# Jemena Northern Gas Pipeline Pty Ltd

## Northern Gas Pipeline

Draft Environmental Impact Statement

APPENDIX G – THREATENED SPECIES SURVEY REPORT

Public

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EcOz Environmental Consultants

# Threatened Species Survey Report for NGP

## Jemena

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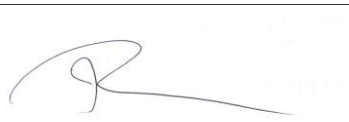
| |  |
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# EXECUTIVE SUMMARY

The Northern Gas Pipeline (NGP) involves the construction of 622 km of pipeline linking existing gas pipelines in the Northern Territory and Queensland. The pipeline will extend from approximately 45 kilometres north-east of Tennant Creek adjacent to an existing gas compressor station facility near Warrego, and will terminate at its gas delivery station adjacent to the existing Mount Isa Mica Creek Power Station. The Project footprint constitutes construction ROW, access tracks, compressor stations, temporary camps, temporary workspaces, vehicle turnarounds, and low consequence water storage dams.

This Project requires assessment under the *Environmental Assessment Act (Northern Territory)* at the level of an Environmental Impact Statement (EIS). The NGP has also been declared a 'controlled action' by the Commonwealth Minister for the Environment and, as such, it requires assessment and a decision about whether approval for it should be given under the *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*). To inform these, Jemena (the proponent) commissioned EcOz Environmental Consultants (EcOz) conducted surveys and assessments that meet the requirements of both the abovementioned approval documents. This document is a report of that survey and is an appendix to the main EIS.

**General scope**

The main purpose of this report is to:

a) Describe the methodology and results of surveys undertaken to determine the likelihood that threatened species occur within the Project footprint

b) Identify whether each threatened species that occurs, or is likely to occur, does so in an 'important population' as defined in the *EPBC Significant Impact Guidelines 1.1* (DOE 2013).

The survey program was designed to target threatened species considered to have potential to occur within the Project footprint. Survey methodology was tailored to align with standard Northern Territory survey guidelines and, where applicable, to meet Commonwealth survey guidelines for nationally-listed species.

This report also provides assessment of nationally-listed migratory species, habitat types, sensitive vegetation types, and threatening processes (such as pests, weeds and fire) specifically related to the habitat suitability of threatened species with the Project footprint.

**Habitat mapping**

Habitat mapping of the Project footprint was undertaken at a scale of 1:10 000 to spatially determine the area and location of habitat that may be (generally) suitable for threatened species. Separate maps and descriptions were made for the Northern Territory and Queensland due to different attributes (and scales) within existing datasets. The Northern Territory Project footprint intersected five broad habitat types (alluvial floodplains, clay plains, desert sandplains, lateritic plains and rises, and sandstone plain and rises) which consisted of 11 smaller landform units. The Queensland Project footprint intersected six broad habitat types (alluvial areas, clay plains, loamy sand plains, ironstone jump-ups, hills and lowlands on metamorphic rocks, and hills and lowlands on granitic rock).

**Sensitive vegetation types**

An assessment of sensitive vegetation types was undertaken for the Northern Territory Project footprint (as Queensland assessment will be undertaken in separate approval documentation, alongside regional ecosystem mapping). Two sensitive vegetation types were identified within the region of the Project footprint – 'riparian vegetation' and 'wetlands'.

Riparian vegetation occurs along the larger creeks and rivers, of which all are located within the Mitchell Grass Downs bioregion (i.e. black soil plains) and were considered to be in relatively poor ecological condition (due to presence of erosion, weeds, and cattle). Four intersection points along the construction

ROW were identified (associated with Ranken River, James River, Georgina River and Blue Bush Creek) as well as several minor crossings associated with access tracks.

Seasonal lakes and swamps (i.e. wetlands) occur in the region of the Project footprint; however, none are intersected or are expected to be impacted upon by construction activities.

No threatened ecological communities (as listed under the *EPBC Act*) occur within the project area.

