survey. However no burrows were observed within the study area. Bilbies may occur within the study area but this cannot be determined without further detailed surveys.

Migratory Species

A number of the species included in the list of significant fauna species that could potentially occur in the project area were migratory terrestrial, marine and wetland species. It is possible that terrestrial migratory bird species may occur occasionally within the study area. However, the study area cannot be considered as significant habitat for migratory species.

One species listed as a Migratory species and a Marine species under the *EPBC Act* was recorded in the survey area, the Rainbow Bee-eater (*Merops ornatus*). The Rainbow Bee-eater migrates to south-western Australia to breed during spring and summer. However they are generally resident in northern Australia, where they remain to breed. The Rainbow Bee-eater nests in burrows excavated in sandy ground or banks. This species is likely to nest within the study area if suitable nesting sites are present. They often take advantage of windrows of soil pushed up by graders and earth moving equipment along tracks.

The Rainbow Bee-eater is a common and widespread species therefore impact to this bird from proposed operations is likely to be low.

3.3.3 Introduced Species

One introduced species; Domestic Dog (*Canus lupis familiaris*) was recorded from the survey area.

3.3.4 Fauna Habitat

Habitat Types

There is only one main habitat type considered to occur within the survey area: pindan shrubland with scattered emergent tree species.



No habitats were recorded that are considered to be specific to the survey area.

No permanent or semi-permanent water points were located within the survey area.

Habitat Value

Disturbances due to human activities that have occurred in the area have reduced the habitat value within some sections of the study area. However, the majority of the study area contains vegetation in good condition which offers excellent habitat for native fauna. The vegetation types present at the site are the dominant vegetation type within the surrounding area, and the surrounding area is generally similar or better condition than within the study area. No habitats were recorded that are considered to be specific to the study area or a significant habitat type.

Habitat Linkages

Fauna corridors and habitat linkage are important to allow animals to move between areas of resource availability. Such corridors are important for ground and aerial fauna, providing cover, resources, and linking areas suitable for rest and reproduction. Habitat corridors assist in maintaining genetic diversity through connection of gene pools, enabling recolonisation of disturbed areas and the provision of habitat. Habitat corridors are important in areas where extensive clearing has occurred to help overcome the effects of habitat fragmentation.

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

The Area A study area is located adjacent to and nearby other areas of fully vegetated remnants. It is considered that the proposed project is not likely to significantly alter or fragment habitat within the Broome area. However with the increase in future developments in the area habitat fragmentation may become an issue. Landcorp should consider the retention of a habitat corridor.



4. Clearing of Native Vegetation

Any clearing of native vegetation will require a permit under Part V Division 2 of the *Environmental Protection Act 1986* (EP Act), except where an exemption applies under Schedule 6 of the Act or is prescribed by regulation in the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*, and it is not in an Environmentally Sensitive Area (ESA).

Table 6 provides an assessment of the proposed project against the “10 Clearing Principles” as outlined in Schedule 5 of the *Environmental Protection Amendment Act 2003* to determine whether it is at variance to the Principles. These Principles aim to ensure that all potential impacts resulting from removal of native vegetation can be assessed in an integrated way.

The project was assessed to be potentially at variance to principle (g), however with appropriate management plans the potential impacts can be managed.



Table 6 Assessment against the Ten Clearing Principles.

Principle Number	Principle	Assessment	Outcome
(a)	Native vegetation should not be cleared if it comprises a high level of biological diversity.	<p>The study area has a moderate level of biological diversity.</p> <p>The field survey data indicated a uniformity of vegetation type across the study area, with little variation in species.</p> <p>There are areas of native vegetation in the general region of the study area that have similar and higher levels of biological diversity to that within the study area.</p>	The proposal is unlikely to be at variance with the Principle.
(b)	Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous Western Australia.	<p>The study area supports a number of native fauna species. One species of conservation national environmental significance was recorded during the survey, the Rainbow Bee-eater. The Rainbow Bee-eater is a common and widespread species and is unlikely to be significantly impacted by the proposed project.</p> <p>Bilbies are known to occur in the general area around Broome and the study area contains suitable habitat for this species. A number of mammal diggings and tracks were observed within the study area during the survey. However no burrows were recorded. Bilbies may occur within the study area but this cannot be determined without further detailed surveys.</p> <p>Given that the vegetation within the study area has been degraded and there is vegetation in similar and better condition available in the surrounding area, the vegetation in the study area is considered unlikely to comprise habitat necessary for the maintenance of significant fauna.</p>	The proposal is unlikely to be at variance with the Principle.



Principle Number	Principle	Assessment	Outcome
(c)	Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.	<p>A search of the DEC and WA Herbarium database indicated that that two DRF and seven PLF species are known to exist in the general Broome area. However, there are no known records of DRF or PLF species within the study area.</p> <p>No DRF or Priority Flora species were recorded from the Area A study area during the flora survey conducted in June 2008.</p>	The proposal is unlikely to be at variance with the Principle.
(d)	Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.	<p>No TECs are known to occur within the study area.</p> <p>The study area is within the buffer zones of one vulnerable community.</p> <p>The flora survey conducted in June 2008 confirmed the vegetation within the study area is not associated with this TEC.</p>	The proposal is unlikely 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.	<p>The extent and status of vegetation identified for the study area (Beard, 1973; Shepherd pers. comm., 2005) has indicated that the vegetation association: Shrublands, pindan; <i>Acacia tumida</i> shrubland with grey box & cabbage gum medium woodland over ribbon grass & curly Spinifex, has 99.8% remaining and is classed <i>Least Concern</i>.</p> <p>Large areas of native vegetation remain within the Broome area and cannot be considered extensively cleared.</p>	The proposal is not at variance with the Principle.
(f)	Native vegetation should not be cleared if it is growing in or in association with a watercourse or wetland.	There are no wetlands or watercourses within the study area.	The proposal is unlikely to be at variance with the Principle.



Principle Number	Principle	Assessment	Outcome
(g)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	<p>The clearing of native vegetation may cause some alterations to the health of adjacent lands.</p> <p>Runoff, sedimentation, and weed dispersal (particularly Declared Plants) are likely to increase.</p> <p>Appropriate management plans will be required to address these potential impacts.</p> <p>A preliminary Acid Sulphate Soils (ASS) assessment is proposed. ASS, if present, will be managed appropriately.</p>	<p>The proposal may be at variance with the Principle.</p> <p>These impacts should be addressed in appropriate management plans.</p>
(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.	There are no conservation areas within or in close proximity to the study area.	The proposal is not at variance with the 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.	<p>The clearing of native vegetation has a potential to cause deterioration in the quality of surface and underground waters.</p> <p>Appropriate drainage design and management plans will mitigate any potential impacts.</p>	The proposal is unlikely to be at variance with the Principle



Principle Number	Principle	Assessment	Outcome
(j)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the intensity of flooding.	The clearing of native vegetation may cause, or exacerbate the incidence or intensity of flooding due to increased runoff in localised areas. High intensity rainfall events during the wet season can lead to flooding events in cleared areas. Appropriate management measures will be required to mitigate potential flooding within cleared areas of the study area.	The proposal is unlikely to be at variance with the Principle.



