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Main Roads WA
Kimberley Region

Report for Great Northern Highway Reconstruction Projects: Bow Reconstruction Project

Environmental Impact Assessment and Environmental Management Plan

May 2007

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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Executive Summary

Main Roads Western Australia Kimberley Region (Main Roads) has commissioned GHD Pty Ltd (GHD) to undertake an Environmental Impact Assessment (EIA) and prepare an Environmental Management Plan (EMP) for the Bow Section of the Great Northern Highway Reconstruction Projects.

This report can be used in the environmental assessment and approvals process. It can also provide the basis for discussion, with relevant environmental agencies, about the need to refer the proposal for statutory approval.

Existing Environment

The EIA indicated that no direct environmental constraints associated with the proposed works were recorded for the survey area.

In summary, the following conclusions on environmental aspects are made:

- No reserves or conservation areas are located within or in the vicinity of the study areas;
- The survey area is criss-crossed with ephemeral watercourses. Water was recorded pooling in historical borrow pits and adjacent to culverts where material has been excavated to improve water flow, or scoured out from channeling water in artificial channels.
- The Bow River was flowing at the time of survey.
- The Canning-Kimberley Groundwater Area covers the entire Kimberley sub-region. Where dewatering, obstruction of groundwater or modification of stream banks is required for roadworks and bridge construction, Main Roads will need to compete the relevant application form as indicated below:
    - For dewatering – 'Application for a 5C Licence to take Groundwater' (Form A); and
    - For modifying beds and banks – 'Application for a 5C licence to take surface water / Application for a 11/17/21 A permit to modify bed and banks / Application to amend a 11/17/21A permit to modify bed and banks' (Form C);
- Works will temporarily increase runoff and sedimentation. With appropriate management actions in place, alteration to hydrology and drainage is not considered likely to be adversely impacted by this project;
- No Environmentally Sensitive Areas are located within or near the vicinity of the study areas;
- A search of the Department of Indigenous Affairs (DIA) Aboriginal Heritage Inquiry System indicates that numerous Aboriginal heritage sites are located within the

survey area. Main Roads should consider this in any decision making with respect to whether a full Aboriginal site assessment should be undertaken;

- The vegetation types described for the survey area are: Low tree savannahs and hummock grasslands: Gently undulating terrain on a variety of sedimentary rocks support low Snappy Gum (*Eucalyptus brevifolia*) over hummock grasslands and gently sloping floodplains support *Melaleuca minutifolia* low woodland over annual sorghums (Graham, 2003c); Savannah woodland over *Triodia* spp. and/or bunch grass; and Grassland with scattered bloodwoods (*Eucalyptus* spp.) and Snappy Gum (*Eucalyptus brevifolia*)
- Based on the current extent of vegetation types in the survey area, they are classified as *Least Concern* in terms of extent of vegetation remaining compared to pre-European extents.
- The condition of the majority of the vegetation in the survey area varies between Condition 1 – 2 (*Excellent* to *Very Good)*. In general the vegetation of the survey area was in excellent condition with little evidence of disturbance and few introduced species. Disturbance was restricted to a number of small, localised areas.
- Desktop surveys identified that there are no known occurrences of Threatened Ecological Communities (TECs) within the study area; however, there are occurrences of 2 known Priority Ecological Communities (PECs) within 30 kilometres of the study area. No TECs or PECs were identified during the field survey.
- The study area contains 8 vegetation types and is considered to contain a moderate species diversity. A total of 218 taxa from 51 families was recorded for the study area. No Declared Rare or Priority flora species were recorded during the survey.
- A total of 15 weed species was recorded within the study area, with weed invasion generally restricted to the edges of the highway and along access tracks and cleared areas, except for Buffel Grass (*Cenchrus ciliaris*), deliberately introduced across much of the rangelands of Western Australia.
- Two noxious weed species (Declared Plants, WONS) were recorded from the survey area.
- A search of the Western Australian Museum's Fauna Database, *FaunaBase,* for an area in a 5 km radius around the study area revealed that 2 bird, no mammal, 8 reptile, 2 amphibian and no fish species have been recorded from the vicinity of the study area. A number of fauna species, particularly birds (56 species), mammals (8 species) and reptiles (7 species) were identified in the field surveys. It should be noted that the field survey was only a reconnaissance survey and no detailed fauna surveys, including trapping, have been undertaken. There are a number of cryptic species that may occur in the study area that can only be identified through further detailed studies.

- Desktop surveys identified a number of protected fauna species that potentially occur within the study area. The field survey did record the Endangered Gouldian Finch within the survey area. Other protected species may occur within the study area on occasion.
- A number of introduced species occur within the study area, including the Brumby, and Feral Cat. Control of resource availability – primarily introduced grasses and water sources (water pooling in historical borrow pits) - can help minimise any increase in feral animal usage of the area caused by project disturbances.
- The survey occurs in relatively unaltered habitat (apart from impacts by mining, roadworks and pastoral activities) and as such currently provides an unbroken habitat between the survey area and surrounds.
- Most of the survey area contains good quality fauna habitat and a number of different habitats are present within the study area, including breakaways, creeklines, grasslands and woodlands. The survey area occurs in a region in which much of the vegetation has been relatively unaltered. The survey area is not considered to contain significant habitat not found in adjacent areas.
- Fauna habitat and linkages will not be significantly disturbed or disrupted by the works planned for these sections. It is not considered that the extraction of material for the highway upgrade will significantly alter the fauna habitat of the region. It can be considered that a disturbance will occur on a local scale, which is likely to impact on individual animals, rather than a population

Management of Impacts

The greatest impact from the proposal to upgrade the Bow Section will be the minor loss of vegetation and habitat from borrow pit areas and the potential to increase weed species across the survey area due to disturbances from roadwork activities. The disturbance of the survey area may cause indirect impacts on the rest of the study area, such as through the introduction of exotic species (particularly weeds) and fire. This will need to be carefully managed (see below).

Avoidance of unnecessary clearing of vegetation should be the first priority for managing impacts on flora and fauna.

It is also recommended that the sections of ‘unusual’ vegetation, such as that along creeklines, rocky outcrops and breakaways, should be avoided where possible, as they contain areas of high habitat value.

Where it is not possible to avoid clearing of native vegetation, impacts can be minimised and managed by a number of measures which are outlined below.

- Minimise clearing, particularly for borrow pits and associated access tracks;
- Avoid clearing or impacting areas with good quality vegetation such as outcrops or breakaways;
- Use areas adjacent to existing disturbance sites in preference to areas that are within undisturbed native vegetation;

- Ensure borrow pit areas are designed and developed to minimise pooling and associated spread of weed species and feral fauna;
- Post-construction, borrow pits and access tracks will be ripped to allow the establishment of native flora.

Any impacts on flora and fauna that cannot be avoided or minimised during the planning stage should be mitigated through management measures that can be undertaken just prior to, during and post-construction.

Specific management actions for the Gouldian Finch indicate that construction works be undertaken during the dry season to avoid impacting the birds during the breeding cycle.

Management of indirect impacts on the rest of the study area, i.e. weed management, will be a high priority for any works undertaken in the relatively undisturbed sections of bushland and along creeklines.

Other impacts addressed include:

- Noise, dust and vibration from construction works are not likely to cause a major impact, however, should be managed for the safety of road users and construction personnel;
- Appropriate fire and waste management should be undertaken to reduce the risk of disturbance to the environment adjacent to the proposed works; and
- There is a minor risk that the construction works will create temporary pollution as a result of fuel or chemical spills or mismanagement of construction materials. This can be controlled with appropriate risk management and mitigation actions.

Requirement for Referral

There are no environmental impacts or issues 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.

It is anticipated that this project will not require formal referral to the Environmental Protection Authority under the *WA Environmental Protection Act 1986*.

This project has been found not to be at variance when assessed against the 10 Clearing Principles.

However, a number of management measures have been outlined to minimise any potential environmental impacts from this proposal.

An application for a clearing permit from the Department of Environment and Conservation (DEC) is not required, however; the requirement for a clearing permit should be considered in relation to the Main Roads Purpose Permit regional clearing limits. The maximum annual clearing limit for the Kimberley region is 200 hectares.

1. Introduction

Main Roads Western Australia Kimberley Region (Main Roads) has commissioned GHD Pty Ltd (GHD) to undertake an Environmental Impact Assessment (EIA) and prepare an Environmental Management Plan (EMP) for the Bow Section of the Great Northern Highway Reconstruction Projects. This report can be used in the environmental assessment and approvals process. It can also provide the basis for discussion, with relevant environmental agencies, about the need to refer the proposal for statutory approval.

1.1 Background

The Great Northern Highway is part of the National route between Perth and Darwin linking the Kimberley Regional population centres of Broome, Derby, Fitzroy Crossing, Halls Creek, Wyndham and Kununurra. It forms the main freight haul link between Perth, the North West and the Kimberley and provides access to important tourist destinations on the coast. It carries a mixture of light tourist and heavy transport vehicles.

The project section is within the Shire of Wyndham / East Kimberley.

This road serves as the only transport corridor for the fast growing mining, cattle, tourism and agriculture industries in the East Kimberley. It provides land transport access to a number of mining industries including the Argyle diamond mine. It serves as a popular tropical summer touring route and provides access to a number of tourist attractions including the Bungle Bungle Ranges (Purnululu). Further, it serves a number of Aboriginal communities scattered over the area.

As a result of the expansion of the Ord River Irrigation Area and the fast growing tourism and mining industries in the East Kimberley, it is expected that the volume of traffic and freight carried on this road will increase considerably in the near future.

1.2 Project Description

The Bow Project involves reconstruction to an improved standard of an existing section of the Halls Creek to Victoria Highway Link of the Great Northern Highway where the pavement has severely deteriorated and the seal width is inadequate.

The majority of the road section is in poor condition and in need of reconstruction. The pavement has an increasing number of failures resulting in partial road closures and freight restrictions. Bow River section is the only narrow seal section remaining between Bow River and Victoria Highway.

1.3 Scope of Report

The scope of work for this project is to prepare an EIA and EMP for the Bow section of the Great Northern Highway Reconstruction Projects. The section will cover 18.50

kilometres from 3010.00 – 3028.50 SLK as well as 28 borrow pits associated with this project. The locations of the borrow pits are described in **Table 1**.

Table 1 Borrow Pit Locations

Borrow Pit #	SLK	Length	Width	Area (ha)	Co-ordinates
1	3009.3	600	400	12	0423260, 8142560 (NW) 0423730, 8142180 (SW)
2	3009.9	500	200	10	0423650, 8142930 (NW) 0424256, 8142766 (SE)
3	3010.5	200	100	2	0423350, 8143990 (NW) 0423550, 8143780 (SE)
4	3011.5	300	300	9	0421500, 8145300 (NW) 0421900, 8145000 (SE)
	3011.5	50	50	0.3	0421777, 8145187
5	3011.5	450	300	13.5	0421000, 8145540 (NW) 0421420, 8145125 (SE)
6	3011.5			71.0	0422000, 8146675 (NW) 0421725, 8145925 (SE)
6A	3011.5	500	400	20	0422750, 8146275 (NW) 0423255, 8146000 (SE)
7	3012	200	100	2	0423425, 8145500 (NW) 0423425, 8145375 (SE)
8	3012.9	200	100	2	0423875, 8146200 (NW) 0423925, 8145875 (SE)
9	3013.6	500	200	10	0424075, 8147000 (NW) 0424275, 8146450 (SE)
9A	3015	900	900	81	0428600, 8148100 (NW) 0429500, 8147200 (SE)
10	9017.2	200	100	2	0421850, 8149675 (NW) 0422050, 8149500 (SE)
11	3018.5	500	200	10	0421125, 8150500 (NW) 0421600, 8150125 (SE)

Borrow Pit #	SLK	Length	Width	Area (ha)	Co-ordinates
12A	3019.3	700	350	24.5	0420750, 8151200 (NW) 0421750, 8151175 (SE)
13	3019.6	575	425	24.4	0419090, 8151325 (NW) 0420425, 8151075 (SE)
14	3021	400	200	8	0419600, 8152750 (NW) 0419800, 8152350 (SE)
15	3021.5	300	200	6	0419750, 8152450 (NW) 0419850, 8152100 (SE)
16	3022.5	300	200	6	0420100, 8154425 (NW) 0420200, 8154050 (SE)
17	3022.5	700	500	35	0420700, 8154250 (NW) 0420725, 8153250 (SE)
18	3024.8	500	700	35	0421000, 8156350 (NW) 0421875, 8156200 (SE)
19	3025.8	450	500	22.5	0419900, 8156450 (NW) 0420050, 8156000 (SE)
20	3026.5	300	350	10.5	0419400, 8156550 (NW) 0419400, 8156200 (SW)
21	3028.3	250	250	6.3	0417600, 8157550 (NW) 0417900, 8157250 (SE)
22	3030	250	250	6.3	0416225, 8158500 (NW) 0416600, 8157975 (SE)
23	3030.8	300	300	9	0415700, 8158550 (NW) 0415850, 8158150 (SE)
Sand 1 – Bow River	3010	251	280	7	0423010, 8143230 (NW) 0423250, 8142930 (SE)
Sand 2 – Bow River	3010	408	300	12	0424500, 8143300 (NW) 0424900, 8143080 (SE)

1.3.1 Desktop Assessment

- Conduct an initial assessment to determine the key environmental aspects that may impact this project;
- Assess all environmental aspects likely to require referral of the project to the EPA;
- A review of the Department of Environment and Conservation's (DEC) Rare and Threatened Flora database;
- A review of the DEC's Threatened Fauna database;
- A review of local and regional significance of plant communities;
- A review of the Western Australian Museum database for threatened and endangered fauna;
- A review of the DEC's Environmentally Sensitive Areas; and
- A review of the Department of Environment and Water Resources (DEWR) database for areas listed under the *Environment Protection and Biodiversity Conservation Act 1999*.

A review of European and Aboriginal heritage within the survey area including information from:

- The Western Australian Heritage Commission;
- A review of the Australian Heritage Places Inventory;
- Records held on Municipal databases;
- National Native Title Tribunal (NNTT); and
- The Department of Indigenous Affairs.

A consideration of the impacts on:

- Air quality;
- Dust;
- Fauna;
- European cultural heritage;
- Aboriginal heritage;
- Surface waters/drainage;
- Groundwater;
- Wetlands and waterways;
- Noise and Vibration;
- Visual amenity;
- Reserves and conservation areas;

Construction issues such as traffic management; and

- Providing all necessary information to obtain permits or approvals under legislative provisions, including those required under the following Acts and Regulations:

- Environmental Protection and Biodiversity Conservation Act 1999;
- Environmental Protection (Clearing of Native Vegetation) Regulations 2004;
- Rights in Water and Irrigation Act 1914;
- Conservation and Land Management Act 1984;
- Wild life Conservation Act 1950;
- Heritage of Western Australia Act 1990; and
- Aboriginal Heritage Act 1972.

1.3.2 Consultation

The following agencies were consulted to determine relevant environmental aspects associated with this project:

- Department of Environment and Conservation;
- Department for Planning and Infrastructure;
- Western Australian Heritage Commission;
- Australian Heritage Paces Inventory (State and Commonwealth);
- Department of Aboriginal Heritage Western Australia;
- National Native Title Tribunal (NNTT); and
- Shire of Derby / West Kimberley.

1.3.3 Flora and Vegetation Survey

A flora and vegetation survey included:

- A site visit by GHD qualified Botanists and an Ecologist;
- A description and condition rating of plant communities in the survey area;
- An inventory of the vascular plant species in the survey area;
- An inventory of weed and introduced plant species;
- An inventory and GIS mapping of plant species considered to be rare and endangered;
- An inventory and GIS mapping of TECs; and
- An opportunistic observation of fauna.

2. Existing Environment

The survey area is located in the Kimberley region of the state's northwest, along the Great Northern Highway near the township of Warmun (**Figure 1**, **Appendix A**).

The section of the Great Northern Highway investigated extended from 3010.00 to 3028.50 SLK near the Bow River. The environmental search area corridor averaged a width of approximately 400 metres both sides of the highway, the offset of which changes about the road centreline. The survey area also included 28 borrow pits within the vicinity of the alignment.

2.1 Climate

The Kimberley region of Western Australia has a tropical monsoon climate with two dominant seasons, separated by short transitional periods, broadly described as dry hot tropical and semi-arid with summer rainfall.

Over the months of November to April, hot and humid conditions prevail, characterising the 'wet' season. The region receives approximately 90% of its rainfall during these months, as unstable low pressure systems dominate the weather patterns.

From May to October, high pressure systems and a predominantly south easterly airflow from the continent's interior bring sunny days with cooler day time and night time temperatures. Rainfall during these months is markedly absent characterising this period as the 'dry' season.

The closest Bureau of Meteorology weather station located to the survey area is at Warmun. Recorded climatic data is summarised below:

- Mean Daily Maximum Temperature: 29.5°C (July) – 39.3°C (Nov)
- Mean Daily Minimum Temperature: 12.5°C (July) – 25.1°C (Dec)
- Annual Rainfall: 707.4 mm (Dec to March)
- Mean Annual Rain Days: 63.2 days

(Source: BOM, 2004)

2.2 Geology, Soils and Topography

The Australian Geological map series 1:250,000 (Lissadell Sheet) was referred to, to determine specific geology and soil characteristics of the project area.

The project area lies within many different geology types. These geology types include colluvium and rubble, weakly porphyritic biotite granodiorite and biotite hornblende tonalite, weakly to moderately foliated and granite rock. A variety of granite rock is present within the project area. Reference to the map describes 5 different forms with varying characteristics of grain size.

2.2.1 Survey Landscape

Within the survey area, a number of small hills, breakaways occur, particularly in the north of the survey area where the relief is incised by small ephemeral creeklines.

North of the Bow River, opposite the Argyle turnoff (Lissadell Road), Mount Nuylasy abuts the survey area.

2.3 Hydrology

2.3.1 Wetlands

Waterways and wetland areas within the Kimberley region are ephemeral, and typically flow or fill during seasonal rainfall events. A search of the Western Australian Wetlands Database (*WetlandBase*) and the *EPBC Act* Protected Matters Search Tool indicates the presence of two Wetlands of International Significance (Ramsar Sites) within the same catchment as the survey area. These are Lake Argyle and Lake Kununurra and the Ord River floodplain.

2.3.2 Drainage

Within the Bow section the Great Northern Highway is intersected by the non-perennial Bow River. Wilson River and a number of smaller creeks are also located within the survey area (**Figure 2**).

Monsoonal rainfall is typical in the region and causes extensive sheetflow flooding over the flat landscape and often creates ephemeral, dendritic drainage lines and rivers with extensive floodplain areas. The often sandy nature of these drainage lines makes them susceptible to erosion from channelised runoff and grazing livestock.

Surface water drains directly off road surfaces. High frequency and high intensity rainfall events during the wet season often causes flooding of the road surface in floodway areas and at river crossings.

2.3.3 Water Management Areas

A search of the Department of Water (DoW) Geographic Data Atlas indicated that the survey area is not within any Gazetted Public Drinking Water Source Areas, however; it does lie within the Canning-Kimberley Groundwater Area. The Canning-Kimberley Groundwater Area covers the entire Kimberley sub-region. It was proclaimed in 1997 under the *Rights in Water and Irrigation Act 1914* to ensure groundwater is abstracted sustainably.

The *Act* gives the DoW the power to manage ground and surface areas and use of land that may impact upon these water sources. Permits are required to allow obstruction or interference with the bed or banks of a watercourse to which there is access by a public road or reserve, or to build or alter a dam on a proclaimed or prescribed watercourse or wetland.

Where dewatering, obstruction of groundwater or modification of stream banks is required for roadworks and bridge construction, Main Roads will need to compete the relevant application form as indicated below:

» For dewatering – 'Application for a 5C Licence to take Groundwater' (Form A); and

For modifying beds and banks – 'Application for a 5C licence to take surface water / Application for a 11/17/21 A permit to modify bed and banks / Application to amend a 11/17/21A permit to modify bed and banks' (Form C).

2.4 Reserves and Conservation Areas

No conservation areas are located within the boundaries of the project area. Reserve 1609 is designated for public purposes and is located within the project area. The reserve titles are contained in **Appendix F**.

2.5 Environmentally Sensitive Areas

A search of the DEC's Native Vegetation Viewer did not indicate that any Environmentally Sensitive Areas (ESAs) are within, or adjacent to the survey area.

2.6 Vegetation and Flora

2.6.1 Vegetation Description

Vegetation of the Kimberley Region has been surveyed, mapped and described by Beard (1979) and is summarised in Wheeler (1992). The project area is situated on the edge of the Hall phytogeographic district and is in close proximity to the Fitzgerald and East Gardener districts (Wheeler, 1992). The project area is likely to be influenced by all three districts. Broad scale vegetation for the Halls district has been summarised below:

» The predominant vegetation is shrub steppe or tree steppe. The grass layer is dominated by *Triodia* species

» Tree steppe has occasional to sparse trees of eucalyptus species.

» Shrub steppe has occasional shrubs of species of *Acacia, Grevillea* and *Hakea.*

» In the Osmond range and the Ord plains there are areas of tree savannah. The tree layer dominated by *Eucalyptus* species and the grass layer by *Aristida* and *Chrysopogon* species

» Cracking clay plains support a treeless grass savannah dominated by *Astrebla* species

In 2001-2 the (then) Department of Conservation and Land Management undertook an extensive audit of the State's terrestrial biodiversity. Detailed information for the State's biogeographic subregions was collated at this time, including information on the vegetation within each survey area. The survey area occurs in an area where three biogeographic subregions meet: Victoria Bonaparte 1 (VP1 – Victoria Bonaparte subregion), Central Kimberley 2 (CK2 – Hart subregion) and Ord Victoria Plains 1

(OVP1 – Ord subregion). The environment of these subregions is described in the Biodiversity Audit of Western Australia's 53 Biogeographical Subregions (Graham, 2003a; 2003b; 2003c) and the vegetation types described for the survey area are included below:

» Low tree savannahs and hummock grasslands: Gently undulating terrain on a variety of sedimentary rocks support low Snappy Gum (*Eucalyptus brevifolia*) over hummock grasslands and gently sloping floodplains support *Melaleuca minutifolia* low woodland over annual sorghums (Graham, 2003c);

» Savannah woodland over *Triodia* spp. and/or bunch grass;

» Grassland with scattered bloodwoods (*Eucalyptus* spp.) and Snappy Gum (*Eucalyptus brevifolia*) (Graham, 2003b)

2.6.2 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 in States where clearing is still occurring (EPA, 2000)

» The "threshold level" below which species loss appears to accelerate exponentially at an ecosystem level is regarded as being at a level of 30% of the pre-European/ pre-1750 extent of the vegetation type;

» A level of 10% of the original extent is regarded as being a level representing *Endangered*; and

» Clearing which would put the threat level into the class below should be avoided.

Such status can be delineated into five (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 areas; their regional extent and reservation status are drawn from Shepherd, *et al*. (2002), and Shepherd pers. comm. These are shown in Table 2.

Table 2 Vegetation extent and status.

Vegetation Association Number	Association Description	Pre-European Extent (Ha)	Current Extent (Ha)	% Remaining	% Pre-European Extent in IUCN Class I-IV Reserves	Occurrence on Site
820	Grasslands, high grass savannah sparse low tree; snappy gum (*Eucalyptus brevifolia*) over upland tall grass & curly spinifex on granite	59, 638.812	59, 638.812	100.00	0.0	Northern section of the road alignment and section of the road alignment adjacent to Mt Nyulasy
825	Grasslands, high grass savannah woodland; cabbage gum & *Eucalyptus foelscheana* over upland tall grass & curly spinifex on basalt	77, 763.125	77, 675.294	99.9	0.0	Northern-most borrow pits and central section of the road alignment
833	Grasslands, short bunch grass savannah sparse low tree; scattered snappy gum over arid short grass on plains	38, 674.877	38, 674.877	100.00	0.0	Southern section of the road alignment and southern borrow pits

Generally the vegetation extents would be considered within the IBRA region of the survey site but as the current survey site crosses IBRA regions the extents for the whole of state were considered. In this case, the percentages remaining for the whole of state and the IBRA extents are equivalent.

The extent of the vegetation in the survey areas is considered intact, with approximately 100% of the pre-European extents of each vegetation type remaining. However, the vegetation is poorly conserved with none of the vegetation types present within IUCN Class I-IV Reserves.

2.6.3 Threatened Ecological Communities

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

Some TECs are protected under the *EPBC Act*. Although TECs are not formally protected under the State *Wildlife Conservation Act 1950,* 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.

A search was undertaken of the DEC's TEC database and found no known occurrences of TECs recorded within the boundary of the survey area.

The search noted that there are known occurrences of the "Vulnerable" TECs known as "Assemblages of Walcott Inlet rainforest swamps" and "Organic mound spring sedgeland community of the North Kimberley Bioregion" within 30 km of the search area.

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.

No Priority Ecological Communities are known from the survey area.

2.6.4 Significant Flora

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 DEWR and/or the EPA.

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

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

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 legislatory protection. A description of the DEC's Conservation Codes that relate to flora species is provided in **Table 9, Appendix C**.

A search of the DEC's Rare Flora Databases and the Western Australian Herbarium (WAHERB) records was performed. These species are outlined in **Table 3** and mapped at **Figure 2 and Figure 3**.

Table 3 Significant Flora Records within the Survey Area. Source: The DEC's Rare Flora Databases.

Species	Conservation Code	Description
Boronia minutipinna	P2	Shrub, to 0.5 m high, leaves pinnate, pinnae 17-35; sepals longer and wider than petals. Fl. white, pink, Jul. Sand. Amongst boulders on plateau.
Boronia jucunda	P1	Slender, aromatic shrub, to 0.7 m high, branches obviously glandular; leaves trifoliolate; sepals longer and wider than petals. Fl. white, May–Jun. Quartzite. Rocky areas in open eucalypt woodland.
Eucalyptus ordiana	P2	Tree (mallee), 2–5.5 m high, bark smooth, powdery. Fl. white, Apr–May. Skeletal soils over sandstone or quartzite. Steep rocky outcrops
Fuirena incrassata	P3	Annual, grass-like or herb (sedge), 0.1–0.3 m high, perianth of 3 bristles and 3 clawed scales; scales 3-veined in basal part and thickened distally. Fl. May–Aug. Sand, sandy clay. Swamps, creek beds, claypans, semi-saline lakes.
Grevillea miniata	P4	Spreading to erect shrub or tree, 1.8–5 m high. Fl. yellow, orange, Apr–Aug. Skeletal sandy soils or sandy loam over quartzite or sandstone. Cliffs or rocky slopes, sometimes along watercourses.
Phyllanthus aridus	P3	Erect, much-branched shrub, to 0.25 m high. Fl. cream, green, May–Jun. Sandstone, gravel, red sand.
Triodia bunglensis	P2	Tussock-forming perennial, grass-like or herb, ca 1.5 m high, foliage resinous, panicle spiciform. Fl. Nov–Dec/Apr–Jul. Sandstone. Cliffs, gorges & domes, often in fissures & cracks.

Of these significant flora the Priority 2 Species *Eucalyptus ordiana* is recorded within the search corridor of the proposed alignment works.

2.7 Fauna

2.7.1 Fauna Species

A search of the Western Australian Museum records (*FaunaBase*) was undertaken for the survey area. The museum records show that 2 amphibians, 2 bird species, no fish species, no mammal species and 8 reptile species have been observed in this area (**Table 13, Appendix D**). The small number of species is indicative of the lack of formal surveys in the area, and does not represent the likely number of species present.

