



CLIENTS | PEOPLE | PERFORMANCE

Main Roads Western Australia

North West Coastal Highway
Reconstruction SLK 45.8 - 49.5

Biological Survey

December 2009



Contents

Executive Summary	i
1. Introduction	3
1.1 Background	3
1.2 Scope of Works	3
2. Methodology	4
2.1 Desktop Assessment	4
2.2 Field Survey	4
3. Desktop Assessment	7
3.1 Climate	7
3.2 Geology and Soils	7
3.3 Reserves and Conservation Areas	8
3.4 Rivers and Wetlands	8
3.5 Public Drinking Water Source Areas	8
3.6 Environmentally Sensitive Areas	8
3.7 Vegetation	9
3.8 Threatened Ecological Communities	11
3.9 Flora	11
3.10 Fauna	13
4. Field Investigation	16
4.1 Vegetation	16
4.2 Flora	19
4.3 Fauna	21
4.4 Field Assessment of Wetlands and Drainage	24
5. Vegetation Clearing	25
6. Requirement for Referral	26
7. Conclusions and Recommendations	27
7.1 Conclusions	27
7.2 Recommendations	28
8. Limitations	29
8.1 Survey Limitations	29



8.2	Report Limitations	30
9.	References	31

Table Index

Table 1	Vegetation Extent and Status	9
Table 2	Regional Assessment of Vegetation Extent (Shepherd, 2005)	10
Table 3	Vegetation Condition Scale (Keighery, 1994)	17
Table 4	Listed Migratory species for the Project Area on the <i>EPBC Act 1999</i> Protected Matters Search Tool	23
Table 5	Habitat type recorded in the Project Area	23
Table 6	Limitations and Constraints	29
Table 7	Conservation Categories and Definitions for <i>EPBC Act</i> Listed Flora and Fauna Species.	40
Table 8	Conservation Codes and Descriptions for DEC Declared Rare and Priority Flora Species.	41
Table 9	Threatened and Priority Flora Species identified in the Threatened Flora Database Search Results and <i>EPBC Act 1999</i> Protected Matters Search Tool	42
Table 10	Department of Agriculture and Food Declared Plant Control Classes	47
Table 11	Flora species recorded during the field survey	48
Table 12	<i>Western Australia Wildlife Conservation Act (1950)</i> Conservation Codes	54
Table 13	DEC Priority Fauna Codes	54
Table 14	Fauna List: NWCH Project Area	55
Table 15	Assessment against the 'Ten Clearing Principles'	60

Figure Index

Figure 1	Locality Map and Known Environmental Constraints	35
Figure 2	Project Area and Priority Flora	36
Figure 3	Vegetation Type	37
Figure 4	Vegetation Condition	38



Appendices

A	Flora	39
B	Fauna	51
C	Department of Environment and Conservation 'Ten Clearing Principles'	59



Executive Summary

The North West Coastal Highway (NWCH) is a major route linking Perth with the North West of the State. A mix of heavy freight vehicles, tourist traffic and commuting vehicles are carried on this road. Over the past five years, six crashes have been reported on the section between 45.56 and 48.56 SLK. All have involved the loss of control.

Main Roads Western Australia (Main Roads) proposes to reconstruct two sections of North West Coastal Highway between SLK 47.0 and 49.0 (the Project).

The Project is located approximately 2.5 km south of Northampton (Figure 1).

Main Roads commissioned GHD to undertake a biological survey for the proposed Project. The purpose of the survey is to provide an appropriate examination and description of the receiving environment to ensure that aspects of biological/ecological significance are identified and recorded.

Suitably qualified GHD Ecologists undertook a biological survey on the 18th August 2009. In summary, the following conclusions on environmental aspects are made:

- » The vegetation of the Project Area is identified by Beard (1976) as likely to contain Vegetation Association 35, which is described as 'Shrublands; jam scrub with scattered York gum'.
 - This vegetation type is considered to be *Vulnerable*, with 10.5% of the pre-European extent considered to be remaining in the Geraldton Sandplains Interim Biogeographic Regionalisation for Australia (IBRA) region (Shepherd, 2005).
 - Based on evidence from the field survey, the original vegetation type has been altered to an extent that it no longer resembles the distinct vegetation type described and mapped by Beard (1976), and is most likely natural regrowth and planted vegetation after previous clearing activities.
- » No Declared Rare Flora species were recorded during the field survey. However, one Priority species, *Acanthocarpus parviflorus* (Priority 3) was recorded within the Project Area. Consultation with DEC is recommended with regards to the recorded presence of this species.
- » There are no conservation reserves within the immediate vicinity of the Project Area.
- » Vegetation condition throughout the Project Area ranged from Condition 5 (*Degraded*) to Condition 6 (*Completely Degraded*). The main disturbance factors were historical clearing for the purpose of road construction and agriculture, and weed invasion.
- » A total of 96 species (52 native species) from 34 families were recorded in the Project Area, which represents low native species diversity.



- » A total of 44 weed species were recorded during the field survey. This represents approximately 46% of the total number of plant species recorded.
 - Two Declared Plants listed under the *Agriculture and Related Resources Act* (1976) were recorded in the Project Area, being **Echium plantagineum* (Paterson's Curse) and **Lantana camara* (Common Lantana). Within the Project Area, one species is recognised as having status as a Weed of National Significance (WONS), being **Lantana camara* (Common Lantana).
- » The reconnaissance fauna survey recorded 27 fauna species. These included: 22 bird species; 3 mammals; and 2 reptiles. One introduced species; the European rabbit was recorded in the Project Area.
 - Potential clearing within the Project Area is not expected to negatively impact upon the local populations of any of these or other fauna species present in the area.
- » One threatened fauna species, the Priority 4 *Pomatostomus superciliosus* subsp. *ashbyi* – White-browed Babbler (western wheatbelt), was recorded in the Project Area during the reconnaissance fauna survey. Threatened fauna species known to occur in the general area, as identified in the desktop assessment, are unlikely if present, to be impacted by clearing of vegetation in the Project area;
- » While the habitat type located in the Project Area is common, limited vegetation surrounding the Project Area exists due to historical clearing for agriculture. The Project Area may provide a habitat linkage between areas of vegetation in the local area; and
- » Based on the findings of the desktop and field assessment, clearing for the Project is considered to be at variance with Clearing Principle (e), due to the *Vulnerable* status of the vegetation remaining within the Project Area. However, the field survey indicates that the original vegetation type has been altered to such an extent that it no longer resembles the remnant vegetation type described and mapped by Beard (1976). As such, this Clearing Principle may no longer apply. Consultation with the DEC is recommended.



1. Introduction

1.1 Background

The North West Coastal Highway (NWCH) is a major route linking Perth with the North West of the State. A mix of heavy freight vehicles, tourist traffic and commuting vehicles are carried on this road. Over the past five years, six crashes have been reported on the section between 45.56 and 48.56 SLK. All have involved the loss of control.

Main Roads Western Australia (Main Roads) proposes to reconstruct two sections of North West Coastal Highway between SLK 47.0 and 49.0 (the Project).

The proposed reconstruction will involve the lowering of vertical crests to increase the line of site for vehicles, increasing road safety and reducing the risk of traffic accidents.

The Project is located approximately 2.5 km south of Northampton (Figure 1).

1.2 Scope of Works

Main Roads commissioned GHD to undertake a biological survey for the proposed Project. The purpose of the survey is to provide an appropriate examination and description of the receiving environment to ensure that aspects of biological/ecological significance are identified and recorded.



2. Methodology

The biological survey included a desktop assessment and field survey as follows:

2.1 Desktop Assessment

The desktop assessment included a literature review of the following factors for the Project Area:

- » Adjoining land use including conservation reserves or other listed areas such as Bush forever sites or red book sites (refer to Section 3.3).
- » Listed wetlands (refer to Section 3.4);
- » Public Drinking Water Source Areas (refer to Section 3.5);
- » Environmentally Sensitive Areas (refer to Section 3.6);
- » Broad vegetation types shown in existing mapping (refer to Section 3.7.1);
- » Remnant vegetation clearing in relation to statutory requirements (refer to Section 3.7.2);
- » Threatened Ecological Communities (refer to Section 3.8);
- » Declared Rare and Priority Flora (refer to Section 3.9.1); and
- » Threatened or otherwise protected Fauna (refer to Section 3.10.2).

2.2 Field Survey

2.2.1 Project Area

The Project Area is situated within the existing road reserve on NWCH, between SLK 45.8 and SLK 49.5, with a survey width of 50 metres either side of the road alignment.

The boundary of the Project Area is identified in Figure 2.

*Note: *** As requested by Main Roads, an assessment of the significance of the biological aspects outside the immediate Project Area (that may either affect the conservation of the roadside or be affected by roadworks with the Project Area) was also undertaken***.*



2.2.2 Flora and Vegetation Survey

Suitably qualified GHD Ecologists undertook a flora and vegetation survey on the 18th August 2009, in with reference to the Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia – Guidance Statement No. 51, EPA, Perth (EPA, 2004a).

The survey was undertaken according to the following process:

- » A *relève*¹ of the Project Area was undertaken to ensure that all vegetation types were covered during the survey. Vegetation types were identified by means of a combination of aerial photography and field observation.
- » The vegetation types and their boundaries were delineated, recording vegetation composition, condition rating, weed species and evidence of disturbance;
- » Vegetation was rated according to the Bush Forever vegetation condition scale (Government of Western Australia, 2000);
- » The presence of potential Threatened Ecological Communities (TECs) in the area was assessed;
- » A search of the Department of Environment and Conservation's (DEC) Threatened Flora databases (DEC, 2009a), NatureMap (Department of Environment and Conservation and Western Australian Museum, 2009) and the *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act) Protected Matters Search Tool (DEWHA, 2009a) was undertaken to identify expected Threatened and Priority flora for the area;
- » Suitable habitat for Declared Rare and Priority Flora species was searched during the survey to determine the presence of recorded and previously unrecorded threatened flora; and
- » Where field identification of plant taxa was not possible, specimens were collected in a systematic manner so that they could be later identified at the West Australian Herbarium by comparison with the reference collection and use of identification keys. Nomenclature of the species follows that of *FloraBase* (DEC, 2009b).

¹ For the purposes of biological survey, a *relève* is defined as an unconfined survey area in which a general statement about the floristic composition of the location can be made.



2.2.3 Fauna Survey

Suitably qualified GHD Ecologists undertook an opportunistic fauna survey concurrently with the flora survey on the 18th August 2009, with reference to *Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia – EPA Guidance Statements No. 56, Perth (EPA, 2004b)*. The fauna survey was undertaken according to the following process:

- » An opportunistic recording of species, including pest, declared or feral animals;
- » Identification of any habitats of significance; and
- » An assessment of the value of the Project Area in providing habitat and facilitating movement between conservation areas.

The fauna survey was limited to terrestrial and vertebrate species.

2.2.4 Field Assessment of Wetlands and Drainage

The field survey included the following with regards to wetlands and drainage:

- » An assessment and description of existing drainage patterns with respect to topography, and to flora and fauna communities; and
- » An inventory and brief description of wetlands in the Project Area, and their conservation value.

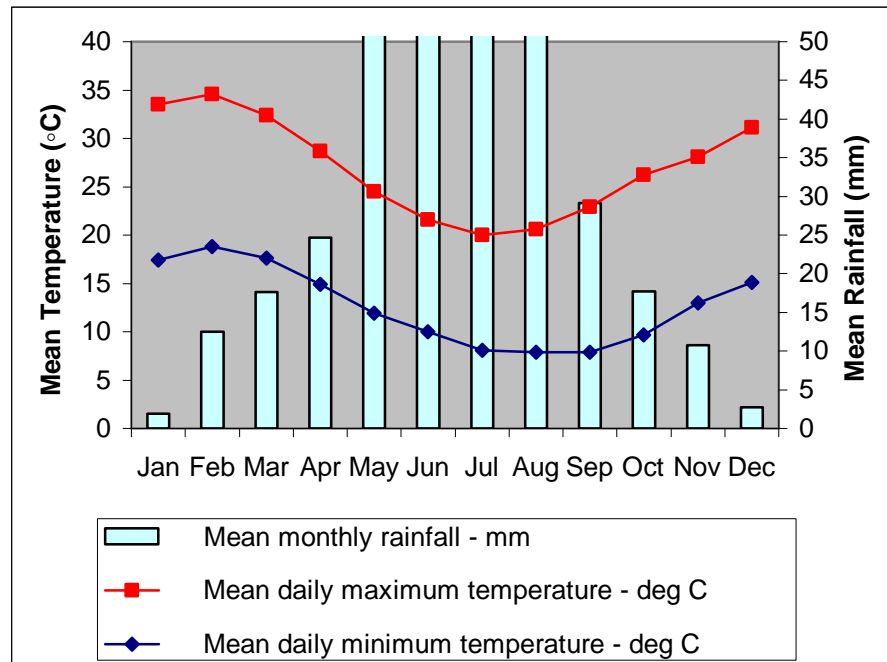
3. Desktop Assessment

3.1 Climate

The closest operating Bureau of Meteorology station located to the Project Area is at Nokanena. Recorded climatic data is graphically presented in Graph 1 and summarised as follows:

- » Mean Maximum Temperature: 34.6°C (February) to 20°C (July)
- » Mean Minimum Temperature: 18.8°C (Feb) to 7.9°C (August and September)
- » Mean Annual Rainfall: 436.8 mm
- » Mean Annual Rain Days: 74 days.