5. Impacts and Management

A range of environmental impacts are possible during the clearing and construction works at the Area A study area. The potential impacts and their management requirements are detailed below.

5.1 Actual and Potential Environmental Impacts

Flora and Vegetation

The main potential impacts on flora and vegetation are:

- » Vegetation clearing. The design of the study area has not yet been finalised; however the survey area occupies approximately 350 ha. This would be the upper limit of vegetation clearing in the unlikely event the whole survey area was cleared;
- » Potential increase and/or spread of invasive and declared weed species; and
- » Potential impacts on the vegetation adjacent to the disturbance, due to edge effects and potential fragmentation of the remaining vegetation.

Fauna

The main faunal impacts of the proposed industrial area are:

- » Clearing of vegetation which is used by fauna species for shelter and linkages between areas of habitat. Removal of vegetation may improve their susceptibility to predation;
- » Habitat fragmentation due to vegetation clearing;
- » Clearing of native vegetation, which may be used by fauna of conservation significance such as the Rainbow Bee-eater and Greater Bilby, for habitat/shelter and/or food sources;
- » Soil disturbance – and potential refuge destruction for ground dwelling, or cryptic fauna species;
- » Death or restriction of movement of wildlife within the area could be caused during vegetation clearing and as a result of development and increased traffic;
- » Changes to understorey and floristics will alter the habitat used by particular fauna species. For example, weed introduction/establishment is likely to occur in bushland adjacent to the study area, even with weed management measures in place. Weed species may provide a resource to fauna species not previously occurring within the area;
- » A potential increase in weedy species within the adjacent bushland, which could lead to a change in fire regime, may occur, potentially impacting on resident terrestrial fauna species and habitat;
- » A potential increase in introduced species such as cats and dogs; and



- » During and after construction, waste, including food scraps, may assist undesirable fauna species increase by providing a resource.

Physical and Social Impacts

- » Alteration to surface drainage and stormwater runoff. As a result of vegetation clearing and the development of building and hard stands, there will be a reduction in infiltration to the ground and an increase in runoff from the site;
- » Nuisance impacts such as dust or pollutant production and noise and vibration will occur during the clearing, construction and development phases of the project; and
- » Additional traffic will be generated as a result of additional residential dwellings, a new primary school, and new businesses. This will create impacts of noise and safety.

5.2 Management of Potential Impacts

Some of the actual and potential impacts of the development of Area A study area will be manageable through design, construction controls and by-laws. Other impacts cannot be easily mitigated.

Biological Impact Management

Clearing of native vegetation cannot be mitigated in the immediate area. The loss of vegetation is not considered significant regionally, but will have an impact visually and on native fauna.

Suggested management actions are as follows:

- » Clearing should be kept to the minimum necessary for proposed development;
- » Minimise clearing adjacent to the development during construction phases;
- » Ensure cleared bushland and topsoil is removed from site or used in rehabilitation of any adjacent disturbed areas;
- » During major clearing, allow any existing fauna to move off-site, if possible, and discourage or prohibit the presence of dogs;
- » A weed management plan should be produced prior to construction; this should contain management measures to reduce the risk of spreading weed species or introducing new species. Management measures should include:
 - During proposed works all vehicles and machinery should be cleaned of plant material and soil before and after entering the site;
 - If imported soils and materials are to be used, they will be certified weed free;
- » Minimise or restrict movement and use of plant and vehicles at dusk and dawn and during night-time hours to reduce impacts to native fauna; and
- » All litter and waste materials should be contained and removed off-site regularly.

Physical and Social Impact Management

- » Ensure drainage design reduces the risk of erosion and flooding;



- » Development of an appropriate stormwater management system;
- » ASS should be further investigated, if present a management plan will be required;
- » Follow Council by-laws with regard to construction noise and dust, and DEC Guidelines where appropriate; and
- » Consider traffic flows during design and develop a traffic management plan for the initial construction phase.



6. Environmental Approvals

6.1 Commonwealth Legislation

A review of the DEWR online database was conducted as part of preparing the PEIA. There are no environmental impacts or issues from this project that would be considered as having a significant impact on matters of national environmental significance, which would render the project a “Controlled Action” or invoke the Commonwealth *EPBC Act 1999*.

Formal referral of this project to the Commonwealth Minister for the Environment is not considered warranted.

6.2 Western Australian Legislation

6.2.1 Environmental Protection Authority

Under the *Environmental Protection Act 1986* (EP Act), proposals which could cause environmental harm can be formally assessed by the Environmental Protection Authority (EPA). The proposed scheme amendment was referred by LandCorp to the EPA as part of the rezoning assessment. The EPA considered that the proposed scheme amendment should not be assessed under Part IV Division 3 of the EP Act. The EPA provided the following advice and recommendations on the following issues:

- » Remnant vegetation;
- » Declared Rare Flora; and
- » Waterlogging and Drainage.

The EPA advises that the environmental issues identified are not assessed and recommends further consideration of the need to assess proposals arising from the scheme amendment when more information is available.

It is unlikely that issues relating to this proposal will trigger a formal assessment by the EPA. The relevant aspects of the proposal are as follows:

- » No Declared Rare plants on the sites;
- » No specially protected animals known to be present;
- » No major hydrological changes or pollution event risks;
- » No major social impacts or risks.

6.2.2 Department of Environment and Conservation

Any clearing of native vegetation will require a permit from the Department of Environment and Conservation (DEC) under Part V of the EP Act, except where exemptions apply under Schedule 6 of the Act or are prescribed in the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*, and not in an Environmentally Sensitive Area (ESA).



6.3 Offsets

Environmental offsets are positive measures that can be taken to counterbalance certain unavoidable negative environmental impacts of development. Offsets can be applied to greenhouse gas emissions, waste management, emissions to water and air, vegetation management, and other environmental management issues such as loss of habitat and biodiversity. For example, the clearing of vegetation for a development may be offset by the management and protection of another area of ecologically equivalent vegetation.

An environmental offset package may be considered where adverse residual environmental impacts are significant enough to make the project unacceptable (EPA, 2006).

Although environmental impacts are not considered to be significant for this project, it is recommended that LandCorp consider offsets for loss of vegetation and fauna habitat, by such options as:

- » Avoidance of unnecessary clearing;
- » Retention of vegetation as part of Public Open Space;
- » Rehabilitation and replanting of local native vegetation in cleared/disturbed areas that are not required for the project; and
- » Purchase of like-for-like (or better) vegetation for conservation protection.

These options, where appropriate, should be applied within areas of similar vegetation types as the survey area as part of best practice environmental management actions.