**Threatened species**

A preliminary assessment of threatened species occurrence determined that nine threatened species (relevant to Northern Territory and/or Commonwealth) had potential to occur within the region of the Project footprint. Of these, targeted field surveys and/or habitat suitability assessment determined the following:

- Two threatened species were recorded within the Project footprint:
  - Carpentarian Antechinus (*Pseudantechinus mimulus*) (relevant to Queensland)
  - Tobermorey Melon (*Austrobryonia argillicola*) (relevant to Northern Territory).
- Two threatened species were not identified within the Project footprint; however, were considered likely to occur within the Project footprint:
  - Grey Falcon (*Falco hypoleucos*) (relevant to Northern Territory)
  - Plains Death Adder (*Acanthophis hawkei*) (relevant to Northern Territory and Queensland).
- Five threatened species were considered unlikely to occur within the Project footprint:
  - Gouldian Finch (*Erythrura gouldiae*)
  - Painted Honeyeater (*Grantiella picta*)
  - Brush-tailed Mulgara (*Dasycercus blythi*)
  - Latz's Grass (*Sporobolus latzii*)
  - Greater Bilby (*Macrotis lagotis*).

Recognised experts from the Northern Territory Department of Land Resource Management (DLRM), as well as specialist scientists for some threatened species, were consulted throughout the survey program to ensure that methods and interpretation of results were sound.

Carpentarian Antechinus (Vulnerable under the *TPWC Act* and *EPBC Act*) occurs within rocky habitat in the eastern section of the Queensland Project footprint (identified at three sites during targeted surveys). This represents a range extension to the south and south-west of other known occurrences. It is expected that the species occur in rocky outcrops, boulder piles or rocky ridges between KP 609.5 and KP 620.5, and that they are part of one population. Habitat mapping determined that a total of 1.04 ha will be directly disturbed during construction works. The population of Carpentarian Antechinus within the Project footprint is considered 'important' (as defined in *EPBC Significant Impact Guidelines 1.1*). Acknowledging the many uncertainties associated with determining the area of occupancy of this population, a conservative estimate of suitable habitat in the local region is 4 369 ha.

Tobermorey Melon (Vulnerable *TPWC Act*) was recorded within clay plains drainage habitat (Mitchell Grass Downs bioregion) of the Northern Territory Project footprint. Records of the species were spread across four catchments of the Ranken River, James River, Georgina River and Blue Bush Creek, and were considered part of one regional population. It is estimated that approximately 106.7 ha of suitable habitat that will be temporarily disturbed by construction works (no permanent disturbances will occur within drainage habitat). Survey results suggest that Tobermorey Melon is likely to be widespread in drainage habitat within the Mitchell Grass Downs bioregion, but is scarce (i.e. occurs in low densities) at each location. The criteria for that population being 'important' (as defined in the *EPBC Significant Impact Guidelines 1.1*) are not satisfied.

Grey Falcon (Vulnerable *TPWC Act*) or potential nests were not identified within the Northern Territory Project footprint during field surveys (or in Queensland); however, the species was incidentally observed (foraging or flying over) on three occasions during field surveys outside the Project footprint confirming their current presence in the region. Grey Flacon could conceivably nest within the Project footprint; however, its preference for tall trees means that – regionally – suitable nesting habitat will be restricted to watercourses

(or telecommunication towers). The Northern Territory Project footprint intersects 3.7 ha of drainage system habitat considered as potential nesting habitat for the species (note: nesting habitat for Queensland Project footprint is not part of report). The limited number of watercourse crossings, relatively narrow construction ROW and short construction timeframe, all combine to suggest there is a low likelihood that a nest site would occur directly in the Project footprint. The occurrence of a few individuals of this species within the Project footprint is not considered 'important' (as defined in *EPBC Significant Impact Guidelines 1.1*).

Plains Death Adder (Vulnerable *TPWC Act* and under the *EPBC Act*) habitat is present within the Project footprint (broadly) within the Mitchell Grass Downs bioregion (clay plains), which falls between KP 355 and KP 561 (plus approximately 108 km of existing access tracks that will require 5 m widening) (equates to approximately 820.1 ha). Targeted field surveys were not conducted for this species for various reasons. Nevertheless, the presence of regional records of the species and the fact that suitable habitat is traversed by the Project footprint indicates a reasonable likelihood that Plains Death Adder will be present. It is assumed that, if extant, occurrences of Plains Death Adder within the Project footprint would constitute a separate population to the numerous records 100 km north. A population of the species within the Project footprint will be considered near the limit of the species' known (south-western) range and, as such, necessary for maintaining the species genetic diversity. Subsequently, the likely population of this species within the Project footprint is considered 'important' (as defined in *EPBC Significant Impact Guidelines 1.1*).

After due assessment, important populations of two threatened species are considered to occur, or likely to occur, within the Project footprint:

- Carpentarian Antechinus (rocky refuge habitat between KP 609.5 & KP 620.5)
- Plains Death Adder (clay plains between KP 355 & KP 561).