(Source: Bureau of Meteorology, 2009a)



Graph 1 Nokanena Temperature and Rainfall

3.2 Geology and Soils

The Project Area is located in the Chapman soil-landscape zone of the Greenough province: *Dissected lateritic terrain (with hills, sandplains, breakaways and plateaux) on colluvium and deeply weathered mantle over gneiss of the Northampton Complex* characterise this zone. *Yellow deep sands with Red shallow loamy duplexes and some Red shallow sandy duplexes, Red loamy earths and Shallow gravels* are found in this area (Tille, 2006).



The Geological Survey of Western Australia (1971) describes the soils of the Project Area as comprising:

- » **Pm** Granulite – includes cordierite gneisses. Predominantly metasedimentary; and
- » **Pq** Feldsparithic quartzite.

3.3 Reserves and Conservation Areas

There are no conservation reserves within the immediate vicinity of the Project Area.

The closest conservation areas are Oakabella Nature Reserve, located approximately 9 km to the south, and Blue Wells Nature Reserve, located approximately 15 km to the north-east.

3.4 Rivers and Wetlands

No rivers or wetlands are located within the Project Area (*WetlandBase*, 2009).

Drainage occurs through a series of ephemeral drainage channels and creeks which flow west towards the ocean.

3.5 Public Drinking Water Source Areas

The Project Area is situated within the Northampton Water Reserve, a Priority 3 (P3) Public Drinking Water Source Area (PDWSA) (Department of Water, 2009).

P3 areas are defined to manage the risk of pollution to the water source from catchment activities. These areas are declared over land where water supply sources coexist with other land uses. Within Priority 3 areas, constraints are made upon land uses with significant pollution potential (Department of Environment, 2004).

The Department of Environment (2004) identifies transport infrastructure land use (i.e.: roads) as 'Acceptable²' in P3 areas.

3.6 Environmentally Sensitive Areas

No Environmentally Sensitive Areas (ESA's) have been recorded within the Project Area (Department of Environment and Conservation, 2009c).

The nearest ESA occurs approximately 3.5 km to the south-east of the Project Area. This ESA forms a buffer area protecting the recorded location of a significant flora species.

² Where a land use is identified as "Acceptable", this use is permitted within that Priority classification area. This means that the land use is accepted by Department of Water as not likely to harm the drinking water source, and is consistent with the management objectives of that priority classification (Department of Environment, 2004).



3.7 Vegetation

3.7.1 Vegetation Types

The vegetation of the Project Area is identified by Beard (1976) as likely to contain the following vegetation association:

- » Vegetation Association 35: Shrublands; jam scrub with scattered York gum.

3.7.2 Vegetation in a Regional Context

A vegetation type is considered under represented if there is less than 30% 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 (Environmental Protection Authority, 2000), namely:

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

Such status can be delineated into five classes (Table 1).

Table 1 Vegetation Extent and Status

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

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

The extent of Vegetation Association 35 is considered to be *Vulnerable*, with 10.5% (or 19,454 ha) of the pre-European extent considered to be remaining in the Geraldton Sandplains Biogeographic Regionalisation for Australia (IBRA) region (Shepherd, 2005) (Table 2).

Refer to Section 4.1.3 for further assessment of this vegetation association in the Project Area.



Table 2 Regional Assessment of Vegetation Extent (Shepherd, 2005)

Vegetation Association Number	Association Description	Pre-European Extent (Ha) in Geraldton Sandplains IBRA region	Current Extent (Ha) in Geraldton Sandplains IBRA region	% Remaining	% Current Extent in IUCN Class I-IV Reserves	Occurrence in Project Area
35	Shrublands; jam scrub with scattered York gum	184513.443	19453.716	10.5	2.9	Entire Project Area



3.8 Threatened Ecological Communities

A search of the DEC's Threatened Ecological Communities (TEC) database was undertaken for the Project Area. No TECs are known to be located within the boundaries of this area.

3.9 Flora

3.9.1 Threatened and Priority Flora

Flora species considered to be significant are listed under the *Wildlife Conservation Act (1950)* and the *Environment Protection and Biodiversity Conservation Act 1999*. The DEC also keeps a list of Priority species that are not listed under legislation but for which the DEC feels there is cause for concern, or for which not enough information is known (Table 7 and Table 8, Appendix A).

Commonwealth

An *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)* Protected Matters Search (DEWHA, 2009a) was undertaken for the Project Area. One EPBC Act protected flora (listed as Endangered) was identified as being likely to occur within a 10 km buffer of the Project Area. This species is included in Table 9, Appendix A.

State

A search was undertaken through the DEC's threatened flora databases (DEC, 2009d) for species of Declared Rare and Priority Flora located within the vicinity of the Project Area. Descriptions of those species recorded from the search are presented in Table 9, Appendix A. Five Declared Rare Flora (DRF) and 11 Priority Flora species were identified in the search area.

The recorded locations of these species are presented in Figure 1. None of the identified species are located within the boundaries of the Project Area.

3.9.2 Weeds

Weeds of National Significance

A framework was endorsed by the Australian Government in 1998 under which Weeds of National Significance (WONS) are identified. Weeds considered as being significant within an agricultural, forestry or environmental context are included in a database of WONS. These species were determined through an assessment of the invasiveness, impacts, potential for spread and socio-economic and environmental values of each species (Australian Government, 2009a).



Declared Plants (DP)

In Western Australia, weeds that are (or may become) a problem to agriculture or the environment can be formally classified as Declared Plants under the *Agriculture and Related Resources Protection Act (1976)*. The Department of Agriculture and Food and the Agriculture Protection Board maintains a list of Declared Plants for Western Australia. If a plant is declared for the whole of the State or for particular Local Government Areas, all landholders are obliged to comply with the specific category of control.

Declarations specify a category, or categories, for each plant according to the control strategies or objectives which the Agriculture Protection Board believes are appropriate in a particular place.

Among the factors considered in categorising Declared Plants are:

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

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

The Department of Agriculture and Food Western Australia (2009) have recorded 82 Declared Plants as occurring within the Shire of Northampton.

3.9.3 Diseases and Pathogens

Phytophthora cinnamomi (Dieback) has been shown to have the greatest and most widespread impact in areas where the average annual rainfall exceeds 600 mm, but in Western Australia (WA) the pathogen can cause disease in stream zones and water-gaining sites in the 400-600 mm zones (CALM, 2003).

It is noted that dieback has been recorded as far north as the Kimberley in Kununurra (Centre for Phytophthora Science and Management, 2009) and therefore the location of the Project Area may be considered to be susceptible to the impact of the *Phytophthora cinnamomi* pathogen.



3.10 Fauna

3.10.1 Existing Fauna Records

A search of NatureMap (DEC and WAM, 2009) records was undertaken for the Project Area, inclusive of a 10 km buffer. The NatureMap records show that 2 amphibian, 5 bird, 1 invertebrate, 2 mammal and 16 reptile species have been officially recorded as present within the search area (Table 14, Appendix B).

3.10.2 Threatened Fauna

The conservation of fauna species and their significance status is currently assessed under both Commonwealth and State Acts. The acts include the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, the Western Australian *Wildlife Conservation Act (1950)*; and the *Wildlife Conservation (Specially Protected Fauna) Notice 2008(2)*.

Commonwealth

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

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

- » Appendices to the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals) for which Australia is a range state under the Convention;
- » The Agreement between the Government of Australia and the Government of the Peoples Republic of China for the Protection of Migratory Birds and their Environment (CAMBA);
- » The Agreement between the Government of Japan and the Government of Australia for the Protection of Migratory Birds and Birds in Danger of Extinction and their Environment (JAMBA);
- » The Agreement between the Government of Australia and the Government of the Republic of Korea on the Protection of Migratory Birds (ROKAMBA); and
- » Listed Migratory species also include species identified in other international agreements approved by the Commonwealth Environment Minister.

The Act also protects Marine listed species on Commonwealth lands and waters.



State

The *Wildlife Conservation Act (1950)* uses a set of Schedules but also classifies species using some of the IUCN categories (Table 12, Appendix B).

In Western Australia, the DEC also produces a supplementary list of Priority Fauna, these being species that are not considered Threatened under the Western Australian *Wildlife Conservation Act (1950)* but for which the Department feels there is a cause for concern. These species have no special legislative protection, but their presence would normally be considered. Such taxa need further survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna. Levels of Priority are described in Table 13, Appendix B.

Assessment

From the DEWHA (DEHWA, 2009a) and DEC threatened fauna database (DEC, 2009d), a number of threatened and migratory fauna species were identified as potentially occurring within the Project Area (Table 14, Appendix B).

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

3.10.3 Fauna Habitat

The dominant habitat type located within the Project Area is likely to be Shrublands (Section 3.7.1). This vegetation would provide shelter for a wide range of fauna species.

Based on aerial photography, the land surrounding the Project Area has been cleared extensively for agriculture. The linear nature of the Project Area may provide a habitat corridor for fauna in the local area.



3.10.4 Introduced Species

The following introduced species are known to occur in the Geraldton Sandplains IBRA region:

- » *Mus domesticus* (House Mouse);
- » *Rattus rattus* (Black Rat, Ship Rat);
- » *Canis lupus dingo* (Dingo);
- » *Vulpes vulpes* (Red Fox);
- » *Felis catus* (Cat);
- » *Oryctolagus cuniculus* (European Rabbit);
- » *Equus caballus* (Brumby, Horse);
- » *Sus scrofa* (Pig);
- » *Bos taurus* (European Cattle);
- » *Capra hircus* (Goat); and
- » *Ovis aries* (Sheep).

Source: Australian Government (2009b).

4. Field Investigation

4.1 Vegetation

In general, the vegetation of the majority of the Project Area has been historically cleared for agricultural purposes (outside the road reserve), with areas of rehabilitation undertaken within the road reserve using native species (dominated by *Acacia acuminata*) as well as introduced Eucalypts towards the northern end. The rehabilitated vegetation has merged into the remnant native vegetation and boundaries between both are no longer distinguishable.

4.1.1 Vegetation Description

One remnant vegetation type was identified within the Project Area as follows:

- » Very open shrubland of *Acacia acuminata*, *A. tetragonophylla* and *Hakea recurva* over weed species (Plate 1). *Eucalyptus camaldulensis* occurs in the lower-lying portions as an emergent tree species.

This vegetation type has been mapped in Figure 3.



Plate 1: Vegetation Type - Very open shrubland of *Acacia acuminata*, *A. tetragonophylla* and *Hakea recurva* over weed species.



4.1.2 Vegetation Condition

Bush Forever Volume 2 (Government of Western Australia, 2000) defines vegetation condition as “a rating given to bushland to categorise disturbance related to human activities. This rating refers to the degree of change in the structure, density and species present in the bushland in relation to undisturbed bushland of the same type.”

The vegetation in the Study Area was given a condition rating based on the Keighery (1994) vegetation condition rating scale. This scale recognises a level of intactness of vegetation, which is defined by the following:

- » Completeness of structural levels;
- » Extent of weed invasion;
- » Historical disturbance from tracks and other clearing or dumping;
- » The potential for natural or assisted regeneration.

The ratings in this scale are described in Table 3.

Table 3 Vegetation Condition Scale (Keighery, 1994)

Assigned Number	Classification	Description
1	<i>Pristine</i>	Pristine or nearly so, no obvious signs of disturbance.
2	<i>Excellent</i>	Vegetation structure intact, disturbance affecting individual species, and weeds are non-aggressive species.
3	<i>Very Good</i>	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
4	<i>Good</i>	Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some aggressive weeds at high density, partial clearing, dieback and grazing.
5	<i>Degraded</i>	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
6	<i>Completely Degraded</i>	The structure of the vegetation is no longer intact and the area is completely or almost without native species. These areas are often described as ‘parkland clearing’ with flora composing weed or crops species with isolated native trees or shrubs.