7. Conclusions and Recommendations

A Preliminary Environmental Impact Assessment and Biological Survey was undertaken for the proposed subdivision and development of Area A in the town of Broome. The results of this assessment are summarised below:

- » No vegetation types surveyed across the study area are considered to be under-represented;
- » Vegetation condition was considered range from *Very Good* to *Completely Degraded*;
- » The study area is described as having a moderate flora species diversity with 95 taxa from 33 families;
- » No Declared Rare or Priority flora species were recorded from the survey area;
- » Fifteen weed species were recorded from the survey area. Weed species were most dominant along tracks and roads, within and adjacent to the light industrial area, and amongst rubbish dumped within the study area;
- » Two introduced species recorded within the study area, the Bellyache Bush and Rubber Tree, are listed as Declared Plants under the *Agriculture and Related Resources Protection Act 1976*. Occurrences of these plants should be controlled using the appropriate control methods as recommended by the Western Australian Department of Agriculture and Food;
- » The study area is located within the buffer zones of one 'Vulnerable' Threatened Ecological Community (TEC); 'vine thickets on the coastal sand dunes of Dampier Peninsula'. However, no TECs or PECs were identified as being present on the site during the field survey;
- » One fauna species of national environmental significance was recorded in the study area. The Rainbow Bee-eater (*Merops ornatus*) is a Migratory and Marine species listed under the EPBC Act. The Rainbow Bee-eater is a common and widespread species and is unlikely to be significantly impacted by the proposed project;
- » No wetlands or watercourses are located within the study area. Roebuck Bay, an internationally significant wetland (RAMSAR listed site) is located within 10 km of the study area. This RAMSAR listed site will not be impacted by the proposed project;
- » No Environmentally Sensitive Areas (ESA) are situated within the study area;
- » The study area is not located within a Public Drinking Water Source Area (PDWSA);
- » The study area intersects a number of Aboriginal Heritage sites which are protected under the *Aboriginal Heritage Act (1972)*. A detailed Aboriginal Heritage survey is recommended in order to determine the impact of the proposed project on Aboriginal Heritage Sites. Approval to disturb these sites will be required;



- » The clearing for the proposed project has been assessed to may be at variance to principle (g), however with appropriate management plans the potential impacts can be managed;
- » A number of potential impacts have been identified as a result of the proposed project. Where possible these impacts should be avoided and minimised in the design stage but where potential impacts still occur management measures will be required to mitigate these issues;
- » Formal referral of this proposal to the Department of Environment, Water, Heritage and the Arts (DEWHA) under the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) is not considered warranted;
- » It is considered unlikely that issues relating to this proposal will trigger a formal assessment by the EPA; and
- » Any clearing of native vegetation will require a permit from the Department of Environment and Conservation (DEC) under Part V of the EP Act, except where exemptions apply under Schedule 6 of the Act or are prescribed in the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*, and not in an Environmentally Sensitive Area (ESA).



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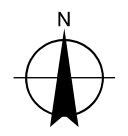
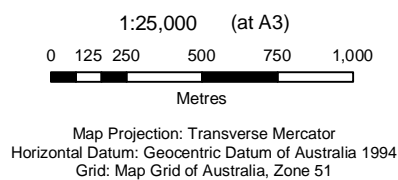
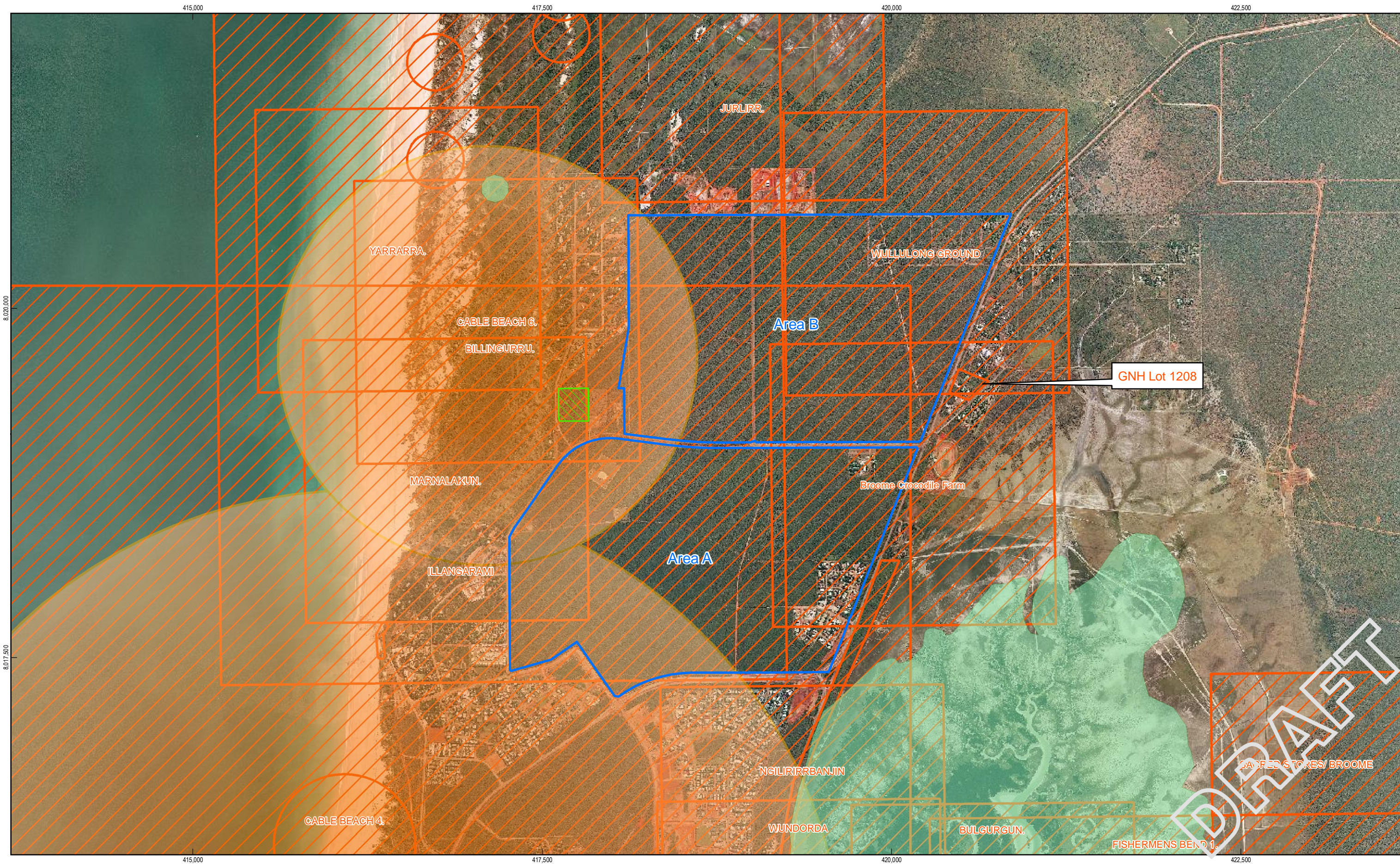
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Appendix A