2.7.2 Significant Fauna

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 C** and the circumstances under which a project will trigger referral to the DEWR are described in **Appendix D**. 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 11, Appendix D**.

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 legislatory 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 12, Appendix D**.

The DEWR 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 DEWR), 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 DEWR 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 4.**

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.

Table 4 Threatened fauna occurring, or likely to occur, in the survey area as indicated by the EPBC Act Protected Matters Search Tool and the DEC's Rare Fauna Databases

				Conservation Status	
Family	**Genus**	**Species**	**Common Name**	**EPBC Act**	**DEC**
Birds					
Accipitridae	*Haliaeetus*	*leucogaster*	White-bellied Sea-Eagle	Migratory	Schedule 3
Anatidae	*Tadorna*	*radjah rufitergum*	Burdekin Duck	Marine	Schedule 4
Ardeidae	*Ixobrychus*	*minutus*	Little Bittern		Priority 4
Charadriidae	*Charadrius*	*veredus*	Oriental Plover, Oriental Dotterel	Migratory, Marine	
Falconidae	*Falco*	*peregrinus*	Peregrine Falcon		Schedule 4
Glareolidae	*Glareola*	*maldivarum*	Oriental Pratincole	Migratory, Marine	
Maluridae	*Malurus*	*coronatus coronatus*	Purple-crowned Fairy Wren (Western)	Vulnerable	Priority 4
Meliphagidae	*Merops*	*ornatus*	Rainbow Bee-eater	Migratory	Schedule 4
Otididae	*Ardeotis*	*australis*	Australian Bustard		Priority 4
Passeridae	*Erythrura*	*gouldiae*	Gouldian Finch	Endangered	Schedule 1, Endangered

				Conservation Status	
Family	**Genus**	**Species**	**Common Name**	**EPBC Act**	**DEC**
Passeridae	*Heteromunia*	*pectoralis*	Pictorella Mannikin		Priority 4
Passeridae	*Neochima*	*ruficauda subclarescens*	Star Finch (Western)		Priority 4
Petroicidae	*Poecilodryas*	*superciliosa cerviniventris*	Derby White-browed Robin	Migratory	
Rostratulidae	*Rostratula*	*australis*	Australian Painted Snipe	Vulnerable	Schedule 1
Rostratulidae	*Rostratula*	*benghalensis* s. lat.	Painted Snipe	Migratory, Marine	
Scolopacidae	*Numenius*	*minutus*	Little Curlew, Little Whimbrel	Migratory, Marine	
Fish					
Pristidae	*Pristis*	*microdon*	Freshwater Sawfish	Vulnerable	
Reptiles					
Crocodylidae	*Crocodylus*	*porosus*	Estuarine, Salt-water Crocodile	Migratory	Schedule 4
Crocodylidae	*Crocodylus*	*johnstoni*	Freshwater Crocodile	Listed	Schedule 4
Molluscs					
Camaenidae	*Mouldingia*	*orientalis*			Schedule 1
Mammals					

				Conservation Status	
Family	**Genus**	**Species**	**Common Name**	**EPBC Act**	**DEC**
Muridae	*Leggadina*	*lakedownensis*	Lakeland Downs Mouse (Kerakenga)		Priority 4

2.8 Acid Sulphate Soils

The DEC (2006) describes Acid Sulphate Soils (ASS) as naturally occurring soils and sediments containing sulphide minerals, predominantly pyrite (an iron sulphide). In an undisturbed state below the watertable, these soils are benign and not acidic. However if the soils are drained, excavated or exposed by lowering of the water table, the sulphides will react with oxygen to form sulphuric acid.

Inappropriate disturbance of these soils can generate large amounts of sulphuric acid and leaching of contaminants naturally occurring in soils. Flushing of acidic leachate to ground-water and surface waters can cause off site impacts including:

- Ecological damage to aquatic and riparian ecosystems;
- Effects on estuarine fisheries and aquaculture projects;
- Contamination of groundwater with arsenic, aluminium and heavy metals;
- Reduction in agricultural productivity through metal contamination of soils; (predominantly by aluminium); and
- Damage to infrastructure through the corrosion of concrete and steel pipes, bridges and other sub-surface assets.

Mapping of ASS by the Western Australian Planning Commission has been prepared for the Perth Metropolitan Region and the southwest region of the state, where the impact of ASS has been assessed as being more significant. No mapping for the Derby and Fitzroy crossing areas has been prepared, however; the survey areas do not occur in low-lying wetlands, salt marshes or tidal flats. It is therefore considered that ASS would not pose an environmental constraint to construction or materials excavation.

2.9 Contaminated Sites

A search of the Department of Environment and Conservation's Contaminated Sites Database provided no record of contaminated sites or potentially contaminated sites within the survey area.

2.10 Heritage

2.10.1 European Heritage

A search of the Australian Heritage Database, the Australian Heritage Inventory and the Heritage Council of Western Australia databases did not indicate any heritage sites within the immediate vicinity of the survey area however it did list the two Ramsar listed wetlands Lake Argyle and Lake Kununurra and the Ord River floodplain as being in the vicinity of the survey site.

2.10.2 Aboriginal Heritage

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

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 a site of previously unknown Aboriginal heritage is to be disturbed, it is advised that a detailed anthropological and archaeological heritage survey is undertaken to find if there are any sites or objects of significance in that area, as it is an offence to disturb all Aboriginal Heritage sites, even those not contained on the Aboriginal Heritage Site Register. In the event that Aboriginal archaeological or ethnographic sites are discovered during construction, there will be a need to meet the requirements of the *Aboriginal Heritage Act 1972.*

A search of the Department of Indigenous Affairs (DIA) Aboriginal Heritage Inquiry System indicates that numerous Aboriginal heritage sites are located within the vicinity of the survey area. These are shown in **Figure 2**. Search results from the Aboriginal Heritage Inquiry System are provided in **Appendix F**.

The following sites intersect the proposed work areas.

Table 5 Aboriginal heritage sites intersecting the proposed works

Site ID	Site Name	Site Type	Additional info
14011	Standing Rock	Mythological, Man-made Structure	-
14012	Sugar Bag Yard Hole	Mythological	Water Source
14013	Hill, Castlereagh Creek	Mythological	-
14017	Tjamindin/ngoakul	Mythological/Quarry	-
14019	Witikara	Mythological	-
17800	Waringarri/Yulilij complex	-	-
12453	Wilson River Quarry	Quarry, Artefacts/Scatter	-
13083	Margumbarren	Mythological	-
13086	Juri Juri	Mythological	-
14010	Yulitj	Mythological	-

In addition, it should be noted that a search under the DIA database does not comprise of a full assessment under the *Aboriginal Heritage Act WA* 1972. This would require

consultation with Aboriginal people with knowledge of the area (usually, but not necessarily Native Title Claimants), and an archaeological survey.

2.10.3 Native Title

The following native title claims exist over the survey area:

» Malarngowem (Active) WC 99/44

» Lumugal WC 06/1 occurs just to the north of the survey area.

An aboriginal heritage assessment may be required, which may require consultation with the above native title claimants.

2.11 Surrounding Land Use

Land use within the region is predominately pastoral land used for cattle grazing. Smaller sections of land along the Great Northern Highway that are not leased remain as vacant crown land. The impact of the highway upgrade will have minimal affect on the current land use within the region.

Cattle grazing on pastoral leases are often on unfenced properties and stray cattle represent a potential hazard to plant and machinery being used during construction, particularly where land away from the highway is being accessed for gravel within potential borrow pit sites.

2.12 Noise and Vibration

There are no nearby residents in close proximity of the proposed works who will be impacted by noise or vibration generated during construction.

Noise and vibration from traffic occurs at present, however; the volume of traffic is low.

2.13 Ambient Air Quality

Any change in air quality is likely to be negligible.

The sandy soils of the project area may create a potential for the generation of dust during construction and rehabilitation, especially at the proposed borrow pits sites, however; the surrounding project area is not populated and it is therefore considered that dust generated will not cause a significant social constraint.

3. Field Investigations

GHD undertook a field survey to examine and further describe the ecology within the survey area. The methodology and results are detailed below.

3.1 Methods

3.1.1 Flora and Vegetation

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 between the 21st of February and the 1st of March 2007.

The flora and vegetation survey was conducted by undertaking walking transects through each borrow pit and at appropriate locations along the alignment corridor, ensuring that all vegetation types at each borrow pit and along the alignment were surveyed. Additionally, areas that were likely to support unusual flora and fauna, such as creeklines and breakaways were surveyed thoroughly by criss-crossing these areas on foot. The walking transects including recording of flora species and mapping of vegetation types and conditions (including weed status).

A full list of species was generated at each borrow pit and along the alignment corridor. Where identification of flora species was uncertain, confirmation was made at the Western Australian State Herbarium. The presence of Declared Rare or Priority Flora was assessed. Vegetation was also assessed to determine the presence of TECs within the survey area. Aerial photography was used to assist in the delineation of vegetation types present in the survey area and the vegetation was rated according to the vegetation condition scale commonly used in the Perth Metropolitan Region (Government of WA, 2000).

Suitable habitat for DRF and Priority Flora species was searched during the survey to determine the presence of previously unrecorded threatened flora.

3.1.2 Fauna

A reconnaissance survey was undertaken in conjunction with the botanical survey by a qualified ecologist, with regard to the *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia – Guidance Statement No. 56*, EPA, Perth.

An assessment of the likelihood of significant fauna, opportunistic records of fauna species, fauna habitat values, and fauna linkage corridors was undertaken.

Nomenclature

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

Limitations

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

Some flora species, such as annuals, are only available for collection at certain times of the year, and others are only identifiable at certain times (such as when they are flowering). Additionally, climatic and stochastic events (such as fire) may affect the presence of plant species. Species that have a very low abundance in the area are more difficult to locate, due to above factors. 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 (following the peak rainfall period), there is the possibility that some species with low abundance in the area have been overlooked.

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.

The Spring survey covered the entire corridor alignment, an area about 18.5 km long and 400 m wide as well as 28 borrow pits of 458.2 hectares. The large scale of this project meant that sampling was conducted using transects and intensive searching of unique areas that are likely to contain unusual flora and fauna species, such as creeklines and breakaways. The majority of species would have been identified using these techniques but there is the possibility that species with a low abundance, or with a very restricted range in the survey area may 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.

This survey was aimed at identifying the terrestrial vertebrate fauna of the survey area; no sampling for invertebrates or fish occurred. The information available on the identification, distribution and conservation status of invertebrates is generally less extensive than that of vertebrate species.

3.2 Hydrology and Drainage

The field assessment of hydrology and drainage confirmed information portrayed in the desktop assessment. The survey area is criss-crossed with ephemeral watercourses. Water was recorded pooling in historical borrow pits and where adjacent to culverts where material has been excavated to improve water flow, or scoured out from channeling water in artificial channels.

The Bow River was recorded to be flowing at the time of survey.

3.3 Vegetation and Flora

3.3.1 Vegetation Description

The vegetation in the survey area is relatively uniform, and is predominantly open woodland over hummock grasslands. The vegetation type differs in areas on breakaways and along creeklines, as well as directly adjacent to the highway or in areas of old disturbances.

The vegetation was classified into eight communities. These communities have been mapped at **Figure 3** and are summarised below:

- **Vegetation Type 1**: Riparian Vegetation: Vegetation along Bow River and creeklines, *Lophostemon grandiflorus, Eucalyptus camaldulensis, Adansonia gregorii, Terminalia platyphylla, Terminalia canescens, Melaleuca argentea* over mixed grass and herb species.
- **Vegetation Type 2:** Mixed Open Woodlands and Grasslands: *Eucalyptus pruinosa, Eucalyptus brevifolia, Bauhinia cunninghamii* and scattered *Corymbia confertiflora* over shrubs and herbs, such as *Carissa lanceolata, Crotalaria novaehollandiae,* mixed hummock grasses, particularly *Chrysopogon fallax, Heteropogon contortus, Eriachne* spp. and *Triodia pungens.*
- **Vegetation Type 3:** Terminalia Woodlands: *Terminalia canescens* dominated along small drainage lines at the base of the breakaways.
- **Vegetation Type 4:** Boab Woodlands/Creeklines: Along smaller creeklines and in areas that receive more runoff (such as the base of the breakaways) vegetation is similar to the mixed open woodlands and grasslands but Boab (*Adansonia gregorii*) dominate the overstorey.
- **Vegetation Type 5:** Hummock Grasslands with Scattered Trees: Similar species to Vegetation Type 2 but with very open overstorey with only scattered Eucalypt species and *Bauhinia cunninghamii.* Grass species (particularly *Triodia* spp.) are dominant.
- **Vegetation Type 6:** Altered/Degraded Vegetation: In old borrow pits and previously cleared areas the original vegetation communities are no longer intact, there are very few overstorey species and disturbance specialist species are dominant, including *Aerva javanica, Calotropis procera.* A number of introduced species occur in these areas.
- **Vegetation Type 7:** Breakaway Vegetation: Scattered *Eucalyptus* spp., *Grevillea pyramidalis, Flueggea virosa* over herbs and Spinifex grasses (*Triodia* spp.).
- **Vegetation Type 8:** Altered Drainage: Sections along the highway and in old borrow pits where the drainage has been altered. Wetland herb species and grasses are dominant; *Sorghum plumosum* is dominant in some sections.

A description of vegetation present along the highway alignment and in each borrow pit is given in **Appendix B**. These include an examination of the vegetation community present, vegetation condition rating and any other points of interest within the site.

3.3.2 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 as outlined below in **Table 6**.

Table 6 Bush Forever (Government of WA, 2000) vegetation condition rating scale.

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

The vegetation condition of the survey area was rated during the field survey using the Bush Forever scale (**Table 6**) and these conditions are mapped at **Figure 4**.

The condition of the majority of the vegetation in the survey area varies between Condition 1 – 2 (*Excellent* to *Very Good)*. In general the vegetation of the survey area was in excellent condition with little evidence of disturbance and few introduced species. Disturbance was restricted to a number of small, localised areas.

The greatest influence on vegetation condition in the region is from the grazing of livestock and wild fires. Disturbances from livestock were particularly evident around watering holes where the movement of large numbers of cattle had caused considerable trampling of vegetation. Localised disturbances have also impacted on the vegetation at specific sites in the survey area, particularly old borrow pits, quarries and earlier roadworks. Introduced species were mainly found on the edge of the highway, in old borrow pits and along the rivers and creeklines.

3.3.3 Threatened Ecological Communities

No Threatened Ecological Communities were recorded within the survey areas.

No Priority Ecological Communities were recorded within the survey areas.

3.3.4 Flora

Vegetation within the survey areas is considered moderately diverse. A total of 218 species (203 native species) from 51 families were recorded from the survey area. Four taxa could only be identified to family due to lack of flowering parts or fruiting bodies. One taxon also remains as an unknown.

Dominant families recorded included:

Poaceae	39 taxa
Papilionaceae	23 taxa
Myrtaceae	14 taxa
Cyperaceae	11 taxa
Euphorbiaceae	11 taxa

Dominant genera recorded from the survey areas included:

Euphorbia	8 taxa
Acacia	6 taxa
Eucalyptus	6 taxa
Tephrosia	6 taxa
Ipomoea	5 taxa
Fimbristylis	5 taxa

A full list of flora species present in the survey area (delineated into road reserve and the individual borrow pit sites) is provided in **Table 10, Appendix B**.

3.3.5 Declared Rare and Priority Flora Species

No Declared Rare Flora or Priority Listed flora species were recorded during the field surveys.

There is a record in the DEC's Rare Flora Databases of the Priority 2 species *Eucalyptus ordiana* within the search corridor of the proposed alignment works (**Figure 3**). Targeted searches for this species were conducted during the field surveys, including in the specific location indicated in the DEC's records. This species was not located but suitable habitat (steep rocky outcrops) was present and Eucalypt species occurred in this area; however, they could not be identified to species due to lack of flowering or fruiting bodies. It is recommended that rocky outcrops be avoided, where possible, to allow retention of suitable habitat for this species.

A number of Boab trees where observed within the survey area, particularly along creeklines and in flats at the base of some rock outcrops. *Adansonia gregorii* (Boab) is a significant species and individual plants should not be disturbed where possible. Boab is a distinctive deciduous tree of the Kimberley with its root like branches sprouting from the top of its thick trunk. It occurs along waterways and on sandplains where the watertable is shallow. In the survey area there are sections with substantial numbers of Boab at the base of large rock outcrops, which would receive substantial run-off from the outcrops. This species is a 'calendar plant' because when its large white flowers appear, it means the wet season is about to begin. The Boab is traditionally of great importance to indigenous peoples, particularly those of the West Kimberley. Various parts of the tree provide food, medicine, fibre, glue and shelter. The gourd like fruit is rich in protein and Vitamin C and carved as an ornament. The bark of the tree is used for making twine and the gum as glue (DoE, 2004).

3.3.6 Weeds and Introduced Species

A total of 15 weed species was recorded within the survey area, comprising approximately 7% of the total number of plant species recorded within the survey area. Dominant weed families include Poaceae (grasses) and Euphorbiaceae (spurges). Generally, weed invasion is restricted to the edges of the highway, in disturbed areas such as old borrow pits and along creeklines.

Two noxious weeds declared under the *Agriculture and Related Resources Protection Act 1976* (*ARRP Act*) were recorded in the survey area: Parkinsonia (*Parkinsonia aculeata*) and Bellyache Bush (*Jatropha gossypifolia*). Under the *ARRP Act* these plants are 'Priority 1' weeds for the whole of state, which means that the movement of plants and their seeds is prohibited, and 'Priority 4' weeds in the survey area, which means that the spread of infestations from properties must be prevented. Additionally, Parkinsonia is listed as one of the twenty 'Weeds of National Significance' (WONS), which means it has been identified as a weed that is causing significant environmental damage. Parkinsonia and Bellyache Bush were recorded along the Bow River and in the borrow pits adjacent to the river. Significant infestations of Parkinsonia have been mapped at **Figure 4**.

The relatively weed-free nature of the majority of the survey area provides for an excellent opportunity to use topsoil in the rehabilitation of the road reserve. However, specific management should aim to prevent further spread of the existing weeds, particularly Parkinsonia and Bellyache Bush (see Section 5.1.3).

3.4 Fauna

3.4.1 Fauna Species

Reconnaissance fauna surveys in the survey area recorded 56 bird species, eight mammal species, seven reptile and four fish species. A full list of observed fauna is provided in **Table 14**, **Appendix C**.

Birds

The Kimberley region of Western Australia has a very rich bird life, with a number of endemic species. There is a high diversity of woodland birds within the survey area, and a number of these were recorded during the field survey (**Table 14**). Additionally, this area has a relatively high diversity of groups such as the parrots, cockatoos and finches, due to the dominance of grass species in the landscape, which provide an important food source to these predominantly granivorous bird species.

A number of wetland bird species occur in the area on floodplains and along the waterways. A number of bird species were recorded using the pools along the Bow River, and it would be expected that the permanent water sources would become even more important to waterbirds towards the dry season, where dense concentrations of birds can occur in a small area.

The field assessment recorded significant bird species (see Section 3.4.2) from the survey area, including the endangered Gouldian Finch.

Mammals

A number of macropod species (kangaroos and wallabies) occur within the survey area, including the Red Kangaroo (*Macropus rufus*), which was recorded on a number of occasions during the field surveys. A number of other mammal species are known to occur in the general area but many are small and nocturnal and were not sighted during the field survey.

The Echidna (*Tachyglossus aculeatus*) was recorded during a previous visit to the survey area (M. Flower, pers. obs.).

A tentative identification of the Northern Brushtail Possum (*Trichosurus vulpecula arnhemensis*) was made from scats observed on a boab at a creek crossing of the GNH near Mount Nuylasy.

Reptiles

Northern Australia has a great diversity of reptile species and a number of species, including lizards, snakes and crocodiles occur in the general region of the survey area. Snakes and lizards would utilise the variety of habitats within the survey area, from the rocky outcrops to the woodlands and grasslands. A number of lizard species were sighted as they basked on rocks.

Ring-tailed Dragon (*Ctenophorus caudicinctus caudicinctus*), Central Military Dragon (*Ctenophorus isolepis isolepis*), Central Netted Dragon (*Ctenophorus nuchalis*), *Diporiphora lalliae* and the Ta-ta lizard (*Lophognathus gilbertii*).

Amphibia

As a generalisation, Western Australia is particularly rich in burrowing amphibian species. It is considered that the Kimberley is likely to contain presently unrecorded frog species, particularly due to the difficulty of access during the wet season.

A number of amphibian species may occur in the survey area around the waterways and wetlands. A number of tadpoles were briefly sighted during the field survey, in small

muddy pools and puddles along ephemeral waterways. No species identification was possible due to the muddy nature of the water and lack of specimens collected.

Fish

The Kimberley region supports a number of fish species, including a relatively high number of endemic species. These fish species occur in the numerous waterways in the area but are strongly influenced by the fluctuating seasons in this area, with many of the creeks and rivers drying out in the dry season.

A number of small freshwater fish species were recorded during the field survey, including some in very small drying puddles. Fish recorded during the field survey included the Hardyhead (*Craterocephalus sp*.), Bony Bream (*Nematalosa erebi*), Spangled Perch (*Leiopotherapon unicolour*) and the Archer Fish (*Toxotes chatareus*).

3.4.2 Significant Fauna

The desktop surveys indicated that a number of protected fauna may occur within the survey area (**Section 2.7.2**). The habitat requirements of these species and the likelihood of their occurrence in the site (with information from the field surveys) are considered below.

White-bellied Sea-Eagle (*Haliaeetus leucogaster*) Schedule 3

The White-bellied Sea-Eagle is a large bird of prey that occurs through India, South-east Asia and Australia. This species occurs in coastal and near-coastal areas of Australia but can also be found inland on major waterways. In the Kimberley this species is common along the coast and at Lake Argyle. It is also known from Lake Kununurra and Argyle Diamond Mine.

Assessment This species is generally found on large bodies of water, such as significant waterways and the ocean. The survey area does not contain optimal habitat for this species and it would be unlikely to occur on the site, except occasionally as a vagrant.

Burdekin Duck (*Tadorna radjah rufitergum*) Schedule 4

The Rajah (Burdekin) Duck is a water bird found in northern Australia, including the north-west of the Kimberley. This species generally inhabits mangrove flats and paperbark swamps but will also visit inland freshwater lagoons and river pools during the wet season.

Assessment This species occurs in the general region of the survey area, at Lake Argyle, Kununurra, Ord River and Argyle Diamond Mine. A pair of this species were observed during a follow-up survey for the Gouldian Finch along the Bow River.

Little Bittern (*Ixobrychus minutus*) Priority 4

This bird species occurs in the north-east of the Kimberley, across to the Northern Territory. The Little Bittern tends to inhabit freshwater swamps, lakes and rivers and prefers well-vegetated margins. It can also occur in brackish areas and coastal lagoons.

Assessment This species occurs in the general region of the survey area and may occur in the larger pools within the survey area, such as along Bow River. This species was not located during the field survey and is generally uncommon in the area.

Peregrine Falcon (*Falco peregrinus*) Schedule 4

The Peregrine Falcon is a bird of prey that occurs throughout Australia, and is widespread across all continents except for Antarctica. The Peregrine Falcon is uncommon but not endangered in Australia; however it is considered endangered on a global scale. This species is a Schedule 4 species under the *Wildlife Conservation Act 1950*, which classifies it as "Other Specially Protected Fauna".

Habitat Assessment This species is uncommon in the area but could potentially utilise the survey area for foraging and it may breed in areas with rocky ledges, cliffs and watercourses. It was not recorded during the field survey

Purple-crowned Fairy Wren (Western) (*Malurus coronatus coronatus*) Vulnerable

The Western Purple-crowned Fairy Wren generally occurs alongside permanent rivers and swamps, in riparian vegetation. It occurs along waterways in the Kimberley and east to the Victoria River in the Northern Territory. It occurs along parts of the Fitzroy River, Drysdale River, Durack River and Ord River systems (DEWR, 2007).

Assessment There is a known population of this species on the Bow River (DEWR, 2007) and this species may occur in the survey area, though it was not recorded during the field survey.

Australian Bustard (*Ardeotis australis*) Priority 4

The Australian Bustard is a tall plains bird that occurs across much of Australia, including across most of WA, excepting heavily wooded areas in the south. The Australian Bustard occurs mainly in open country, such as low heath or lightly wooded grassland. This species is often found in recently burnt areas.

Assessment Australian Bustards occur in the survey area and were sighted adjacent to the highway on a number of occasions during the field survey.

Gouldian Finch (*Erythrura gouldiae*) Endangered

The Gouldian Finch was formerly distributed across northern Australia but now occurs only in a few sites in Queensland and at scattered locations across the Northern Territory and in Western Australia. This species lives in savannah woodlands with a grassy understorey, often in hilly areas and around permanent waters. Gouldian Finches nest in tree hollows, particularly Snappy Gum (*Eucalyptus brevifolia*) in Western Australia and feed on grasses.

Assessment Gouldian Finches are known from the general region of the survey area and a single Gouldian Finch was sighted during the field surveys at Bow River, adjacent to Borrow Pit 2 (**Figure 3**).

Pictorella Mannikin (*Heteromunia pectoralis*) Priority 4

This bird species occurs in the drier northern tropical grasslands of Australia. It occurs from the Kimberley in Western Australia to Queensland. It mainly inhabits open grassland or Spinifex country with occasional trees or grassy flats around creeks. Pictorellas must visit water once a day but can travel a large distance every day. This species has been recorded from Lake Argyle and the Argyle Diamond Mine.

Assessment This species is known from the general region of the survey area and may occur in the survey area. It was not recorded during the field survey.

Star Finch (Western) (*Neochima ruficauda subclarescens*) Priority 4

The Western Star Finch occurs in the north of Western Australia with separate populations in the Pilbara and the Kimberley. This finch species is nomadic and inhabits grasslands and eucalypt woodlands near water. It tends to favour lush green riparian vegetation. Star Finches have been recorded from Argyle Diamond Mine.

Assessment The Western Star Finch occurs in the general area and may inhabit parts of the survey area near the rivers and creeklines. This species was not recorded during the field survey.

Australian Painted Snipe (*Rostratula benghalensis australis*) Vulnerable/Schedule 1

The Australian Painted Snipe is an aquatic bird species that has a scattered distribution throughout Australia. This species is found in shallow inland waters. It can occur in both fresh and brackish waters and in wetlands that are permanently or temporarily filled. The Australian Painted Snipe nests amongst reed-like vegetation near water.

Assessment This species is known from records in the west of the Kimberley and in the Northern Territory but is not common from the general region of the survey area. Additionally, there are no significant wetlands within the survey area and this species would be highly unlikely to occur in the survey area.

Freshwater Sawfish (*Pristis microdon*) Vulnerable

The Freshwater Sawfish is known from fresh or weakly saline rivers in northern Australia, including the Fitzroy, Durack and Ord Rivers in Western Australia. This species appears to be restricted to the larger tributaries of the major rivers, such as the Fitzroy River (Morgan *et al.,* 2002).

Assessment This species is unlikely to occur in the smaller rivers and creeklines within the survey area, but may occur in the Bow River.

Freshwater Crocodile (*Crocodylus johnstoni*) Schedule 4

Freshwater crocodiles are widespread across northern Australia and occur in permanent freshwater rivers, gorges and billabongs.

Assessment Freshwater Crocodiles occur in the waterways in the area and may occur in the survey area, dependent on the water levels of the rivers in the area. This species was not sighted during the reconnaissance surveys.

***Mouldingia orientalis* Schedule 1**

Mouldingia orientalis is a land snail known from limestone hillocks west of Lissadell Homestead. It is thought that the range of this species has been significantly reduced by the flooding of the Ord River Valley.