Vegetation condition throughout the Project Area ranged from Condition 5 (*Degraded*) to Condition 6 (*Completely Degraded*). The main disturbance factor was weed invasion from historical grazing for the purpose of agriculture (also invading the road reserve) and road establishment (refer to Figure 4 for vegetation condition mapping). As indicated, the majority of the Project Area has been previously cleared, with areas of rehabilitation within the road reserve.

Plate 2 gives an indication of the extent of weed invasion in the Project Area.



Plate 2: Vegetation Condition - Indication of weed invasion in the Project Area.

4.1.3 Local and Regional Significance of the Vegetation

Beard (1976) describes the Project Area as likely to contain vegetation association: Vegetation Association 35: Shrublands; jam scrub with scattered York gum. This vegetation is considered *Vulnerable* under this categorisation, with 10.5% (or 19,454 ha) of its original area remaining in the Geraldton Sandplains IBRA region (Shepherd, 2005).

Based on evidence from the field survey, the original vegetation type has been altered to an extent that it no longer resembles the distinct vegetation type described and mapped by Beard (1976). The vegetation located in the Project Area does not correlate with Vegetation Association 35, and is most likely natural regrowth and planted vegetation after previous clearing activities.

4.1.4 Threatened / Priority Ecological Communities

The vegetation type identified during the time of survey is not considered to represent any Threatened or Priority Ecological Community. GHD does not consider vegetation types within the Project Area to hold particular conservation significance.



4.2 Flora

The field survey was conducted in Spring, as recommended by Guidance Statement No. 51 (EPA, 2004a). The Winter rainfall received by the Project Area was approximately average, and as such, the timing of the survey and the representation of annuals in the Project Area is considered adequate.

Results from the field survey revealed a total of 96 species from 34 families (52 native flora and 44 introduced species). This represents a low degree of species diversity due to previous disturbance in the Project Area and extent of weed invasion.

The dominant families were:

- » Poaceae (grasses) 18 taxa;
- » Asteraceae (daisies) 17 taxa;
- » Myrtaceae (myrtles) 6 taxa;
- » Papilionaceae 6 taxa; and
- » Mimosaceae (wattles) 5 taxa.

The dominant genera were:

- » *Acacia* 5 taxa;
- » *Rhodanthe* 4 taxa; and
- » *Eucalyptus* 3 taxa.

A full list of flora identified in the Project Area is provided in Table 11, Appendix A.

4.2.1 Threatened Flora Species

No Endangered or Vulnerable species pursuant to section 178 of the *Environment Protection and Biodiversity Conservation Act 1999* were located during the survey.

No plant taxa gazetted as Declared Rare Flora pursuant to subsection 2 of section 23F of the *Wildlife Conservation Act (1950)* (Atkins, 2008) were located in the Project Area.

One Priority Flora species was recorded from the Project Area, being:

- » *Acanthocarpus parviflorus* (Priority 3).

The recorded location of this Priority species in the Project Area is provided in Figure 2.



Further information with regards to the habitat and distribution of this Priority species is provided as follows:

Acanthocarpus parviflorus (Priority 3) is a rhizomatous, tufted perennial, herb, 0.15-0.4 m high, flowering white in May through to June. It prefers a habitat of sand over limestone or sandstone. Its known distribution includes Carnarvon and Geraldton Sandplains bioregions (DEC, 2009b). According to the Australia's Virtual Herbarium (2009) there are 22 records of the species *Acanthocarpus parviflorus* mapped from Geraldton to Shark Bay, within Western Australia (WA).

During the field survey, *Acanthocarpus parviflorus* (Priority 3) was recorded in only one location (269290 mE; 6858461 mN [GDA1994, Zone 50]). Only one plant was recorded from the Project Area, with the collection from a granite outcrop immediately east of the road formation.

Based on the known distribution and observations recorded during the field survey, clearing of vegetation in the Project Area is considered unlikely to impact upon the taxon as a whole.

4.2.2 Locally Significant Flora Species

No species recorded during the survey are considered locally significant. No native species were recorded during the survey exhibiting an extension to their known range.

One weed species, **Conyza sumatrensis* (Tall Fleabane) was recorded exhibiting an extension to its known range. While this species is known from the Abrolhos Islands, the closest Western Australian Herbarium record in the mainland is from Jurien Bay, approximately 200 km south of the Project Area. However, Hussey *et al.* (2007) indicate that this species shows a range that includes the townsite of Geraldton at its northern extent.

4.2.3 Weed Species

A total of 44 weed species were recorded during the field survey. This represents approximately 46% of the total number of plant species recorded. The dominant weed families included: Poaceae (grasses) and Asteraceae (daisies).

The weed species recorded were observed to be in high densities throughout the Project Area, being the dominant ground cover in the Project Area.

Weeds Of National Significance (WONS)

Within the Project Area, one species is recognised as having status as a WONS:

» **Lantana camara* (Common Lantana).

This WONS was recorded in one location within the Project Area [269258 mE 6858486 mN (GDA 1994, Zone 50)].

Declared Plants (DP)

Two species, Declared under the *Agricultural and Related Resources Protection Act 1976*, was recorded in the Project Area: namely:



- » *Echium plantagineum* (Paterson's Curse) P1 (for the whole of the State); and
- » *Lantana camara* (Common Lantana) P1 (for the whole of the State).

Paterson's Curse was observed to be scattered along the length of the Project Area.

Management of weed species during clearing activities will be required for this Project, with particular regard to these two weed species classified as Declared Plants and WONS (Recommendation 3, Section).

4.3 Fauna

4.3.1 Fauna Survey Records

The reconnaissance fauna survey recorded 27 fauna species. These included:

- » 22 bird species;
- » 3 mammals; and
- » 2 reptiles.

A full list of observed fauna is provided in Table 14, Appendix B.

4.3.2 Threatened Fauna

One threatened fauna species was recorded during the field survey. The DEC listed Priority 4 species White-browed Babbler (western wheatbelt) (*Pomatostomus superciliosus* subsp. *ashbyi*) was observed within the Project Area. No other threatened fauna species were recorded during the field survey.

The desktop assessment indicated that a number of protected fauna may occur within the Project Area (refer to Section 3.10.2). The habitat requirements of these species and the likelihood of their occurrence in the Project Area (with information from the field survey) are considered as follows:

Peregrine Falcon (*Falco peregrinus*) Schedule 4 [WC Act 1950], Listed Migratory [EPBC Act 1999]

The Peregrine Falcon has a wide global range, occurring in many countries around the world. It is currently assessed as Least Concern in the ICUN Red List of Threatened Species, as global population trends are thought to be relatively stable (Birdlife International, 2008). They live in a wide range of habitats, with a preference for areas near cliffs along coastlines, rivers and ranges.

Assessment: This species usually prefers nesting sites along cliff edges. There are no cliff edges located in the Project Area. This species may fly over the Project Area during foraging trips, but is not considered to exclusively use the Project Area for refuge or breeding purposes.



White-browed Babbler (western wheatbelt) (*Pomatostomus superciliosus ashbyi*) Priority 4 [DEC]

This species inhabits eucalypt forests and woodlands where they create bulky domed nests for breeding and roosting. They forage near the ground where they forage on insects and seeds. The species is generally restricted to larger fragments of remnant vegetation as they do not seem to cope well with introduced edges (Garnett & Crowley, 2000).

Assessment: Suitable habitat for this species was located in the Project Area. In addition, this taxon was recorded from the Project Area. Based on this species being generally restricted to larger fragments of remnant vegetation, the Project is unlikely to have significant impact upon the species at a regional level. The remnant vegetation within the Project Area may provide a corridor to facilitate movement of this species between larger areas of remnant vegetation.

Shield-backed Trapdoor Spider (*Idiosoma nigrum*) Schedule 1 [WC Act 1950]

This species is in decline in its patchy distribution through the northern and central wheat-belt and coastal plain. It is a long-lived species that is very sensitive to disturbance. The species burrows in heavy clay soil of York Gum (*Eucalyptus loxophleba*) and jam (*Acacia acuminata*) forests. Their burrows comprise of a thin trapdoor made up of a fan of twig-lines in litter (DEWHA, 2009b).

Assessment: Based on the disturbed nature of the Project Area, this species is considered unlikely to occur. Note: The reconnaissance fauna survey did not include an assessment of invertebrate species.

4.3.3 Marine and Migratory Listed Species

Eight Marine/Migratory Listed species, protected under the *Environment Protection and Biodiversity Conservation Act 1999*, were recorded during the field survey (Table 14, Appendix B). Vegetation clearing for the Project is considered unlikely to adversely impact on these Migratory and Marine Listed species, based on their mobile nature.

Many of these migratory species are considered common in Western Australia and do not have special protection under the Western Australian *Wildlife Conservation Act 1950*.

A number of Marine and Migratory Listed species, protected under the *EPBC Act*, were identified as likely to occur in the Project Area (DEWHA, 2009a). Table 4 provides comment on the likelihood of these species occurring in the Project Area.

Table 4 Listed Migratory species for the Project Area on the EPBC Act 1999 Protected Matters Search Tool

Species	Status	Comment
White-bellied Sea Eagle <i>Haliaeetus leucogaster</i>	Migratory (CAMBA), Marine	May fly over the Project Area.
Cattle Egret <i>Ardea ibis</i>	Migratory (CAMBA, JAMBA), Marine	May fly over the Project Area.
Rainbow Bee-eater <i>Merops ornatus</i>	Migratory (JAMBA, Marine)	May occur in the Project Area.
Great Egret <i>Ardea alba</i>	Migratory (CAMBA, JAMBA), Marine	May fly over the Project Area.
Fork-tailed Swift <i>Apus pacificus</i>	Migratory (CAMBA, JAMBA, ROKAMBA), Marine	May fly over the Project Area.


4.3.4 Habitat Types and Habitat Linkages

One habitat type was identified in the Project Area (Table 5).

Based on the field survey, habitat exists for a limited range of fauna species in the Project Area, with a majority of the vegetation degraded from historical clearing.

While the habitat type located in the Project Area is common, limited vegetation surrounding the Project Area exists. The Project Area may provide a habitat linkage between areas of vegetation in the local area.

Table 5 Habitat type recorded in the Project Area

Habitat Type	Photographs
Degraded Shrubland	



4.3.5 Introduced Fauna Species

One introduced species, the European Rabbit (*Oryctolagus cuniculus*), was recorded in the Project Area.

The presence of this introduced fauna species has resulted in grazing pressure, which has negatively impacted upon the vegetation condition within the Project Area.

4.3.6 Fauna Impacts

Clearing of vegetation within the Project Area is considered to have minimal impact on fauna species, as no species are thought to use the Project Area exclusively. It is not considered that the clearing of vegetation will significantly alter the fauna habitat of the region. Disturbance is most likely to occur on a local scale, impacting individual animals, rather than a species.

The Project Area however, is not wholly surrounded by similar continuous vegetation, with grazing pressures and historical clearing altering the surrounding vegetation from its pre-European state. While the Project Area does not contain significant habitat for fauna species, it may provide a vegetation corridor for mobile species in the area.

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 extent of habitat. There will be a minor loss of refuge vegetation and associated foraging resources; and
- » Harm/deaths/displacement of individual animals. This may occur during clearing activities.

4.4 Field Assessment of Wetlands and Drainage

No wetlands or rivers were recorded in the Project Area during the field survey. A number of minor, ephemeral creeklines cross the Project Area through constructed culverts.

A dam located on agricultural land, to the west of the Project Area provides an environment for bird species with a preference for water habitats.



5. Vegetation Clearing

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

Main Roads have been granted a Purpose Clearing Permit (CPS 818/4) under the provisions of the *Environmental Protection (Clearing of Native Vegetation) Regulations 2004*. This permit provides for Main Roads to conduct such clearing associated with roadwork projects in accordance with additional requirements as set out in the Purpose Permit.