**Migratory-listed species**

Six EPBC-listed migratory bird species were determined as having a high chance of occurring within the Project footprint; however, no 'important' habitat sites for these species will be intersected by the Project footprint. It is not likely that nationally-listed migratory species will trigger the *EPBC Act*.

- Fork-tailed Swift (*Apus pacificus*)
- Rainbow Bee-eater (*Merops ornatus*)
- Oriental Plover (*Charadrius veredus*)
- Oriental Pratincole (*Glareola maldivarum*)
- Great Egret (*Ardea alba*)
- Cattle Egret (*Ardea ibis*).

**Existing threatening processes**

Four main threatening processes were relevant to the Project footprint in regards to potential impacts on habitat suitability for flora and fauna (in particular threatened species).

- Pests – Seven introduced fauna species occur in the region of the Project footprint, of which Feral Cat (*Felis catus*), Red Fox (*Vulpes vulpes*), Domestic Cattle (*Bos taurus*) and One-humped Camel (*Camelus dromedarius*) were confirmed as present within the Project footprint during field studies.
- Weeds – A complete weed survey of the Project footprint was not part of the scope of this report; however, incidental and opportunistic weed records made during fieldwork noted that the following weeds (of potential management significance) were present within (or close to) the Project footprint.
    - Noogoora Burr (*Xanthium strumarium*) (declared species)
    - Parkinsonia (*Parkinsonia aculeata*) (declared species)
    - Mesquite (*Prosopis pallida*) (declared species)
    - Annual Mission Grass (*Pennisetum pedicellatum*) (declared species)
    - Buffel Grass (*Cenchrus ciliaris*) and Kapok Bush (*Aerva javanica*) (non-declared species)

- Fire in the region of the Project footprint is strongly associated with presence and extent of spinifex-dominated landscapes (i.e. hummock grasslands). Fire mapping indicates that approximately half of the Project footprint has burnt 2 to 3 times between 2003 and 2016. This is on the higher scale of burning frequency for central Australia. The most significant fire period for the Project region (in recent years) was in 2011, when the majority of the western half (KP 0 – KP 354) of the Project footprint was burnt. In that year, several large-scale, spinifex-fuelled fires swept through the region. These fires burnt large areas of long unburnt (> 13 years) and previously burnt (with < 7 years) vegetation communities. The black soil plains between KP 353 and KP 561 generally experienced no fires between 2003 and 2016 – likely due to cattle grazing (fuel-load reduction) and perhaps the lack of spinifex-dominated grasslands (Figure 2-9).
- Pastoralism – The construction ROW crosses pastoral leases for 99% of the Queensland length and 50% of the Northern Territory length. The level of impacts from pastoral activities on threatened species will be dependent on the management of station (i.e. stocking rates, provision of artificial water points and prescribed burns), and on the sensitivity of vegetation communities to grazing. Observations of pastoral impacts within the Project footprint were collected during field studies as part of determining the habitat suitability for targeted threatened species.

# TABLE OF CONTENTS

***** *Please note that this report is formatted for double-sided printing* *****

# Tables



# Figures

# Appendices

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# 1 INTRODUCTION

## 1.1 PROJECT DESCRIPTION

The Northern Gas Pipeline (NGP) is a gas pipeline Project involving the construction of 622 km of pipeline linking the existing gas pipelines in the Northern Territory and Queensland. The pipeline will extend from approximately 45 kilometres north-east of Tennant Creek beside an existing gas compressor station facility near Warrego, and will terminate at its gas delivery station adjacent to the existing Mount Isa Mica Creek Power Station (see Figure 1-1). Jemena is the proponent of this NGP Project.

This Project requires assessment under the *Environmental Assessment Act (Northern Territory)* at the level of an Environmental Impact Statement (EIS). The NGP has also been declared a 'controlled action' by the Commonwealth Minister for the Environment and, as such, it requires assessment and a decision about whether approval for it should be given under the *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act*).

The 'Project footprint' is shown in Figure 1-2 and comprises:

- The 30 m wide Right Of Way (ROW) within which the pipeline will be buried.
- Temporary construction camps
- Compressor stations and ancillary infrastructure
- Establishment of new access tracks
- Widening of existing access tracks
- Access tracks (disturbance area)
- Temporary work spaces
- Vehicle turnarounds
- Low consequence water storage dams for construction and hydrostatic pressure testing (12ML).