Assessment This species is not known to occur in the survey area, but was not assessed during this survey, as the reconnaissance fauna survey was restricted to vertebrate species.

Lakeland Downs Mouse (Kerakenga) (*Leggadina lakedownensis*) Priority 4

The Lakeland Downs Mouse occurs in tropical coastal northern Australia, including the Kimberley. Generally this species is found in moist tussock grassland or tropical savannah. This species is known from Argyle Diamond Mine.

Assessment The survey area contains habitat for this species and there is the potential for this mouse to occur in the survey area. Confirmation of the presence of this species is considered to require extensive trapping surveys.

Migratory Species

A number of Migratory species, protected under the *EPBC Act,* may occur in the survey area and two of these species were recorded during the field survey; the Common Sandpiper (*Tringa hypoleucos*) and the Rainbow Bee-eater (*Merops ornatus*). The Common Sandpiper occurs across much of Australia, generally uncommon and scattered. This species inhabits a variety of coastal and inland wetlands. Rainbow Bee-eaters are common throughout most of Australia and are highly migratory, wintering in the north of Australia, and offshore islands, including New Guinea. Rainbow Bee-eaters were common throughout the survey area, particularly at watercourses and pools.

3.4.3 Introduced Species

A number of introduced species were recorded from the survey area, including domestic livestock. These included:

- *Bos indicus* Brahman Bull
- *Canus familiaris* ?Domestic/Camp Dog
- *Equus caballus* Brumby
- *Felis catus* Feral Cat

3.4.4 Fauna Habitat and Linkages

Within the Bow section area, the extent of vegetation remains relatively unaltered apart from localised impacts from roadworks, mining and pastoral activities.

Habitat Types

There are four main habitat types within the survey area:

- Woodlands;
- Grasslands;
- Breakaways;
- Wetlands/Creeklines.

Better habitat (that which is least impacted by roadworks or pastoral activities) includes the breakaways and creeklines. Breakaways provide shelter for a number of fauna species including reptiles and small mammals. Creekline vegetation – riparian vegetation

is often described as containing the highest diversity of plant species available for refuge or forage resources for fauna species.

Habitat Importance

Most of the Bow section vegetation is in pristine-excellent condition and retains good quality habitat value. The current pits are considered to retain little habitat value.

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 are important in areas where extensive clearing has occurred to help overcome the effects of habitat fragmentation. These corridors assist in maintaining genetic diversity through connection of gene pools, enabling recolonisation of disturbed areas and the provision of habitat. Where contiguous bushland areas can not be maintained a connection can still be maintained through “stepping stones”, which are isolated patches of vegetation close enough together to allow certain species to move between them. Stepping stones are primarily of importance to very mobile species such as birds. Birds often require ‘flyways’, vegetated areas along a bush corridor, which they can use to move between habitat areas. These corridors can provide shelter from predators and rest sites.

The project area is not considered to contain any significant breaks to habitat linkages, being completely surrounded by relatively unaltered rangeland. Creekline and riparian vegetation is considered to be vital for providing corridors for fauna species utilising waterways and pools.

3.4.5 Fauna Impacts

Upgrade of the Bow section is considered to have minimal impact on fauna species, as no species are considered to use the site exclusively. It is not considered that the extraction of material for the highway upgrade will significantly alter the fauna habitat of the region. It can be considered that a disturbance will occur on a local scale, which is likely to impact on individual animals, rather than a species. The Bow section survey area is wholly surrounded by continuous vegetation, with major disturbance by fire and/or livestock grazing. The survey area does not contain vegetation or habitat zones that are not present within the surrounding areas.

Impacts are likely to occur to individual animals and include:

» Minor loss of habitat and feeding areas. This is not considered to be a substantial impact on current areal extent of habitat. There will be a minor loss of refuge vegetation and associated foraging resources.

» Harm/deaths/displacement of individual animals may occur during borrow pit excavation and road construction activities.

4. Clearing of Native Vegetation

4.1.1 Assessment Against the Clearing Principles

Main Roads Western Australia was issued with a statewide vegetation clearing permit (Purpose Permit CPS 818/3), granted under section 51E of the *Environmental Protection Act 1986*, on the 1st February 2006 by the Department of Environment and Conservation. The Purpose Permit allows Main Roads to clear native vegetation for project activities. Any clearing of native vegetation must be assessed against the ten clearing principles outlined in the permit.

This project has been assessed against the ten clearing principles below in **Table 7**. The project has been assessed to be not at variance with the clearing principles.

Table 7 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.	The remnant native vegetation is considered to contain a moderate to high level of biological diversity. The biological diversity within the survey area is similar to that of the surrounding area. Breakaways and rocky hills within the Kimberley tend to support unusual species, including endemic species and have a higher diversity than the surrounding areas. Where possible, it is recommended that the breakaways and rocky hills be retained.	Clearing is unlikely to be variance with principle. Where possible breakaways and rocky hills should be retained.
(b)	Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	The survey area supports a number of native fauna species, including some significant fauna species, such as the Gouldian Finch (Endangered) and the Australian Bustard (Priority 4). However, the habitat of the survey area is not unique and there are large areas of suitable habitat for these species adjacent to the survey area. The habitat within the survey area cannot be thought of as 'significant habitat' for these species. The presence of these species should be addressed in the management plans for these works and direct impacts on these species avoided (see Section 5.2)	Clearing is unlikely to be variance with 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.	No Declared Rare or Priority flora species were recorded during this survey. There is one record of the Priority Two species *Eucalyptus ordiana* within the survey area and it is recommended that the area in which it has previously been recorded be avoided. This species was not recorded during this survey.	Clearing is unlikely to be variance with principle. Impacts on previously recorded *Eucalyptus ordiana* should be avoided.
(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.	The native vegetation within the survey area does not comprise of the whole or part of, nor is necessary for the maintenance of a TEC.	Clearing is unlikely to be variance with 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.	The native vegetation recorded within the survey areas is not considered to be under-represented, with 100% of the pre-European vegetation extents remaining. All of the vegetation types within the survey area are widespread and occur across the Kimberley.	Clearing is unlikely to be variance with principle.
(f)	Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.	There are a number of smaller drainage lines within the survey area but these waterways are ephemeral, and typically flow or fill during seasonal rainfall events. The vegetation along these drainage lines is not considered to be wetland dependant, due to the ephemeral nature of the drainage lines and creeks within the survey area. The Bow River is located in the south of the survey area; however, it is not known at this stage whether clearing along this waterway will be required.	Clearing is unlikely to be variance with principle, unless clearing along the Bow River is required. Clearing of vegetation along Bow River should be avoided and existing disturbed areas used for any roadworks required in this area.

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.	The clearing of remnant native vegetation will cause some alterations to the health of adjacent lands, such as through weed dispersal. The amount of vegetation required to be cleared is minimal compared to the remaining vegetation within and adjacent to the survey area and this clearing will not cause 'appreciable land degradation'. Appropriate management plans will be required to mitigate potential impacts.	Clearing is unlikely to be variance with principle. Potential impacts should be addressed in appropriate management plans.
(h)	Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	The remnant native vegetation is not associated with any adjacent or nearby conservation areas.	Clearing is unlikely to be variance with principle.
(i)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water	The potential clearing of remnant native vegetation is not likely to cause deterioration in the quality of surface or underground waters. The amount of vegetation required to be cleared is minimal compared to the remaining vegetation within and adjacent to the survey area. Clearing near waterways (such as Bow River) should be appropriately managed to prevent any potential impacts, such as erosion and sedimentation.	Clearing is unlikely to be variance with principle. Potential impacts should be addressed in appropriate management plans.
(j)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.	The amount of clearing of native remnant vegetation required for this project is low and is not considered to be likely to cause, exacerbate, the incidence or intensity of flooding events.	Clearing is unlikely to be variance with principle.

5. Management of Environmental Impacts

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

5.1 Flora and Vegetation

Clearing of native vegetation will be required for both the upgrade of the highway and material extraction. Potential impacts on flora and vegetation are not only restricted to loss of native vegetation within the clearing area but also to impacts on the vegetation adjacent to the disturbance, due to edge effects and potential fragmentation of the remaining vegetation.

5.1.1 Avoidance of Impacts

» Avoid impacting areas of variable vegetation, such as vegetation along creeklines, rock outcrops and breakaways as these areas generally tend to have higher biodiversity values and are of value as fauna habitat.

» Boab trees hold cultural significance to Aboriginal people disturbance to Boab trees will be avoided wherever possible.

5.1.2 Management of Clearing

» Clearing will be kept to the minimum necessary for the soil extraction and access tracks;

» Access tracks, vehicle parking and temporary materials storage will be located on existing cleared areas or on grassy sites which incur minimum loss of trees and shrubs; and

» Once the pits are exhausted, the disturbed areas will be rehabilitated as soon as possible.

5.1.3 Weed Management

A number of weeds were recorded during the field survey, including two declared plants: Bellyache Bush and Parkinsonia (which is also a WONS). There is a risk of spreading these weed species during proposed works but these impacts can be managed through cleaning vehicles and machinery of soil and vegetative material after entry to these areas. These weeds should be controlled where they are found on Main Roads land within the survey area. Control Actions for these weeds have been attached at **Appendix G**.

The following management actions will apply:

» All vehicles and machinery will be cleaned of plant material and soil before and after entering known weed areas.

» If imported soils and materials are to be used, they will be certified weed free.

5.1.4 Treatment of Cleared Vegetation and Topsoil

Any vegetation or soil removed as part of the works will be treated so as not to damage remaining vegetation or alter surface drainage.

The majority of seeds present within topsoil are held within the top 100 mm of soil. Where vegetation has been cleared (trees and shrubs removed), the top 100 mm of soil from these areas will be stripped and stored in stockpiles no more than 1 m in height. Management of topsoil stockpiles is imperative to maintaining the value of the stored material, as topsoil represents a valuable tool for revegetation and rehabilitation. The storing of topsoil for extended periods of time is also known to decrease the viability of the soil seed reserves, which results in depressed levels of recruitment once the soil is re-spread.

Topsoil should therefore be removed in stages representative of the progress of the highway rehabilitation. Topsoil should then be re-spread evenly at the completion of the roadworks to a depth of 75 to 100 mm over disturbed soil surfaces.

The following management actions will apply:

- Cleared vegetation will be retained on-site for use in site rehabilitation and erosion control;
- Cleared vegetation will not be burnt on-site;
- Stripped topsoil will be retained adjacent to the temporary side tracks, pits, and other disturbed area for use in rehabilitation;
- Any removed topsoil should be used as soon as possible following works;
- Materials and topsoil stockpiles will be located so as not to restrict or interfere with existing drainage; and

Any spoil produced will be used to fill borrow pits or spread evenly over cleared or thinly vegetated areas to ensure that sheet flow drainage is not adversely impacted by windrows or stockpiles.

5.2 Fauna

This project will have impact on native fauna through loss of habitat and habitat linkages. However, the clearing required for this project will be minimal, relative to the remaining habitat areas surrounding the works area.

The upgrade of the highway is not likely to have any major impacts on fauna, as an existing highway is being upgraded and impacts on fauna already exist in this area. Additionally, the clearing required for temporary access ways and borrow pits will be temporary. Individual animals are likely to move from the areas disturbed by construction activities, but should return once the works are complete and the land rehabilitated.

Impacts on important habitat areas should be avoided, where possible. Important habitat areas include riparian vegetation along creeklines and around water pools, and rock outcrops and breakaways.

Risks and management options for specific significant fauna species are discussed below.

5.2.1 Gouldian Finch

The Gouldian Finch is under threat due to the fact that it feeds exclusively on seed from a handful of wet-season grasses, which can be in short supply at the onset of the wet season, depending on previous season's fire and rainfall. Grazing by stock and feral animals combined with unfavourable fire regimes are considered to cause the greatest decline in Gouldian Finch numbers.

Outside of the breeding season the Gouldian Finch is partly migratory (Australian Museum, 2003). Birds move in quite large flocks to more coastal areas and return back inland to breed when the rainy season arrives.

To minimise potential impact on this species it is considered that construction works be undertaken during the dry season.

5.2.2 Other Fauna Species

During the works in all areas the following management actions should apply:

- If possible, undertake clearing at a time of year that is least likely to impact on breeding or nesting species (i.e. avoid clearing from late in the wet season to the early dry season),
- Ensure borrow pits are left hydrologically neutral to prevent water pooling which may enhance the success of feral fauna species.
- No pets, traps or firearms will be allowed on the project site
- Barriers to native fauna movement will be minimised
- Any animals disturbed by the works should be allowed to leave the site before further work occurs
- No native fauna (including venomous snakes) will be impaired or killed by construction personal. Fauna can only be destroyed as a last resort by a designated and trained person; and
- Any trenched or open excavations will be checked daily for fauna and any fauna will be removed as soon as possible without damage to the animal.
- Minimise or restrict movement and use of plant and vehicles at dusk and dawn and during night-time hours; and

5.3 Aboriginal Heritage

Ten Aboriginal heritage sites intersect the proposed works and many more sites are listed on the surrounding land. The proximity and number of Aboriginal heritage sites requires referral to Main Roads' Aboriginal Liaison Officer, and it is also likely an archaeological and ethnographic survey will be required.

There is the potential that material of significance to Aboriginal people is discovered or uncovered during the project. Requirements for management of such items are bound by the Aboriginal Heritage Act as follows:

- If any human skeletal material is uncovered, work shall cease within 20 m of the material and it shall be reported to the Police as soon as possible;
- If any artefacts or material of apparent Aboriginal origin is discovered, work shall cease within 20 m of the material and the Project Manager shall acquire the services of a qualified archaeologist to investigate the material and take the appropriate actions.

5.4 Visual Amenity

There will be no major visual impact from the establishment of the majority of the borrow pits for the Great Northern Highway rehabilitation project. Most of the current borrow pits are at such a distance from the current highway alignment as to have surrounding bushland obscure the view of the pits from motorists. The new borrow pit sites are also at such a distance from the road that visual amenity of the landscape will not be impacted.

Machinery storage areas, stockpiling of soils and campsite establishment during works will be a temporary source of visual impact.

To minimise the longer-term visual impact the following should occur:

- No spoil heaps or other materials will be left in view of the road;
- Rehabilitation will be carried out as soon as possible following completion of works in each area.

5.5 Construction Issues

A range of construction impacts are predicted or possible. These include:

- Noise and vibration;
- Dust production;
- Pollution through the use of fuels, chemicals or from general construction rubbish; and
- Traffic management requirements.

The management of these impacts will include the following general actions.

5.5.1 Noise and Vibration

Construction noise will occur due to earth works, road rehabilitation works and vehicle movement along Great Northern Highway and the access tracks. As there are no residents in close proximity, noise and vibration will not pose a social constraint.

5.5.2 Dust Reduction and Mitigation

Dust may be generated from the clearing of vegetation, earthworks, spillage of soil material and vehicle movements along sealed and unsealed roads. The following methods of dust management will be used:

- Water tankers will be available at all times to wet down exposed surfaces on works areas, laydown sites, spoil dumps and topsoil and materials heaps;
- Minimise as far as possible dust generating activities;

» Dust lift will be monitored through visual and other means and all complaints responded to rapidly; and

» Dust from movement of vehicles will be managed at all times. This will include wetting down, road sweeping, and the implementation of suitable speed limits.

5.5.3 Pollution and Rubbish

There is a minor risk that the construction works will create temporary pollution as a result of fuel or chemical spills or mismanagement of construction materials. This will be managed through the following general actions:

» Any bulk fuel and oil stores will be bunded and managed in accordance with Australian Standards;

» If vehicle or machinery servicing is to occur on site it will occur in designated servicing areas which are supplied with adequate spill trays and spill response equipment; and

» All rubbish and construction waste will be contained in lidded bins and removed regularly to an approved landfill.

5.5.4 Access and Traffic Management

Increased traffic volumes arising from the movement of construction and transport vehicles may result in some localised short-term adverse impacts on local and regional traffic movements. The following potential impacts have been identified:

» Risk of injury to road users due to construction vehicles operating at the sites; and

» Potential damage to roads and spillage of carted materials, particularly sand.

Management strategies to be employed will include:

» The use of appropriate personal safety and traffic management signs;

» Advance notification of construction activities, particularly to local residents; and

» Any significant amounts of material spilled from construction vehicles will be cleaned up on occurrence.

5.6 Alterations to Waterways and Drainage

Drainage impacts during construction works are issues in respect to maintaining existing surface water flows. As the majority of drainage on the surveyed areas is intermittent and poorly defined the risks of significant impacts to surface water flows are low. Rehabilitation works may interfere with the defined drainage lines of the non-perennial, Bow River and the creeks that surround the area. The following impacts are likely to occur:

» Works on the floodway zone have the potential to cause downstream deposition;

» There are minor risks of erosion in the pit areas; and

» Pit excavation has the potential to create temporary pools following rainfall.

5.6.1 Drainage Management

In order to mitigate any drainage impacts that may occur, the following management measures will be initiated:

» Borrow pits will be shaped, where possible, to ensure that water retention does not occur within excavated areas;

» Existing natural drainage paths and drainage channels along road reserves will not be unnecessarily blocked or restricted by material stockpiles; and

» Any material that is found to block drainage will be removed.

Rehabilitation works carried out on road edges have the potential to temporarily impact on local drainage flows through scouring and subsequent silt deposition.

The following management will be applied:

» Vegetation and soil disturbance will be minimised around works; and

» Disturbed areas will be compacted and stabilised as soon as possible.

5.6.2 Water Extraction and Waterways Impacts

Where dewatering, obstruction of groundwater or modification of stream banks in major waterways is required for roadworks, Main Roads will need to compete the relevant application form as indicated below. Application forms are available from the DoW website:

» For dewatering – 'Application for a 5C Licence to take Groundwater' (Form A); and

» For modifying beds and banks – 'Application for a 5C licence to take surface water / Application for a 11/17/21 A permit to modify bed and banks / Application to amend a 11/17/21A permit to modify bed and banks' (Form C).

5.7 Rehabilitation

Rehabilitation of the project area is important to ensure that any visual and environmental impacts of the works are short term. The following rehabilitation procedures will be carried out during and after construction works:

» Pits will be shaped and contoured to ensure that the likelihood of water ponding is reduced;

» Any compacted ground will be ripped or scarified where revegetation is required;

» Cleared topsoil and vegetation will be respread over disturbed areas;

» All rubbish, materials heaps or other debris will be removed; and

» Access tracks will be deep ripped and blocked off where possible.

5.8 Environmental Management

5.8.1 Inductions and Training

» Construction personnel should be made aware of the issues and actions in this Management Plan so that they do not unnecessarily damage the environment during the works phase.

» Emergency training in relation to fires, chemical spills or other risks shall be carried out early in the construction phase.

5.8.2 Management of Environmental Incidents

The process that will be followed in the event of an environmental incident occurring will include:

» Reporting of the incident in an incident log;

» Time limits for incident reporting and response;

» Assessment of the significance of each incident;

» Discontinuation of the work which gave rise to the incident;

» Reporting incidents to regulatory authorities and stakeholders; and

» Satisfactory and timely remediation/mitigation of impacts.

6. Requirement for Referral

6.1 Commonwealth Government

A review of the Department of Environment and Water Resources (DEWR) online database was conducted as part of preparing this EIA. There are no environmental impacts or issues 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 Government

6.2.1 Environmental Protection Authority

The proposed project incorporates the rehabilitation of the existing pavement overlay and widening of three sections of the Great Northern Highway. The Main Roads Purpose Permit (812/3) which been granted to Main Roads under section 51E of the *Environmental Protection Act 1986*, allows the clearance of native vegetation for this project activity. However, this Permit does not authorise the clearance of native vegetation for project activities where:

» The clearing may be seriously at variance with the clearing principles; or

» Those project activities are incorporated in any proposal that is referred to and assessed under Part IV of the EP Act by the EPA.

An assessment of the proposed rehabilitation works was completed and the project was not found to be at variance with these principles. It is anticipated that this project will not require formal referral to the Environmental Protection Authority under the *WA Environmental Protection Act 1986*.

6.2.2 Department of Environment and Conservation

The project has been assessed to not be at variance with the ten clearing principles. However, a number of management measures have been outlined to minimise any potential environmental impacts from this proposal.

An application for a clearing permit from the Department of Environment and Conservation (DEC) is not required, however; the requirement for a clearing permit should be considered in relation to the Main Roads Purpose Permit regional clearing limits. The maximum annual clearing limit for the Kimberley region is 200 hectares.

7. Conclusions and Recommendations

An Environmental Impact Assessment (EIA) conducted for the Great Northern Highway Reconstruction Project (Bow Section) indicated that no direct environmental constraints associated with the proposed works were recorded for the survey area.

7.1 Existing Environment

In summary, the following conclusions on environmental aspects are made:

- No reserves or conservation areas are located within or in the vicinity of the study areas;
- The survey area is criss-crossed with ephemeral watercourses. Water was recorded pooling in historical borrow pits and adjacent to culverts where material has been excavated to improve water flow, or scoured out from channelling water in artificial channels.
- The Bow River was flowing at the time of survey.
- The Canning-Kimberley Groundwater Area covers the entire Kimberley sub-region. Where dewatering, obstruction of groundwater or modification of stream banks is required for roadworks and bridge construction, Main Roads will need to compete the relevant application form as indicated below:
    - For dewatering – 'Application for a 5C Licence to take Groundwater' (Form A); and
    - For modifying beds and banks – 'Application for a 5C licence to take surface water / Application for a 11/17/21 A permit to modify bed and banks / Application to amend a 11/17/21A permit to modify bed and banks' (Form C);
- Works will temporarily increase runoff and sedimentation. With appropriate management actions in place, alteration to hydrology and drainage is not considered likely to be adversely impacted by this project;
- No Environmentally Sensitive Areas are located within or near the vicinity of the study areas;
- A search of the Department of Indigenous Affairs (DIA) Aboriginal Heritage Inquiry System indicates that numerous Aboriginal heritage sites are located within the survey area. Main Roads should consider this in any decision making with respect to whether a full Aboriginal site assessment should be undertaken;
- The vegetation types described for the survey area are: Low tree savannahs and hummock grasslands: Gently undulating terrain on a variety of sedimentary rocks support low Snappy Gum (*Eucalyptus brevifolia*) over hummock grasslands and gently sloping floodplains support *Melaleuca minutifolia* low woodland over annual sorghums (Graham, 2003c); Savannah woodland over *Triodia* spp. and/or bunch grass; and

Grassland with scattered bloodwoods (*Eucalyptus* spp.) and Snappy Gum (*Eucalyptus brevifolia*)

- Based on the current extent of vegetation types in the survey area, they are classified as *Least Concern* in terms of extent of vegetation remaining compared to pre-European extents.
- The condition of the majority of the vegetation in the survey area varies between Condition 1 – 2 (*Excellent* to *Very Good)*. In general the vegetation of the survey area was in excellent condition with little evidence of disturbance and few introduced species. Disturbance was restricted to a number of small, localised areas.
- Desktop surveys identified that there are no known occurrences of Threatened Ecological Communities (TECs) within the study area; however, there are occurrences of 2 known Priority Ecological Communities (PECs) within 30 kilometres of the study area. No TECs or PECs were identified during the field survey.
- The study area contains 8 vegetation types and is considered to contain a moderate species diversity. A total of 218 taxa from 51 families was recorded for the study area. No Declared Rare Flora or Priority flora species were recorded during the survey.
- A total of 15 weed species was recorded within the study area, with weed invasion generally restricted to the edges of the highway and along access tracks and cleared areas, such as the infiltration basins, except for Buffel Grass (*Cenchrus ciliaris*), deliberately introduced across much of the rangelands of Western Australia.
- Two noxious weed species (Declared Plants, WONS) were recorded from the survey area.
- A search of the Western Australian Museum's Fauna Database, *FaunaBase,* for an area in a 5 km radius around the study area revealed that 2 bird, no mammal, 8 reptile, 2 amphibian and no fish species have been recorded from the vicinity of the study area. A number of fauna species, particularly birds (56 species), mammals (8 species) and reptiles (7 species) were identified in the field surveys. It should be noted that the field survey was only a reconnaissance survey and no detailed fauna surveys, including trapping, have been undertaken. There are a number of cryptic species that may occur in the study area that can only be identified through further detailed studies.
- Desktop surveys identified a number of protected fauna species that potentially occur within the study area. The field survey did record the Endangered Gouldian Finch within the survey area. Other protected species may occur within the study area on occasion.
- A number of introduced species occur within the study area, including the Brumby, and Feral Cat. Control of resource availability – primarily introduced grasses and water sources (water pooling in historical borrow pits) – can help minimise any increase in feral animal usage of the area caused by project disturbances.
- The survey occurs in relatively unaltered habitat (apart from impacts by mining, roadworks and pastoral activities) and as such currently provides an unbroken habitat between the survey area and surrounds.

- Most of the survey area contains good quality fauna habitat and a number of different habitats are present within the study area, including breakaways, creeklines, grasslands and woodlands. The survey area occurs in a region in which much of the vegetation has been relatively unaltered. The survey area is not considered to contain significant habitat not found in adjacent areas.
- Fauna habitat and linkages will not be significantly disturbed or disrupted by the works planned for these sections. It is not considered that the extraction of material for the highway upgrade will significantly alter the fauna habitat of the region. It can be considered that a disturbance will occur on a local scale, which is likely to impact on individual animals, rather than a population

7.2 Management of Impacts

The greatest impact from the proposal to upgrade the Bow Section will be the minor loss of habitat from borrow pit areas and the potential to increase weed species across the survey area due to disturbances from roadwork activities. The disturbance of the survey area may cause indirect impacts on the rest of the study area, such as through the introduction of exotic species (particularly weeds) and fire. This will need to be carefully managed (see below).

Avoidance of unnecessary clearing of vegetation should be the first priority for managing impacts on flora and fauna.

It is also recommended that the sections of 'unusual' vegetation, such as that along creeklines, rocky outcrops and breakaways, should be avoided where possible, as they contain areas of high habitat value.

Where it is not possible to avoid clearing of native vegetation, impacts can be minimised and managed by a number of measures which are outlined below.

- Minimise clearing, particularly for borrow pits and associated access tracks;
- Avoid clearing or impacting areas with good quality vegetation such as outcrops or breakaways;
- Use areas adjacent to existing disturbance sites in preference to areas that are within undisturbed native vegetation;
- Ensure borrow pit areas are designed and developed to minimise pooling and associated spread of weed species and feral fauna;
- Post-construction, borrow pits and access tracks will be ripped to allow the establishment of native flora.

Any impacts on flora and fauna that cannot be avoided or minimised during the planning stage should be mitigated through management measures that can be undertaken just prior to, during and post-construction.

Specific management actions for the Gouldian Finch indicate that construction works be undertaken during the dry season to avoid impacting the birds during the breeding cycle.

Management of indirect impacts on the rest of the study area, i.e. weed management, will be a high priority for any works undertaken in the relatively undisturbed sections of bushland and along creeklines.

Other impacts addressed include:

» Noise, dust and vibration from construction works are not likely to cause a major impact, however, should be managed for the safety of road users and construction personnel;

» Appropriate fire and waste management should be undertaken to reduce the risk of disturbance to the environment adjacent to the proposed works; and

» There is a minor risk that the construction works will create temporary pollution as a result of fuel or chemical spills or mismanagement of construction materials. This can be controlled with appropriate risk management and mitigation actions.

7.3 Requirement for Referral

There are no environmental impacts or issues 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.

It is anticipated that this project will not require formal referral to the Environmental Protection Authority under the *WA Environmental Protection Act 1986*.