This Project has been assessed against the 'Ten Clearing Principles' (Table 15, Appendix C). The following is a summary of the findings of this assessment:

- » Based on evidence from the field survey, the original vegetation type has been significantly altered to an extent that it no longer resembles the distinct vegetation type described and mapped by Beard (1976). The vegetation located in the Project Area does not correlate with Vegetation Association 35, and is a combination of natural regrowth and planted vegetation after previous clearing activities. Any vegetation, whether it be remnant or rehabilitated is considered to be of value, particularly in areas where vegetation has been extensively cleared. As such, the Project is considered to be at variance with clearing principle 'e'. Consultation with DEC is recommended;
- » In relation to Clearing Principle 'a', one Priority species, *Acanthocarpus parviflorus* (Priority 3) was recorded within the Project Area. This species was recorded at only one location within the surveyed area. This area is unlikely to be impacted as it occurs on a small granite outcrop adjacent to the road formation. The vegetation is not considered to be necessary for the continued existence of this Priority species. While the presence of this species is not considered to be at variance with clearing principle 'a', it is recommended that the presence of the Priority 3 species in the Project Area be discussed with the DEC; and
- » The Project is not likely to be at variance with any of the other nine 'Clearing Principles'.



6. Requirement for Referral

Referral to the Environmental Protection Authority (EPA) or Department of the Environment, Water, Heritage and the Arts (DEWHA) is not considered to be warranted for this Project.



7. Conclusions and Recommendations

7.1 Conclusions

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

- » The vegetation of the Project Area is identified by Beard (1976) as likely to contain Vegetation Association 35, which is described as 'Shrublands; jam scrub with scattered York gum'.
 - This vegetation type is considered to be *Vulnerable*, with 10.5% of the pre-European extent considered to be remaining in the Geraldton Sandplains Interim Biogeographic Regionalisation for Australia (IBRA) region (Shepherd, 2005).
 - Based on evidence from the field survey, the original vegetation type has been altered to an extent that it no longer resembles the distinct vegetation type described and mapped by Beard (1976), and is most likely natural regrowth and planted vegetation after previous clearing activities.
- » No Declared Rare Flora species were recorded during the field survey. However, one Priority species, *Acanthocarpus parviflorus* (Priority 3) was recorded within the Project Area. Consultation with DEC is recommended with regards to the recorded presence of this species.
- » There are no conservation reserves within the immediate vicinity of the Project Area.
- » Vegetation condition throughout the Project Area ranged from Condition 5 (*Degraded*) to Condition 6 (*Completely Degraded*). The main disturbance factors were historical clearing for the purpose of road construction and agriculture, and weed invasion.
- » A total of 96 species (52 native species) from 34 families were recorded in the Project Area, which represents low native species diversity.
- » A total of 44 weed species were recorded during the field survey. This represents approximately 46% of the total number of plant species recorded.
 - Two Declared Plants listed under the *Agriculture and Related Resources Act* (1976) were recorded in the Project Area, being **Echium plantagineum* (Paterson's Curse) and **Lantana camara* (Common Lantana). Within the Project Area, one species is recognised as having status as a Weed of National Significance (WONS), being **Lantana camara* (Common Lantana).
- » The reconnaissance fauna survey recorded 27 fauna species. These included: 22 bird species; 3 mammals; and 2 reptiles. One introduced species; the European rabbit was recorded in the Project Area.



- Potential clearing within the Project Area is not expected to negatively impact upon the local populations of any of these or other fauna species present in the area.
- » One threatened fauna species, the Priority 4 *Pomatostomus superciliosus* subsp. *ashbyi* – White-browed Babbler (western wheatbelt), was recorded in the Project Area during the reconnaissance fauna survey. Threatened fauna species known to occur in the general area, as identified in the desktop assessment, are unlikely if present, to be impacted by clearing of vegetation in the Project area;
- » While the habitat type located in the Project Area is common, limited vegetation surrounding the Project Area exists due to historical clearing for agriculture. The Project Area may provide a habitat linkage between areas of vegetation in the local area; and
- » Based on the findings of the desktop and field assessment, clearing for the Project is considered to be at variance with Clearing Principle (e), due to the *Vulnerable* status of the vegetation remaining within the Project Area. However, the field survey indicates that the original vegetation type has been altered to such an extent that it no longer resembles the remnant vegetation type described and mapped by Beard (1976). As such, this Clearing Principle may no longer apply. Consultation with the DEC is recommended.

7.2 Recommendations

The following recommendations are provided for potential clearing in the Project Area:

- » **Recommendation 1:** It is recommended that works be undertaken for this Project in summer, reducing the chance for weather to adversely impact construction activities. Rehabilitation is suggested to be undertaken at the end of summer to ensure that native flora can take advantage of winter rainfall.
- » **Recommendation 2:** Based on the findings of the desktop and field assessment, clearing is considered to be at variance with Clearing Principle 'e', due to the *Vulnerable* status of the vegetation remaining in the Project Area. However, the field survey indicates that the original vegetation type has been altered to such an extent that it no longer resembles the remnant vegetation type described and mapped by Beard (1976). As such, this Clearing Principle may no longer apply. Consultation with the DEC is recommended to determine the status of the vegetation in the Project Area.
- » **Recommendation 3:** It is recommended that DEC is informed of the presence of the Priority 3 *Acanthocarpus parviflorus* within the Project Area; and
- » **Recommendation 4:** The high number of recorded weed species should be confined by implementing as far as practicable, weed management during Project works, so as to reduce the risk of introducing weeds to other bushland from the Project Area.



8. Limitations

8.1 Survey Limitations

An outline of the limitations of this survey is provided in Table 6.

Table 6 Limitations and Constraints

Variable	Impact on Survey Outcomes
Date of Site Survey	18 th August 2009
Access Problems	No access problems were encountered.
Experience levels	The ecologists who executed these surveys were practitioners suitably qualified in their respective fields. Coordinating Botanist: Joshua Foster (Senior Ecologist); Field Staff: Joshua Foster (Senior Ecologist) and Melissa Scott (Ecologist), Taxonomy: Joshua Foster (Senior Ecologist) and Melissa Scott (Ecologist), Data Interpretation: Joshua Foster (Senior Ecologist) and Melissa Scott (Ecologist)
Timing ³ , weather, season.	The survey was undertaken in mid August 2009. The area had received 328.8 millimetres of rainfall in the 6 months prior to the survey (February to July). This is only 1.9 mm lower than the mean rainfall of 330.7 mm received during the same time period (1882-2009) (Bureau of Meteorology, 2009b). Of note, the months May to July 2009 (3 months prior to the survey) received a higher than mean rainfall at Northampton (008100) (Bureau of Meteorology, 2009b). Flora composition changes over time, with flora species having specific growing periods, especially annuals and ephemerals (some plants lasting for a markedly brief time, some only a day or two). Therefore, the results of future botanical surveys in this location may differ from the results of this survey.
Completeness	As the survey was conducted only once rather than several times over the course of a year some annual, ephemeral condition specific species may be present that were not recorded in the survey. Species that were senescent or immature were identified in the field to Genus or Family level only (where possible). A comprehensive species list has not been prepared for areas that do not constitute a natural vegetation area, such as gardens or areas that have been totally cleared.
Determination	This survey makes inferences about vegetation types that have the potential to be TECs. However, a decision as to the presence or absence of TECs at the site remains the responsibility of the DEC's Species & Communities Branch. The taxonomy and conservation status of the Western Australian flora are dynamic. This report was prepared in reliance on taxonomy and conservation current at the time, but it should be noted this may change.

³ EPA Guidance Statement 51 (2004) stipulates that flora and vegetation surveys should be undertaken following the season that contributes the greatest rainfall in the region. In the Northern Province, this is after summer. In the Eremaean Province, rainfall is sporadic, and in the South-west Province the main rain is in winter, requiring surveys to be undertaken in spring. Short-term variances in normal weather patterns (e.g. drought) may necessitate supplementary survey work at other times of year or in later years to take into account temporal changes in diversity.



8.2 Report Limitations

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

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

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



9. References

- Atkins, K.J. (2008) Declared Rare and Priority Flora List for Western Australia, 26 February 2008. Department of Environment and Conservation. Como, WA.
- Australian Government (2009a) Weeds of National Significance (WONS) accessed online at: <http://www.weeds.gov.au/weeds/lists/wons.html> on 21/05/2009.
- Australian Government (2009b) Australian Natural Resources Atlas: Natural Resource Topics – Biodiversity Assessment, Exotic Mammals. Accessed online at: <http://www.anra.gov.au/topics/vegetation/assessment/wa/index.html> 24/06/2009.
- Australia's Virtual Herbarium (2009) Map Search Interface (Public Access Level). Centre for Plant Biodiversity Research. Accessed online at: <http://www.anbg.gov.au/cgi-bin/avh.cgi> on [13/11/09].
- Beard, J.S. (1976). *Vegetation Survey of Western Australia, 1:250,000 Series*. The Vegetation of the Geraldton Area. VegMap Publications, Perth.
- Birdlife International (2008) *Falco peregrinus*. In: IUCN 2009. IUCN Red List of Threatened Species. Version 2009.1. accessed online at: www.icunredlist.org on [24/08/09].
- Bureau of Meteorology (2009a) *Climate Averages for Australian Sites – Nokanena* Australian Government Bureau of Meteorology. Available at: http://www.bom.gov.au/climate/averages/tables/cw_008267.shtml on [11/07/09].
- Bureau of Meteorology (2009b) Daily Rainfall – Northampton. Australian Government Bureau of Meteorology. Accessed at: http://www.bom.gov.au/jsp/ncc/cdio/weatherData/av?p_nccObsCode=136&p_display_type=dailyDataFile&p_startYear=2009&p_stn_num=008100 on [16/11/09].
- Centre for Phytophthora Science and Management (2009) Fishing for Phytophthora: Results. Accessed online at: <http://www.fishingforphytophthora.murdoch.edu.au/> on [28/10/2009].
- Conservation And Land Management (CALM, 2003) *Phytophthora cinnamomi* and disease caused by it. Volume 1-Management Guidelines. Department of Conservation and Land Management, Government of Western Australia. Accessed at: http://www.calm.wa.gov.au/projects/pdf_files/DBmanual2003.pdf on [30/10/2009].
- Department of Agriculture and Food Western Australia (2008) List of Declared Plants. Accessed online at: http://www.agric.wa.gov.au/content/PW/WEED/DEC/dec_plants_list.pdf on [21/05/2009].