Figures

- Figure 1** **Location Map and Environmental Constraints**
- Figure 2** **Transect Locations**
- Figure 3** **Vegetation Type**
- Figure 4** **Vegetation Condition**



- LEGEND**
- Study Area Boundary - GHD - 20080530
 - TEC / PEC site buffers - DEC - 20080606
 - Aboriginal Heritage Sites - DIA - 200802
 - Environmentally Sensitive Areas - DEC - 200804
 - DEC Estate - DEC - 20080605



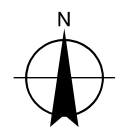
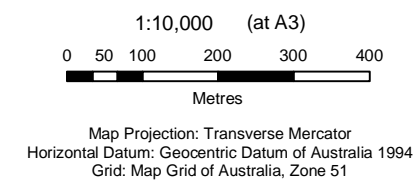
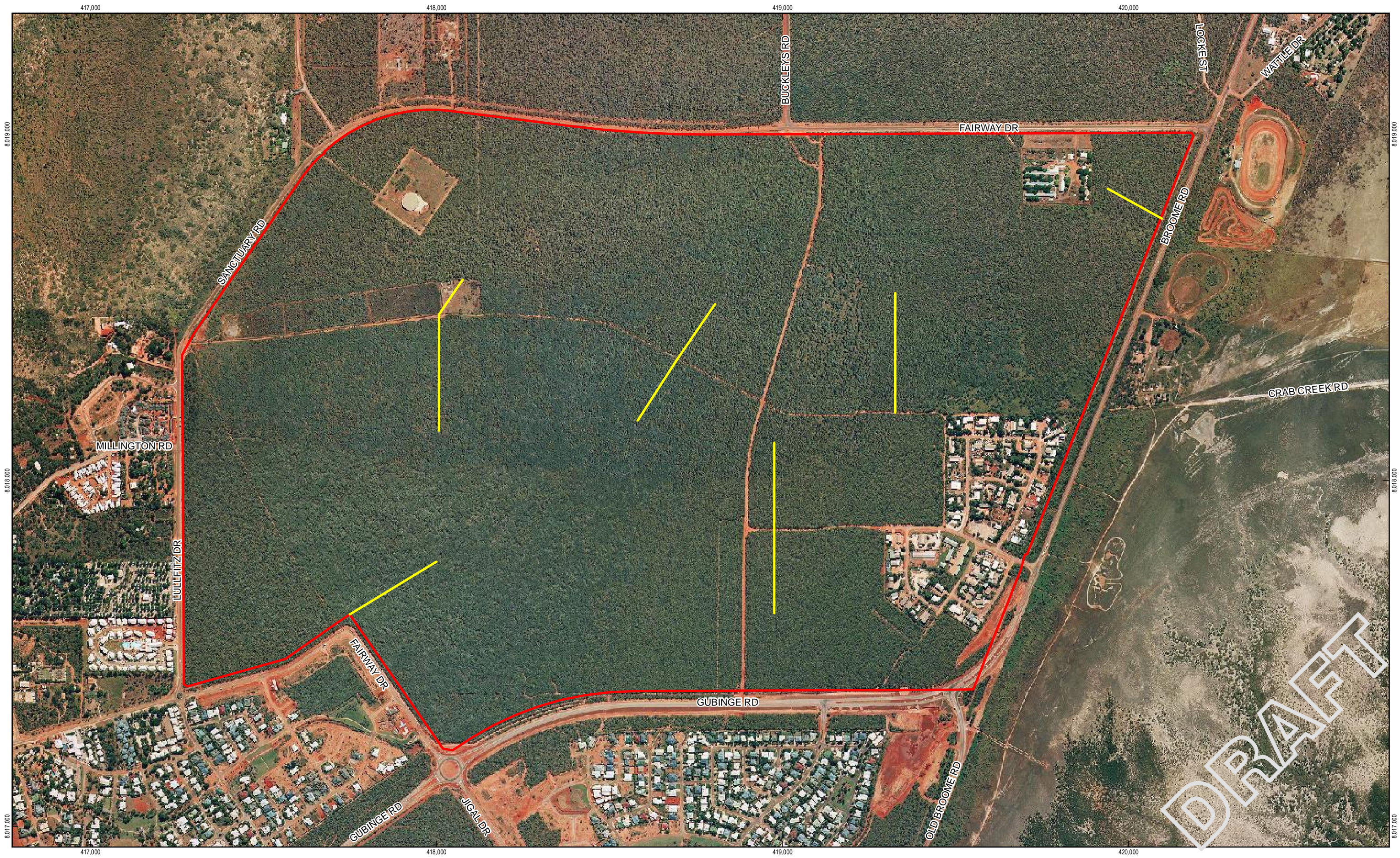
Landcorp
Broome Industrial