This project has been found not to be at variance when assessed against the 10 Clearing Principles.

However, a number of management measures have been outlined to minimise any potential environmental impacts from this proposal.

An application for a clearing permit from the Department of Environment and Conservation (DEC) is not required, however; the requirement for a clearing permit should be considered in relation to the Main Roads Purpose Permit regional clearing limits. The maximum annual clearing limit for the Kimberley region is 200 hectares.

8. Report Limitations

This report presents the results of a vegetation and flora assessment undertaken in February and March 2007 for the purpose of this commission. The data and advice provided herein relate only to the project and structures described herein and must be reviewed by a competent scientist/botanist before being used for any other purpose. GHD accepts no responsibility for other use of the data.

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

An understanding of site conditions depends on the integration of many pieces of information, some regional, some site specific, some structure specific and some experience based. Hence, this report should not be altered, amended or abbreviated, issued in part or incomplete in any way without prior checking and approval by GHD. GHD accepts no responsibility for any circumstances that arise from the issue of the report that has been modified in any way as outlined above.

9. References

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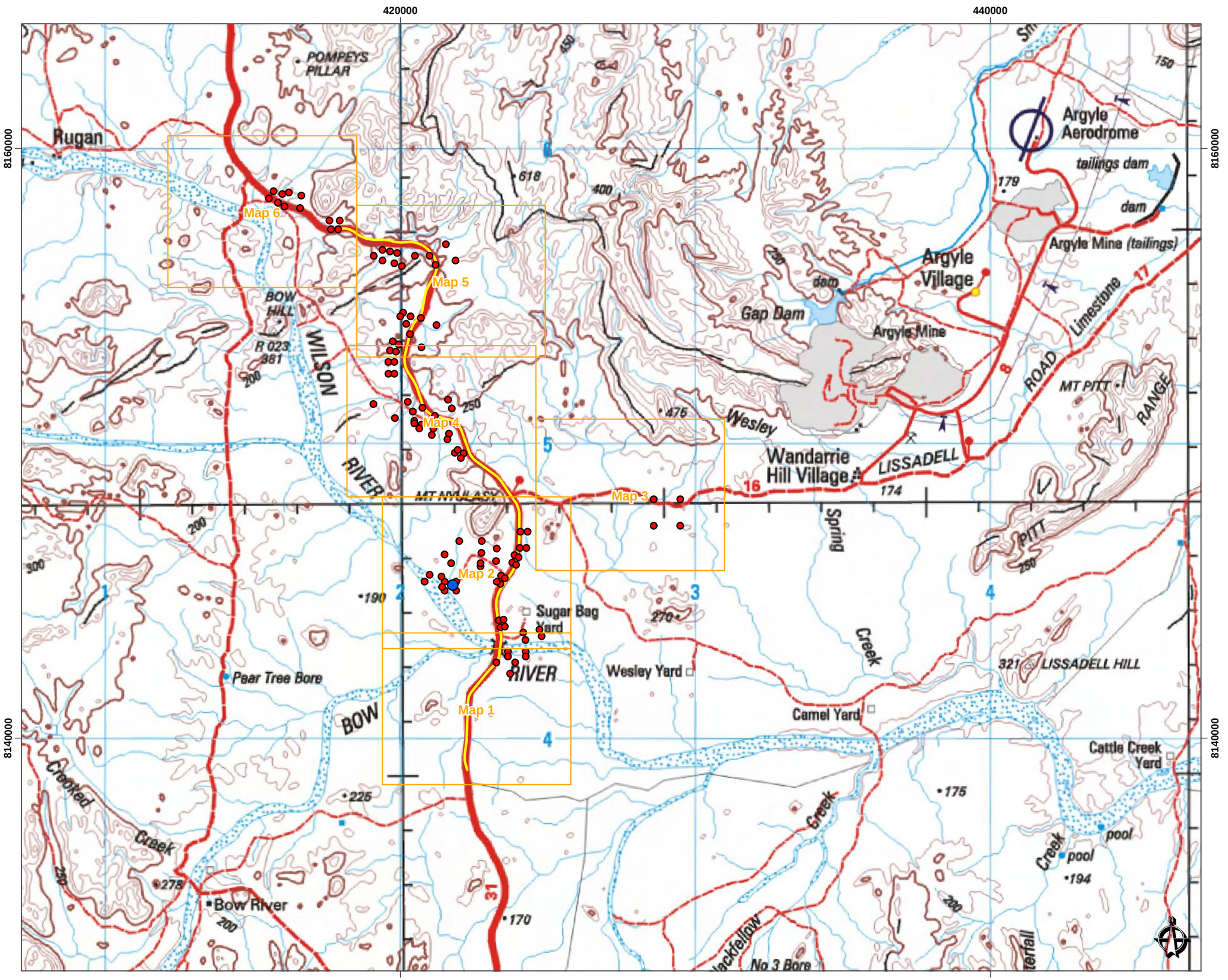
Appendix A

Figures



LEGEND

- Borrow Pit Coordinates (Main Roads Provided)
- Water Source
- Road Section to be Surveyed
- Map Extents

NOTE THAT POSITIONAL ERRORS CAN BE > 5M IN SOME AREAS

SCALE

1.25 0 1.25 2.5 3.75km

1:125,000 at A3

LOCALITY MAP

Kimberley Region

CREATED BY	CHECKED	APPROVED
MD		

HORIZONTAL DATUM: GDA94 **PROJECTION:** MGA ZONE 51

HEIGHT DATUM: **METADATA RECORDED:**

DATE	FILE LOCATION
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REVISION	DRAWING NO
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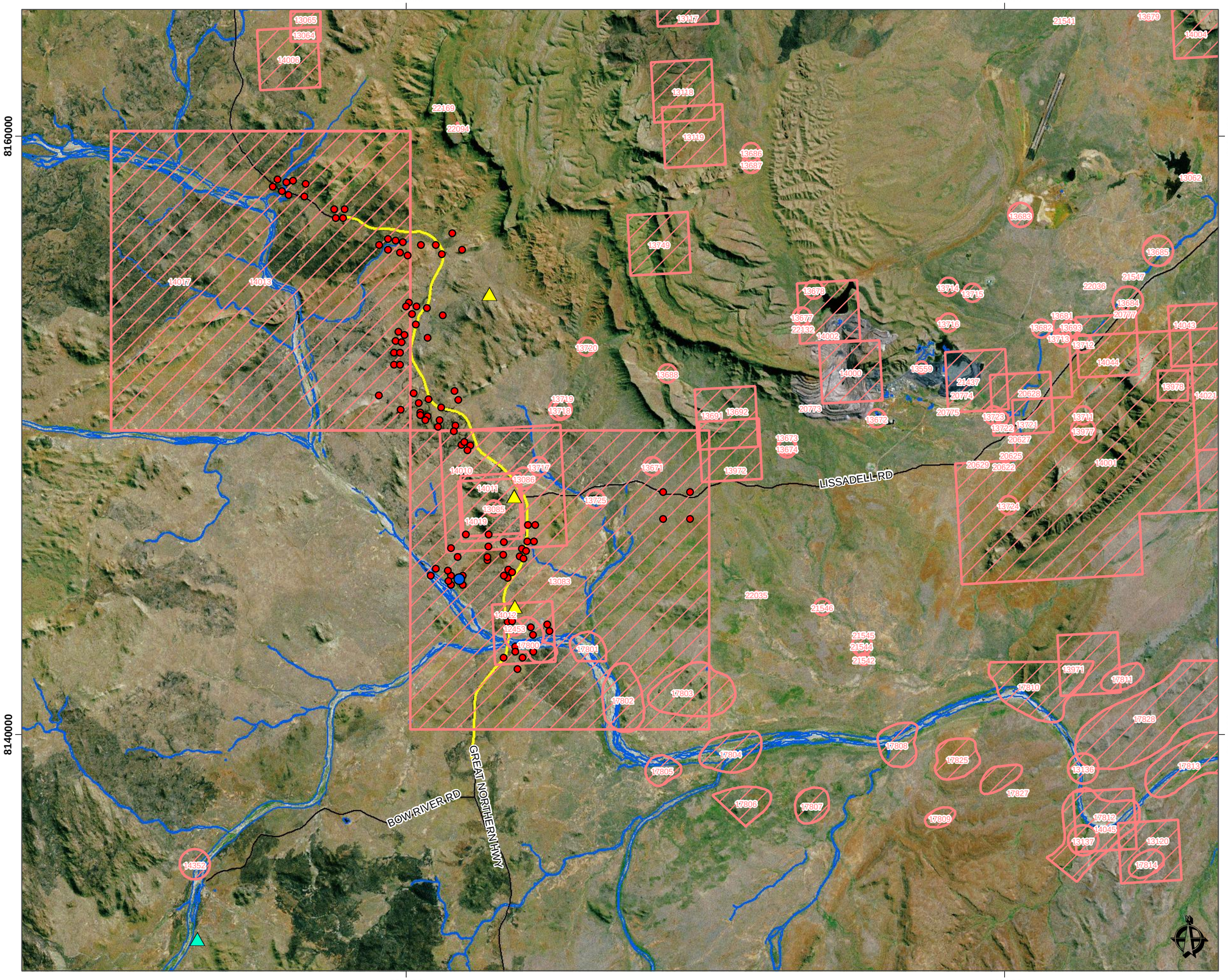
mainroads WESTERN AUSTRALIA GHD CLIENTS|PEOPLE|PERFORMANCE

GREAT NORTHERN HIGHWAY
VEGETATION SURVEY
BOW SECTION

Figure 1
Locality



LEGEND

- Borrow Pit Coordinates (Main Roads Provided)
- Water Source
- Road Section to be Surveyed
- Major Watercourse
- Aboriginal Heritage Site
- Clearing Regulations - Environmentally Sensitive Areas

Declared Rare & Priority Flora

- (R) Declared Rare Flora - Extant Taxa
- Priority 1 - Poorly Known Taxa
- Priority 2 - Poorly Known Taxa
- Priority 3 - Poorly Known Taxa
- Priority 4 - Rare Taxa

NOTE THAT POSITIONAL ERRORS CAN BE > 5M IN SOME AREAS

SCALE

1.25 0 1.25 2.5 3.75km

1:125,000 at A3

LOCALITY MAP

Kimberley Region

CREATED BY	CHECKED	APPROVED
NT		

HORIZONTAL DATUM: GDA94 **PROJECTION:** MGA ZONE 52

HEIGHT DATUM: **METADATA RECORDED:**

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mainroads WESTERN AUSTRALIA

GHD CLIENTS|PEOPLE|PERFORMANCE

GREAT NORTHERN HIGHWAY
VEGETATION SURVEY
BOW SECTION

Figure 2
Environmental Constraints

414000
416000
418000
8160000
8158000
8156000
GREAT NORTHERN HWY
Wilson River
6
1
6
2
1
3

LEGEND

- Borrow Pit Coordinates (Main Roads Provided)
- Water Source
- Borrow Pits
- Road Survey Extents
- Road Section to be Surveyed
- Road Centrelines

Declared Rare & Priority Flora

- (R) Declared Rare Flora - Extant Taxa
- Priority 1 - Poorly Known Taxa
- Priority 2 - Poorly Known Taxa
- Priority 3 - Poorly Known Taxa
- Priority 4 - Rare Taxa

Vegetation Type

- 1. Riparian Vegetation
- 2. Mixed Open Woodlands + Grasslands
- 3. Terminalia Woodlands
- 4. Boab Woodlands/Creelines + Boab
- 5. Hummock Grasslands + Scattered Trees
- 6. Altered/Degraded Vegetation
- 7. Breakaway Vegetation
- 8. Altered Drainage

NOTE THAT POSITIONAL ERRORS CAN BE > 5M IN SOME AREAS

SCALE

200 0 200 400 600m

1:20,000 at A3

LOCALITY MAP

Kimberley Region

CREATED BY	CHECKED	APPROVED
NT		

HORIZONTAL DATUM: GDA94 **PROJECTION:** MGA ZONE 52

HEIGHT DATUM: **METADATA RECORDED:**

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mainroads WESTERN AUSTRALIA

GHD CLIENTS|PEOPLE|PERFORMANCE

GREAT NORTHERN HIGHWAY
VEGETATION SURVEY
BOW SECTION

Figure 3
Vegetation Type - Map 6

420000 422000 424000

8158000 8156000 8154000

LEGEND

- Borrow Pit Coordinates (Main Roads Provided)
- Water Source
- Borrow Pits
- Road Survey Extents
- Road Section to be Surveyed
- Road Centrelines

Declared Rare & Priority Flora

- (R) Declared Rare Flora - Extant Taxa
- Priority 1 - Poorly Known Taxa
- Priority 2 - Poorly Known Taxa
- Priority 3 - Poorly Known Taxa
- Priority 4 - Rare Taxa

Vegetation Type

1. Riparian Vegetation
2. Mixed Open Woodlands + Grasslands
3. Terminalia Woodlands
4. Boab Woodlands/Creelines + Boab
5. Hummock Grasslands + Scattered Trees
6. Altered/Degraded Vegetation
7. Breakaway Vegetation
8. Altered Drainage

NOTE THAT POSITIONAL ERRORS CAN BE > 5M IN SOME AREAS

SCALE

200 0 200 400 600m

1:20,000 at A3

LOCALITY MAP

Kimberley Region

CREATED BY	CHECKED	APPROVED
NT		

HORIZONTAL DATUM: GDA94 **PROJECTION:** MGA ZONE 52

HEIGHT DATUM: **METADATA RECORDED:**

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mainroads WESTERN AUSTRALIA GHD CLIENTS|PEOPLE|PERFORMANCE

GREAT NORTHERN HIGHWAY
VEGETATION SURVEY
BOW SECTION

Figure 3
Vegetation Type - Map 5

420000 422000 424000

8152000

8150000

LEGEND

- Borrow Pit Coordinates (Main Roads Provided)
- Water Source
- Borrow Pits
- Road Survey Extents
- Road Section to be Surveyed
- Road Centrelines

Declared Rare & Priority Flora

- (R) Declared Rare Flora - Extant Taxa
- Priority 1 - Poorly Known Taxa
- Priority 2 - Poorly Known Taxa
- Priority 3 - Poorly Known Taxa
- Priority 4 - Rare Taxa

Vegetation Type

- 1. Riparian Vegetation
- 2. Mixed Open Woodlands + Grasslands
- 3. Terminalia Woodlands
- 4. Boab Woodlands/Creelines + Boab
- 5. Hummock Grasslands + Scattered Trees
- 6. Altered/Degraded Vegetation
- 7. Breakaway Vegetation
- 8. Altered Drainage

NOTE THAT POSITIONAL ERRORS CAN BE > 5M IN SOME AREAS

SCALE

200 0 200 400 600m

1:20,000 at A3

LOCALITY MAP

Kimberley Region

CREATED BY	CHECKED	APPROVED
NT		

HORIZONTAL DATUM: GDA94 **PROJECTION:** MGA ZONE 52

HEIGHT DATUM: **METADATA RECORDED:**

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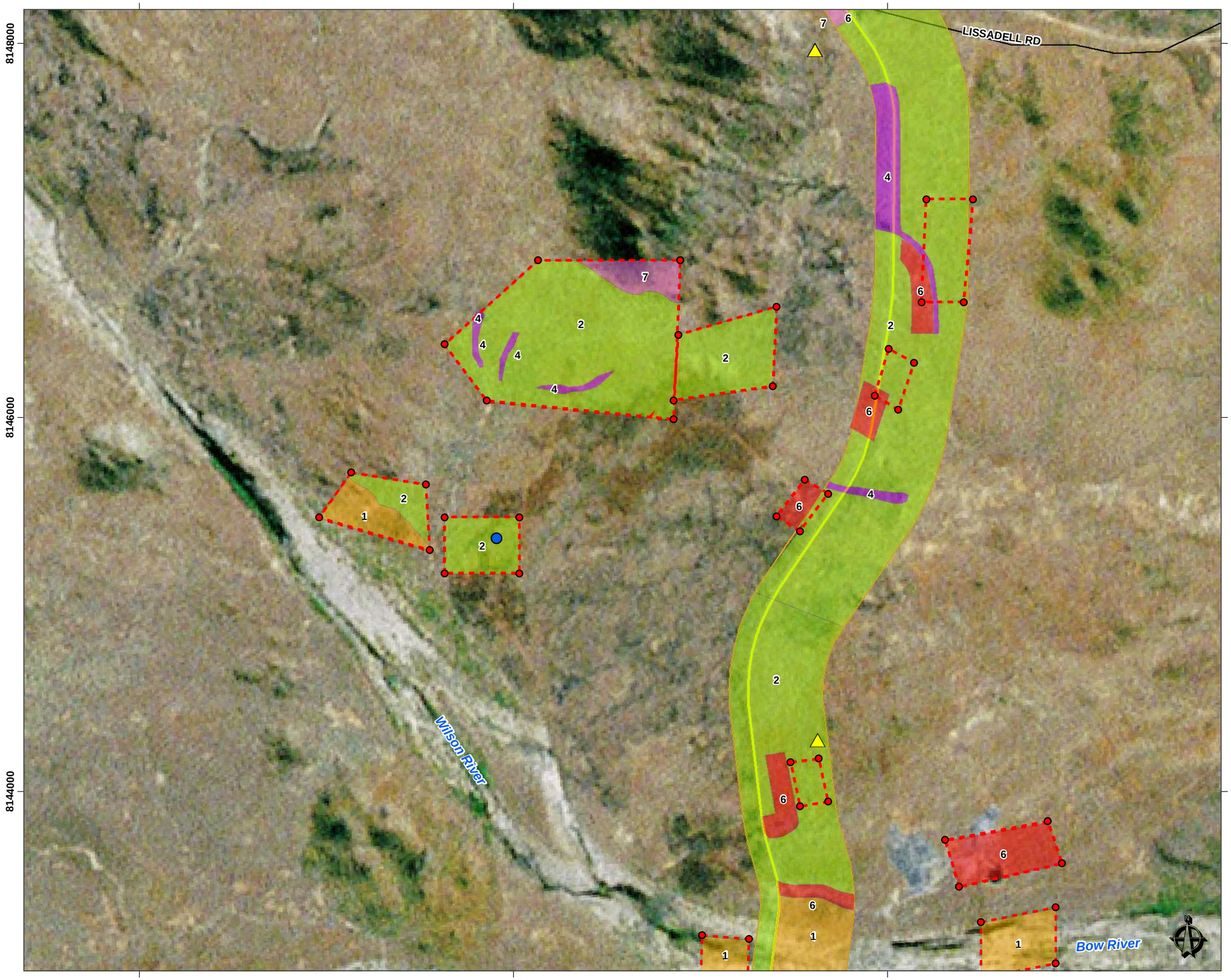
mainroads WESTERN AUSTRALIA

GHD CLIENTS|PEOPLE|PERFORMANCE

GREAT NORTHERN HIGHWAY
VEGETATION SURVEY
BOW SECTION

Figure 3
Vegetation Type - Map 4



LEGEND

- Borrow Pit Coordinates (Main Roads Provided)
- Water Source
- Borrow Pits
- Road Survey Extents
- Road Section to be Surveyed
- Road Centrelines

Declared Rare & Priority Flora

- (R) Declared Rare Flora - Extant Taxa
- Priority 1 - Poorly Known Taxa
- Priority 2 - Poorly Known Taxa
- Priority 3 - Poorly Known Taxa
- Priority 4 - Rare Taxa

Vegetation Type

- 1. Riparian Vegetation
- 2. Mixed Open Woodlands + Grasslands
- 3. Terminalia Woodlands
- 4. Boab Woodlands/Creelines + Boab
- 5. Hummock Grasslands + Scattered Trees
- 6. Altered/Degraded Vegetation
- 7. Breakaway Vegetation
- 8. Altered Drainage

NOTE THAT POSITIONAL ERRORS CAN BE > 5M IN SOME AREAS
AERIAL PHOTOGRAPHY SOURCED FROM MRWA.

SCALE

200 0 200 400 600m

1:20,000 at A3

LOCALITY MAP

Kimberley Region

CREATED BY	CHECKED	APPROVED
NT		

HORIZONTAL DATUM: GDA94 **PROJECTION:** MGA ZONE 52

HEIGHT DATUM: **METADATA RECORDED:**

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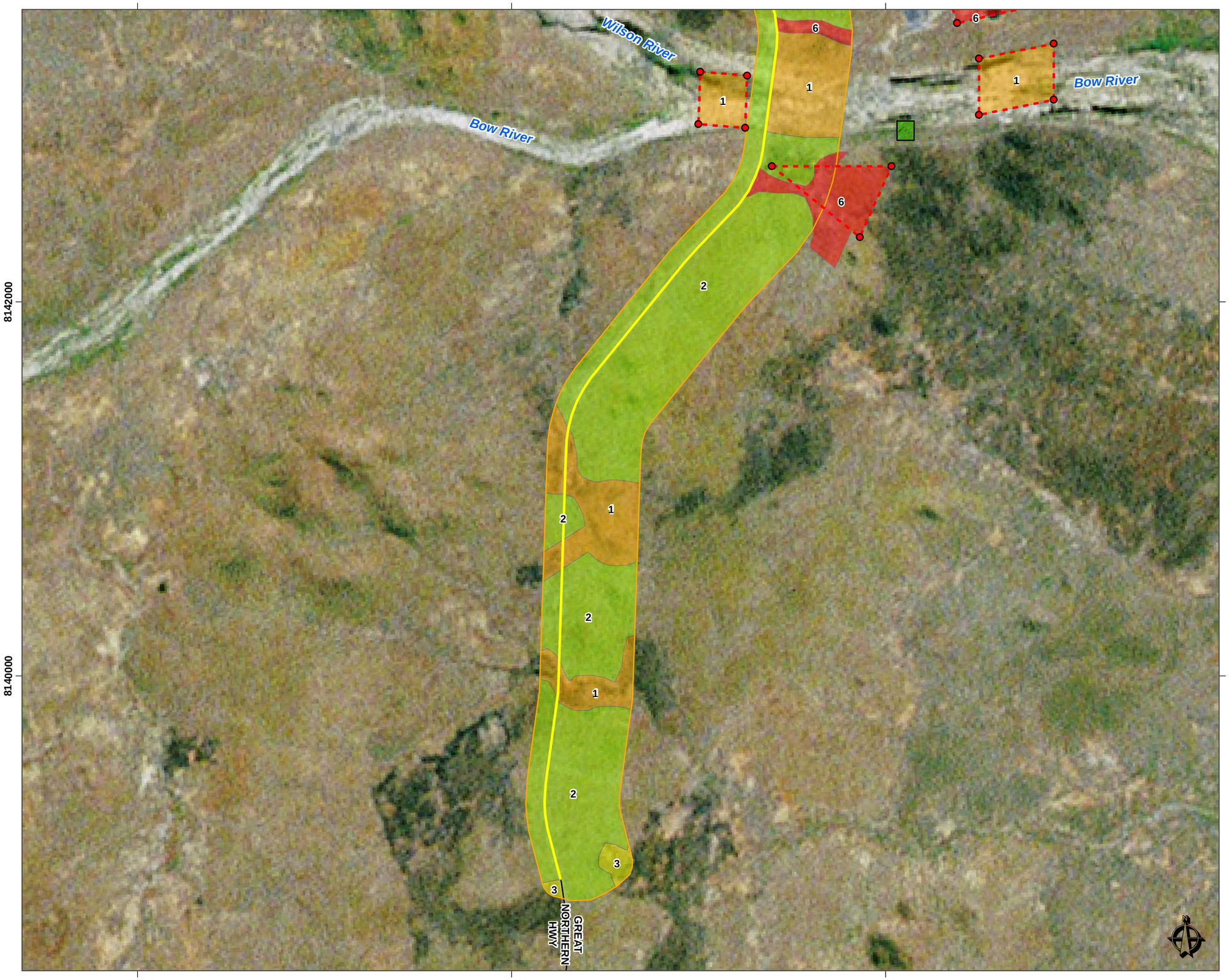
mainroads WESTERN AUSTRALIA GHD CLIENTS|PEOPLE|PERFORMANCE

GREAT NORTHERN HIGHWAY
VEGETATION SURVEY
BOW SECTION

Figure 3
Vegetation Type - Map 2



LEGEND

- Borrow Pit Coordinates (Main Roads Provided)
- Water Source
- Borrow Pits
- Road Survey Extents
- Road Section to be Surveyed
- Road Centrelines

Declared Rare & Priority Flora

- (R) Declared Rare Flora - Extant Taxa
- Priority 1 - Poorly Known Taxa
- Priority 2 - Poorly Known Taxa
- Priority 3 - Poorly Known Taxa
- Priority 4 - Rare Taxa

Vegetation Type

- 1. Riparian Vegetation
- 2. Mixed Open Woodlands + Grasslands
- 3. Terminalia Woodlands
- 4. Boab Woodlands/Creelines + Boab
- 5. Hummock Grasslands + Scattered Trees
- 6. Altered/Degraded Vegetation
- 7. Breakaway Vegetation
- 8. Altered Drainage

- Gouldian Finch Sighting

NOTE THAT POSITIONAL ERRORS CAN BE > 5M IN SOME AREAS

SCALE

200 0 200 400 600m

1:20,000 at A3

LOCALITY MAP

Kimberley Region

CREATED BY	CHECKED	APPROVED
NT		

HORIZONTAL DATUM: GDA94 **PROJECTION:** MGA ZONE 52

HEIGHT DATUM: **METADATA RECORDED:**

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REVISION	DRAWING NO
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mainroads WESTERN AUSTRALIA GHD CLIENTS|PEOPLE|PERFORMANCE

GREAT NORTHERN HIGHWAY
VEGETATION SURVEY
BOW SECTION

Figure 3
Vegetation Type - Map 1

426000
428000
430000
8150000
8148000
8146000
LISSADELL RD
2
6
6
2
N

LEGEND

- Borrow Pit Coordinates (Main Roads Provided)
- Water Source
- Borrow Pits
- Road Survey Extents
- Road Section to be Surveyed
- Road Centrelines

Declared Rare & Priority Flora

- (R) Declared Rare Flora - Extant Taxa
- Priority 1 - Poorly Known Taxa
- Priority 2 - Poorly Known Taxa
- Priority 3 - Poorly Known Taxa
- Priority 4 - Rare Taxa

Vegetation Type

- 1. Riparian Vegetation
- 2. Mixed Open Woodlands + Grasslands
- 3. Terminalia Woodlands
- 4. Boab Woodlands/Creelines + Boab
- 5. Hummock Grasslands + Scattered Trees
- 6. Altered/Degraded Vegetation
- 7. Breakaway Vegetation
- 8. Altered Drainage

NOTE THAT POSITIONAL ERRORS CAN BE > 5M IN SOME AREAS

SCALE

200 0 200 400 600m

1:20,000 at A3

LOCALITY MAP

Kimberley Region

CREATED BY	CHECKED	APPROVED
NT		

HORIZONTAL DATUM: GDA94 **PROJECTION:** MGA ZONE 52

HEIGHT DATUM: **METADATA RECORDED:**

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REVISION	DRAWING NO
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mainroads WESTERN AUSTRALIA GHD CLIENTS|PEOPLE|PERFORMANCE

GREAT NORTHERN HIGHWAY
VEGETATION SURVEY
BOW SECTION

Figure 3
Vegetation Type - Map 3

414000
416000
418000
8160000
8158000
8156000
GREAT NORTHERN HWY
Wilson River
5
2
5
1-2
3
3
4
1-2

LEGEND

- Borrow Pit Coordinates (Main Roads Provided)
- Water Source
- Borrow Pits
- Road Survey Extents
- Road Section to be Surveyed
- Road Centrelines