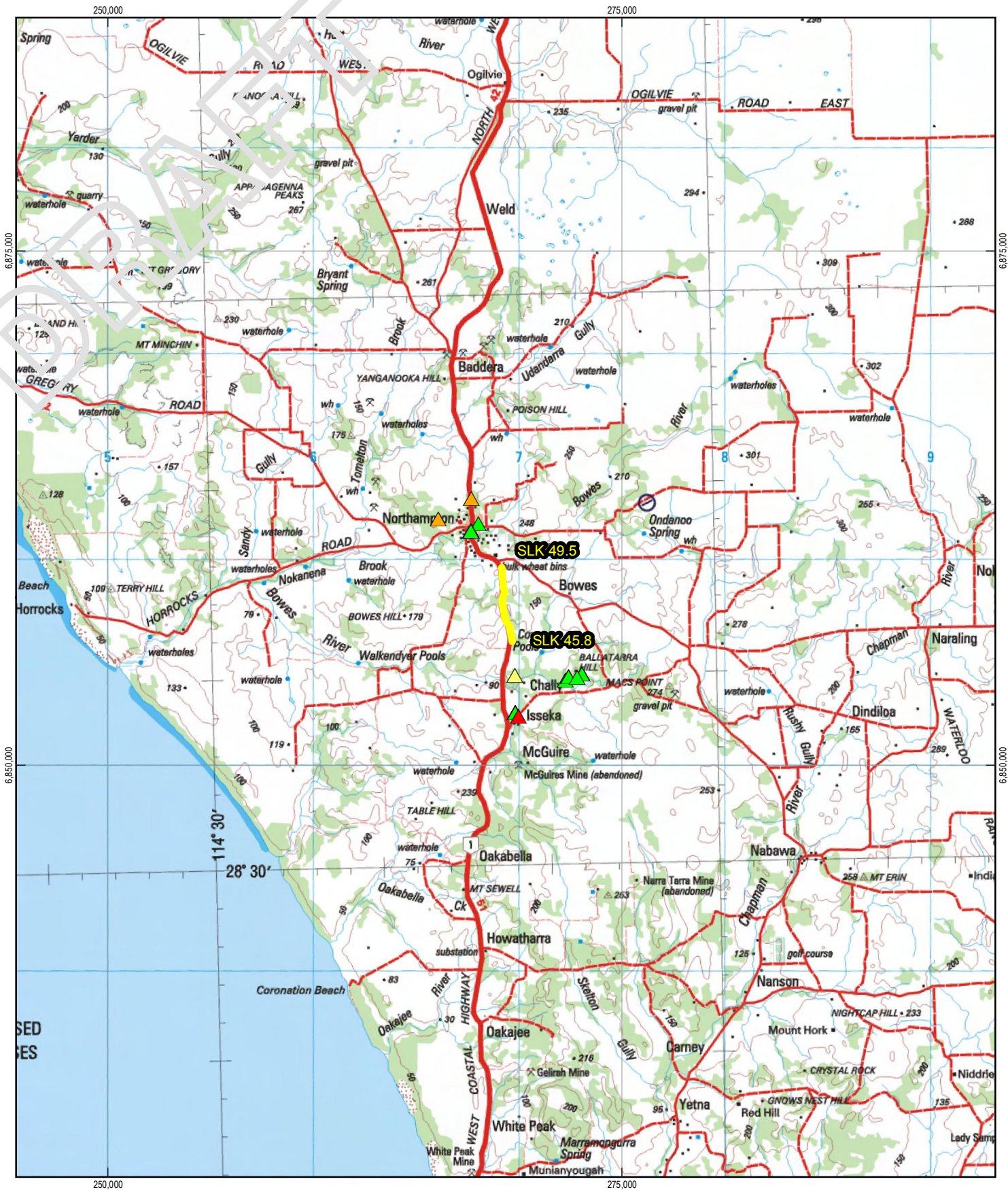
- Department of Agriculture and Food Western Australia (2009) Declared Plants Search – Shire of Northampton, Accessed online at: http://www.agric.wa.gov.au/PC_93088.html on [22/06/2009].
- Department of Environment (2004) Water Quality Protection Note: Land use compatibility in Public Drinking Water Source Areas. Government of Western Australia, July 2004. Accessed online at: <http://www.water.wa.gov.au/Waterways+health/Drinking+water/Water+source+protection+plans/default.aspx> on [12/11/2009].
- Department of Environment and Conservation (2009a) Threatened Flora Database Search Request. Reference Numbers: Reference Numbers: 47-0609 [25 June 2009].
- Department of Environment and Conservation (2009b) *FloraBase*. Accessed online at: <http://florabase.calm.wa.gov.au/> on [24/06/2009].
- Department of Environment and Conservation (2009c) *Native Vegetation Map Viewer*. Accessed online at: http://portal.environment.wa.gov.au/portal/page?_pageid=53,2569721&_dad=portal&_schema=PORTAL on [09/07/09].
- Department of Environment and Conservation (2009d) Threatened Fauna Database Search Results Ref No. 2009/000355 #2742 [16 July 2009].
- Department of Environment and Conservation and Western Australian Museum (DEC and WAM, 2009) *NatureMap*: Mapping Western Australia's biodiversity. Accessed online at : <http://naturemap.dec.wa.gov.au/default.aspx> on [10/07/2009].
- Department of the Environment, Water, Heritage and the Arts (DEWHA, 2009a) *Environment Protection and Biodiversity Conservation Act Protected Matters Search Tool: North West Coastal Highway*. Accessed online at <http://www.environment.gov.au/erin/ert/epbc> on [29/06/2009].
- Department of the Environment, Water, Heritage and the Arts (DEWHA, 2009b) Australian Biological Resources Study: Australian Faunal Directory. Species: *Idiosoma nigrum* Main, 1952. Accessed online at: http://www.environment.gov.au/biodiversity/abrs/online-resources/fauna/afd/taxa/Idiosoma_nigrum on [24/09/09].
- Department of Water (2009) Geographic Data Atlas, Accessed online at: <http://portal.water.wa.gov.au/portal/page/portal/MapsDataAtlases/GeographicDataAtlas> on 29/06/2009
- Environmental Protection Authority (EPA, 2000) *Environmental Protection of Native Vegetation in Western Australia*. Clearing of native vegetation, with particular reference to the agricultural area. Position Statement No. 2. Environmental Protection Authority, Perth, Western Australia.
- Environmental Protection Authority (2004a) Guidance for the Assessment of Environmental Factors (in accordance with the Environmental Protection Act 1986).



- Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia. Guidance Statement No. 51. June 2004. Western Australia
- Environmental Protection Authority (2004b) Guidance for the Assessment of Environmental Factors (in accordance with the Environmental Protection Act 1986). Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia. Guidance Statement No. 56. June 2004. Western Australia.
- Garnett, S. T. & Crowley G. M. (2000) *The Action Plan for Australian Birds 2000*, pp 351 – 352 Taxon Summary, White-browed Babbler (western wheatbelt) accessed online at:
<http://www.environment.gov.au/biodiversity/threatened/publications/action/birds2000/pubs/wbrowed-babbler.pdf> on [24/08/09].
- Geological Survey of Western Australia (1971) Geraldton – Houtman Abrolhos Sheet SH 50-1 and Part Sheet SH 49-4, Geology by Playford, Willmott, Johnstone, Horwitz and Baxter, published by Bureau of Mineral Resources, Geology and Geophysics, Department of National Development, Canberra, ACT.
- Government of Western Australia (2000) Bush Forever Volume 2. Directory of Bush Forever Sites. Department of Environmental Protection, Perth, Western Australia.
- Hussey, B.M. J., Keighery, G.J, Dodd, J, Lloyd, S.G. and R.D. Cousens (2007). *Western Weeds: A guide to the weeds of Western Australia*. 2nd Edn. The Weeds Society of Western Australia, Victoria Park, Western Australia.
- Keighery, B.J. (1994). *Bushland Plant Survey. A Guide to Plant community Survey for the Community*. Wildflower Society of Western Australia (Inc), Nedlands, Western Australia.
- Shepherd (2005) *Pre-European Vegetation- Western Australia* (NVIS compliant version). Department of Agriculture and Food, Western Australia.
- Tille, P. (2006) *Soil - landscapes of Western Australia's Rangelands and Arid Interior. Resource Management Technical Report 313*. Department of Agriculture and Food, Government of Western Australia. Accessed online at:
http://www.asris.csiro.au/downloads/state_agencies/tr2007_slwarai_ptille_nomaps.pdf on [12/07/09].
- WetlandBase* (2009) The Western Australian Wetlands Database. State of Western Australia. Accessed online at:
<http://spatial.agric.wa.gov.au/wetlands/framesetup.asp> on [12/11/09].



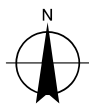
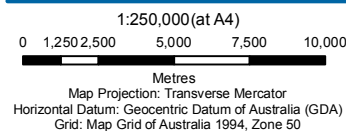
Figures



LEGEND

- Project Area
- Rare and Priority Flora***
- ▲ Rare
- ▲ Priority 1
- ▲ Priority 2
- ▲ Priority 3
- ▲ Priority 4

*WA Herb & DEFL Database Search Reference 47-0609



Main Roads Western Australia
North West Coastal Highway
Reconstruction SKL 45.8-49.5

Job Number 61-24196
Revision A
Date 06 OCT 2009

**Locality Map &
Environmental Constraints**

Figure 1



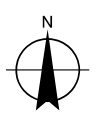
- LEGEND**
- Project Area
 - Acanthocarpus parviflorus* (Priority 3)

1:17,500 (at A4)

0 87.5 175 350 525 700

Metres

Map Projection: Transverse Mercator
 Horizontal Datum: Geocentric Datum of Australia (GDA)
 Grid: Map Grid of Australia 1994, Zone 50

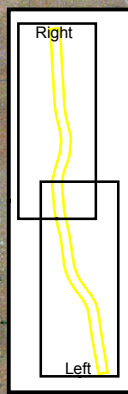
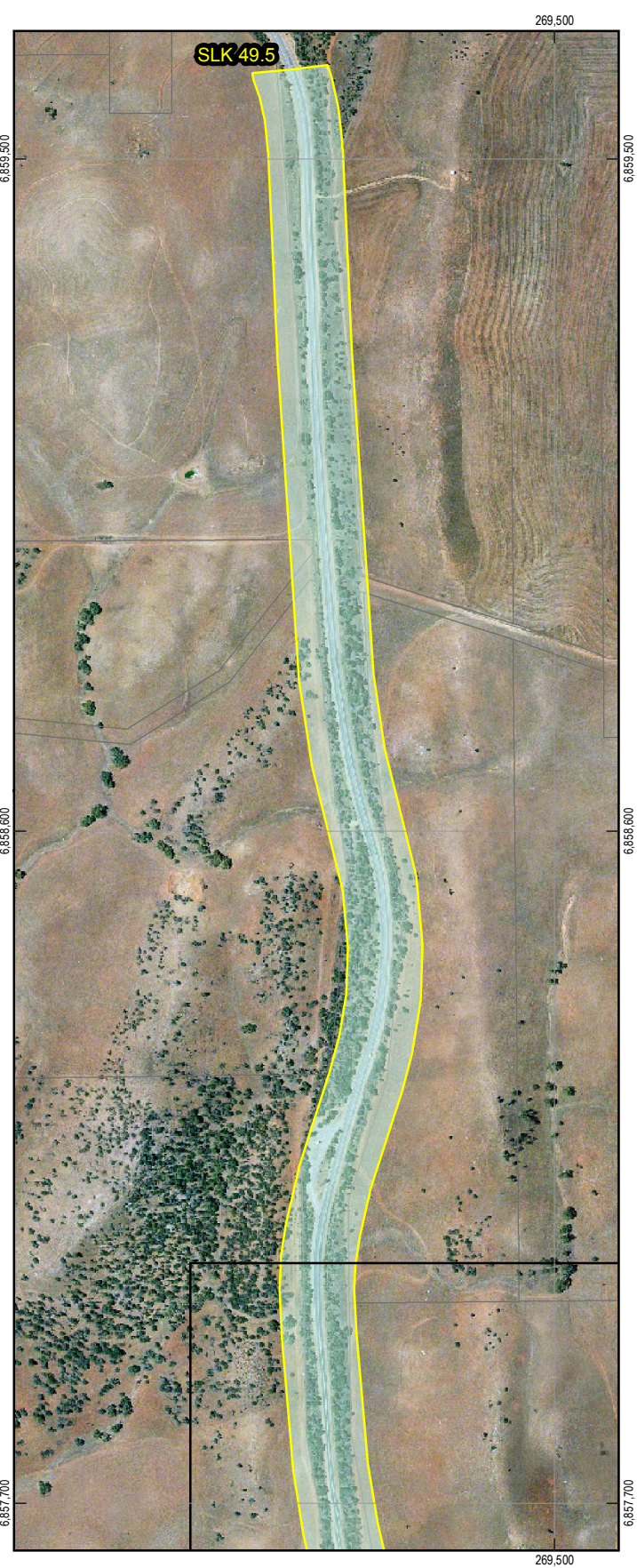


Main Roads Western Australia
 North West Coastal Highway
 Reconstruction SKL 45.8-49.5

Job Number	61-24196
Revision	A
Date	06 OCT 2009

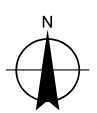
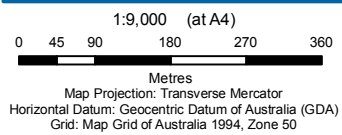
Project Area and Priority Flora **Figure 2**

Z:\AU\Geraldton\Projects\6124196\GIS\mxd\6124196-E011.mxd
 76 Forrest Street Geraldton WA 6530 T 61 8 9964 3677 F 61 8 9921 7997 E getmail@ghd.com.au W www.ghd.com.au
 © 2009. While GHD has taken care to ensure the accuracy of this product, GHD and SLIP, GHD make no representations or warranties about its accuracy, completeness or suitability for any particular purpose.
 GHD and SLIP, GHD cannot accept liability of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred as a result of the product being inaccurate, incomplete or unsuitable in any way and for any reason.
 Data Source: Landgate: Northampton Mosaic - 2008; GHD: Project Area - 20090216, Acanthocarpus parviflorus (Priority 3) - 20091005. Created by: mlogue



LEGEND

- Project Area
- Cadastre
- Vegetation Type**
- Very open shrubland of *Acacia acuminata*, *A. tetragonophylla* and *Hakea recurva* over weed species