**Environmental Constraints
Site Overview**

Job Number	6122611
Revision	A
Date	30 October 2008

Figure 1

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LEGEND

- Transects - GHD - 20081031
- Study Area Boundary - GHD - 20080530



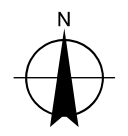
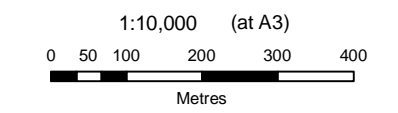
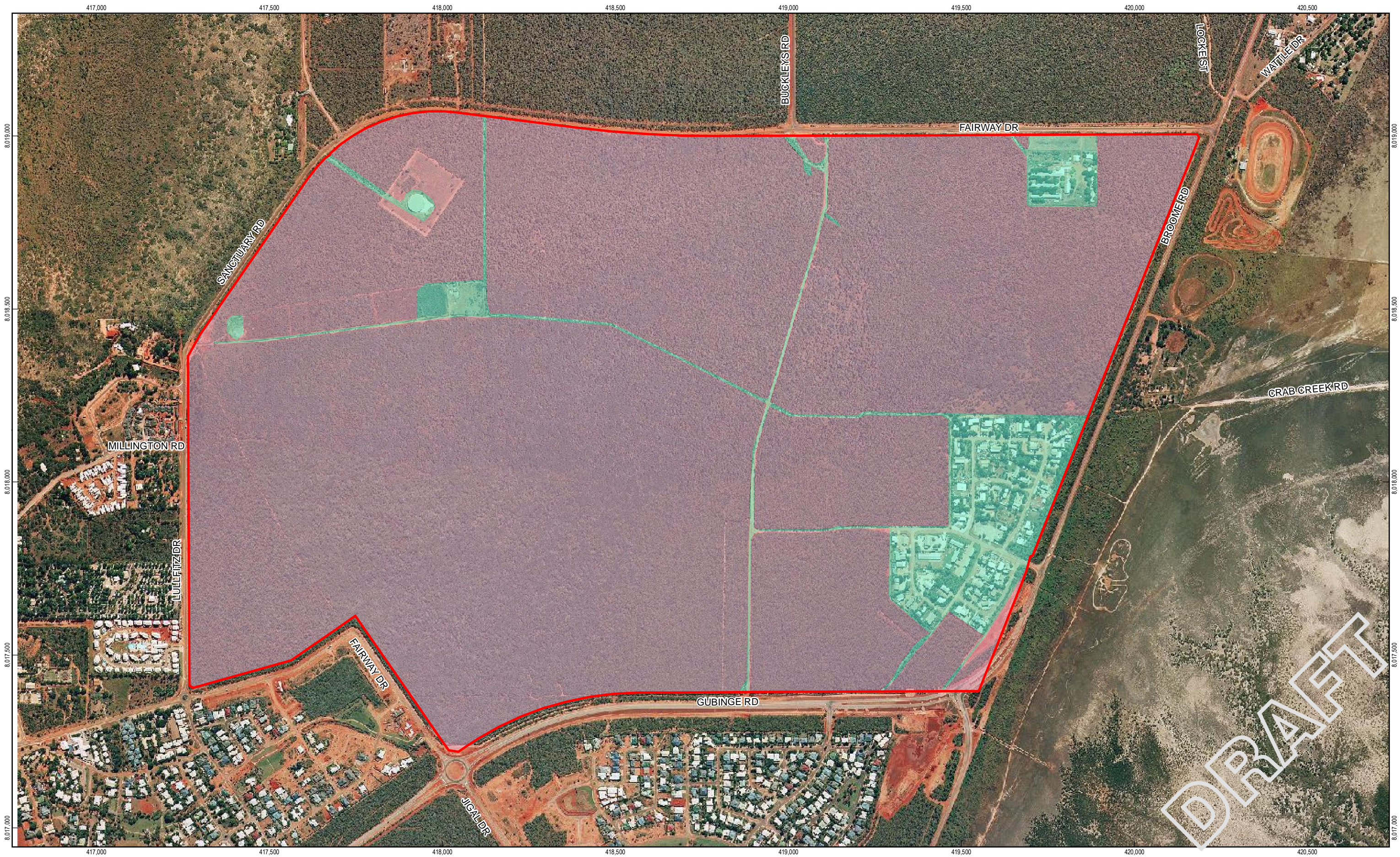
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**Site A
Transects**

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Revision	A
Date	30 October 2008

Figure 2

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LEGEND

Vegetation Types - GHD - 20081030

- Degraded/cleared vegetation
- Mixed acacia tall open shrubland

Study Area Boundary - GHD - 20080530

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

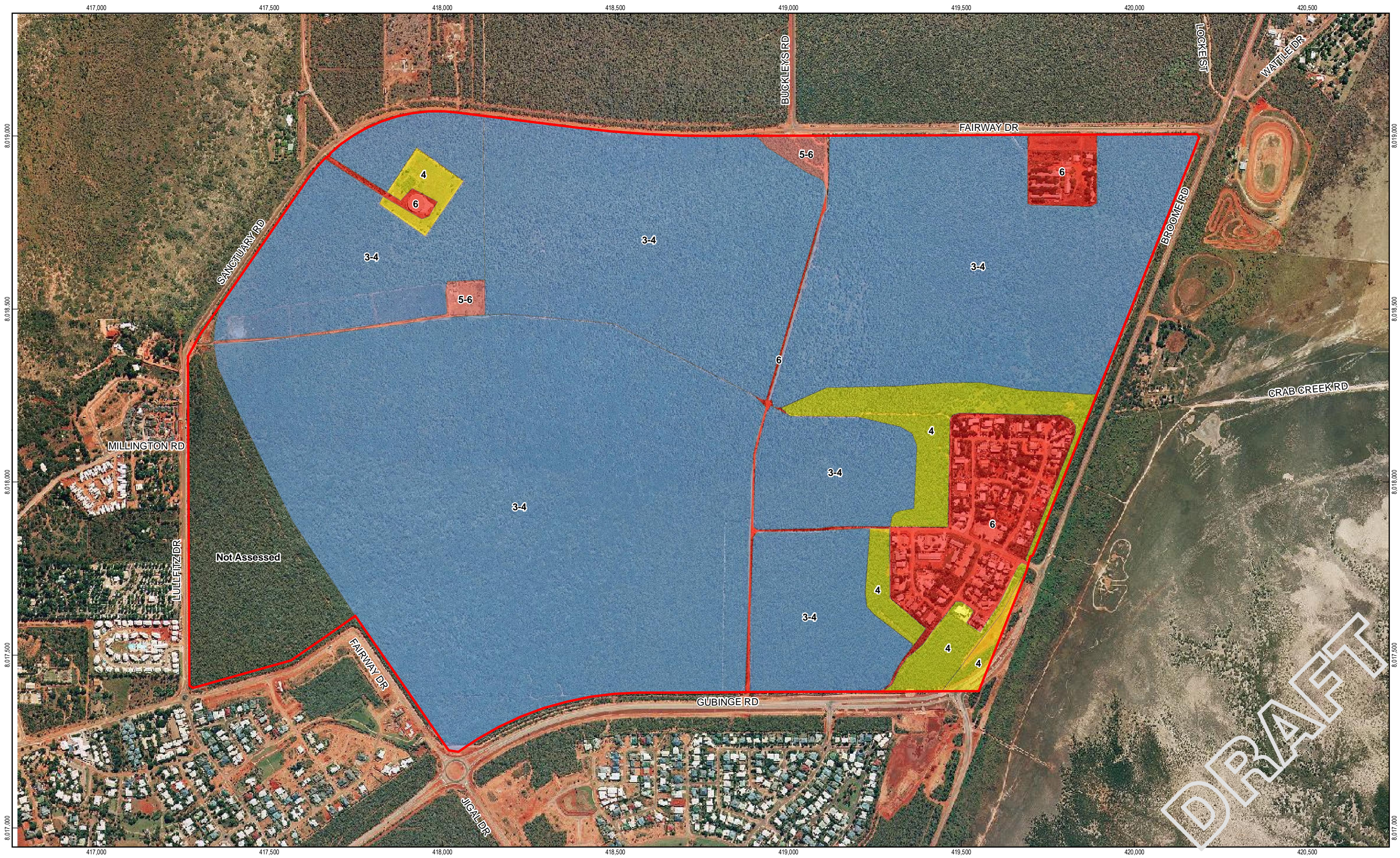


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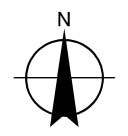
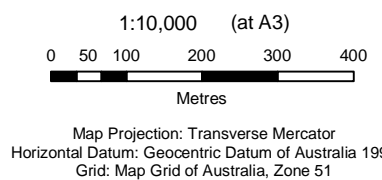
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 Revision | A
 Date | 30 OCT 2008

**Area A
 Vegetation Types**

Figure 3



DRAFT



LEGEND

Study Area Boundary - GHD - 20080530

Vegetation Condition - GHD - 20081030

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



Landcorp
Broome Industrial

Area A
Vegetation Condition

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Revision	A
Date	30 OCT 2008

Figure 4

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Appendix B

Vegetation and Flora

Bush Forever (Government of WA, 2000)
Vegetation Condition Rating Scale

Conservation Categories and Definitions for *EPBC Act* Listed Flora and Fauna Species

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

Department of Agriculture Declared Plant Classes
(Standard Control Codes).