Declared Rare & Priority Flora

- (R) Declared Rare Flora - Extant Taxa
- Priority 1 - Poorly Known Taxa
- Priority 2 - Poorly Known Taxa
- Priority 3 - Poorly Known Taxa
- Priority 4 - Rare Taxa

Vegetation Condition

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

NOTE THAT POSITIONAL ERRORS CAN BE > 5M IN SOME AREAS

SCALE

200 0 200 400 600m

1:20,000 at A3

LOCALITY MAP

Kimberley Region

CREATED BY	CHECKED	APPROVED
NT		

HORIZONTAL DATUM: GDA94 **PROJECTION:** MGA ZONE 52

HEIGHT DATUM: **METADATA RECORDED:**

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REVISION	DRAWING NO
0	6119131-G81

mainroads WESTERN AUSTRALIA

GHD CLIENTS|PEOPLE|PERFORMANCE

GREAT NORTHERN HIGHWAY
VEGETATION SURVEY
BOW SECTION

Figure 4
Vegetation Condition - Map 6

LEGEND

- Borrow Pit Coordinates (Main Roads Provided)
- Water Source
- Borrow Pits
- Road Survey Extents
- Road Section to be Surveyed
- Road Centrelines

Declared Rare & Priority Flora

- (R) Declared Rare Flora - Extant Taxa
- Priority 1 - Poorly Known Taxa
- Priority 2 - Poorly Known Taxa
- Priority 3 - Poorly Known Taxa
- Priority 4 - Rare Taxa

Vegetation Condition

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

NOTE THAT POSITIONAL ERRORS CAN BE > 5M IN SOME AREAS

SCALE

200 0 200 400 600m

1:20,000 at A3

LOCALITY MAP

Kimberley Region

CREATED BY	CHECKED	APPROVED
NT		

HORIZONTAL DATUM: GDA94 **PROJECTION:** MGA ZONE 52

HEIGHT DATUM: **METADATA RECORDED:**

DATE	FILE LOCATION
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REVISION	DRAWING NO
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mainroads WESTERN AUSTRALIA

GHD CLIENTS|PEOPLE|PERFORMANCE

GREAT NORTHERN HIGHWAY
VEGETATION SURVEY
BOW SECTION

Figure 4
Vegetation Condition - Map 5

420000
422000
424000
8152000
8150000
1-2
2
5
4
3
6
2-3

LEGEND

- Borrow Pit Coordinates (Main Roads Provided)
- Water Source
- Borrow Pits
- Road Survey Extents
- Road Section to be Surveyed
- Road Centrelines

Declared Rare & Priority Flora

- (R) Declared Rare Flora - Extant Taxa
- Priority 1 - Poorly Known Taxa
- Priority 2 - Poorly Known Taxa
- Priority 3 - Poorly Known Taxa
- Priority 4 - Rare Taxa

Vegetation Condition

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

NOTE THAT POSITIONAL ERRORS CAN BE > 5M IN SOME AREAS

SCALE

200 0 200 400 600m

1:20,000 at A3

LOCALITY MAP

Kimberley Region

CREATED BY	CHECKED	APPROVED
NT		

HORIZONTAL DATUM: GDA94 **PROJECTION:** MGA ZONE 52

HEIGHT DATUM: **METADATA RECORDED:**

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REVISION	DRAWING NO
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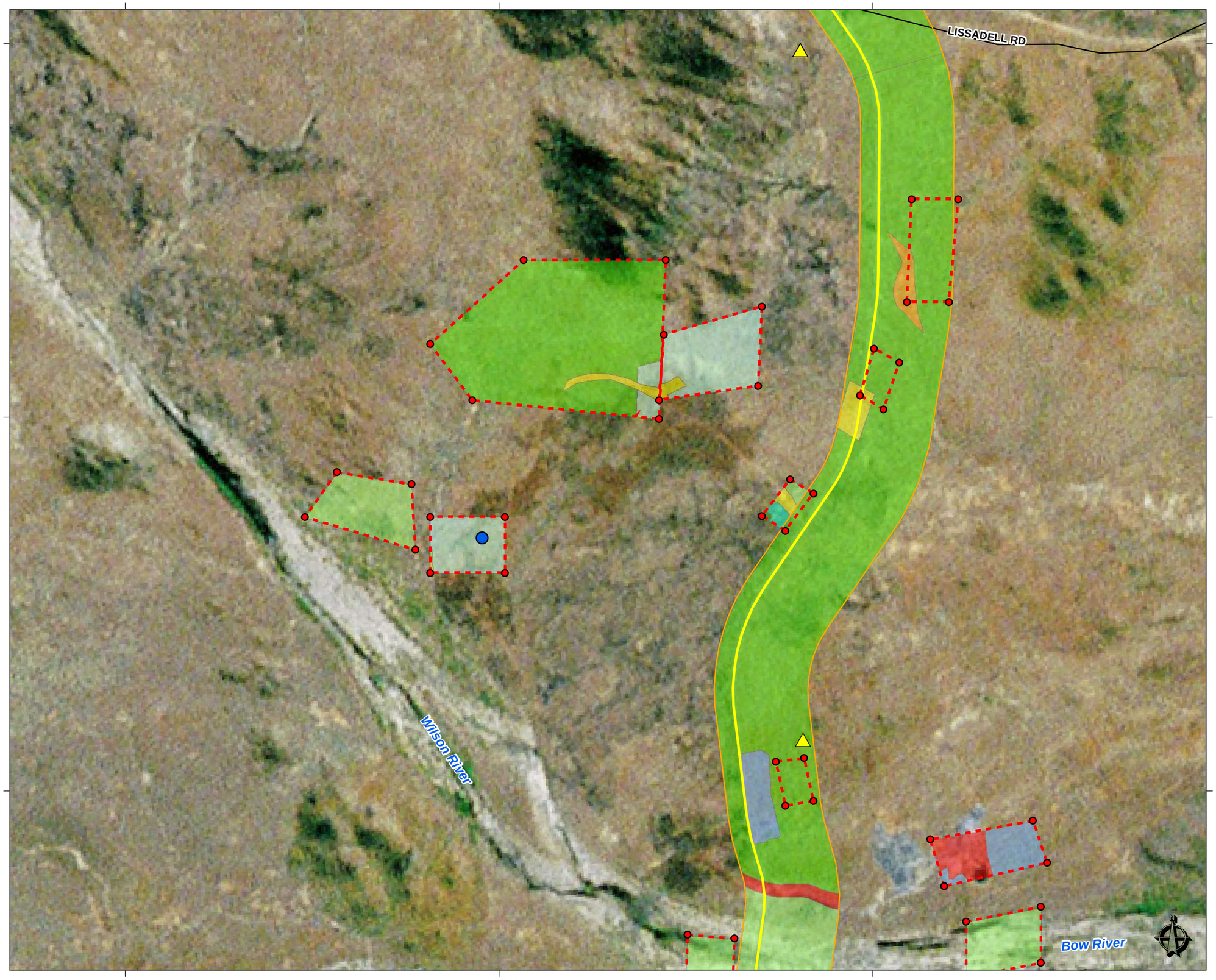
mainroads WESTERN AUSTRALIA GHD CLIENTS|PEOPLE|PERFORMANCE

GREAT NORTHERN HIGHWAY
VEGETATION SURVEY
BOW SECTION

Figure 4
Vegetation Condition - Map 4



LEGEND

- Borrow Pit Coordinates (Main Roads Provided)
- Water Source
- Borrow Pits
- Road Survey Extents
- Road Section to be Surveyed
- Road Centrelines

Declared Rare & Priority Flora

- (R) Declared Rare Flora - Extant Taxa
- Priority 1 - Poorly Known Taxa
- Priority 2 - Poorly Known Taxa
- Priority 3 - Poorly Known Taxa
- Priority 4 - Rare Taxa

Vegetation Condition

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

NOTE THAT POSITIONAL ERRORS CAN BE > 5M IN SOME AREAS
AERIAL PHOTOGRAPHY SOURCED FROM MRWA.

SCALE

200 0 200 400 600m

1:20,000 at A3

LOCALITY MAP

Kimberley Region

CREATED BY	CHECKED	APPROVED
NT		

HORIZONTAL DATUM: GDA94 **PROJECTION:** MGA ZONE 52
HEIGHT DATUM: **METADATA RECORDED:**

DATE	FILE LOCATION
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REVISION	DRAWING NO
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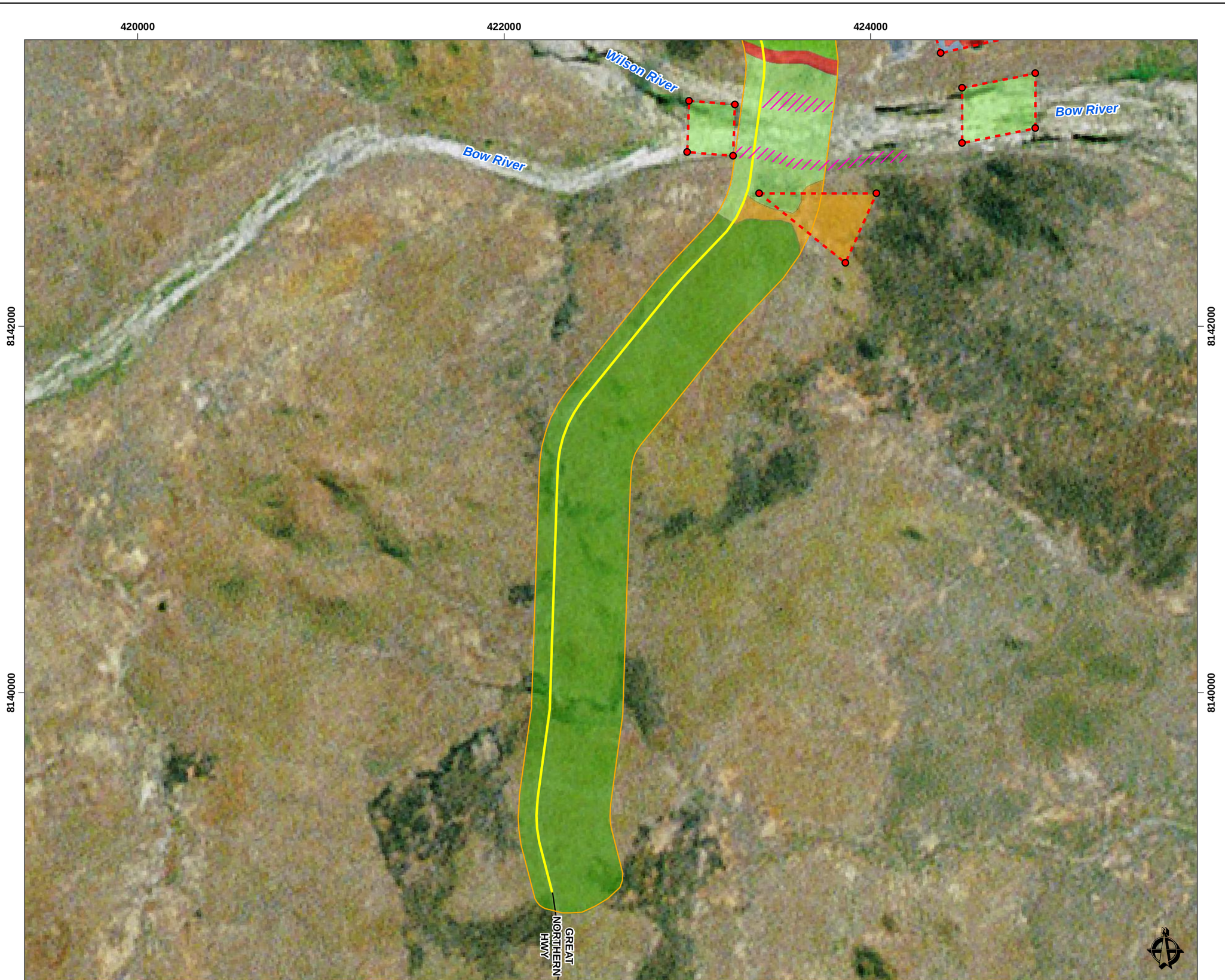
mainroads WESTERN AUSTRALIA GHD CLIENTS|PEOPLE|PERFORMANCE

GREAT NORTHERN HIGHWAY
VEGETATION SURVEY
BOW SECTION

Figure 4
Vegetation Condition - Map 2



LEGEND

- Borrow Pit Coordinates (Main Roads Provided)
- Water Source
- Borrow Pits
- Road Survey Extents
- Road Section to be Surveyed
- Road Centrelines

Declared Rare & Priority Flora

- (R) Declared Rare Flora - Extant Taxa
- Priority 1 - Poorly Known Taxa
- Priority 2 - Poorly Known Taxa
- Priority 3 - Poorly Known Taxa
- Priority 4 - Rare Taxa

Vegetation Condition

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

NOTE THAT POSITIONAL ERRORS CAN BE > 5M IN SOME AREAS

SCALE

200 0 200 400 600m

1:20,000 at A3

LOCALITY MAP

Kimberley Region

CREATED BY	CHECKED	APPROVED
NT		

HORIZONTAL DATUM: GDA94 **PROJECTION:** MGA ZONE 52

HEIGHT DATUM: **METADATA RECORDED:**

DATE	FILE LOCATION
19.07.07	G:\61\19131\GIS\MXDS\6119131-G76_Rev2.mxd

REVISION	DRAWING NO
0	6119131-G76

mainroads WESTERN AUSTRALIA

GHD CLIENTS|PEOPLE|PERFORMANCE

GREAT NORTHERN HIGHWAY
VEGETATION SURVEY
BOW SECTION

Figure 4
Vegetation Condition - Map 1

426000
428000
430000
8150000
8148000
8146000
LISSADELL RD
2
6
3
2
mE
mN
E
N

LEGEND

- Borrow Pit Coordinates (Main Roads Provided)
- Water Source
- Borrow Pits
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- Road Section to be Surveyed
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- (R) Declared Rare Flora - Extant Taxa
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NOTE THAT POSITIONAL ERRORS CAN BE > 5M IN SOME AREAS

SCALE

200 0 200 400 600m

1:20,000 at A3

LOCALITY MAP

Kimberley Region

CREATED BY	CHECKED	APPROVED
NT		

HORIZONTAL DATUM: GDA94 **PROJECTION:** MGA ZONE 52

HEIGHT DATUM: **METADATA RECORDED:**

DATE	FILE LOCATION
13.06.07	G:\61\19131\GIS\MXDS\6119131-G78_Rev1.mxd

REVISION	DRAWING NO
0	6119131-G78

mainroads WESTERN AUSTRALIA GHD CLIENTS|PEOPLE|PERFORMANCE

GREAT NORTHERN HIGHWAY
VEGETATION SURVEY
BOW SECTION

Figure 4
Vegetation Condition - Map 3

Appendix B

Vegetation

Borrow Pit No: 1 **Survey Date:** 23-02-2007

Vegetation Description: Mixed grassland with occasional Eucalypts: *Corymbia opaca, Eucalyptus brevifolia, E. pruinosa, Bauhinia cunninghamii* over *Hakea arborescens, Carissa lanceolata, Heliotropium tenuifolium, Chrysopogon fallax, Eriachne fastigiata, E. obtusa,*

Condition: 1-2 (majority of site); 5 (previously disturbed areas)

Disturbance: Previous borrow pit present at the northern extent of the site. Smaller disturbed sections are scattered throughout the remainder of the site.

Plate 1 Photograph of borrow pit 1 showing previously disturbed areas.

Borrow Pit No: 2 **Survey Date:** 23-02-2007

Vegetation Description: Low open woodland over mixed grasses and herbs. Low Open Woodland of *Corymbia opaca, Eucalyptus pruinosa* and occasional *Eucalyptus camaldulensis* over *Hakea arborescens, Grevillea striata* over mixed grasses, *Triodia* spp., Eriachne sp. and mixed herbs, including *Portulaca* spp., *Calandrinia uniflora*,

Condition: 2

Disturbance: Old borrow pit location. Some tracks are present within the site boundaries.

Other: Creek present within site.

Plate 2 Vegetation present within borrow pit 2.

Borrow Pit No: 3 **Survey Date:** 23-02-2007

Vegetation Description: Low open Eucalypt woodland over mixed grasses: *Corymbia opaca, Eucalyptus pruinosa* over *Dolichandrone heterophylla, Aerva javanica, Carissa lanceolata, Calotropis procera, Heliotropium tenuifolium, Euphorbia australis* over *Chrysopogon fallax, Eriachne obtusa, Sorghum plumosum, Triodia* spp.,

Condition: 3/4

Disturbance: Northern end of site has previously been utilised as a borrow pit area.

Other: Low species diversity noted within site.

Plate 3 Vegetation at Borrow Pit 3

Borrow Pit No: 4 **Survey Date**: 22-02-2007

Vegetation Description: Open Eucalypt woodland over mixed grasses: *Corymbia opaca, Eucalyptus brevifolia, E. pruinosa, Terminalia canescens, Bauhinia cunninghamii, Adansonia gregorii* over *Ehretia saligna, Hakea arborescens, Atalaya hemiglauca* over *Carissa lanceolata, Aerva javanica, Gomphrena canescens, Crotalaria novae-hollandiae, Sesbania cannabina* with mixed grasses, including *Eragrostis speciosa, Eriachne glauca, E. obtusa, Heteropogon contortus, Triodia bitextura.*

Condition: 2/3 (east); 4 (west)

Disturbance: Some areas of the site have previously been disturbed (clearing / borrow pit).

Other: N/A

Plate 4 Photograph of previously disturbed area at borrow pit 4.

Borrow Pit No: 5 **Survey Date:** 22-02-2007

Vegetation Description: Open Eucalypt woodland over mixed grasses: *Corymbia opaca, Eucalyptus brevifolia, Eucalyptus pruinosa, Terminalia canescens, Cochlospermum fraseri, Ficus* spp., *Hakea arborescens* over *Dolichandrone heterophylla, Carissa lanceolata, Euphorbia* spp., *Buchnera linearis* over mixed grasses, including *Alloteropsis semialata, Chrysopogon fallax, Enneapogon polyphyllus, Eragrostis setifolia, Eriachne obtusa,*

Close to river is riparian vegetation with dominant species being *Lophostemon grandiflorus Terminalia* spp. and *Adansonia gregorii.*

Condition: 2

Disturbance: N/A

Other: N/A

Plate 5 Vegetation present at borrow pit 5.

Borrow Pit No: 6 **Survey Date:** 22-02-2007

Vegetation Description: Hummock grassland with occasional Eucalypts and various tree species. *Corymbia opaca, Eucalyptus brevifolia, Bauhinia cunninghamii, Ehretia saligna, Gyrocarpus americanus, Hakea* spp., *Grevillea pyramidalis* over *Acacia* spp., *Heliotropium tenuifolium, Polymeria ambigua, Euphorbia coghlanii, Goodenia coronopifolia* over *Chrysopogon fallax, Triodia* sp., *Eriachne obtusa, Heteropogon contortus, Themeda triandra.*

Vegetation at creekline is dominated by *Adansonia gregorii*, *Lophostemon grandiflorus*, *Bauhinia cunninghamii*, *Terminalia canescens*, *Dolichandrone heterophylla, Arundinella nepalensis* and *Cleome viscosa.*

Condition: 1/2

Disturbance: Site appears to have been recently burnt.

Other: Site is very rocky.

Plate 6 Vegetation present within creek at borrow pit 6.

Borrow Pit No: 6A **Survey Date:** 22-02-2007

Vegetation Description: Mixed grassland dominated by spinifex and occasional Eucalypt trees: *Corymbia opaca, Eucalyptus brevifolia, Eucalyptus pruinosa* and *Cochlospermum fraseri,* over *Grevillea* spp., *Hakea lorea* over *Senna notabalis, Gomphrena* spp., *Euphorbia coghlanii, Crotalaria novae-hollandiae* and mixed grasses, particularly *Chryspogon fallax, Triodia pungens, Heteropogon contortus, Eriachne obtusa.*

Condition: 2/3

Disturbance: Site appears to have previously been used as a borrow pit. Disturbance is evident close to the roadside.

Other: N/A

Plate 7 Vegetation present within borrow pit 6A.

Borrow Pit No: 7 **Survey Date:** 22-02-2007

Vegetation Description: Open Eucalypt woodland over mixed grassland. *Eucalyptus pruinosa*, *Corymbia opaca* and *Bauhinia cunninghamii* over mixed grasses, including *Chrysopogon fallax, Heteropogon contortus, Triodia bitextura, T. pungens,* and understorey species including *Cleome viscosa, Polymeria ambigua, Tribulus terrestris* and *Solanum beaugleholei*.

Condition: 3 (area of condition 1 in east of site)

Disturbance: Area has been disturbed by cattle grazing, but there are no other obvious affects of degradation at the site.

Other: N/A

Plate 8 Vegetation present within borrow pit 7.

Borrow Pit No: **8** **Survey Date:** **22-02-2007**

Vegetation Description: Mixed grassland with occasional Eucalypts. *Corymbia opaca, C. confertiflora, Eucalyptus brevifolia, E. pruinosa, Bauhinia cunninghamii* over *Ehretia saligna, Dolichandrone heterophylla, Hakea arborescens, Grevillea pyramidalis, Carissa lanceolata, Cleome* spp., *Tinospora smilacina* and mixed grasses, *Alloteropsis semialata, Chrysopogon fallax, Eragrostis speciosa, Eriachne* spp., *Triodia pungens, Xerochloa laniflora,*

Condition: 4

Disturbance: old borrow pit – ground disturbance, over and mid-storey depleted.

Other:

Plate 9 Vegetation present at borrow pit site 8.

Borrow Pit No: 9 **Survey Date:** 22-02-2007

Vegetation Description: Hummock Grassland with occasional Eucalypts: Occasional *Corymbia confertiflora, Corymbia opaca, Eucalyptus pruinosa, Bauhinia cunninghamii*. over *Grevillea pyramidalis, Hakea arborescens, Dolichandrone heterophylla, Ehretia saligna, Carissa lanceolata,* over *Heliotropium tenuifolium, Polymeria ambigua, Crotalaria medicaginea, Indigofera linnaei* and *Tephrosia laxa;* site dominated by mixed grasses: *Eriachne obtusa*, *Panicum decompositum, Chrysopogon fallax, Echinochloa colona* and Cyperaceae spp.

Adansonia gregorii and *Terminalia canescens* are present within and adjacent to creekline along northern boundary of the site.

Condition: 5 (old borrow pit area); 1/2 (area around outside of old borrow pit)

Disturbance: Majority of the site has previously been disturbed by roadworks. Old borrow pits are still evident in the landscape.

Other: Open water in present within an old borrow pit. Some aquatic birds were observed to be utilising this water source. The open borrow pit occurs at the following location:

GPS co-ordinates: 424152 E 8146660 N

Plate 10 Vegetation present within borrow pit 9.

Borrow Pit No: 9A **Survey Date:** 21-02-2007

Vegetation Description: Low open Eucalypt woodland (<10 m) over mixed grass understorey: dominant species include *Eucalyptus brevifolia, Corymbia opaca* and *Eucalyptus pruinosa* over *Dolichandrone heterophylla*, mixed grasses including *Heteropogon contortus,* herb species, including *Ipomoea* spp and Papilionaceae spp. and scattered *Calotropis procera*.

Condition: 2 (some sections of 3 and 6 in old disturbed areas and along the road)

Disturbance: North side of road appears to have been burnt approximately 3 years prior to survey. Some disturbance is evident from previous roadwork activities. Close to the road are disturbed areas with clayey soil. Cattle were noted to be grazing on the south side of the road. Condition of vegetation is considered to be *Excellent*, however there is some damage from cattle grazing is evident.

Other: Northwest corner of borrow pit is approximately 10 m from a creek. An ephemeral drainage line runs though the southeast corner of the site. A waterhole is present at the following location: GPS co-ordinates: 429134 E; 8147841 N (WGS 84, Zone 50)

Plate 11 Photograph taken from northwest corner.

Borrow Pit No: 10 **Survey Date:** 23-02-2007

Vegetation Description: Low open woodland over mixed grasses. Occasional Eucalypt spp., *Bauhinia cunninghamii, Gyrocarpus americanus, Atalaya hemiglauca, Terminalia canescens* (dominant), *Dolichandrone heterophylla,* over *Carissa lanceolata, Ptilotus* spp., *Crotalaria* spp., *Cleome viscosa, Polymeria ambigua, Goodenia* spp., *Cyperus macrostachyos, Fimbristylis* spp. over mixed grasses.

Adansonia gregorii and *Heteropogon contortus* are present within and adjacent to the creekline.

Condition: 1/2

Disturbance: Old borrow pit is present just north of the site, close to the road.

Other: Rock in middle of site appears to be deposited – old disturbance?.

Plate 12 Vegetation present within burrow pit 10. Photograph has been taken looking west across the site.

Borrow Pit No: 11 **Survey Date:** 23-02-2007

Vegetation Description: Low open Eucalypt woodland over low shrubs and mixed grasses and herbs. *Corymbia opaca, C. confertiflora, Bauhinia cunninghamii, Terminalia canescens, Grevillea pyramidalis, Dolichandrone heterophylla* over *Carissa lanceolata, Cleome* spp., *Hybanthus* spp., *Boerhavia paludosa, Fimbristylis* spp., *Tinospora smilacina* and mixed grasses, *Alloteropsis semialata, Chrysopogon fallax, Eriachne* spp., *Triodia bitextura.* Gently sloping hill in the southern section of the site is dominated by *Sorghum plumosum.*

Condition: 1/2 - 3

Disturbance: At the northern end of the site, trees are of similar ages (young) and there are some cleared areas however there are no visible signs of deliberate disturbance. The southern end of the site appears to be an old borrow pit area. Central area of site is condition 3, due to cattle grazing. Weeds are notably absent.

Other: The central section of the site has black soil. *Sorghum plumosum* is dominant within the creekline.

Plate 13 Vegetation present within borrow pit 11.

Borrow Pit No: 12 **Survey Date:** 23-02-2007

Vegetation Description: Low open Eucalypt woodland over spinifex. *Corymbia opaca, Eucalpytus brevifolia, E. pruinosa, Bauhinia cunninghamii, Gyrocarpus americanus, Terminalia canescens* over *Grevillea* spp., *Brachychiton diversifolius, Carissa lanceolata, Cleome* spp., *Euphorbia coghlanii, Corchorus sidoides, Triumfetta plumigera, Indigofera* sp., *Zornia* spp., *Eriachne obtusa, Heteropogon contortus, Sorghum plumosum*

Condition: 1/2

Disturbance: Little disturbance factors evident; has had recent fire through

Other: Creekline occurs just outside of site.

Plate 14 Vegetation present within borrow pit 12.

Borrow Pit No: **12A** **Survey Date:** **23-02-2007**

Vegetation Description: Open Eucalypt woodland over mixed grasses including spinifex. *Corymbia opaca, Eucalyptus brevifolia, Adansonia gregorii, Bauhinia cunninghamii, Terminalia canescens, Ehretia saligna, Grevillea* spp. over *Acacia adoxa, A. orthocarpa, Calytrix exstipulta, Ptilotus* spp., *Heliotropium* spp., *Cleome* spp., *Cartonema spicatum, Ipomoea eriocarpa, Corchorus sidoides, Polymeria ambigua, Sesbastiana chamaelea,* Papilionaceae spp. and Cyperaceae spp. over mixed grasses including *Triodia bitextura* (dominant).

Unique species on rocky outcrop and in drainage area off rocky outcrop.