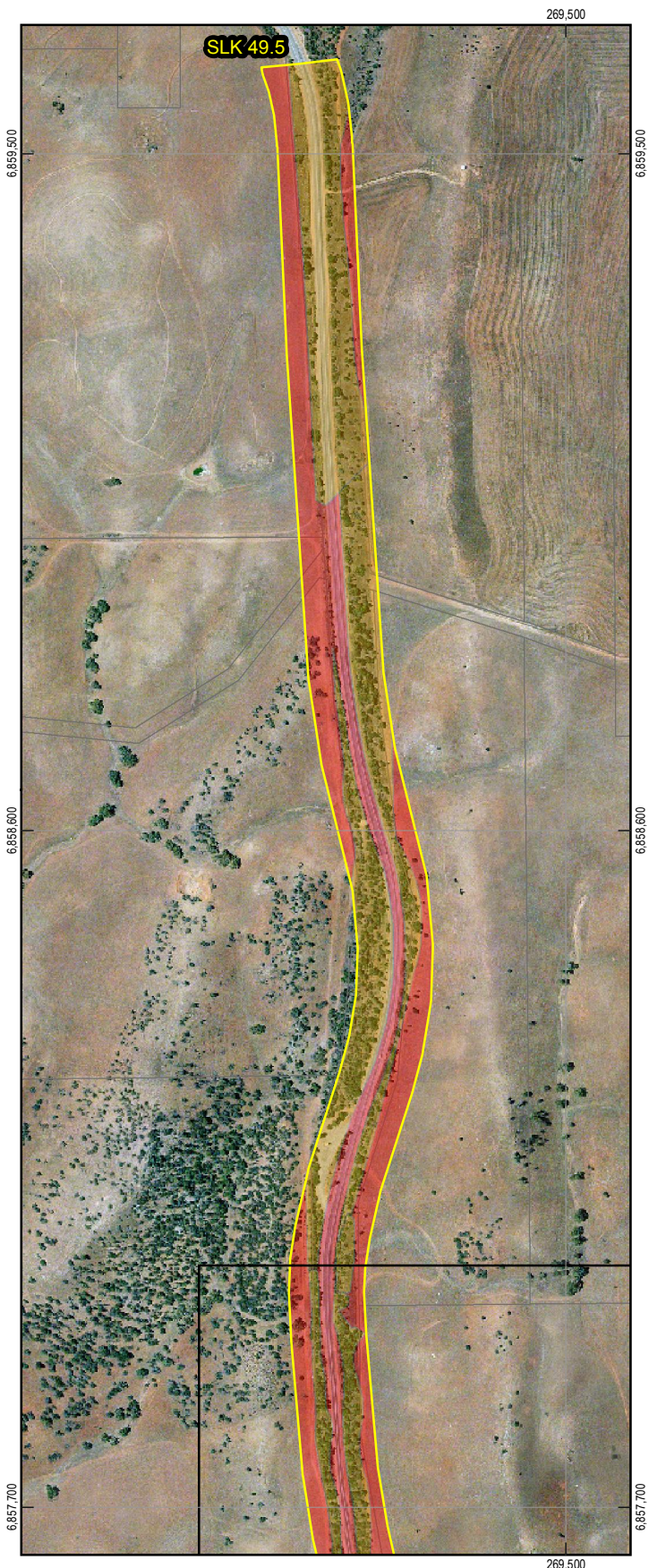
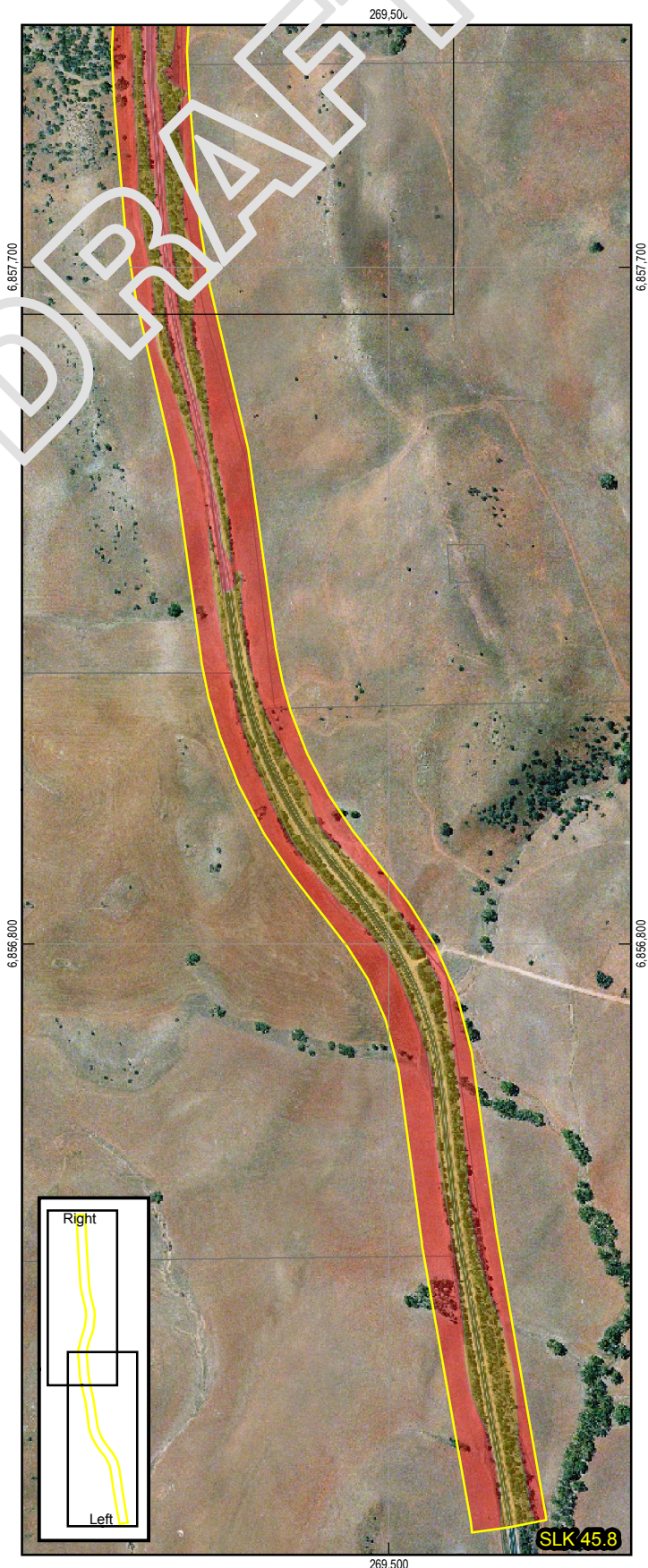
Main Roads Western Australia
North West Coastal Highway
Reconstruction SKL 45.8-49.5

Job Number	61-24196
Revision	A
Date	06 OCT 2009

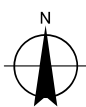
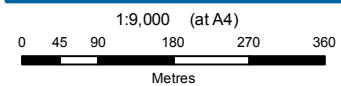
Vegetation Type

Figure 3

Z:\AU\Geraldton\Projects\61124196\GIS\mxd\6124196-E012b.mxd
 © 2009. While GHD has taken care to ensure the accuracy of this product, GHD and SLIP, GHD make no representations or warranties about its accuracy, completeness or suitability for any particular purpose.
 GHD and SLIP, GHD cannot accept liability of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred as a result of the product being inaccurate, incomplete or unsuitable in any way and for any reason.
 Data Source: Landgate: Northampton Mosaic - 2003, Cadastre (LGATE-002) - 200906; GHD: Project Area - 20090216, Vegetation Type - 20091005. Created by: mlogue



- LEGEND**
- Project Area
 - Cadastre
- Vegetation Condition**
- 1 - Pristine
 - 2 - Excellent
 - 3 - Very Good
 - 4 - Good
 - 5 - Degraded
 - 6 - Completely Degraded



Main Roads Western Australia
North West Coastal Highway
Reconstruction SKL 45.8-49.5

Job Number 61-24196
Revision A
Date 06 OCT 2009

Vegetation Condition

Figure 4



Appendix A

Flora

Flora Conservation Categories

Significant Flora Species

Declared Plants Criteria

Project Area Flora Species List



Table 7 Conservation Categories and Definitions for EPBC Act Listed Flora and Fauna Species.

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



Table 8 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.
X: Declared Rare Flora – Presumed Extinct Taxa	Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such.
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 – 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.



Table 9 Threatened and Priority Flora Species identified in the Threatened Flora Database Search Results and EPBC Act 1999 Protected Matters Search Tool

Species	Conservation Code	Description ¹	Flowering Time ¹	Preferred Habitat ¹	Distribution ¹	Data Source	Likelihood of Occurrence
<i>Acacia megacephala</i>	Priority 2	Erect, often spindly, spinose shrub, 0.9–2 m high. Fl. yellow	Jul–Sep	White/yellow sand. Sandplains	Southwest Botanical Province: Geraldton Sandplains	WAHerb ²	Unlikely – preferred habitat not present
<i>Acacia pelophila</i>	Priority 1	Dense, spreading shrub, 0.9–2 m high. Fl. yellow	Jul–Aug	Clay. Saline creeklines	Southwest Botanical Province: Geraldton Sandplains	WAHerb ²	Unlikely – preferred habitat not present
<i>Caladenia bryceana</i> subsp. <i>cracens</i>	Vulnerable Declared Rare	Tuberous, perennial, herb, 0.03–0.08 m high. Fl. green, yellow	Aug–Sep	Sand over limestone. South of Kalbarri in low heath on limestone hills; north in winter-moist flats	Southwest Botanical Province: Geraldton Sandplains	EPBC Act Protected Matters Search ³	Unlikely – preferred habitat not present
<i>Caladenia elegans</i>	Declared Rare	Tuberous, perennial, herb, 0.2–0.3 m high. Fl. yellow	Jul–Aug	Clayey loam. Winter-wet clay flats	Southwest Botanical Province: Geraldton Sandplains	WAHerb ² DR&PF ⁴	Unlikely – preferred habitat not present



Species	Conservation Code	Description ¹	Flowering Time ¹	Preferred Habitat ¹	Distribution ¹	Data Source	Likelihood of Occurrence
<i>Caladenia hoffmanii</i>	Endangered Declared Rare	Tuberous, perennial, herb, 0.13–0.3 m high. Fl. green, yellow, red	Aug–Oct	Clay, loam, laterite, granite. Rocky outcrops and hillsides, ridges, swamps and gullies	Southwest Botanical Province: Geraldton Sandplains	EPBC Act Protected Matters Search ³	Low – very minor habitat present (but disturbed).
<i>Calytrix pimeleoides</i>	Priority 3	Loose, erect shrub, 0.5–1.6 m high. Fl. cream, yellow	Aug–Oct	Grey or yellow-brown sand, laterite. Sandplains, flats, hills, outcrops	Southwest Botanical Province: Geraldton Sandplains	WAHerb ²	Possible – minor (but disturbed) habitat present
<i>Commersonia bivillosa</i>	Priority 1	Spreading, prostrate shrub, to 0.4 m high. Fl. white, pink	Aug–Oct	Red soils, yellow sandy gravel, laterite. Sandplains, slopes, ridges, roadsides.	Eremaean Botanical Province: Murchison Southwest Botanical Province: Geraldton Sandplains	DR&PF ⁴	Possible – minor (but disturbed) habitat present
<i>Diuris recurva</i>	Priority 4	Tuberous, perennial, herb, 0.2–0.3 m high. Fl. yellow, brown	Jul–Aug	Loam. Winter-wet areas	Southwest Botanical Province: Avon Wheatbelt, Geraldton Sandplains, Jarrah Forrest	WAHerb ²	Unlikely – preferred habitat not present



Species	Conservation Code	Description ¹	Flowering Time ¹	Preferred Habitat ¹	Distribution ¹	Data Source	Likelihood of Occurrence
<i>Eucalyptus blaxellii</i>	Vulnerable Declared Rare	Mallee, 1–4 m high, bark smooth. Fl. white, cream	Aug–Nov	Grey sand, clay. Rocky hillsides, creek flats	Southwest Botanical Province: Avon Wheatbelt, Geraldton Sandplains	EPBC Act Protected Matters Search ³ WAHerb ²	Possible – minor (but disturbed) habitat present
<i>Eucalyptus cuprea</i>	Endangered Declared Rare	Mallee, 2.5–5 m high, bark rough to 1.5 m, box-type. Fl. white	Aug–Nov	Shallow soils over granite	Southwest Botanical Province: Geraldton Sandplains	EPBC Act Protected Matters Search ³	Unlikely – preferred habitat not present
<i>Gastrolobium propinquum</i>	Priority 3	Low, bushy shrub, to 1(–1.8) m high. Fl. orange, yellow, red	Jun–Sep	Clay, clay-loam or sandy clay soils, granite, shale. Hills, flats, drainage lines, winter-wet areas.	Southwest Botanical Province: Avon Wheatbelt, Geraldton Sandplains	WAHerb ²	Unlikely – preferred habitat not present
<i>Grevillea triloba</i>	Priority 3	Diffuse or spreading shrub, (0.4–) 0.9–1.5(–2.5) m high. Fl. white, pink	Jun–Oct	Sandy loam on sandstone or limestone, lateritic soils	Southwest Botanical Province: Geraldton Sandplains	WAHerb ²	Unlikely – preferred habitat not present