Flora Species Recorded During the Field Survey of
the Study Area – June 2008



Table 7 Bush Forever (Government of WA, 2000) Vegetation Condition Rating Scale

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

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

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

Table 9 Conservation Codes and Descriptions for DEC Declared Rare and Priority Flora Species

Conservation Code	Description
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.

Table 10 Department of Agriculture Declared Plant Classes (Standard Control Codes).

Priority Class	Description
P1	Prohibits movement of plants or their seeds within the State. This prohibits the movement of contaminated machinery and produce including livestock and fodder.
P2	Eradicate infestation to destroy and prevent propagation each year until no plants remain. The infested area must be managed in such a way that prevents the spread of seed or plant parts on or in livestock, fodder, grain, vehicles and/or machinery.
P3	Control infestation in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set all plants.
P4	Prevent the spread of infestation from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set on all plants.
P5	Infestations on public lands must be controlled



Table 11 Flora Species Recorded During the Field Survey of the Study Area – June 2008

Family	Genus	Species	Common name	Status
Amaranthaceae	<i>Achyranthes</i>	<i>asper</i>	Chaff Flower	
Amaranthaceae	<i>Aerva</i>	<i>javanica</i>	Kapok Bush	*
Amaranthaceae	<i>Alternanthera</i>	<i>angustifolia</i>		
Amaranthaceae	<i>Gomphrena</i>	<i>flaccida</i>	Gomphrena weed	
Amaranthaceae	<i>Ptilotus</i>	<i>calostachyus</i>	Weeping Mulla Mulla	
Amaranthaceae	<i>Ptilotus</i>	<i>polystachyus</i>	Prince of Wales Feather	
Asclepiadaceae	<i>Calotropis</i>	<i>procera</i>	Rubber Tree	* DP
Asclepiadaceae	<i>Marsdenia</i>	<i>viridiflora</i> subsp. <i>tropica</i>	Bush Banana	
Asteraceae	<i>Pterocaulon</i>	<i>sphacelatum</i>	Apple Bush	
Asteraceae	<i>Xanthium</i>	<i>strumarium</i>	Noogoora Burr	* DP
Azioaceae	<i>Trianthema</i>	<i>pilosa</i>		
Boraginaceae	<i>Heliotropium</i>	<i>tenuifolium</i>	Mamukata	
Boraginaceae	<i>Trichodesma</i>	<i>zeylanicum</i>	Camel Bush	
Caesalpiniaceae	<i>Bauhinia</i>	<i>cunninghamii</i>		
Caesalpiniaceae	<i>Senna</i>	<i>occidentalis</i>	Curry Bush	*
Caesalpiniaceae	<i>Senna</i>	<i>costata</i>		
Caesalpiniaceae	<i>Senna</i>	<i>notabilis</i>	Cockroach Bush	
Campanulaceae	<i>Wahlenbergia</i>	<i>caryophylloides</i>		
Caryophyllaceae	<i>Polycarpaea</i>	<i>corymbosa</i>		
Caryophyllaceae	<i>Polycarpaea</i>	<i>longiflora</i>		
Combretaceae	<i>Terminalia</i>	<i>cunninghamii</i>	Pindan Quandong	
Combretaceae	<i>Terminalia</i>	<i>hadleyana</i>		
Convolvulaceae	<i>Bonamia</i>	<i>linearis</i>		
Convolvulaceae	<i>Evolvulus</i>	<i>alsinoides</i>	Tropical Speedwell	
Convolvulaceae	<i>Merremia</i>	<i>davenportii</i>		
Cucurbitaceae	<i>Citrullus</i>	<i>lanatus</i>	Pie Melon	*
Cucurbitaceae	<i>Cucumis</i>	<i>maderaspatanus</i>		
Droseraceae	<i>Drosera</i>	<i>indica</i>		
Euphorbiaceae	<i>Jatropha</i>	<i>gossypifolia</i>	Bellyache Bush	* DP
Goodeniaceae	<i>Goodenia</i>	<i>sepalosa</i>		



Gyocarpaceae	<i>Gyocarpus</i>	<i>americanus</i> subsp. <i>pachyphyllus</i>	
Lamiaceae	<i>Cyanostegia</i>	<i>cyanoclalyx</i>	Northern Tinsel Flower
Lamiaceae	<i>Hyptis</i>	<i>suaveolens</i>	Mint Bush *
Lamiaceae	<i>Ocimum</i>	<i>basilicum</i>	Basil Bush *
Malvaceae	<i>Abutilon</i>	<i>hannii</i>	
Malvaceae	<i>Abutilon</i>	<i>otocarpum</i>	Desert Chinese Lantern
Malvaceae	<i>Gossypium</i>	<i>australe</i>	Native Cotton
Malvaceae	<i>Hibiscus</i>	<i>leptocladus</i>	
Malvaceae	<i>Hibiscus</i>	<i>sabdariffa</i>	Rosella *
Malvaceae	<i>Sida</i>	<i>acuta</i>	*
Malvaceae	<i>Sida</i>	<i>arenicola</i>	
Malvaceae	<i>Sida</i>	<i>rohlena</i>	
Meliaceae	<i>Melia</i>	<i>azedarach</i>	Cape Lilac
Mimosaceae	<i>Acacia</i>	<i>adoxa</i>	
Mimosaceae	<i>Acacia</i>	<i>colei</i>	Coles Wattle
Mimosaceae	<i>Acacia</i>	<i>eriopoda</i>	Broome Pindan Wattle
Mimosaceae	<i>Acacia</i>	<i>holosericea</i>	Candelbra Wattle
Mimosaceae	<i>Acacia</i>	<i>monticola</i>	Red Wattle
Mimosaceae	<i>Acacia</i>	<i>tumida</i>	Pindan Wattle
Mimosaceae	<i>Albizia</i>	<i>canescens</i>	
Myrtaceae	<i>Corymbia</i>	<i>greeniana</i>	
Myrtaceae	<i>Corymbia</i>	<i>polycarpa</i>	
Myrtaceae	<i>Corymbia</i>	<i>zygophylla</i>	
Myrtaceae	<i>Eucalyptus</i>	<i>sp</i>	
Myrtaceae	<i>Melaleuca</i>	<i>alsophila</i>	
Myrtaceae	<i>Melaleuca</i>	<i>nervosa</i>	Fibre Bark
Oleaceae	<i>Jasminum</i>	<i>didymum</i>	
Papilionaceae	<i>Crotalaria</i>	<i>medicaginea</i>	
Papilionaceae	<i>Erythrina</i>	<i>vespertilio</i>	Yulbah
Papilionaceae	<i>Galactia</i>	<i>tenuiflora</i>	
Papilionaceae	<i>Indigofera</i>	<i>colutea</i>	Sticky Indigo
Papilionaceae	<i>Stylosanthes</i>	<i>hamata</i>	Verano Stylo *