Condition: 1/2 (majority of site); 4 (west corner of site, near road with old borrow pit present)

Disturbance: N/A

Other: Slightly heavier and wetter soils were observed at the site. A number of wetland or dampland plant species observed in the south-west area of the site, in a drainage area.

Plate 15 Vegetation present within borrow pit 12A. Photograph is taken from the top of a hilly area overlooking grasses, spinifex and Eucalypt trees.

Borrow Pit No: 13 **Survey Date:** 22-02-2007

Vegetation Description: Low open Eucalypt woodland over grasses. *Eucalyptus brevifolia, Corymbia confertiflora, Bauhinia cunninghamii*, *Terminalia canescens, Grevillea striata* over *Carissa lanceolata, Calotropis procera, Ptilotus exaltatus, Crotalaria* spp., *Tephrosia laxa, Polymeria ambigua, Triumfetta plumigera, Cleome* spp., *Aristida pruinosa, Chrysopogon fallax, Eragrostis speciosa, Eriachne obtusa, Heteropogon contortus* and *Triodia* spp.

Bauhinia cunninghamii and *Terminalia canescens* are dominant in the flatter areas of the site. *Adansonia gregorii* (Boab) growing within the creekline.

Condition: 1/2 (majority of site); 4-5 in area of old borrow pit (some regrowth)

Disturbance: Site has previously been disturbed – old borrow pit area.

Other: Large pit occurs next to creekline. Site also has pristine hilltops.

Plate 16 Vegetation present at borrow pit 13. Photograph is looking over towards ridge top present within the survey area.

Borrow Pit No: 14 **Survey Date:** 22-02-2007

Vegetation Description: Low open Eucalypt woodland over mixed grasses: *Eucalyptus brevifolia, Corymbia confertiflora, Bauhinia cunninghamii*, *Terminalia canescens, Grevillea pyramidalis, Ehretia saligna* over *Acacia adoxa, Carissa lanceolata, Heliotriopium tenuifolium, Corchorus sidoides, Crotalaria novae-hollandiae, Euphorbia coghlanii, Tinospora smilacina* and mixed grasses, *Eriachne obtusa, Heteropogon contortus, Triodia* sp.

Condition: 1/2

Disturbance: N/A

Other: Rocky quartz area was observed in the southeast corner of the site. Some areas of the site are quite open and covered with quartz sand.

Plate 17 Vegetation present at borrow pit 14.

Borrow Pit No: 15 **Survey Date:** 22-02-2007

Vegetation Description: Low open Eucalypt woodland over spinifex grasses: *Corymbia opaca, Cochlospermum fraseri, Terminalia canescens, Grevillea pyramidalis* over *Acacia adoxa, Trichodesma zeylanicum, Heliotropium tenuifolium, Euphorbia coghlanii, Tephrosia laxa* over *Triodia bitextura, T. pungens.*

Condition: 1/2

Disturbance: Livestock grazing.

Other: Co-ordinates given for the borrow pit site were wrong, and site was located using aerial maps of the search area. Some discrepancies relating to the exact location of the site may have been encountered as a consequence.

Plate 18 Vegetation present within borrow pit 15, looking northwest over site.

Borrow Pit No: 16 **Survey Date:** 22-02-2007

Vegetation Description: Low open Eucalypt woodland over mixed grasses: *Corymbia opaca, Eucalyptus brevifolia, Bauhinia cunninghamii, Cochlospermum fraseri, Grevillea pyramidalis, Hakea arborescens* over *Acacia orthocarpa, Carissa lanceolata, Cleome* spp., *Euphorbia australis, Boerhavia paludosa, Tephrosia* spp., *Hybanthus* spp., *Enneapogon polyphyllus, Eriachne obtusa,*

Condition: 1/2

Disturbance: fire?

Other: N/A

Plate 19 Vegetation present within borrow pit 16.

Borrow Pit No: 17 **Survey Date:** 22-02-2007

Vegetation Description: Low open woodland over mixed grasses. *Eucalyptus brevifolia, Corymbia opaca*, *C. confertiflora, Bauhinia cunninghamii, Cochlospermum fraseri, Terminalia canescens, Grevillea* spp., over *Carissa lanceolata, Calotropis procera, Cleome* spp., *Boerhavia paludosa, Dicanthium fecundum, Enneapogon polyphyllus, Eragrostis speciosa, Eriachne obtusa, Heteropogon contortus* and *Triodia bitextura.*

Grevillea pyrimidalis is dominant near the roadside. Granite outcrop vegetation includes *Portulaca pilosa, Calytrix exstipulata*, *Calandrinia uniflora*, *Cyperus latzii, C. microcephalus, Heliotropium tenuifolium* and *Goodenia coronopifolia.*

Alloteropsis semialata, Sorghum plumosum and *Chrysopogon fallax* are also dominant within and adjacent to the creekline.

Condition: 1/2

Disturbance: On the eastern side of the road, some previous disturbance to the landscape was noted. Disturbance appears to be an old borrow pit site. Some disturbance to vegetation through cattle grazing.

Other: Scattered granite rocks present throughout site. Creekline in centre of the site runs through a granite dyke (runs east-west). A large boab tree was noted to occur at the following location:

GPS co-ordinates: 420811 E 8153988 N (WGS 84, Zone 50)

Plate 20 Vegetation and granite domes present within borrow pit 17.

Borrow Pit No: 18 **Survey Date:** 22-02-2007

Vegetation Description: Low open woodland over grassland. *Eucalyptus brevifolia, Terminala arostrata* over *Carissa lanceolata, Senna notabilis*, *Cleome viscosa*, *Boerhavia paludosa*, *Ptilotus* spp., *Euphorbia* spp. and mixed grasses, *Aristida pruinosa, Chrysopogon fallax, Digitaria cilaris, Eulalia aurea* and *Triodia bitextura*.

Creekline has dense fringing *Lophostemon grandiflorus*, *Cochlospermum fraseri*, *Terminalia* sp. and *Ehretia saligna* over mixed grasses.

Condition: 1/2

Disturbance:

Other: Vegetation on the north-eastern side of the road was noted to have different vegetation than the rest of the site.

Plate 21 Vegetation present within borrow pit 18.

Borrow Pit No: 19 **Survey Date:** 21-02-2007

Vegetation Description: Low open woodland over grassland. *Eucalyptus pruinosa*, *Eucalyptus brevifolia, Bauhinia cunninghamii*, *Cochlospermum fraseri, Brachychiton viscidulus* over *Carissa lanceolata*, *Sesbania cannabina, Euphorbia* sp., *Themeda triandra*, *Chrysopogon fallax*, *Eriachne obtusa*, *Aristida pruinosa.*

Portulaca pilosa, Grevillea pyramidalis and *Flueggea virosa* present on occasional rocky outcrops.

Condition: 1/2

Disturbance: none evident

Other:

Plate 22 Vegetation present within borrow pit 19.

Borrow Pit No: 20 **Survey Date:** 21-02-2007

Vegetation Description: Low woodland: *Corymbia confertifloa, Eucalyptus camaldulensis, Eucalyptus ?dampieri, Bauhinia cunninghamii, Gyrocarpus americanus, Terminalia canescens* over *Carissa lanceolata, Senna magnifolia, Indigofera linnaei, Corchorus sidoides* over *Triodia bitextura, T. pungens*. Some *Adansonia gregorii* and *Lophostemon grandiflorus* are present next to creekline.

Condition: 1/2

Disturbance: Creekline appears to be undisturbed and vegetation is in *Excellent* condition.

Other: Site starts on ridge and then grades down to the creekline. Appears to be an Aboriginal camping area located on the edge of creek and there may be potential stone tools / artefact scatter at this location.

Plate 23 Vegetation present within creekline.

Borrow Pit No: 21 **Survey Date:** 21-02-2007

Vegetation Description: Open woodland over mixed grasses: *Eucalyptus brevifolia, Bauhinia cunninghamii, Gyrocarpus americanus, Terminalia canescens, Grevillea pyramidalis* over *Cleome viscosa, Euphorbia* spp., *Crotalaria novae-hollandiae, Chrysopogon fallax, Enneapogon polyphyllus, Heteropogon contortus, Triodia bitextura*

Fringing woodland of *Terminalia canescens* along creekline.

Condition: 1/2 (majority of site); 4 (next to creekline)

Disturbance: Areas next to creekline appear to have been cleared previously.

Other: Creekline runs through centre of site.

Plate 24 Vegetation present within Borrow Pit 21

Borrow Pit No: 22 **Survey Date:** 21-02-2007

Vegetation Description: Mixed grassland with scattered Eucalypt trees. *Eucalyptus pruinosa*, *Eucalyptus brevifolia, Bauhinia cunninghamii, Terminalia canescens, Cochlospermum fraseri, Dolichandrone heterophylla, Ehretia saligna* over *Carissa lanceolata, Calotropis procera, Polymeria ambigua Cleome viscosa, Portulaca* spp., *Fimbristylis* and mixed grasses, including *Chrysopogon fallax, Aristida contorta, A. pruinosa, Dactyloctenium radulans, Eriachne obtusa, Heteropogon contortus* and *Triodia* spp. Localised patches where *Triumfetta plumigera*. and *Crotalaria novae-hollandiae* are dominant.

Condition: 2 (majority of site); 5 (old borrow pit); 6 (along road and in pull-off)

Disturbance: Western side of the road is disturbed with a pull-off from the road. Disturbance was noted on the eastern side of the road around a large culvert. Borrow pit area is also disturbed in the north and central areas.

Other: Large termite mounds were noted within the centre of the borrow pit site.

Plate 25 Vegetation present within borrow pit 22.

Borrow Pit No: 23 **Survey Date:** 21-02-2007

Vegetation Description: Mixed grassland with scattered Eucalypt trees. *Eucalyptus brevifolia, Eucalyptus pruinosa*, *Bauhinia cunninghamii* and some *Acacia* ssp. occur around the edges of the borrow pit but the centre of the pit is mainly comprised of a grassland of *Chrysopogon fallax , Enneapogon polyphyllus* and *Sporobolus australasicus* with *Gossypium australe*, *Salsola tragus*, *Calotropis procera** and *Aerva javanica**.

Condition: 3

Disturbance: Area has previously been used as a borrow pit (approximately 40 m in from road side). Native vegetation directly adjacent to road is in *Good* condition.

Other: Site is very close to March Fly Creek (water present within creek).

Plate 26 Photograph of old borrow pit area.

Borrow Pit No: **MRWA Quarry** **Survey Date:** **23-02-2007**

Vegetation Description: Low open woodland over mixed grasses. Open woodland of *Terminalia canescens*, *T. arostrata, Cochlospermum fraseri, Brachychiton* sp., *Bauhinia cunninghamii* with occasional *Eucalyptus* spp. over *Acacia* spp., *Carissa lanceolata, Aerva javanica, Calotropis procera, Cleome viscosa, Fimbristylis* spp., *Euphorbia* spp., *Eriachne obtusa, Heteropogon contortus, Xerochloa laniflora* and *Chrysopogon fallax.* Occasional *Adansonia gregorii* on creeklines.

Condition: 3/4 (majority); 6 (old quarry)

Disturbance: The site is quite degraded as it is part of an old blue metal site, obvious disturbance in the north where the old quarry is located but the rest of the site has been impacted by the quarry and has evidence of disturbance, including altered drainage and the introduction of introduced species.

Other: Eucalypts occur on areas where blue metal were observed.

Plate 27 Vegetation present within creekline that runs through MRWA Quarry.

Appendix C

Flora

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

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

Flora List for the Survey Area. Recorded 21/02/07-01/03/07

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

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

Table 9 Conservation 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 Flora List for the Survey Area. Recorded 21/02/07-01/03/07

Family	Genus	Species	Common Name	Status	Road Corridor	1	2	3	4	5	6	6A	7	8	9	9A	10	11	12	12A	13	14	15	16	17	18	19	20	21	22	23	MRWA Quarry
?					+																											
Amaranthaceae	*Aerva*	*javanica*	Kapok Bush	*	+			+	+							+															+	+
Amaranthaceae	*Gomphrena*	*canescens*	Batchelors Buttons									+				+																
Amaranthaceae	*Gomphrena*	*leptoclada*			+		+		+			+		+		+	+															
Amaranthaceae	*Ptilotus*	*corymbosus*			+		+										+			+						+					+
Amaranthaceae	*Ptilotus*	*exaltatus*	Tall Mulla Mulla																		+											
Amaranthaceae	*Ptilotus*	*fusiformis*			+				+	+		+	+	+		+	+			+		+	+			+	+			+	+	
Apocynaceae	*Carissa*	*lanceolata*	Conkerberry		+	+	+	+	+	+				+	+	+	+	+	+		+	+		+	+	+	+	+		+		+
Asclepiadaceae	*Calotropis*	*procera*	Calotrope	*	+			+				+				+					+				+				+	+	+	+
Asclepiadaceae	*Marsdenia*	*angustata*			+												+			+								+				
Asteraceae	*Pterocaulon*	*serrulatum*			+	+	+			+											+											+
Asteraceae	*Tridax*	*procumbens*	Tridax	*	+					+						+									+							+
Bignoniaceae	*Dolichandrone*	*heterophylla*	Lemon Wood		+	+		+			+			+	+	+	+	+												+		
Bombacaceae	*Adansonia*	*gregorii*	Boab		+		+		+	+	+				+	+	+			+	+				+			+				+
Boraginaceae	*Ehretia*	*saligna*	False Cedar (Native Willow)		+		+		+		+			+	+					+		+	+		+	+	+			+	+	

Family	Genus	Species	Common Name	Status	Road Corridor	1	2	3	4	5	6	6A	7	8	9	9A	10	11	12	12A	13	14	15	16	17	18	19	20	21	22	23	MRWA Quarry
Boraginaceae	*Heliotropium*	*glabellum*			+															+												
Boraginaceae	*Heliotropium*	*tenuifolium*	Mamukata		+	+		+	+		+	+	+	+	+	+	+	+		+	+	+	+	+	+	+		+		+	+	
Boraginaceae	*Trichodesma*	*zeylanicum*	Camel Bush		+			+								+							+									
Byblidaceae	*Byblis*	*liniflora*	Northern Byblis															+														
Caesalpiniaceae	*Parkinsonia*	*aculeata*	Parkinsonia	* WONS / DP	+		+																									
Caesalpiniaceae	*Senna*	*magnifolia*																										+				
Caesalpiniaceae	*Senna*	*notabilis*			+							+														+						
Caesalpiniaceae	*Senna*	sp.								+																						
Caesalpiniaceae	*Senna*	*venusta*														+																
Caesalpiniaceae	*Bauhinia*	*cunninghamii*	Bauhinia		+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+		+	+		+		+	+	+	+
Capparaceae	*Capparis*	*umbonata*	Wild Orange																		+											
Capparaceae	*Cleome*	*tetrandra*			+									+				+	+	+	+			+	+							
Capparaceae	*Cleome*	*viscosa*	Tick Weed		+			+		+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+	+	+
Caryophyllaceae	*Polycarpaea*	sp.			+	+										+																
Caryophyllaceae	*Polycarpaea*	*spirostylis* subsp. *glabra*			+		+		+																							
Caryophyllaceae	*Polycarpaea*	*corymbosa*			+							+			+								+			+				+		

Family	Genus	Species	Common Name	Status	Road Corridor	1	2	3	4	5	6	6A	7	8	9	9A	10	11	12	12A	13	14	15	16	17	18	19	20	21	22	23	MRWA Quarry
Chenopodiaceae	*Salsola*	*tragus*	Rolypoly		+	+	+			+											+										+	+
Cochlospermaceae	*Cochlospermum*	*fraseri*	Kapok Bush		+		+			+		+				+							+	+	+	+	+			+		+
Combretaceae	*Terminalia*	*arostrata*	Crocodile Tree		+		+																									+
Combretaceae	*Terminalia*	*canescens*	Joolal		+		+		+	+	+				+		+	+	+	+	+	+	+		+			+	+	+		+
Combretaceae	*Terminalia*	*platyphylla*			+		+			+																						
Combretaceae	*Terminalia*	sp.			+																					+	+					
Commelinaceae	*Cartonema*	*spicatum*			+													+		+												
Commelinaceae	*Cyanotis*	*axillaris*		RE	+												+	+		+												
Commelinaceae	*Murdannia*	*graminea*	Baniyu		+																					+				+		
Convolvulaceae	*Evolvulus*	*alsinoides*	Tropical Speedwell													+																
Convolvulaceae	*Ipomoea*	*coptica*														+																
Convolvulaceae	*Ipomoea*	*eriocarpa*			+					+					+	+	+	+		+						+						
Convolvulaceae	*Ipomoea*	*nil*														+														+		
Convolvulaceae	*Ipomoea*	*polymorpha*														+																
Convolvulaceae	*Ipomoea*	sp.																									+					
Convolvulaceae	*Jacquemontia*	*pannosa*																										+		+		
Convolvulaceae	*Polymeria*	*ambigua*	Morning Glory		+		+				+		+		+	+	+		+	+	+	+	+		+					+		

Family	Genus	Species	Common Name	Status	Road Corridor	1	2	3	4	5	6	6A	7	8	9	9A	10	11	12	12A	13	14	15	16	17	18	19	20	21	22	23	MRWA Quarry
Cucurbitaceae	*Citrullus*	*lanatus*	Pie Melon													+																
Cucurbitaceae	*Mukia*	*maderaspatana*			+											+									+					+		
Cuscutaceae	*Cuscuta*	sp.		*	+		+																									
Cyperaceae	*Bulbostylis*	*barbata*																													+	
Cyperaceae	*Cyperus*	*latzii*		RE	+					+										+					+	+		+				
Cyperaceae	*Cyperus*	*macrostachyos*			+		+								+		+	+		+												+
Cyperaceae	*Cyperus*	*microcephalus*			+																	+	+		+							
Cyperaceae	*Cyperus*	sp.														+																
Cyperaceae	*Fimbristylis*	*cardiocarpa*			+										+	+	+		+	+												
Cyperaceae	*Fimbristylis*	*depauperata*							+		+							+			+											
Cyperaceae	*Fimbristylis*	*macassarensis*			+										+										+					+		+
Cyperaceae	*Fimbristylis*	*microcarya*			+								+													+						
Cyperaceae	*Fimbristylis*	*schultzii*			+					+						+	+	+		+										+		+
Cyperaceae	*Schoenoplectus*	*dissachanthus*			+										+																	
Droseraceae	*Drosera*	*?lanata*																+			+											
Euphorbiaceae	*Euphorbia*	*australis*			+			+					+				+							+		+						+
Euphorbiaceae	*Euphorbia*	*coghlanii*	Namana		+						+	+							+	+		+	+		+	+						+
Euphorbiaceae	*Euphorbia*	*comans*														+																

Family	Genus	Species	Common Name	Status	Road Corridor	1	2	3	4	5	6	6A	7	8	9	9A	10	11	12	12A	13	14	15	16	17	18	19	20	21	22	23	MRWA Quarry
Euphorbiaceae	*Euphorbia*	*drummondii*	Caustic Weed		+																								+	+	+	
Euphorbiaceae	*Euphorbia*	*hirta*	Asthma Plant	*	+					+																			+			
Euphorbiaceae	*Euphorbia*	*mitchelliana*														+																
Euphorbiaceae	*Euphorbia*	sp.								+							+										?	+				
Euphorbiaceae	*Euphorbia*	sp. B Kimberley Flora (B.J. Carter 629)														+											+			+		
Euphorbiaceae	*Flueggea*	*virosa*			+		+		+				+									+		+		+	+			+	+	
Euphorbiaceae	*Jatropha*	*gossypifolia*	Bellyache Bush	* WONS / DP	+	+	+																									
Euphorbiaceae	*Sebastiania*	*chamaelea*			+															+												
Goodeniaceae	*Goodenia*	*coronopifolia*			+	+	+		+		+			+	+	+	+	+		+	+			+	+	+				+		
Goodeniaceae	*Goodenia*	*odonnellii*															+															
Goodeniaceae	*Goodenia*	*sepalosa var. sepalosa*			+		+									+															+	
Haemodoraceae	*Haemodorum*	*ensifolium*			+												+			+												
Hernandiaceae	*Gyrocarpus*	*americanus*	Helicopter Tree		+					+	+						+		+						+			+	+	+		
Malvaceae	*Gossypium*	*australe*	Native Cotton		+			+			+	+	+			+															+	
Malvaceae	*Sida*	*?hackettiana*		RE																										+		

Family	Genus	Species	Common Name	Status	Road Corridor	1	2	3	4	5	6	6A	7	8	9	9A	10	11	12	12A	13	14	15	16	17	18	19	20	21	22	23	MRWA Quarry
Malvaceae	*Triumfetta*	*ryeae*														+																
Meliaceae	*Owenia*	*vernicosa*	Emu Apple		+																	+	+	+	+		+	+				
Menispermaceae	*Tinospora*	*smilacina*	Snake Vine		+	+	+		+	+			+	+		+	+	+	+		+	+		+	+					+	+	
Mimosacaceae	*Vachellia*	*farnesiana*	Mimosa Bush	*	+		+																									
Mimosaceae	*Acacia*	*adoxa*			+						+									+	+	+	+			+	+					
Mimosaceae	*Acacia*	*ancistrocarpa*	Fitzroy Wattle							+						+																
Mimosaceae	*Acacia*	*holosericea*	Candelbra Wattle		+	+					+					+																+
Mimosaceae	*Acacia*	*lysiphloia*	Turpentine Wattle													+																
Mimosaceae	*Acacia*	*orthocarpa*	Needleleaf Wattle		+															+	+		+	+	+							
Mimosaceae	*Acacia*	*wickhamii Benth.* subsp. *wickhamii*			+																					+	+					
Mimosaceae	*Neptunia*	*dimorphantha*	Sensitive Plant													+																
Molluginaceae	*Glinus*	*oppositifolius*			+	+			+	+						+																+
Moraceae	*Ficus*	*?coronulata*	River Fig							+																		+				
Moraceae	*Ficus*	*opposita*	Sandpaper Fig		+											+									+							
Moraceae	*Ficus*	sp.			+					+																+						

Family	Genus	Species	Common Name	Status	Road Corridor	1	2	3	4	5	6	6A	7	8	9	9A	10	11	12	12A	13	14	15	16	17	18	19	20	21	22	23	MRWA Quarry
Myrtaceae	*Calytrix*	*exstipulata*	Kimberley Heather		+						+									+	+											
Myrtaceae	*Corymbia*	*confertiflora*			+	+								+	+		+	+		+	+	+			+	+		+				+
Myrtaceae	*Corymbia*	*grandiflora*			+																											
Myrtaceae	*Corymbia*	*opaca*			+	+	+	+	+	+	+	+	+	+	+	+			+	+	+			+	+	+						+
Myrtaceae	*Corymbia*	sp.														+																
Myrtaceae	*Eucalyptus*	*?dampieri*																									+	+			+	
Myrtaceae	*Eucalyptus*	*brevifolia*	Snappy Gum		+				+	+	+	+		+		+			+	+	+	+		+	+	+	+		+	+	+	
Myrtaceae	*Eucalyptus*	*camaldulensis*	River Gum				+			+																		+				
Myrtaceae	*Eucalyptus*	*grandiflora*			+																								+		+	
Myrtaceae	*Eucalyptus*	*pruinosa*	Silver Box		+	+	+	+	+	+	+	+	+	+	+	+			+								+			+	+	+
Myrtaceae	*Eucalyptus*	sp.															+													+		
Myrtaceae	*Lophostemon*	*grandiflorus*	Freshwater Mangrove		+		+		+	+	+															+		+				
Myrtaceae	*Melaleuca*	*argentea*	Silver Cadjeput		+		+																									
Myrtaceae	*Melaleuca*	*minuitifolia*																+														
Nyctaginaceae	*Boerhavia*	*schomburgkiana*			+												+								+				+			
Nyctaginaceae	*Boerhavia*	*paludosa*			+			+							+	+		+		+	+	+		+	+					+		

Family	Genus	Species	Common Name	Status	Road Corridor	1	2	3	4	5	6	6A	7	8	9	9A	10	11	12	12A	13	14	15	16	17	18	19	20	21	22	23	MRWA Quarry
Onagraceae	*Ludwigia*	*perennis*			+					+											+					+						
Papilionaceae	*?*																													+		
Papilionaceae	*?*				+												+			+											
Papilionaceae	*?Indigofera*	sp.			+		+		+				+		+	+	+		+	+						+						
Papilionaceae	*Aeschynomene*	*indica*	Budda Pea		+					+																+						
Papilionaceae	*Crotalaria*	*medicaginea*			+									+	+	+	+	+		+	+	+	+	+	+					+		+
Papilionaceae	*Crotalaria*	*novae-hollandiae*	New Holland Rattlepod		+		+	+	+	+	+	+	+			+	+				+	+				+			+		+	+
Papilionaceae	*Cullen*	*badocanum*			+		+									+				+	+										
Papilionaceae	*Galactia*	*tenuiflora*			+															+							+					
Papilionaceae	*Indigofera*	*linifolia*			+																											+
Papilionaceae	*Indigofera*	*linnaei*	Birdsville Indigo		+										+					+		+	+					+				
Papilionaceae	*Rhynchosia*	*minima*	Rhynchosia													+															+	
Papilionaceae	*Rhynchosia*	sp.														+																
Papilionaceae	*Sesbania*	*cannabina*	Sesbania Pea		+		+		+								+	+		+					+		+					+
Papilionaceae	*Stylosanthes*	*hamata*	Verano Stylo	*																										+		
Papilionaceae	*Tephrosia*	*brachyodon*														+	+	+						+								
Papilionaceae	*Tephrosia*	*laxa*			+										+						+		+	+	+	+						

Family	Genus	Species	Common Name	Status	Road Corridor	1	2	3	4	5	6	6A	7	8	9	9A	10	11	12	12A	13	14	15	16	17	18	19	20	21	22	23	MRWA Quarry
Papilionaceae	*Tephrosia*	*leptoclada*																													+	
Papilionaceae	*Tephrosia*	*rosea var. clementii*																				+										
Papilionaceae	*Tephrosia*	sp. B Kimberley Flora (B.J. Carter 629)																				+					+	+				
Papilionaceae	*Tephrosia*	*supina*														+																
Papilionaceae	*Zornia*	*muelleriana*			+													+	+	+	+											
Papilionaceae	*Zornia*	*prostrata*			+				+	+	+		+						+						+							
Papilionaceae	*Zornia*	*prostrata* var. *prostrata*			+		+		+	+														+								
Passifloraceae	*Passiflora*	*foetida*	Stinking Passion Flower	*						+																						+
Pedaliaceae	*Josephinia*	*eugeniae*	Josephinia Burr		+		+									+					+											
Poaceae	*?*												+																			
Poaceae	*?*				+															+												
Poaceae	*Alloteropsis*	*semialata*	Cockatoo Grass		+		+		+	+				+				+		+	+				+							
Poaceae	*Aristida*	*contorta*	Bunched Kerosene Grass																											+		