Species	Conservation Code	Description ¹	Flowering Time ¹	Preferred Habitat ¹	Distribution ¹	Data Source	Likelihood of Occurrence
<i>Ptilotus chortophytum</i>	Priority 1	Tuberous, erect perennial, herb, to 0.15 m high, leaves oblanceolate, succulent, 4-35 mm long, 1-5 mm wide; spike green, ovoid, or cylindrical, 12-48 mm long, 10-15 mm wide; bract 4-6 mm long; bracteole 3-5.5 mm long; tepals 5-7.5 mm long; 2 Fertile stamens, 3 staminodes; ovary glabrous; style slightly sigmoid, 4.5-5 mm long, eccentrically fixed to ovary. Fl. green, yellow	Sep–Nov	Gravel. Rocky hills, shale scree slopes	Eremaean Botanical Province: Murchison Southwest Botanical Province: Geraldton Sandplains	WAHerb ²	Unlikely – preferred habitat not present
<i>Scaevola oldfieldii</i>	Priority 3	Erect shrub, to 2.3 m high. Fl. white	Aug–Dec	Sand, loam, clay. Near rivers	Southwest Botanical Province: Geraldton Sandplains	WAHerb ²	Possible – minor (but disturbed) habitat present



Species	Conservation Code	Description ¹	Flowering Time ¹	Preferred Habitat ¹	Distribution ¹	Data Source	Likelihood of Occurrence
<i>Serichonus gracilipes</i>	Priority 3	Evergreen shrub, 0.2–0.7 m high. Fl. white, pink	Aug–Sep	Red sandy clay over granite, brown sandy clay loam with laterite gravel, yellow-brown sandy loam over sandstone. Rock crevices, rocky gullies, margins of summits and basal slopes of mesas, near rock outcrops	Southwest Botanical Province: Geraldton Sandplains	WAHerb ² DR&PF ⁴	Unlikely – preferred habitat not present
<i>Verticordia chrysostachys</i> var. <i>pallida</i>	Priority 3	Erect to spreading shrub, 0.6–2 m high. Fl. yellow, cream	Sep–Jan	Yellow sand. Sandplains, sand dunes	Southwest Botanical Province: Avon Wheatbelt, Geraldton Sandplains	WAHerb ²	Unlikely – preferred habitat not present

¹ Data Source Department of Environment and Conservation (DEC, 2009b) FloraBase accessed online at <http://florabase.calm.wa.gov.au/> on 25/06/2009.

² WA Herbarium Database Search Reference 47-0609 (DEC, 2009a).

³ Department of the Environment, Water, Heritage and the Arts (DEWHA, 2009a) Protected Matters Search Tool.

⁴ DEC Declared Rare and Priority Flora Database Search Reference 47-0609 (DEC, 2009a).



Table 10 Department of Agriculture and Food Declared Plant Control Classes

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

Source: Department of Agriculture and Food (2008)



Table 11 Flora species recorded during the field survey

Family	Genus	Species	Common Name	Status
Apiaceae	<i>Trachymene</i>	<i>pilosa</i>	Native Parsnip	
Asparagaceae	<i>Chamaescilla</i>	<i>corymbosa</i>	Blue Squill	
Asparagaceae	<i>Thysanotus</i>	<i>manglesianus</i>	Fringed Lily	
Asteraceae	<i>Arctotheca</i>	<i>calendula</i>	Capeweed	*
Asteraceae	<i>Brachyscome</i>	sp. (insufficient material)		
Asteraceae	<i>Calotis</i>	<i>multicaulis</i>	Many-stemmed Burr-daisy	
Asteraceae	<i>Cephalipterum</i>	<i>drummondii</i>	Pompom Head	
Asteraceae	<i>Conyza</i>	<i>sumatrensis</i>		*RE
Asteraceae	<i>Cotula</i>	<i>turbinata</i>	Funnel Weed	*
Asteraceae	<i>Hedypnois</i>	<i>rhagadioloides</i>	Cretan Weed	*
Asteraceae	<i>Hypochaeris</i>	<i>glabra</i>	Smooth Catsear	*
Asteraceae	<i>Monoculus</i>	<i>monstrosus</i>	Stinking Roger	*
Asteraceae	<i>Olearia</i>	<i>dampieri</i>		
Asteraceae	<i>Rhodanthe</i>	<i>chlorocephala</i>		
Asteraceae	<i>Rhodanthe</i>	<i>citrina</i>		
Asteraceae	<i>Rhodanthe</i>	<i>manglesii</i>		
Asteraceae	<i>Rhodanthe</i>	<i>spicata</i>		
Asteraceae	<i>Sonchus</i>	<i>oleraceus</i>	Common Sowthistle	*
Asteraceae	<i>Urospermum</i>	<i>picroides</i>	False Hawkbit	*
Asteraceae	<i>Ursinia</i>	<i>anthemoides</i>	Ursinia	*
Boraginaceae	<i>Echium</i>	<i>plantagineum</i>	Paterson's Curse	*DP
Brassicaceae	<i>Brassica</i>	<i>tournefortii</i>	Mediterranean Turnip	*
Brassicaceae	<i>Brassica</i>	<i>campestris</i>	Canola	*
Brassicaceae	<i>Raphanus</i>	<i>raphanistrum</i>	Wild Radish	*
Caryophyllaceae	<i>Cerastium</i>	<i>glomeratum</i>	Mouse Ear Chickweed	*
Caryophyllaceae	<i>Petrorhagia</i>	<i>dubia</i>	Velvet Pink	*
Caryophyllaceae	<i>Polycarpon</i>	<i>tetraphyllum</i>	Fourleaf Allseed	*
Chenopodiaceae	<i>Enchylaena</i>	<i>tomentosa</i>	Barrier Saltbush	
Chenopodiaceae	<i>Salsola</i>	<i>tragus</i>	Roly Poly	
Convolvulaceae	<i>Convolvulus</i>	<i>remotus</i>		
Crassulaceae	<i>Crassula</i>	<i>colorata</i> var. <i>acuminata</i>		
Dasyopogonaceae	<i>Acanthocarpus</i>	<i>parviflorus</i>		P3



Family	Genus	Species	Common Name	Status
Dioscoreaceae	<i>Dioscorea</i>	<i>hastifolia</i>	Warrine	
Fumariaceae	<i>Fumaria</i>	<i>capreolata</i>	Whiteflower Fumitory	*
Geraniaceae	<i>Erodium</i>	<i>botrys</i>	Corkscrews, Long Storksbill	*
Geraniaceae	<i>Erodium</i>	<i>cygnorum</i>	Blue Heronsbill	
Haemodoraceae	<i>Conostylis</i>	<i>prolifera</i>	Mat Cottonheads	
Haemodoraceae	<i>Haemodorum</i>	sp. (insufficient material)		
Hemerocallidaceae	<i>Caesia</i>	<i>micrantha</i>	Pale Grass-lily	
Hemerocallidaceae	<i>Dianella</i>	<i>revoluta</i>	Blueberry Lily	
Loranthaceae	<i>Amyema</i>	<i>fitzgeraldii</i>	Pincushion Mistletoe	
Loranthaceae	<i>Lysiana</i>	<i>casuarinae</i>		
Mimosaceae	<i>Acacia</i>	<i>acuminata</i>	Jam	
Mimosaceae	<i>Acacia</i>	<i>multispicata</i>	Miniritchie	
Mimosaceae	<i>Acacia</i>	<i>rostellifera</i>	Summer-scented Wattle	
Mimosaceae	<i>Acacia</i>	<i>saligna</i>	Orange Wattle	
Mimosaceae	<i>Acacia</i>	<i>tetragonophylla</i>	Kurara	
Myrtaceae	<i>Callistemon</i>	<i>phoeniceus</i>	Lesser Bottlebush	
Myrtaceae	<i>Eucalyptus</i>	<i>camaldulensis</i>	River Red Gum	
Myrtaceae	<i>Eucalyptus</i>	<i>leptopoda</i> subsp. <i>elevata</i>	Tammin Mallee	
Myrtaceae	<i>Eucalyptus</i>	sp. (planted)		+
Myrtaceae	<i>Melaleuca</i>	<i>stereophloia</i>		
Myrtaceae	<i>Melaleuca</i>	<i>viminea</i>	Mohan	
Orchidaceae	? <i>Prasophyllum</i>	sp. (insufficient material)	Leek Orchid	
Oxalidaceae	<i>Oxalis</i>	<i>pes-caprae</i>	Soursob	*
Papilionaceae	<i>Gastrolobium</i>	<i>oxylobioides</i>	Champion Bay Poison	+
Papilionaceae	<i>Leptosema</i>	<i>aphyllum</i>		
Papilionaceae	<i>Lupinus</i>	<i>angustifolius</i>	Narrowleaf Lupin	
Papilionaceae	<i>Lupinus</i>	<i>cosentinii</i>	Western Australian Blue Lupin	*
Papilionaceae	<i>Medicago</i>	<i>polymorpha</i>	Burr Medic	*
Papilionaceae	<i>Trifolium</i>	<i>hirtum</i>	Rose Clover	*
Pittosporaceae	<i>Pittosporum</i>	<i>ligustrifolium</i>		
Poaceae	<i>Austrostipa</i>	? <i>flavescens</i>		
Poaceae	<i>Avena</i>	<i>barbata</i>	Bearded Oat	*
Poaceae	<i>Avena</i>	<i>sativa</i>	Oats	*
Poaceae	<i>Briza</i>	<i>maxima</i>	Blowfly Grass	*



Family	Genus	Species	Common Name	Status
Poaceae	<i>Bromus</i>	<i>diandrus</i>	Great Brome	*
Poaceae	<i>Bromus</i>	<i>hordeaceus</i>	Soft Brome	*
Poaceae	<i>Cenchrus</i>	<i>ciliaris</i>	Buffel Grass	*
Poaceae	<i>Cynodon</i>	<i>dactylon</i>	Couch	*
Poaceae	<i>Ehrharta</i>	<i>longiflora</i>	Annual Veldt Grass	*
Poaceae	<i>Eragrostis</i>	<i>curvula</i>	African Lovegrass	*
Poaceae	<i>Hordeum</i>	<i>leporinum</i>	Barley Grass	*
Poaceae	<i>Lamarkia</i>	<i>aurea</i>	Golden-top	*
Poaceae	<i>Lolium</i>	<i>rigidum</i>	Wimmera Ryegrass	*
Poaceae	<i>Melinis</i>	<i>repens</i>	Natal Redtop	*
Poaceae	<i>Pennisetum</i>	<i>setaceum</i>	Fountain Grass	*
Poaceae	<i>Themeda</i>	<i>triandra</i>	Kangaroo Grass	
Poaceae	<i>Triticum</i>	<i>aestivum</i>	Wheat	*
Poaceae	<i>Vulpia</i>	<i>myuros</i>	Rat's Tail Fescue	*
Polygonaceae	<i>Muehlenbeckia</i>	<i>adpressa</i>	Climbing Lignum	
Portulacaceae	<i>Calandrinia</i>	sp. (insufficient material)		
Primulaceae	<i>Anagallis</i>	<i>arvensis</i>	Pimpernel	*
Proteaceae	<i>Grevillea</i>	<i>intricata</i>		+
Proteaceae	<i>Hakea</i>	<i>preissii</i>	Needle Tree	
Proteaceae	<i>Hakea</i>	<i>recurva</i>	Djarnokmurd	
Ranunculaceae	<i>Clematis</i>	<i>linearifolia</i>		
Rubiaceae	<i>Galium</i>	sp. (insufficient material)		*
Sapindaceae	<i>Dodonaea</i>	<i>inaequifolia</i>		
Scrophulariaceae	<i>Zaluzianskya</i>	<i>divaricata</i>	Zedweed	*
Solanaceae	<i>Lycium</i>	<i>ferocissimum</i>	African Boxthorn	*
Solanaceae	<i>Solanum</i>	<i>lasiophyllum</i>	Flannel Bush	
Solanaceae	<i>Solanum</i>	<i>nigrum</i>	Black Berry Nightshade	*
Thymelaeaceae	<i>Pimelea</i>	<i>microcephala</i>	Shrubby Riceflower	
Verbenaceae	<i>Lantana</i>	<i>camara</i>	Common Lantana	*DP/WONS
Vitaceae	<i>Clematicissus</i>	<i>angustissima</i>		

Where: * = weed / exotic species, + = planted species, DP = Declared Plant, WONS = Weed of National Significance, P3 = Priority 3, RE=Range Extension.