Papilionaceae	<i>Zornia</i>	<i>chaetophora</i>	
Papilionaceae	<i>Zornia</i>	<i>prostrata</i>	
Passifloraceae	<i>Passiflora</i>	<i>foetida</i> var <i>hispida</i>	Wild Passionfruit *
Poaceae	<i>Aristida</i>	<i>holathera</i>	
Poaceae	<i>Aristida</i>	<i>inaequiglumis</i>	Feathertop Threawn
Poaceae	<i>Cenchrus</i>	<i>ciliaris</i>	Buffel Grass *
Poaceae	<i>Chrysopogon</i>	<i>pallidus</i>	Ribbon Grass
Poaceae	<i>Cymbopogon</i>	<i>ambiguus</i>	Scentgrass
Poaceae	<i>Cymbopogon</i>	<i>bombycinus</i>	Silky Oil Grass
Poaceae	<i>Dactyloctenium</i>	<i>radulans</i>	Button grass
Poaceae	<i>Eragrostis</i>	<i>eriopoda</i>	Woolly But
Poaceae	<i>Setaria</i>	<i>apiculata</i>	Pigeon Grass
Poaceae	<i>Sporobolus</i>	<i>actinocladius</i>	Ray Grass
Poaceae	<i>Sporobolus</i>	<i>australasicus</i>	Fairy Grass
Poaceae	<i>Triodia</i>	<i>?schinzii</i>	(Feathertop Spinifex)
Poaceae	<i>Whiteochloa</i>	<i>cymbiformis</i>	
Proteaceae	<i>Hakea</i>	<i>arborescens</i>	Tree Hakea
Proteaceae	<i>Hakea</i>	<i>macrocarpa</i>	
Proteaceae	<i>Persoonia</i>	<i>falcata</i>	Wild Pear
Rhamnaceae	<i>Ziziphus</i>	<i>mauritiana</i>	Zornia *
Rubiaceae	<i>Oldenlandia</i>	<i>argillacea</i>	
Santalaceae	<i>Santalum</i>	<i>lanceolatum</i>	Tropical Sandalwood
Sapindaceae	<i>Atalaya</i>	<i>hemiglauca</i>	
Sapindaceae	<i>Distichostemon</i>	<i>hispidulus</i> var. <i>phyllopterus</i>	
Sapotaceae	<i>Sersalisia</i>	<i>sericea</i>	Nangi
Solanaceae	<i>Solanum</i>	<i>cunninghamii</i>	
Sterculiaceae	<i>Rulingia</i>	<i>loxophylla</i>	
Sterculiaceae	<i>Waltheria</i>	<i>indica</i>	
Tiliaceae	<i>Corchorus</i>	<i>sidoides</i>	Flannel Weed
Tiliaceae	<i>Grewia</i>	<i>breviflora</i>	
Tiliaceae	<i>Grewia</i>	<i>retusifolia</i>	Dog's Balls
Tiliaceae	<i>Triumfetta</i>	<i>petandra</i>	*

* Introduced



DP Declared Plant



Appendix C

Fauna

EPBC Act Fauna Conservation Categories

Western Australian Wildlife Conservation Act 1950
Conservation Codes

DEC Priority Fauna Codes

Listing of Potentially Occurring Significant, Rare and
Priority Fauna Species within the Broome Study
Area (Source: DEC, WAM and DEWHA databases)

Fauna Species Observed within the Survey 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.

(See **Table 8**)

Critically endangered and endangered species

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

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

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

Vulnerable species

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

- » lead to a long-term decrease in the size of an important population of a species, or
- » reduce the area of occupancy of an important population, or
- » fragment an existing important population into two or more populations, or
- » adversely affect habitat critical to the survival of a species, or
- » disrupt the breeding cycle of an important population, or



- » modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline, or
- » result in invasive species that are harmful a vulnerable species becoming established in the vulnerable species' habitat*, or
- » interferes substantially with the recovery of the species.

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

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

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

Listed migratory species

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

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

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

An area of important habitat is:

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

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

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



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.



Table 12 Western Australian Wildlife Conservation Act 1950 Conservation Codes

Conservation Code	Description
Schedule 1	"...fauna that is rare or likely to become extinct, are declared to be fauna that is in need of special protection."
Schedule 2	"...fauna that is presumed to be extinct, are declared to be fauna that is in need of special protection."
Schedule 3	"...birds that are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction, are declared to be fauna that is in need of special protection."
Schedule 4	"...fauna that is in need of special protection, otherwise than for the reasons mentioned [in Schedule 1 – 3]"

Table 13 DEC Priority Fauna Codes

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

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



Table 14 Listing of Potentially Occurring Significant, Rare and Priority Fauna Species within the Broome Study Area (Source: DEC, WAM and DEWHA databases)

Family	Genus	Species	Common Name	Listing under EPBC Act	Listing under Wildlife Conservation Act 1950 or DEC Priority List	DEC Database	EPBC Protected Matters Search Tool
Birds							
Psittacidae	<i>Polytelis</i>	<i>alexandrae</i>	Princess Parrot		Priority 4	+	
Scolopacidae	<i>Numenius</i>	<i>madagascariensis</i>	Eastern Curlew		Priority 4	+	
Scolopacidae	<i>Burhinus</i>	<i>grallarius</i>	Bush Stonecurlew		Priority 4	+	
Accipitridae	<i>Haliaeetus</i>	<i>leucogaster</i>	White-bellied Sea-Eagle	Migratory (Terrestrial)			+
Apodidae	<i>Apus</i>	<i>pacificus</i>	Fork-tailed Swift	Migratory (Marine)			+
Ardeidae	<i>Ardea</i>	<i>alba</i>	Great Egret, White Egret	Migratory (Wetland/Marine)			+
Ardeidae	<i>Ardea</i>	<i>ibis</i>	Cattle Egret	Migratory (Wetland/Marine)			+
Charadriidae	<i>Charadrius</i>	<i>leschenaultia</i>	Greater Sand Plover, Large Sand Plover	Migratory (Wetland)			+
Charadriidae	<i>Charadrius</i>	<i>mongolus</i>	Lesser Sand Plover, Mongolian Plover	Migratory (Wetland)			+
Charadriidae	<i>Charadrius</i>	<i>veredus</i>	Oriental Plover, Oriental Dotteral	Migratory (Wetland)			+