Family	Genus	Species	Common Name	Status	Road Corridor	1	2	3	4	5	6	6A	7	8	9	9A	10	11	12	12A	13	14	15	16	17	18	19	20	21	22	23	MRWA Quarry
Poaceae	*Aristida*	*pruinosa*	Gulf Feathertop Wiregrass		+											+					+					+	+			+		
Poaceae	*Aristida*	sp.			+		+		+	+														+			+					
Poaceae	*Arundinella*	*nepalensis*	Reedgrass		+		+		+	+	+	+																				
Poaceae	*Brachyachne*	*convergens*	Spider Grass (Kimberley Couch)		+		+		+			+		+		+													+	+	+	+
Poaceae	*Cenchrus*	*elymoides*			+																					+						
Poaceae	*Cenchrus*	*setiger*	Birdwood Grass	*												+																
Poaceae	*Chloris*	*barbata*	Purpletop Chloris	*	+	+																										
Poaceae	*Chrysopogon*	*fallax*	Golden Beard Grass		+	+		+	+	+	+	+	+	+	+	+	+	+			+					+	+		+	+	+	+
Poaceae	*Cymbopogon*	*bombycinus*	Silky Oilgrass		+		+				+					+			+													
Poaceae	*Dactyloctenium*	*radulans*	Button Grass		+											+	+	+		+									+	+	+	+
Poaceae	*Dichanthium*	*fecundum*	Curly Bluegrass		+																				+							
Poaceae	*Digitaria*	*ciliaris*	Summer Grass	*	+		+									+	+									+						
Poaceae	*Echinochloa*	*colona*	Awnless Barnyard Grass	*	+										+	+	+															

Family	Genus	Species	Common Name	Status	Road Corridor	1	2	3	4	5	6	6A	7	8	9	9A	10	11	12	12A	13	14	15	16	17	18	19	20	21	22	23	MRWA Quarry
Poaceae	*Enneapogon*	*polyphyllus*	Leafy Nineawn		+					+						+								+	+				+		+	
Poaceae	*Eragrostis*	*amabilis*		*																												
Poaceae	*Eragrostis*	*setifolia*	Neverfail Grass							+																						
Poaceae	*Eragrostis*	*speciosa*	Handsome Lovegrass		+				+					+							+				+					+		
Poaceae	*Eriachne*	*avenacea*			+																					+						
Poaceae	*Eriachne*	*fastigiata*			+	+			+					+		+	+				+						+					
Poaceae	*Eriachne*	*glauca*	Pan Wandarrie Grass		+									+			+	+		+												
Poaceae	*Eriachne*	*obtusa*	Northern Wandarrie Grass		+	+		+	+	+	+	+	+	+	+	+	+	+	+	+	+	+		+	+		+			+	+	+
Poaceae	*Eulalia*	*aurea*			+																					+						
Poaceae	*Heteropogon*	*contortus*	Bunch Speargrass		+			+	+		+	+	+	+		+	+	+	+	+	+	+	+			+				+	+	+	+
Poaceae	*Panicum*	*decompositum*	Native Millet		+										+	+	+			+						+						
Poaceae	*Perotis*	*rara*	Comet Grass		+		+			+						+										+						
Poaceae	*Sorghum*	*plumosum*	Plume Canegrass		+			+		+								+	+	+	+				+							
Poaceae	*Sporobolus*	*australasicus*	Fairy Grass		+										+	+														+	+	
Poaceae	*Themeda*	*triandra*	Kangaroo Grass								+					+											+					

Family	Genus	Species	Common Name	Status	Road Corridor	1	2	3	4	5	6	6A	7	8	9	9A	10	11	12	12A	13	14	15	16	17	18	19	20	21	22	23	MRWA Quarry
Poaceae	*Triodia*	*bitextura*	Curly Spinifex		+	+	+	+	+				+				+	+		+	+		+		+	+		+	+	+		
Poaceae	*Triodia*	*pungens*	Soft Spinifex		+			+				+	+	+			+				+		+					+				
Poaceae	*Triodia*	*schinzii*																												+	+	
Poaceae	*Triodia*	sp.	Spinifex		+		+				+					+						+	+			+	+		+	+	
Poaceae	*Triopogon*	*laniflora*	Five Minute Grass													+																
Poaceae	*Urochloa*	*holosericea*														+		+														
Poaceae	*Xerochloa*	*laniflora*	Rice Grass		+	+	+		+					+		+	+	+		+	+									+		+
Polygalaceae	*Polygala*	*rhinanthoides*														+																
Portulacaceae	*Calandrinia*	*uniflora*			+	+	+		+				+	+		+	+	+	+	+	+				+					+		
Portulacaceae	*Portulaca*	*bicolor*														+																
Portulacaceae	*Portulaca*	*digyna*			+		+		+	+			+			+	+		+							+			+		+
Portulacaceae	*Portulaca*	*pilosa*	Djanggara		+	+	+		+	+	+	+	+		+	+	+	+								+		+		+		+
Portulacaceae	*Portulaca*	sp.														+											+					
Proteaceae	*Grevillea*	*dimidiata*	Caustic Bush									+																				
Proteaceae	*Grevillea*	*dryandri*			+														+	+	+	+				+						

Family	Genus	Species	Common Name	Status	Road Corridor	1	2	3	4	5	6	6A	7	8	9	9A	10	11	12	12A	13	14	15	16	17	18	19	20	21	22	23	MRWA Quarry
Proteaceae	*Grevillea*	*pyramidalis*	Caustic Bush		+		+				+	+		+	+			+	+	+		+	+	+	+		+	+	+		+	+
Proteaceae	*Grevillea*	*striata*	Beefwood																		+											+
Proteaceae	*Hakea*	*arborescens*	Common Hakea		+	+	+		+	+	+			+	+	+	+								+	+	+			+		+
Proteaceae	*Hakea*	*lorea*	Witinti								+	+																				
Proteaceae	*Persoonia*	*falcata*	Wild Pear																			+										
Rubiaceae	*Gardenia*	*resinosa* F. Muell. subsp. *resinosa*																				+										
Rubiaceae	*Oldenlandia*	*galioides*			+												+	+		+												
Rubiaceae	*Oldenlandia*	*mitrasacmoides*			+															+												
Rubiaceae	*Spermacoce*	*laevigata*			+											+	+	+		+	+			+				+				
Sapindaceae	*Atalaya*	*hemiglauca*	Whitewood						+								+							+				+		+		
Sapindaceae	*Dodonaea*	*physocarpa*			+															+		+									+
?Sapotaceae	*?Pouteria*	*sericea*	?Nangi																									+		+		
Scrophulariaceae	*Buchnera*	*asperata*			+																											
Scrophulariaceae	*Buchnera*	*linearis*	Blackrod		+	+	+			+			+		+																	
Scrophulariaceae	*Lindernia*	*clausa*			+												+			+												
Scrophulariaceae	*Stemodia*	*grossa*	Marsh Stemodia													+												+				+

Family	Genus	Species	Common Name	Status	Road Corridor	1	2	3	4	5	6	6A	7	8	9	9A	10	11	12	12A	13	14	15	16	17	18	19	20	21	22	23	MRWA Quarry
Scrophulariaceae	*Stemodia*	*viscosa*	Pagurda		+	+					+																					
Scrophulariaceae	*Striga*	*curviflora*														+																
Solanaceae	*Mitrasacme*	*nudicaulus* Blume var. *nudicaulus*			+		+				+						+						+									
Solanaceae	*Solanum*	*beaugleholei*			+		+					+	+			+																+
Sterculiaceae	*Brachychiton*	*diversifolius*	Northern Kurrajong																+			+										
Sterculiaceae	*Brachychiton*	*viscidulus*																									+					
Tiliaceae	*Corchorus*	*sidoides*	Flannel Weed		+		+				+		+			+	+	+	+	+	+	+	+	+	+		+	+			+	
Tiliaceae	*Triumfetta*	*plumigera*			+	+		+			+						+		+		+	+								+	+	
Tiliaceae	*Triumfetta*	*triandra*			+		+											+		+												
Typhaceae	*Typha*	*domingensis*	Bulrush		+																											
Ulmaceae	*Celtis*	*australiensis*																									+					
Ulmaceae	*Trema*	*tomentosa* var. *viridis*																					+									
Violaceae	*Hybanthus*	*aurantiacus*			+						+						+	+	+	+				+	+							
Violaceae	*Hybanthus*	*enneaspermus*	Blue Fairy's Aprons		+					+						+	+	+			+			+		+				+		
Zygophyllaceae	*Tribulopis*	*pentandra*														+																
Zygophyllaceae	*Tribulopis*	*angustifolia*			+		+						+								+				+							

Family	Genus	Species	Common Name	Status	Road Corridor	1	2	3	4	5	6	6A	7	8	9	9A	10	11	12	12A	13	14	15	16	17	18	19	20	21	22	23	MRWA Quarry
Zygophyllaceae	*Tribulus*	*terrestris*	Caltrop		+			+								+				+												

*	Introduced species
DP	Declared Plant, noxious weed declared under the *ARRP Act*
WONS	Weed of National Significance
RE	Range Extension
?	Identification to species was not completely certain due to lack of distinctive features

Appendix D

Fauna

EPBC Act Fauna Conservation Categories

Western Australian Wildlife Conservation Act 1950 Conservation Codes

DEC Priority Fauna Codes.

Fauna Species that may occur in the Survey area (*FaunaBase*)

Fauna Species Recorded in the Survey Area during the Field Survey

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 thespecies.

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 11 *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 12 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 13 Fauna Species that may occur in the Survey area (*FaunaBase*)

(Source: Western Australian Museum *FaunaBase* Search for 5 km radius of survey area)

				Conservation Status	
Family	**Genus**	**Species**	**Common Name**	**EPBC**	**DEC**
Amphibia					
Myobatrachidae	*Limnodynastes*	*ornatus*	Ornate Frog		
Hylidae	*Cyclorana*	*australis*	Giant Frog		
Birds					
Aegothelidae	*Aegotheles*	*cristatus*	Australian Owlet Night-jar		
Pachycephalidae	*Colluricinda*	*harmonica brunnea*			
Mammals					
No records					
Fishes					
No records					
Reptiles					
Agamidae	*Ctenophorus*	*caudicinctus*	Ring Tailed Rock Dragon		
Agamidae	*Diporiphora*	*arnhemica*			
Agamidae	*Diporiphora*	*bennettii*			
Gekkonidae	*Gehyra*	*nana*			
Scincidae	*Tiliqua*	*multifasciata*	Central Blue Tongue		
Varinidae	*Varanus*	*acanthurus*	Spiny-tailed Monitor		
Varinidae	*Varanus*	*kingorum*	Long-tailed Rock Monitor		
Varinidae	*Varanus*	*tristis tristis*	Black-headed Monitor		

Table 14 Fauna Species Recorded in the Survey Area during the Field Survey. Recorded 21/02/07-01/03/07

				Conservation Status	
Family	**Genus**	**Species**	**Common Name**	**DEC**	**EPBC**
Birds					
Acanthizidae	*Smicrornis*	*brevirostris*	Weebill		
Accipitridae	*Circus*	*approximans*	Swamp Harrier		Marine
Accipitridae	*Haliastur*	*sphenurus*	Whistling Kite		Marine
Anatidae	*Anas*	*superciliosa*	Pacific Black Duck		
Anatidae	*Tadorna*	*rajah*	Rajah Shelduck	Schedule 4	Marine
Artamidae	*Artamus*	*cinereus*	Black-faced Woodswallow		
Campephagidae	*Coracina*	*novaehollandiae*	Black-faced Cuckoo-shrike		Marine
Casuaridae	*Dromaius*	*novaehollandiae*	Emu		
Ciconiidae	*Ephioppiorhynchus*	*asiaticus*	Black-necked Stork, Jabiru		
Climacteridae	*Climacteris*	*melanura*	Black-tailed Treecreeper		
Columbidae	*Geopelia*	*cuneata*	Diamond Dove		
Columbidae	*Geophaps*	*plumifera*	Spinifex Pigeon		
Columbidae	*Ocyphaps*	*lophotes*	Crested Pigeon		
Coraciidae	*Eurystomus*	*orientalis*	Dollarbird		Marine
Corvidae	*Corvus*	*orru*	Torresian Crow		
Cracticidae	*Cracticus*	*nigrogularis*	Pied Butcherbird		
Cracticidae	*Cracticus*	*tibicen tibicen*	Australian Magpie		
Dicruridae	*Grallina*	*cyanoleuca*	Magpie-lark		Marine
Dicruridae	*Rhipidura*	*leucophrys*	Willie Wagtail		

				Conservation Status	
Family	**Genus**	**Species**	**Common Name**	**DEC**	**EPBC**
Falconidae	*Falco*	*berigora*	Brown Falcon		
Falconidae	*Falco*	*cenchroides*	Australian Kestrel		
Gruidae	*Grus*	*rubicunda*	Brolga	?	
Halcyonidae	*Todiramphus*	*sanctus*	Sacred Kingfisher		Marine
Hirundinidae	*Hirundo*	*ariel*	Fairy Martin		
Hirundinidae	*Hirundo*	*nigricans*	Tree Martin		
Maluridae	*Malurus*	*melanocephalus*	Red-backed Fairy-wren		
Maluridae	*Malurus*	*sp.*	Fairy Wren		
Meliphagidae	*Conopophila*	*rufogularis*	Rufous-throated Honeyeater		
Meliphagidae	*Lichenostomus*	*flavescens*	Yellow-tinted Honeyeater		
Meliphagidae	*Lichenostomus*	*virescens*	Singing Honeyeater		
Meliphagidae	*Manorina*	*flavigula*	Yellow-throated Miner		
Meliphagidae	*Philemon*	*argenticeps*	Silver-crowned Friarbird		
Meliphagidae	*Philemon*	*citreogularis*	Little Friarbird		
Meropidae	*Merops*	*ornatus*	Rainbow Bee-eater		Migratory, Marine
Otididae	*Ardeotis*	*australis*	Australian Bustard	Priority 4	
Pardalotidae	*Pardalotus*	*striatus*	Striated Pardalote		
Passeridae	*Emblema*	*pictum*	Painted Finch		
Passeridae	*Erythrura*	*gouldiae*	Gouldian Finch	Schedule 1	Endangered, Migratory
Passeridae	*Peophila*	*acuticauda*	Long-tailed Finch		
Passeridae	*Peophila*	*personata*	Masked Finch		

				Conservation Status	
Family	**Genus**	**Species**	**Common Name**	**DEC**	**EPBC**
Passeridae	*Taeiopygia*	*bichenovii*	Double-barred Finch		
Passeridae	*Taeiopygia*	*guttata*	Zebra Finch		
Petroicidae	*Microeca*	*fascinans*	Jacky Winter		
Pomatostomidae	*Pomatostomus*	*temporalis*	Grey-crowned Babbler		
Psittacidae	*Aprosmictus*	*erythropterus*	Red Winged Parrot		
Psittacidae	*Cacatua*	*galerita*	Sulphur-crested Cockatoo		
Psittacidae	*Cacatua*	*roseicapilla*	Galah		
Psittacidae	*Cacatua*	*sanguinea sanguinea*	Little Corella		
Psittacidae	*Melopsittacus*	*undulatus*	Budgerigar		
Psittacidae	*Nymphicus*	*hollandicus*	Cockatiel, Weiro		
Psittacidae	*Platycercus*	*venustus*	Northern Rosella		
Rallidae	*Porzana*	*tabuensis*	Spotless Crake		Marine
Scolopacidae	*Tringa*	*hypoleucos*	Common Sandpiper		Migratory, Marine
Sylviidae	*Cincloramphus*	*cruralis*	Brown Songlark		
Sylviidae	*Cisticola*	*exilis*	Golden-headed Cisticola		
Turnicidae	*Turnix*	*maculosa*	Red-backed Button-quail		
Mammals					
Bovidae	*Bos*	*indicus*	Brahman Bull	domestic	
Canidae	*Canus*	*familiaris*	?Domestic/Camp Dog		
Equidae	*Equus*	*caballus*	Brumby		
Felidae	*Felis*	*catus*	Feral Cat		

				Conservation Status	
Family	**Genus**	**Species**	**Common Name**	**DEC**	**EPBC**
Macropodidae	*Macropus*	*rufus*	Red Kangaroo		
Macropodidae	*Macropus*	*sp.*			
Phalangeridae	*Trichosurus*	*vulpecula arnhemensis*	Northern Brushtail Possum		
Tachyglossidae	*Tachyglossus*	*aculeatus*	Echidna		
Reptiles					
Agamidae	*Ctenophorus*	*caudicinctus caudicinctus*	Ring-tailed Dragon		
Agamidae	*Ctenophorus*	*isolepis isolepis*	Central Military Dragon		
Agamidae	*Ctenophorus*	*nuchalis*	Central Netted Dragon		
Agamidae	*Diporiphora*	*lalliae*			
Agamidae	*Lophognathus*	*gilbertii*	Ta-ta Lizard, Gilbert's Dragon		
Scincidae	*?Cryptoblepharus*	*plagiocephalus*			
Scincidae	Skink	*sp.*			
Fishes					
Atherinidae	*Craterocephalus*	*sp.*	Hardyhead		
Clupeidae	*Nematalosa*	*erebi*	Bony Bream		
Terapontidae	*Leiopotherapon*	*unicolor*	Spangled Perch		
Toxotidae	*Toxotes*	*chatareus*	Archer Fish		

Appendix E

Reserves

WESTERN AUSTRALIA

REGISTER NUMBER	
3695/DP37695	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	**N/A**

RECORD OF QUALIFIED CERTIFICATE OF CROWN LAND TITLE

VOLUME **LR3128** FOLIO **510**

UNDER THE TRANSFER OF LAND ACT 1893
AND THE LAND ADMINISTRATION ACT 1997

NO DUPLICATE CREATED

The undermentioned land is Crown land in the name of the STATE of WESTERN AUSTRALIA, subject to the interests and Status Orders shown in the first schedule which are in turn subject to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 3695 ON DEPOSITED PLAN 37695

STATUS ORDER AND PRIMARY INTEREST HOLDER:
(FIRST SCHEDULE)

STATUS ORDER/INTEREST: RESERVE WITHOUT MANAGEMENT ORDER

PRIMARY INTEREST HOLDER: STATE OF WESTERN AUSTRALIA

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. I967463 PART RESERVE 1609 FOR THE PURPOSE OF PUBLIC PURPOSES REGISTERED 28.7.2004.

Warning: (1) A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Lot as described in the land description may be a lot or location.
(2) The land and interests etc. shown hereon may be affected by interests etc. that can be, but are not, shown on the register.
(3) The interests etc. shown hereon may have a different priority than shown.

----------END OF CERTIFICATE OF CROWN LAND TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: DP37695 [SHEET 1].
PREVIOUS TITLE: LR3115-797.
PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA: SHIRE OF WYNDHAM-EAST KIMBERLEY.

NOTE 1: A000001A CORRESPONDENCE FILE 02322-1989-01RO.
NOTE 2: I967461 SUBJECT TO SURVEY - NOT FOR ALIENATION PURPOSES

WESTERN AUSTRALIA

REGISTER NUMBER	
397/DP37397	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
N/A	**N/A**

RECORD OF QUALIFIED CERTIFICATE OF CROWN LAND TITLE

VOLUME **LR3128** FOLIO **733**

UNDER THE TRANSFER OF LAND ACT 1893
AND THE LAND ADMINISTRATION ACT 1997

NO DUPLICATE CREATED

The undermentioned land is Crown land in the name of the STATE of WESTERN AUSTRALIA, subject to the interests and Status Orders shown in the first schedule which are in turn subject to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 397 ON DEPOSITED PLAN 37397

STATUS ORDER AND PRIMARY INTEREST HOLDER:
(FIRST SCHEDULE)

STATUS ORDER/INTEREST: RESERVE WITHOUT MANAGEMENT ORDER

PRIMARY INTEREST HOLDER: STATE OF WESTERN AUSTRALIA

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. I967463 PART RESERVE 1609 FOR THE PURPOSE OF PUBLIC PURPOSES REGISTERED 28.7.2004.

Warning: (1) A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required. Lot as described in the land description may be a lot or location.
(2) The land and interests etc. shown hereon may be affected by interests etc. that can be, but are not, shown on the register.
(3) The interests etc. shown hereon may have a different priority than shown.

----------END OF CERTIFICATE OF CROWN LAND TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND: DP37397 [SHEET 1].
PREVIOUS TITLE: LR3115-798.
PROPERTY STREET ADDRESS: NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA: SHIRE OF WYNDHAM-EAST KIMBERLEY.

NOTE 1: A000001A CORRESPONDENCE FILE 02322-1989-01RO.
NOTE 2: I967462 SUBJECT TO SURVEY - NOT FOR ALIENATION PURPOSES

Appendix F

Heritage

Aboriginal Heritage Inquiry Results

Search Criteria

109 sites in a search box. The box is formed by these diagonally opposed corner points:

MGA Zone 52	
Northing	Easting
8130000	410000
8165000	445000

Disclaimer

Aboriginal sites exist that are not recorded on the Register of Aboriginal Sites, and some registered sites may no longer exist. Consultation with Aboriginal communities is on-going to identify additional sites. The AHA protects all Aboriginal sites in Western Australia whether or not they are registered.

Copyright

Legend

Restriction		Access		Status	
N	No restriction	C	Closed	I	Interim register
M	Male access only	O	Open	P	Permanent register
F	Female access	V	Vulnerable	S	Stored data

Coordinate Accuracy

Accuracy is shown as a code in brackets following the site coordinates.

[Reliable]	The spatial information recorded in the site file is deemed to be reliable, due to methods of capture.
[Unreliable]	The spatial information recorded in the site file is deemed to be unreliable due to errors of spatial data capture and/or quality of spatial information reported.

Spatial Accuracy

Index coordinates are indicative locations and may not necessarily represent the centre of sites, especially for sites with an access code “closed” or “vulnerable”. Map coordinates (Lat/Long) and (Easting/Northing) are based on the GDA 94 datum. The Easting / Northing map grid can be across one or more zones. The zone is indicated for each Easting on the map, i.e. '5000000:Z50' means Easting=5000000, Zone=50.

Site ID	Status	Access	Restriction	Site Name	Site Type	Additional Info	Informants	Coordinates	Site No.
12453	P	O	N	Wilson River Quarry	Quarry, Artefacts / Scatter			423634mE 8143565mN Zone 52 [Reliable]	K02757
13064	P	O	N	Mark Hill	Artefacts / Scatter			416634mE 8163665mN Zone 52 [Unreliable]	K02152
13065	P	O	N	Walt Hill	Artefacts / Scatter			416634mE 8163665mN Zone 52 [Unreliable]	K02153
13083	P	C	N	Margumbarren	Mythological			Not available for closed sites	K02117
13085	P	O	N	Lullumallulu	Mythological			422934mE 8147565mN Zone 52 [Reliable]	K02119
13086	P	O	N	Juri Juri	Mythological			423934mE 8148565mN Zone 52 [Unreliable]	K02120
13117	P	C	N	Daanbum	Mythological			Not available for closed sites	K02094
13118	P	C	N	Budulangum	Mythological			Not available for closed sites	K02095
13119	P	C	N	Dalurru	Mythological			Not available for closed sites	K02096
13120	P	C	N	Guwandji Spring	Mythological			Not available for closed sites	K02097
13136	P	O	N	Guwandji.	Ceremonial, Mythological	Camp		442634mE 8138865mN Zone 52 [Unreliable]	K02113
13137	P	O	N	Wungunabany	Mythological			442634mE 8136465mN Zone 52 [Unreliable]	K02114

Site ID	Status	Access	Restriction	Site Name	Site Type	Additional Info	Informants	Coordinates	Site No.
13559	P	O	N	Limestone Creek	Painting, Artefacts / Scatter	(Archeological Deposit), [Other: ?]		437234mE 8152265mN Zone 52 [Unreliable]	K01623
13671	I	O	N	Argyle 16	Artefacts / Scatter			428234mE 8148965mN Zone 52 [Reliable]	K01431
13672	S	O	N	Argyle 17.	Artefacts / Scatter	Camp		435734mE 8150565mN Zone 52 [Unreliable]	K01432
13673	P	O	N	Argyle 18.	Artefacts / Scatter	(Archeological Deposit), [Other: ?]		432734mE 8149665mN Zone 52 [Unreliable]	K01433
13674	P	O	N	Argyle 19	Artefacts / Scatter			432734mE 8149565mN Zone 52 [Reliable]	K01434
13677	I	O	N	Argyle 22	Artefacts / Scatter			433234mE 8153965mN Zone 52 [Reliable]	K01437
13678	I	O	N	Argyle 23	Artefacts / Scatter			433634mE 8154865mN Zone 52 [Reliable]	K01438
13679	P	O	N	Argyle 24.	Artefacts / Scatter	(Archeological Deposit), [Other: ?]		444834mE 8164165mN Zone 52 [Reliable]	K01439
13681	P	O	N	Argyle 26	Artefacts / Scatter			441934mE 8153665mN Zone 52 [Unreliable]	K01441
13682	P	O	N	Argyle 27	Artefacts / Scatter			441234mE 8153565mN Zone 52 [Reliable]	K01442
13683	P	O	N	Argyle 28	Artefacts / Scatter			440534mE 8157365mN Zone 52 [Unreliable]	K01443

Site ID	Status	Access	Restriction	Site Name	Site Type	Additional Info	Informants	Coordinates	Site No.
13684	P	O	N	Argyle 29	Quarry, Artefacts / Scatter			444134mE 8154465mN Zone 52 [Unreliable]	K01444
13685	P	O	N	Argyle 30	Artefacts / Scatter			445134mE 8156165mN Zone 52 [Unreliable]	K01445
13686	P	O	N	Argyle 31	Artefacts / Scatter			431534mE 8159465mN Zone 52 [Reliable]	K01446
13687	I	O	N	Argyle 32	Artefacts / Scatter			431534mE 8159065mN Zone 52 [Reliable]	K01447
13688	I	O	N	Argyle 33	Artefacts / Scatter			428734mE 8152065mN Zone 52 [Unreliable]	K01448
13691	I	C	N	Argyle 36	Mythological, Artefacts / Scatter			Not available for closed sites	K01451
13692	P	O	N	Argyle 37	Artefacts / Scatter			430843mE 8150835mN Zone 52 [Reliable]	K01452
13693	P	O	N	Argyle 38	Quarry, Artefacts / Scatter			442234mE 8153565mN Zone 52 [Unreliable]	K01453
13711	P	O	N	Argyle 1	Man-Made Structure, Artefacts / Scatter			442634mE 8150665mN Zone 52 [Reliable]	K01416
13712	P	O	N	Argyle 2.	Artefacts / Scatter	Archeological Deposit		442634mE 8153065mN Zone 52 [Reliable]	K01417
13713	P	O	N	Argyle 3.	Artefacts / Scatter, Midden / Scatter	(Archeological Deposit), Camp, [Other: ?]		441934mE 8153265mN Zone 52 [Reliable]	K01418

Site ID	Status	Access	Restriction	Site Name	Site Type	Additional Info	Informants	Coordinates	Site No.
13714	P	O	N	Argyle 4	Artefacts / Scatter			438134mE 8154965mN Zone 52 [Reliable]	K01419
13715	P	O	N	Argyle 5	Artefacts / Scatter			438934mE 8154765mN Zone 52 [Reliable]	K01420
13716	S	O	N	Argyle 6	Artefacts / Scatter			438134mE 8153765mN Zone 52 [Reliable]	K01421
13717	P	O	N	Argyle 7.	Artefacts / Scatter	Rockshelter		424434mE 8148965mN Zone 52 [Unreliable]	K01422
13718	P	O	N	Argyle 8	Quarry, Artefacts / Scatter			425134mE 8150865mN Zone 52 [Unreliable]	K01423
13719	P	O	N	Argyle 9	Artefacts / Scatter			425234mE 8150865mN Zone 52 [Unreliable]	K01424
13720	P	O	N	Argyle 10	Artefacts / Scatter			426034mE 8152965mN Zone 52 [Reliable]	K01425
13721	I	O	N	Argyle 11	Artefacts / Scatter			440495mE 8150406mN Zone 52 [Reliable]	K01426
13722	S	O	N	Argyle 12	Artefacts / Scatter			439934mE 8150565mN Zone 52 [Reliable]	K01427
13723	P	O	N	Argyle 13	Artefacts / Scatter			439634mE 8150665mN Zone 52 [Reliable]	K01428
13724	P	O	N	Argyle 14	Artefacts / Scatter	Camp		440134mE 8147665mN Zone 52 [Reliable]	K01429