Appendix B

Fauna

Fauna Conservation Codes

Recorded and Observed Fauna



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 7.

Critically endangered and endangered species

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

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

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

Vulnerable species

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

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



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

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

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

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

Listed Migratory species

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

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

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

An area of important habitat is:

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

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

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



Table 12 Western Australia Wildlife Conservation Act (1950) Conservation Codes

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

Table 13 DEC Priority Fauna Codes

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

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



Table 14 Fauna List: NWCH Project Area

Family	Genus	Species	Common Name	Conservation Codes					Record
				EPBC	WC	DEC	Exotic		
Amphibians									
MYOBATRACHIDAE	<i>Heleioporus</i>	<i>albopunctatus</i>	Western Spotted Frog						3
MYOBATRACHIDAE	<i>Limnodynastes</i>	<i>dorsalis</i>	Western Banjo Frog						3
Birds									
ACCIPITRIDAE	<i>Accipiter</i>	<i>fasciatus</i> subsp. <i>fasciatus</i>							3
ACCIPITRIDAE	<i>Aquila</i>	<i>audax</i>	Wedge-tailed Eagle	Mi					x
ACCIPITRIDAE	<i>Circus</i>	<i>assimilis</i>	Spotted Harrier	Mi					x
ACCIPITRIDAE	<i>Haliaeetus</i>	<i>leucogaster</i>	White-bellied Sea-Eagle	Mi, Ma					1
APODIDAE	<i>Apus</i>	<i>pacificus</i>	Forktailed Swift	Mi					1
ARDEIDAE	<i>Ardea</i>	<i>alba</i>	Great Egret, White Egret	Mi					1
ARDEIDAE	<i>Ardea</i>	<i>ibis</i>	Cattle Egret	Mi					1
ARDEIDAE	<i>Ardea</i>	<i>pacifica</i>	White-necked Heron, Pacific Heron						x
CAMPEPHAGIDAE	<i>Coracina</i>	<i>novaehollandiae</i>	Black-faced Cuckoo-shrike	Ma					x
CINCLOSOMATIDAE	<i>Psophodes</i>	<i>occidentalis</i>	Western Wedgebill (Chiming Wedgebill)						3
COLUMBIDAE	<i>Streptopelia</i>	<i>senegalensis</i>	Laughing Turtledove				*		x
CORVIDAE	<i>Corvus</i>	<i>coronoides</i>	Australian Raven						x
CRACTICIDAE	<i>Cracticus</i>	<i>tibicen</i>	Australian Magpie						x
CRACTICIDAE	<i>Cracticus</i>	<i>tibicen</i> subsp. <i>dorsalis</i>	White-backed Magpie						3



Family	Genus	Species	Common Name	Conservation Codes					Record
				EPBC	WC	DEC	Exotic		
CUCULIDAE	<i>Cuculus</i>	<i>pallidus</i>	Pallid Cuckoo	Ma					x
DICAEIDAE	<i>Dicaeum</i>	<i>hirundinaceum</i>	Mistletoebird						3
DICRURIDAE	<i>Grallina</i>	<i>cyanoleuca</i>	Australian Magpie-lark	Ma					x
DICRURIDAE	<i>Rhipidura</i>	<i>leucophrys</i>	Willie Wagtail						x
FALCONIDAE	<i>Falco</i>	<i>cenchroides</i>	Australian Kestrel	Mi, Ma					x
FALCONIDAE	<i>Falco</i>	<i>longipennis</i>	Australian Hobby	Mi					x
FALCONIDAE	<i>Falco</i>	<i>peregrinus</i>	Peregrine Falcon	Mi	S4				2
HIRUNDINIDAE	<i>Cheramoeca</i>	<i>leucosternus</i>	White-backed Swallow						x
HIRUNDINIDAE	<i>Hirundo</i>	<i>neoxena</i>	Welcome Swallow	Ma					x
MELIPHAGIDAE	<i>Lichenostomus</i>	<i>penicillatus</i>	White-plumed Honeyeater						x
MELIPHAGIDAE	<i>Manorina</i>	<i>flavigula</i>	Yellow-throated Miner						x
MEROPIIDAE	<i>Merops</i>	<i>ornatus</i>	Rainbow Bee-eater	Mi					1
MOTACILLIDAE	<i>Anthus</i>	<i>australis</i>	Australian Pipit, Richard's Pipit						x
PACHYCEPHALIDAE	<i>Colluricincla</i>	<i>harmonica</i>	Grey Shrike-thrush						3,x
PACHYCEPHALIDAE	<i>Pachycephala</i>	<i>rufiventris</i>	Rufous Whistler						x
POMATOSTOMIDAE	<i>Pomatostomus</i>	<i>superciliosus ashbyi</i>	White-browed Babbler (western wheatbelt)			P4			2
PSITTACIDAE	<i>Cacatua</i>	<i>roseicapilla</i>	Galah						x
PSITTACIDAE	<i>Platycercus</i>	<i>zonarius</i>	Australian Ringneck						x
Mammals									
BOVIDAE	<i>Ovis</i>	<i>aries</i>	Domestic Sheep					+	x
DASYURIDAE	<i>Sminthopsis</i>	<i>crassicaudata</i>	Fat-tailed Dunnart						3



Conservation Codes

Family	Genus	Species	Common Name	EPBC	WC	DEC	Exotic	Record
MACROPODIDAE	<i>Macropus</i>	sp.	Macropod species					x
MURIDAE	<i>Oryctolagus</i>	<i>cuniculus</i>	European Rabbit				*	x
PHALANGERIDAE	<i>Trichosurus</i>	<i>vulpecula</i> subsp. <i>vulpecula</i>	Common Brushtail Possum					3
Reptiles								
AGAMIDAE	<i>Ctenophorus</i>	<i>reticulatus</i>	Western Netted Dragon					3
BOIDAE	<i>Antaresia</i>	<i>stimsoni</i> subsp. <i>stimsoni</i>						3
ELAPIDAE	<i>Pseudechis</i>	<i>australis</i>	Mulga Snake					3
ELAPIDAE	<i>Pseudonaja</i>	<i>modesta</i>	Ringed Brown Snake					3
ELAPIDAE	<i>Pseudonaja</i>	<i>nuchalis</i>	Gwardar					3
GEKKONIDAE	<i>Gehyra</i>	<i>variegata</i>						3
GEKKONIDAE	<i>Nephrurus</i>	<i>levis</i> subsp. <i>occidentalis</i>						3
PYGOPODIDAE	<i>Delma</i>	<i>butleri</i>						3
PYGOPODIDAE	<i>Delma</i>	<i>fraseri</i>						3
PYGOPODIDAE	<i>Delma</i>	<i>tincta</i>						3
PYGOPODIDAE	<i>Lialis</i>	<i>burtonis</i>						3
PYGOPODIDAE	<i>Pygopus</i>	<i>lepidopodus</i>	Common Scaly Foot					3
SCINCIDAE	? <i>Cryptoblepharus</i>	sp.	Skink species					x
SCINCIDAE	<i>Lerista</i>	<i>gerrardii</i>						3
SCINCIDAE	<i>Lerista</i>	<i>lineopunctulata</i>						3
SCINCIDAE	<i>Tiliqua</i>	<i>rugosa</i>	Bobtail					x
SCINCIDAE	<i>Tiliqua</i>	<i>rugosa</i> subsp. <i>rugosa</i>						3



Family	Genus	Species	Common Name	Conservation Codes				
				EPBC	WC	DEC	Exotic	Record
TYPHLOPIDAE	<i>Ramphotyphlops</i>	<i>leptosoma</i>						3
Invertebrates								
IDIOPIDAE	<i>Idiosoma</i>	<i>nigrum</i>	Shield-backed Trapdoor Spider		S1			2,3
KEY								
Status:			Record:					
Mi=	Migratory	1= EPBC Act Protected Matters Search Tool						
V=	Vulnerable	2= DEC Threatened Fauna Database Search						
S=	Schedule	3= NatureMap						
P=	Priority	x= Field survey						
E=	Endangered							
*	Introduced species							
+	Domestic species							



Appendix C

Department of Environment and
Conservation 'Ten Clearing Principles'



Table 15 Assessment against the ‘Ten Clearing Principles’

Principle Number	Principle	Assessment	Outcome
(a)	Native vegetation should not be cleared if it comprises a high level of biological diversity.	<p>96 flora species were recorded during the field survey (52 native and 44 introduced). Vegetation condition throughout the Project Area ranged from Condition 5 (Degraded) to Condition 6 (Completely Degraded).</p> <p>The native vegetation in the area comprises a low degree of native biological diversity that is of a comparable level of diversity to the remaining native vegetation in the area.</p> <p>One Priority species: <i>Acanthocarpus parviflorus</i> (P3) was recorded within the Project Area during the field survey.</p> <p>This species was recorded at only one location within the surveyed area. This area is unlikely to be impacted as it occurs on a small granite outcrop adjacent to the road formation. The vegetation is not considered to be necessary for the continued existence of this Priority species.</p> <p>Consultation with DEC is recommended.</p>	The Project is not considered to be at variance with the Principle.
(b)	Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	The vegetation comprises habitat for a number of fauna species, including the Priority 4 Pomatostomus superciliosus ashbyi (White-browed Babbler (western wheatbelt) but this habitat is not considered significant habitat for fauna indigenous to Western Australia.	The Project is not considered to be at variance with the Principle.
(c)	Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.	No Declared Rare Flora species were recorded during the field survey.	The Project is not considered to be at variance with the Principle.
(d)	Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.	No Threatened Ecological Communities were recorded during the field survey or identified during from desktop assessment.	The Project is not considered to be at variance with the Principle.



Principle Number	Principle	Assessment	Outcome
(e)	Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.	<p>The mapped vegetation association in the Project Area retains 10.5% of the pre-European extent considered to be remaining in the Geraldton Sandplains IBRA region (refer to Section 3.7.2).</p> <p>Based on evidence from the field survey, the original vegetation type has been significantly altered to an extent that it no longer resembles the distinct vegetation type described and mapped by Beard (1976). The vegetation located in the Project Area does not correlate with Vegetation Association 35, and is a combination of natural regrowth and planted vegetation after previous clearing activities.</p> <p>Any vegetation, whether it be remnant or rehabilitated is considered to be of value, particularly in areas where vegetation has been extensively cleared. As such, the Project is considered to be at variance with this principle.</p>	The Project is considered to be at variance with this Principle.
(f)	Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.	There are no water courses or wetlands within the Project Area. A number of ephemeral creeklines cross the Project Area through constructed culverts.	The Project is not considered to be at variance with the Principle.
(g)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	Short-term soil erosion may occur at the Project site due to excavation requirements. However, any long-term soil erosion can be mitigated by use of appropriate design and site management measures.	The Project is not considered to be at variance with the Principle.
(h)	Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	<p>There are no conservation reserves within the immediate vicinity of the Project Area.</p> <p>The closest conservation areas are Oakabella Nature Reserve, located approximately 9 km to the south, and Blue Wells Nature Reserve, located approximately 15 km to the north-east.</p> <p>These conservation areas are a significant distance from the Project Area. Clearing of vegetation within the Project Area is not likely to have an impact on the environmental values of these conservation areas.</p>	The Project is not considered to be at variance with the Principle.



Principle Number	Principle	Assessment	Outcome
(i)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	It is not considered that the proposed vegetation clearing will alter the quality of surface or ground waters within the Project Area.	The Project is not considered to be at variance with the Principle.
(j)	Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the incidence or intensity of flooding.	The clearing of native vegetation is not considered to cause any alteration to flood duration or flood height.	The Project is not considered to be at variance with the Principle.



GHD

76 Forrest Street Geraldton WA 6530
PO BOX 164 Geraldton WA 6531
T: (08) 9964 3677 F: (08) 9921 7997 E: geraldtonmail@ghd.com.au

© GHD 2009

This document is and shall remain the property of GHD. The document may only be used for the purpose for which it was commissioned and in accordance with the Terms of Engagement for the commission. Unauthorised use of this document in any form whatsoever is prohibited.

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	M. Scott	J. Foster		A. Nagle		03/12/2009