Family	Genus	Species	Common Name	Listing under EPBC Act	Listing under Wildlife Conservation Act 1950 or DEC Priority List	DEC Database	EPBC Protected Matters Search Tool
Charadriidae	<i>Pluvialis</i>	<i>squatarola</i>	Grey Plover	Migratory (Wetland)			+
Falconidae	<i>Falco</i>	<i>hypoleucos</i>	Grey Falcon	Priority 4		+	
Glareolidae	<i>Glareola</i>	<i>maldivarum</i>	Oriental Pratincole	Migratory (Wetland)			+
Hirundinidae	<i>Hirundo</i>	<i>rustica</i>	Barn Swallow	Migratory (Terrestrial)			+
Laridae	<i>Sterna</i>	<i>albifrons</i>	Little Tern	Migratory (Marine)			+
Meropidae	<i>Merops</i>	<i>ornatus</i>	Rainbow Bee-eater	Migratory (Terrestrial)			+
Passeridae	<i>Erythrura</i>	<i>gouldiae</i>	Gouldian Finch	Endangered / Migratory (Terrestrial)	Schedule 1		+
Rostratulidae	<i>Rostratula</i>	<i>australis</i>	Australian Painted Snipe	Vulnerable/Migratory (Wetland)	Schedule 1		+
Scolopacidae	<i>Actitis</i>	<i>hypoleucos</i>	Common Sandpiper	Migratory (Wetland)			+
Scolopacidae	<i>Arenaria</i>	<i>interpres</i>	Ruddy Turnstone	Migratory (Wetland)			
Scolopacidae	<i>Calidris</i>	<i>canutus</i>	Red Knot, Knot	Migratory (Wetland)			+



Family	Genus	Species	Common Name	Listing under EPBC Act	Listing under Wildlife Conservation Act 1950 or DEC Priority List	DEC Database	EPBC Protected Matters Search Tool
Scolopacidae	<i>Calidris</i>	<i>ferruginea</i>	Curlew Sandpiper	Migratory (Wetland)			+
Scolopacidae	<i>Calidris</i>	<i>ruficollis</i>	Red-necked Stint	Migratory (Wetland)			+
Scolopacidae	<i>Calidris</i>	<i>tenuirostris</i>	Great Knot	Migratory (Wetland)			+
Scolopacidae	<i>Heteroscelus</i>	<i>brevipes</i>	Grey-tailed Tattler	Migratory (Wetland)			+
Scolopacidae	<i>Limicola</i>	<i>falcinellus</i>	Broad-billed Sandpiper	Migratory (Wetland)			+
Scolopacidae	<i>Limosa</i>	<i>lapponica</i>	Bar-tailed Godwit	Migratory (Wetland)			+
Scolopacidae	<i>Limosa</i>	<i>limosa</i>	Black-tailed Godwit	Migratory (Wetland)			+
Scolopacidae	<i>Numenius</i>	<i>minutus</i>	Little Curlew, Little Whimbrel	Migratory (Wetland)			+
Scolopacidae	<i>Numenius</i>	<i>phaeopus</i>	Whimbrel	Migratory (Wetland)			+
Scolopacidae	<i>Tringa</i>	<i>nebularia</i>	Common Greenshank, Greenshank	Migratory (Wetland)			+
Scolopacidae	<i>Xenus</i>	<i>cinereus</i>	Terek Sandpiper	Migratory (Wetland)			+



Family	Genus	Species	Common Name	Listing under EPBC Act	Listing under Wildlife Conservation Act 1950 or DEC Priority List	DEC Database	EPBC Protected Matters Search Tool
Tytonidae	<i>Tyto</i>	<i>novaeollandiae kimberli</i>	Masked Owl (northern)	Vulnerable	Priority 1		+
Mammals							
Dasyuridae	<i>Dasyercus</i>	<i>cristicauda</i>	Mulgara	Vulnerable	Schedule 1		+
Phalangeridae	<i>Wyulda</i>	<i>squamicaudata</i>	Scaly-tailed Possum		Priority 3	+	
Thylacomyidae	<i>Macrotis</i>	<i>lagotis</i>	Greater Bilby	Vulnerable	Schedule 1	+	+



Table 15 Fauna Species Observed within the Survey Area

Family	Genus	Species	Common Name	Conservation Status
Reptiles				
Agamidae	<i>Amphibolurus</i>	<i>gilberti</i>	Gilbert's Dragon; Ta-ta Lizard	
Mammals				
Macropodidae	<i>Macropus</i>	<i>agilis</i>	Agile Wallaby	
Canidae	<i>Canus</i>	<i>lupis familiaris</i>	Dog	*
Birds				
Accipitridae	<i>Haliastur</i>	<i>sphenurus</i>	Whistling Kite	
Artamidae	<i>Cracticus</i>	<i>nigrogularis</i>	Pied Butcherbird	
Cacatuidae	<i>Cacatua</i>	<i>sanguinea</i>	Little Corella	
Campephagidae	<i>Coracina</i>	<i>novaehollandiae</i>	Black-faced Cuckoo-shrike	
Columbidae	<i>Geopelia</i>	<i>cuneata</i>	Diamond Dove	
Columbidae	<i>Ocyphaps</i>	<i>lophotes</i>	Crested Pigeon	
Dicruridae	<i>Grallina</i>	<i>cyanoleuca</i>	Magpie-lark	
Meropidae	<i>Merops</i>	<i>ornatus</i>	Rainbow Bee-eater	Migratory/Marine EPBC
Corvidae	<i>Corvus</i>	<i>orru</i>	Torresian Crow	
Plataleidae	<i>Threskiornis</i>	<i>spenicollis</i>	Straw Necked Ibis	



Family	Genus	Species	Common Name	Conservation Status
Dicruridae	<i>Rhipidura</i>	<i>leucophrys</i>	Willie Wagtail	
Accipitridae	<i>Milvus</i>	<i>migrans</i>	Black Kite	
Meliphagidae	<i>Certhionix</i>	<i>pectoralis</i>	Banded Honeyeater	
Passeridae	<i>Taeniopygia</i>	<i>bichenovii</i>	Double-barred Finch	
Dicruridae	<i>Rhipidura</i>	<i>fuliginosa</i>	Grey Fantail	
Pomatostomidae	<i>Pomatostomus</i>	<i>temporalis</i>	Grey-crowned Babbler	
Pachycephalidae	<i>Pachycephala</i>	<i>rufiventris</i>	Rufous Whistler	
Psittacidae	<i>Aprosmictus</i>	<i>erythropterus</i>	Red-winged Parrot	
Meliphagidae	<i>Melithreptus</i>	<i>albogularis</i>	White-throated Honeyeater	

* Introduced



Appendix D

Declared Plants Control Methods



GHD

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