Site ID	Status	Access	Restriction	Site Name	Site Type	Additional Info	Informants	Coordinates	Site No.
13725	P	O	N	Argyle 15	Artefacts / Scatter			426334mE 8147865mN Zone 52 [Unreliable]	K01430
13749	P	C	N	S. Blatchford Escarpment	Mythological		*Registered Informant names available from DIA.	Not available for closed sites	K01400
13767	S	O	N	Tracey	Artefacts / Scatter		*Registered Informant names available from DIA.	423330mE 8130805mN Zone 52 [Unreliable]	K01363
13971	P	C	N	Nambalawalina/muwundul	Mythological, Quarry			Not available for closed sites	K01123
13972	P	C	N	Tjamindum/nanbum.	Ceremonial, Mythological	[Other: PA 68]		Not available for closed sites	K01124
13977	P	O	N	Mt Pitt Rockhole.		[Other: PA 67, NO SPECIFIC DETAILS]		442634mE 8150165mN Zone 52 [Reliable]	K01129
14000	P	C	N	Kilkaynim/dayiwul.	Ceremonial, Mythological	Plant Resource	*Registered Informant names available from DIA.	Not available for closed sites	K01098
14001	P	C	N	Daiwul/gundarriny	Mythological		*Registered Informant names available from DIA.	Not available for closed sites	K01099
14002	P	C	N	Devil Devil Spring.	Mythological, Artefacts / Scatter	[Other: PA 69]	*Registered Informant names available from DIA.	Not available for closed sites	K01100
14006	P	C	N	Pangkaltji	Mythological			Not available for closed sites	K01104
14010	P	C	N	Yulitj	Mythological			Not available for closed sites	K01108
14011	P	C	N	Standing Rock	Mythological, Man-Made Structure			Not available for closed sites	K01109

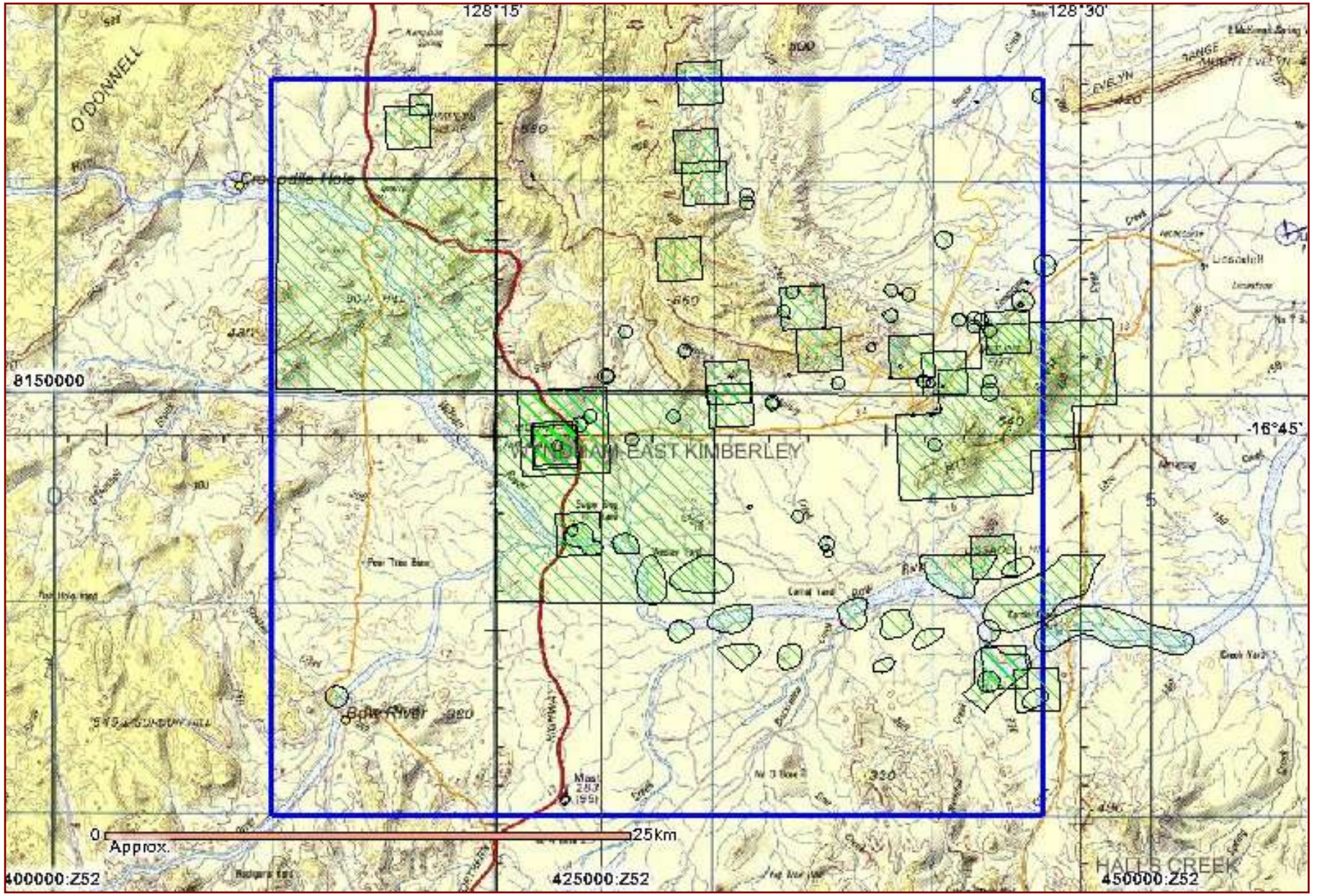
Site ID	Status	Access	Restriction	Site Name	Site Type	Additional Info	Informants	Coordinates	Site No.
14012	P	C	N	Sugar Bag Yard Hole.	Mythological	Water Source		Not available for closed sites	K01110
14013	P	C	N	Hill, Castlereagh Creek	Mythological			Not available for closed sites	K01111
14017	P	C	N	Tjamindin/ngoakul	Mythological, Quarry			Not available for closed sites	K01115
14019	P	C	N	Witikara	Mythological			Not available for closed sites	K01117
14044	P	C	N	Mt Pitt Spring 2.	Mythological	[Other: PA 66]	*Registered Informant names available from DIA.	Not available for closed sites	K01087
14045	P	C	N	Kowintji	Mythological			Not available for closed sites	K01088
14352	P	O	N	Bow River	Quarry, Artefacts / Scatter			412934mE 8135665mN Zone 52 [Unreliable]	K00728
17800	I	O	N	Waringarri / Yulilij Complex			*Registered Informant names available from DIA.	424167mE 8143164mN Zone 52 [Reliable]	
17801	I	O	N	Gelinaban			*Registered Informant names available from DIA.	426080mE 8142937mN Zone 52 [Reliable]	
17802	I	O	N	Waringarri 01			*Registered Informant names available from DIA.	427259mE 8141236mN Zone 52 [Reliable]	
17803	I	O	N	Waringarri 02			*Registered Informant names available from DIA.	429545mE 8141511mN Zone 52 [Reliable]	
17804	I	O	N	Unnamed Site (Turkey Creek / Bow River Junction)			*Registered Informant names available from DIA.	430841mE 8139414mN Zone 52 [Reliable]	

Site ID	Status	Access	Restriction	Site Name	Site Type	Additional Info	Informants	Coordinates	Site No.
17805	I	O	N	Ethnographic Site			*Registered Informant names available from DIA.	428598mE 8138797mN Zone 52 [Reliable]	
17806	I	O	N	Waringarri 03			*Registered Informant names available from DIA.	431223mE 8137587mN Zone 52 [Reliable]	
17807	I	O	N	Unnamed Ethnographic Site			*Registered Informant names available from DIA.	433566mE 8137628mN Zone 52 [Reliable]	
17808	I	O	N	Lunja / Archaeological Site Complex			*Registered Informant names available from DIA.	436429mE 8139653mN Zone 52 [Reliable]	
17809	I	O	N	Waringarri 04			*Registered Informant names available from DIA.	437854mE 8137233mN Zone 52 [Reliable]	
17810	I	O	N	Mawurrungarrim			*Registered Informant names available from DIA.	441232mE 8141425mN Zone 52 [Reliable]	
17811	I	O	N	Waringarri 7			*Registered Informant names available from DIA.	443943mE 8141920mN Zone 52 [Reliable]	
17812	I	O	N	Wonggonaba			*Registered Informant names available from DIA.	442969mE 8136641mN Zone 52 [Reliable]	
17813	I	O	N	Gawun.Ji			*Registered Informant names available from DIA.	448345mE 8138925mN Zone 52 [Reliable]	
17814	I	O	N	Wolarriban			*Registered Informant names available from DIA.	444745mE 8135682mN Zone 52 [Reliable]	
17825	I	O	N	Waringarri 5			*Registered Informant names available from DIA.	438431mE 8139182mN Zone 52 [Reliable]	

Site ID	Status	Access	Restriction	Site Name	Site Type	Additional Info	Informants	Coordinates	Site No.
17827	I	O	N	Waringarri 6			*Registered Informant names available from DIA.	439895mE 8138501mN Zone 52 [Reliable]	
17828	I	O	N	Waringarri 8			*Registered Informant names available from DIA.	445143mE 8140658mN Zone 52 [Reliable]	
20622	I	O	N	Argyle 41	Artefacts / Scatter	[Other: Knapping floor]		439983mE 8149087mN Zone 52 [Reliable]	
20623	I	O	N	Argyle 42	Artefacts / Scatter	[Other: Knapping floor]		440045mE 8149090mN Zone 52 [Reliable]	
20624	I	O	N	Argyle 43	Artefacts / Scatter	[Other: Knapping Floors]		440100mE 8149088mN Zone 52 [Reliable]	
20625	I	O	N	Argyle 44	Artefacts / Scatter	[Other: Knapping floor]		440224mE 8149363mN Zone 52 [Reliable]	
20626	I	O	N	Argyle 45	Artefacts / Scatter	[Other: Knapping Floor]		440424mE 8149395mN Zone 52 [Reliable]	
20627	I	O	N	Argyle 46	Artefacts / Scatter	[Other: Knapping Floor]		440514mE 8149961mN Zone 52 [Reliable]	
20628	I	C	F	Limestone Creek Women'S Burial Cave	Skeletal material/Burial	Rockshelter, [Other: rocky outcrops]		Not available for closed sites	
20629	I	O	N	Nick 3 Artefact Scatter	Artefacts / Scatter			439131mE 8149065mN Zone 52 [Reliable]	
20773	I	O	N	Beeken Gorge Scatter	Artefacts / Scatter			433516mE 8150940mN Zone 52 [Reliable]	

Site ID	Status	Access	Restriction	Site Name	Site Type	Additional Info	Informants	Coordinates	Site No.
20774	I	O	N	Nick 1 Artefact Scatter	Artefacts / Scatter			438583mE 8151365mN Zone 52 [Reliable]	
20775	P	O	N	Nick 2 Artefact Scatter	Artefacts / Scatter			438123mE 8150815mN Zone 52 [Reliable]	
20777	I	O	N	Lissadell Road Historical Camp	Historical	Camp	*Registered Informant names available from DIA.	444043mE 8154286mN Zone 52 [Reliable]	
21437	S	C	N	Ord Hydro Isolated Artefacts	Artefacts / Scatter	[Other: Multiple Isolated Artefacts]	*Registered Informant names available from DIA.	Not available for closed sites	
21539	P	O	N	Argyle 50	Artefacts / Scatter			438573mE 8154811mN Zone 52 [Reliable]	
21540	P	O	N	Argyle 51	Quarry, Artefacts / Scatter			437795mE 8153846mN Zone 52 [Unreliable]	
21541	I	O	N	Argyle 47	Artefacts / Scatter			442020mE 8163888mN Zone 52 [Unreliable]	
21542	I	O	N	Rte/adm 0803-01	Artefacts / Scatter			435305mE 8142520mN Zone 52 [Reliable]	
21543	I	O	N	Rte/adm 0803-02	Artefacts / Scatter			435196mE 8142768mN Zone 52 [Reliable]	
21544	I	O	N	Rte/adm 0803-03	Artefacts / Scatter			435233mE 8142978mN Zone 52 [Reliable]	
21545	I	O	N	Rte/adm 0803-04	Grinding patches / grooves			435299mE 8143227mN Zone 52 [Reliable]	

Site ID	Status	Access	Restriction	Site Name	Site Type	Additional Info	Informants	Coordinates	Site No.
21546	I	O	N	Rte/adm 0803-5	Artefacts / Scatter			433918mE 8144264mN Zone 52 [Reliable]	
21547	I	O	N	Rte/adm 0803-06	Artefacts / Scatter			444326mE 8155353mN Zone 52 [Reliable]	
22035	I	O	N	Rte/adm 0803-07	Artefacts / Scatter			431722mE 8144700mN Zone 52 [Reliable]	
22036	I	O	N	Argyle State Agreement Area Isolated Artefacts	Artefacts / Scatter	[Other: Isolated artefacts]		443020mE 8155030mN Zone 52 [Unreliable]	
22094	I	O	N	Argyle Iron Ore Fs5 (Aio/fs5)	Quarry	Ochre		421749mE 8160292mN Zone 52 [Reliable]	
22132	I	O	N	Argyle 48	Artefacts / Scatter			433483mE 8153619mN Zone 52 [Reliable]	
22169	I	O	N	Argyle Iron Ore 3 (Aio/fs3)	Artefacts / Scatter			421260mE 8160979mN Zone 52 [Reliable]	



Legend

- Highlighted Area
- Town
- Map Area
- Search Area

Appendix G

Weed Management

Department of Agriculture and Food
Government of Western Australia

Declared plant in Western Australia

Parkinsonia (*Parkinsonia aculeata*)

Printable version

See also: Control Method | Weed description | Declared plants list

Category: P1
Location: for the whole of the State

Category: P2
Location: For the municipal districts of Ashburton (S), Carnarvon (S), Coolgardie (S), Cue (S), Dundas (S), East Pilbara (S), Exmouth (S), Kalgoorlie/Boulder (C), Laverton (S), Leonora (S), Meekatharra (S), Menzies (S), Mount Magnet (S), Murchison (S), Ngaanyatjarraku (S), Port Hedland (T), Roebourne (S), Sandstone (S), Shark Bay (S), Upper Gascoyne (S), Wiluna (S), Yalgoo (S).

Category: P4
Location: For the municipal districts of Broome (S), Derby-West Kimberley (S), Halls Creek (S), Wyndham-East Kimberley (S).

Standard Control Codes (these may vary for individual plants)

P1 REQUIREMENTS Prohibits movement	The movement of plants or their seeds is prohibited within the State. This prohibits the movement of contaminated machinery and produce including livestock and fodder.
P2 REQUIREMENTS Aim is to eradicate infestation	Treat all plants to destroy and prevent propagation each year until no plants remain. The infested area must be managed in such a way that prevents the spread of seed or plant parts on or in livestock, fodder, grain, vehicles and/or machinery.
P4 REQUIREMENTS Aims to prevent infestation spreading beyond existing boundaries of infestation.	The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set all plants:- - within 100 metres inside of the boundaries of the infested property - within 50 metres of roads and highwater mark on waterways - within 50 metres of sheds, stock yards and houses Treatment must be done prior to seed set each year. Properties with less than 2 hectares of infestation must

	treat the entire infestation. Additional areas may be ordered to be treated.
Special considerations	In the case of P4 infestations where they continue across property boundaries there is no requirement to treat the relevant part of the property boundaries as long as the boundaries of the infestation as a whole are treated. There must be agreement between neighbours in relation to the treatment of these areas .

Control Method

Recommended herbicides	:	• When actively growing Garlon™ 600 Grazon™ DS Access™ Velpar® L • Moist soil if possible, subsurface treatment if dry Velpar® L

Herbicide	:	Garlon™ 600 (Other trade names also available)
Active ingredient	:	600 g/litre triclopyr (Group I)
Rates of dilution for spot spraying	:	1:60 in distillate
Amount of product per 10 litres distillate	:	160 mL in distilate
Rate of product per hectare	:	Not Recommended
Time of application	:	When actively growing
Remarks	:	Apply as basal-bark spray to mature trees. May need follow-up treatment. Mix only what can be used on day of spraying - agitate regularly.
More information and other control methods	:	ı Grub individual plants. ı Trees greater than 5 m in height should be treated by stem injection.

Herbicide	:	Grazon™ DS (Other trade names with same actives also available)
Active ingredient	:	300 g/litre triclopyr + 100 g/litre picloram (Group I)
Amount of product per 10 litres water	:	35 mL
Rate of product per hectare	:	Not Recommended
Time of application	:	When actively growing
Time of application	:	To trees under 2 m in height
Remarks	:	ı Add Uptake™ spraying oil @ 50 mL per 10 L of water mix.

		ı Thoroughly wet foliage.
More information and other control methods	:	ı Grub individual plants. ı Trees greater than 2 m in height should be treated by stem injection. ı Poor control if trees under moisture stress.

Herbicide	:	Access™
Active ingredient	:	240 g/L triclopyr + 120 g/L picloram (Group I)
Rates of dilution for spot spraying	:	1:60 in distillate
Amount of product per 10 litres distillate	:	160 mL
Time of application	:	Plants up to stem diameter of 5 cm
Remarks	:	Use low pressure spray (<200 kPa) and liberally spray bark until run - off. Treat to height of 30 cm above ground.
More information and other control methods	:	Do not treat stems that are wet or have been burnt.

Herbicide	:	Velpar® L (Group C)
Active ingredient	:	250 g/litre hexazinone
Rates of dilution for spot spraying	:	Apply neat with a 'spot gun' to soil at 4 mL/m of tree height
Rate of product per hectare	:	Not recommended
Time of application	:	Apply to moist soil if possible. Use sub-surface treatment if dry.
Remarks	:	Needs rain to activate. Keep clear of desirable trees. Apply spots between stem and dripline. Clean 'spot gun' thoroughly after use.

Herbicide	:	Velpar® L
Active ingredient	:	250 g/litre hexazinone (Group C)
Amount of product per 10 litres water	:	35 mL
Wetting agent dilution	:	1:400 BS 1000
Time of application	:	Trees under 2 m tall
Remarks	:	ı Avoid spraying under dry conditions or when trees bearing pods. ı Apply to foliage.

Weed Description

Family: Caesalpiniaceae
Form : Tree – Perennial
Status: Present in WA
(click to view image)

Parkinsonia is a native of tropical America. It was introduced into northern Australia as an ornamental plant, because of its attractive foliage and its drought tolerance. It was then known as Jerusalem thorn. Currently it is a serious weed in pastoral

areas of the Kimberleys and Pilbara. Parkinsonia is a Weed of National Significance.

Parkinsonia grows best in moist conditions along river banks and flats where it forms dense thickets. It does particularly well on tropical black soils. Once established it withstands heat and drought. It is well established in tropical Queensland, the Northern Territory and parts of Western Australia. Hundreds of kilometres of the banks of Lake Argyle, Christmas Creek and the Ord, De Grey, Maitland and Ashburton rivers are infested with Parkinsonia.

It is a large shrub or small tree growing up to 8 metres high. It sometimes has only a single stem but it usually branches close to the base following mechanical damage. The trunk and branches have bright green bark.

Leaves: Light green, narrow, very thin and up to 30 cm long, with numerous minute leaflets on both edges. Stiff spines about 12 mm long are formed on the branches at the base of each leaf. The spines persist on the older branches and trunks.

Flowers: Bright yellow and fragrant. They are 1 to 2 cm wide and are borne in loose bundles on long flower stalks hanging near the ends of the branches. Parkinsonia flowers mainly in May and June, but individual plants may flower throughout the year.

Fruit&Seeds: Long seed pods with marked constrictions between each seed. The pods are 5-10 cm long and straw coloured when ripe. Each pod contains several hard brown seeds. Many of the seeds are hard and will germinate years later, in some cases after long immersion in water. The pods float and are spread by floods.

Other relevant information related to this topic:

- Western Australia Quarantine and Inspection Service
- Permitted and quarantine species list
- Weed of National Significance
- Permit for minor off-label-use of a registered agvet chemical product (Permit number - per4984)
- Off-label permit (olp) for use of a registered agvet chemical product (Permit numb per4590)

Department of Agriculture and Food
Government of Western Australia

Declared plant in Western Australia

Bellyache bush (*Jatropha gossypifolia*)

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See also: Control Method | Weed description | Declared plants list

Category: P2
Location: For the municipal districts of Albany (C), Armadale (C), Augusta-Margaret River (S), Bassendean (T), Bayswater (C), Belmont (C), Beverley (S), Boddington (S), Boyup Brook (S), Bridgetown-Greenbushes (S), Brookton (S), Broomehill (S), Bruce Rock (S), Bunbury (C), Busselton (S), Cambridge (T), Canning (C), Capel (S), Carnamah (S), Chapman Valley (S), Chittering (S), Claremont (T), Cockburn (C), Collie (S), Coolgardie (S), Coorow (S), Corrigin (S), Cottesloe (T), Cranbrook (S), Cuballing (S), Cue (S), Cunderdin (S), Dalwallinu (S), Dandaragan (S), Dardanup (S), Denmark (S), Donnybrook-Balingup (S), Dowerin (S), Dumbleyung (S), Dundas (S), East Fremantle (T), Esperance (S), Fremantle (C), Geraldton (C), Gingin (S), Gnowangerup (S), Goomalling (S), Gosnells (C), Greenough (S), Harvey (S), Irwin (S), Jerramungup (S), Joondalup (C), Kalamunda (S), Kalgoorlie/Boulder (C), Katanning (S), Kellerberrin (S), Kent (S), Kojonup (S), Kondinin (S), Koorda (S), Kulin (S), Kwinana (T), Lake Grace (S), Laverton (S), Leonora (S), Mandurah (C), Manjimup (S), Meekatharra (S), Melville (C), Menzies (S), Merredin (S), Mingenew (S), Moora (S), Morawa (S), Mosman Park (T), Mount Magnet (S), Mount Marshall (S), Mukinbudin (S), Mullewa (S), Mundaring (S), Murchison (S), Murray (S), Nannup (S), Narembeen (S), Narrogin (S), Narrogin (T), Nedlands (C), Ngaanyatjarraku (S), Northam (S), Northam (T), Northampton (S), Nungarin (S), Peppermint Grove (S), Perenjori (S), Perth (C), Pingelly (S), Plantagenet (S), Quairading (S), Ravensthorpe (S), Rockingham (C), Sandstone (S), Serpentine-Jarrahdale (S), Shark Bay (S), South Perth (C), Stirling (C), Subiaco (C), Swan (S), Tambellup (S), Tammin (S), Three Springs (S), Toodyay (S), Trayning (S), Upper Gascoyne (S), Victoria Park (T), Victoria Plains (S), Vincent (T), Wagin (S), Wandering (S), Wanneroo (S), Waroona (S), West Arthur (S), Westonia (S), Wickepin (S), Williams (S), Wiluna (S), Wongan-Ballidu (S), Woodanilling (S), Wyalkatchem (S), Yalgoo (S), Yilgarn (S), York (S).

Category: P1
Location: for the whole of the State

Category: P4
Location: For the municipal districts of Ashburton (S), Broome (S), Carnarvon (S), Derby-West Kimberley (S), East Pilbara (S), Exmouth (S), Halls Creek (S), Port Hedland (T), Roebourne (S), Wyndham-East Kimberley (S).

Standard Control Codes (these may vary for individual plants)

P1 REQUIREMENTS Prohibits movement	The movement of plants or their seeds is prohibited within the State. This prohibits the movement of contaminated machinery and produce including livestock and fodder.
P2	Treat all plants to destroy and prevent propagation

REQUIREMENTS Aim is to eradicate infestation	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.
P4 REQUIREMENTS Aims to prevent infestation spreading beyond existing boundaries of infestation.	The infested area must be managed in such a way that prevents the spread of seed or plant parts within and from the property on or in livestock, fodder, grain, vehicles and/or machinery. Treat to destroy and prevent seed set all plants:- - within 100 metres inside of the boundaries of the infested property - within 50 metres of roads and highwater mark on waterways - within 50 metres of sheds, stock yards and houses Treatment must be done prior to seed set each year. Properties with less than 2 hectares of infestation must treat the entire infestation. Additional areas may be ordered to be treated.
Special considerations	In the case of P4 infestations where they continue across property boundaries there is no requirement to treat the relevant part of the property boundaries as long as the boundaries of the infestation as a whole are treated. There must be agreement between neighbours in relation to the treatment of these areas .

Control Method

Recommended herbicides	:	Metsulfuron Fluroxypyr Picloram / triclopyr

Herbicide	:	Metsulfuron, Various Trade Names
Active ingredient and Group	:	600 g/kg metsulfuron-methyl (Group B)
Rate of product	:	1 g/10 L water
Wetting Agent	:	Pulse 1:500 BS -1000 1mL/1L water
Time of application		Actively growing seedlings to flowering plants.
Remarks	:	Spray to thoroughly wet foliage, using a high spray volume.
More information	:	Do not apply if rain is expected within four hours.
And other control measures	:	Treatments like metsulfuron will leave the grasses which will help compete with germinating seedlings and also allow fuel to carry a fire which also kills seedlings and adult plants.

Herbicide	:	Starane™ Tomigan® Flagship®
Active ingredient and Group	:	200 g/L fluroxypyr (Group I)
Rate of product	:	50 mL/10 L water
Wetting Agent	:	1:400 Non ionic
Time of application		Actively growing seedlings to flowering plants.

Herbicide	:	Grazon™ DS, Grass-up Herbicide, Tri-pick, Trichloram, Picker Herbicide
Active ingredient and Group	:	Triclopyr 300 g/L + picloram 100 g/L (Group I)
Rate of product	:	15 mL/10L
Wetting Agent	:	Non ionic such as BS-1000 ai 100 mL/100 L water
Time of application		Wet season while there is adequate moisture and plants are actively growing.
And other control measures	:	Cut stem/stump using Triclopyr(Garlon™600 etc.) 1:50 in diesel or Access™(triclopyr + picloram) @ 1:60 in diesel can also be used throughout the year.

Weed Description

Family: Euphorbiaceae
Form : Shrub -Perennial
Status: Present in WA
(click to view image)

Erect shrub or small tree to 4 m high, deciduous in dry conditions. Native of tropical Central and South America and Caribbean islands.

Stems: Hairy, non-woody.
Leaves: Initially purplish but green when mature, sticky, 5.5–14 cm long, 7.5–12.5 cm wide, rounded in outline, leaf stalks 4.5–11.5 cm long. Leaf margins and leaf stalks with gland-tipped hairs; leaves alternate, margins deeply 3–5 lobed;
Flowers: Flower head branched. Flowers about 1 cm across. Petals purple with yellow base. Flowers most of year but chiefly late summer and autumn.
Fruit: An oblong lobed capsule to 1.2 cm long, capsule, initially green, ripening dark brown. Mostly 3 or 4 seeded.
Seeds: Brown seeds to 0.8 cm long, slightly mottled.
Roots: Fleshy and tuberous.

Other relevant information related to this topic:

- Western Australia Quarantine and Inspection Service
- Permitted and quarantine species list
- CSIRO biological control
- Permit for minor off-label-use of a registered agvet chemical product (Permit number - per4984)

- Off-label permit (olp) for use of a registered agvet chemical product (Permit numb per4590)

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