## 1.2 CONTEXT

Preliminary analysis undertaken for the Notice of Intent and EPBC Referral for the NGP Project indicated it is possible that threatened species occur within the Project footprint. Therefore, Project activities could have an impact on these species if present (or adjacent to) the Project footprint. For species within the Northern Territory that are listed as threatened under the *Territory Parks & Wildlife Conservation Act (TPWC Act)*, and for species (within the Northern Territory and/or Queensland) listed under the *EPBC Act*, the concern is whether there is an important population (as defined by DoE 2013) occurring within the Project footprint that is likely to be impacted upon by Project activities. If an important population occurs or is likely to occur, the impact assessment must then consider whether, after mitigation and management, the Project is likely to cause a significant impact on that population. This will inform decision-making as to whether approval should be granted and what, if any, conditions are required. It will also inform offset calculations for any matters protected under the *EPBC Act*.

Threatened species listed under Queensland legislation only are not addressed in this report.

Preliminary analysis indicated there are no threatened ecological communities within the Project footprint.

The process that was adopted for threatened species impact assessment as part of the NGP Project EIS and EA compliance is illustrated in Figure 1-3.

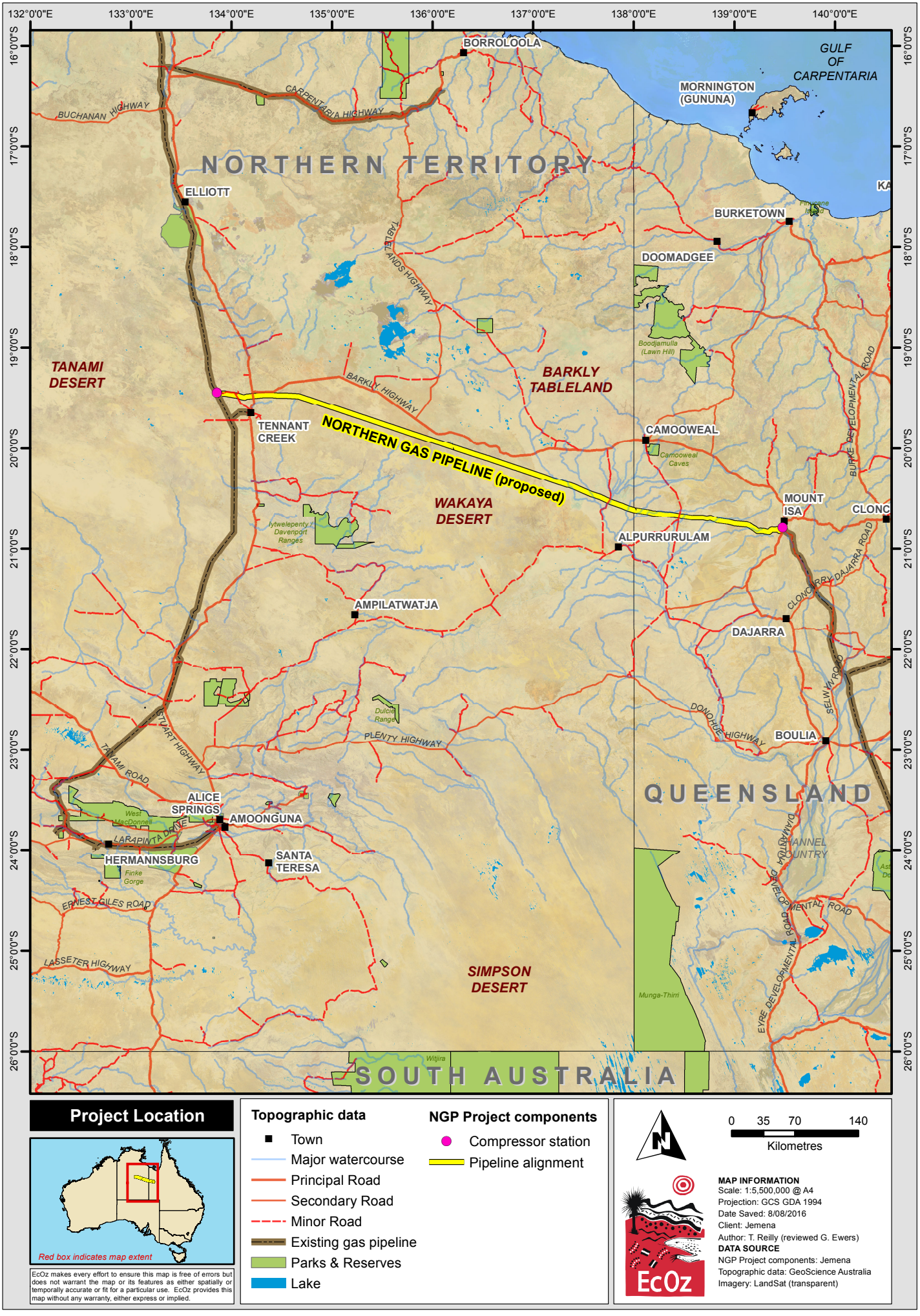


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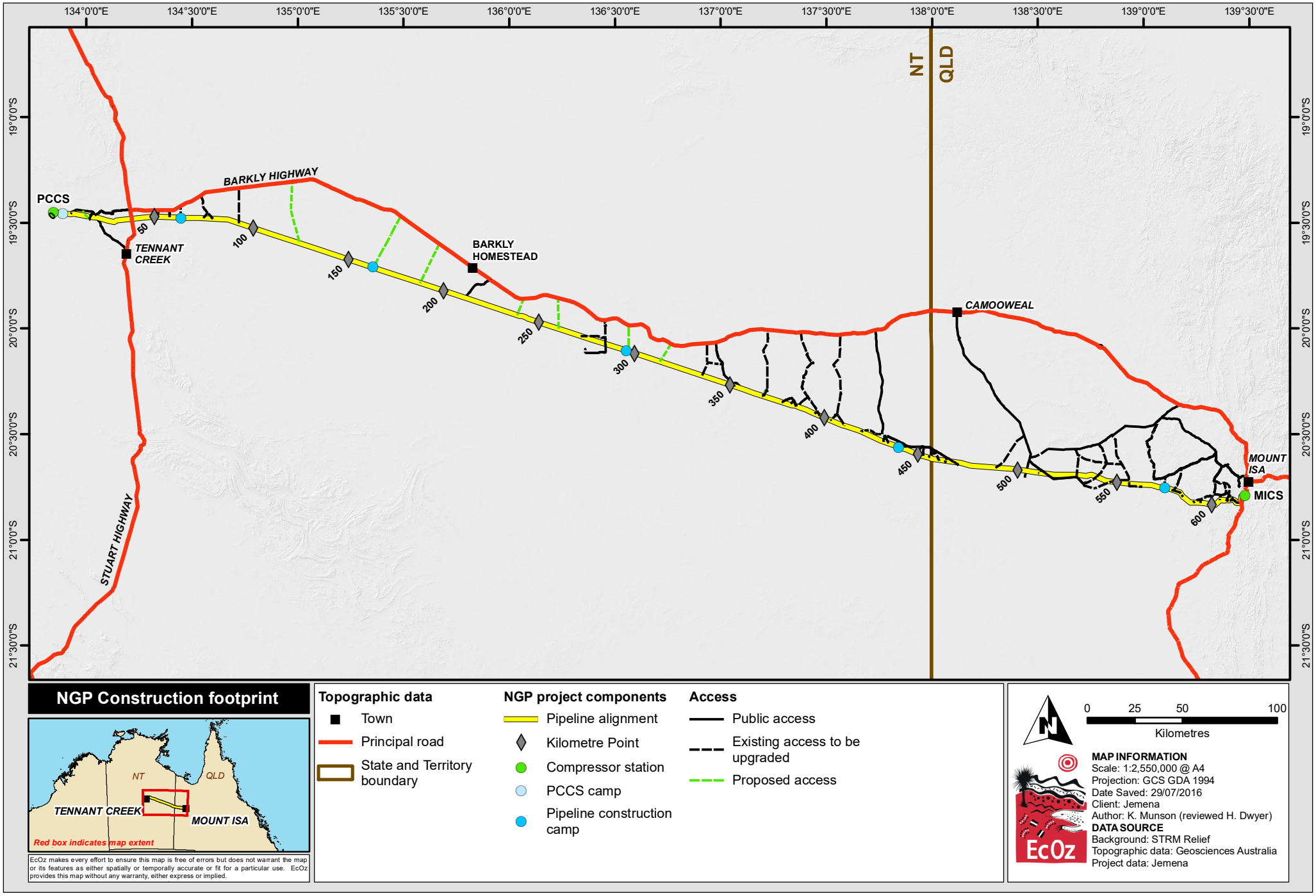
**Figure 1-1. Map of location of NGP Project**




Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\JEMENA\EIS (NT)\01 Project Files\Ch2\Figure 2-7. Map of NGP construction footprint.mxd

**Figure 1-2. Map of Project footprint components**

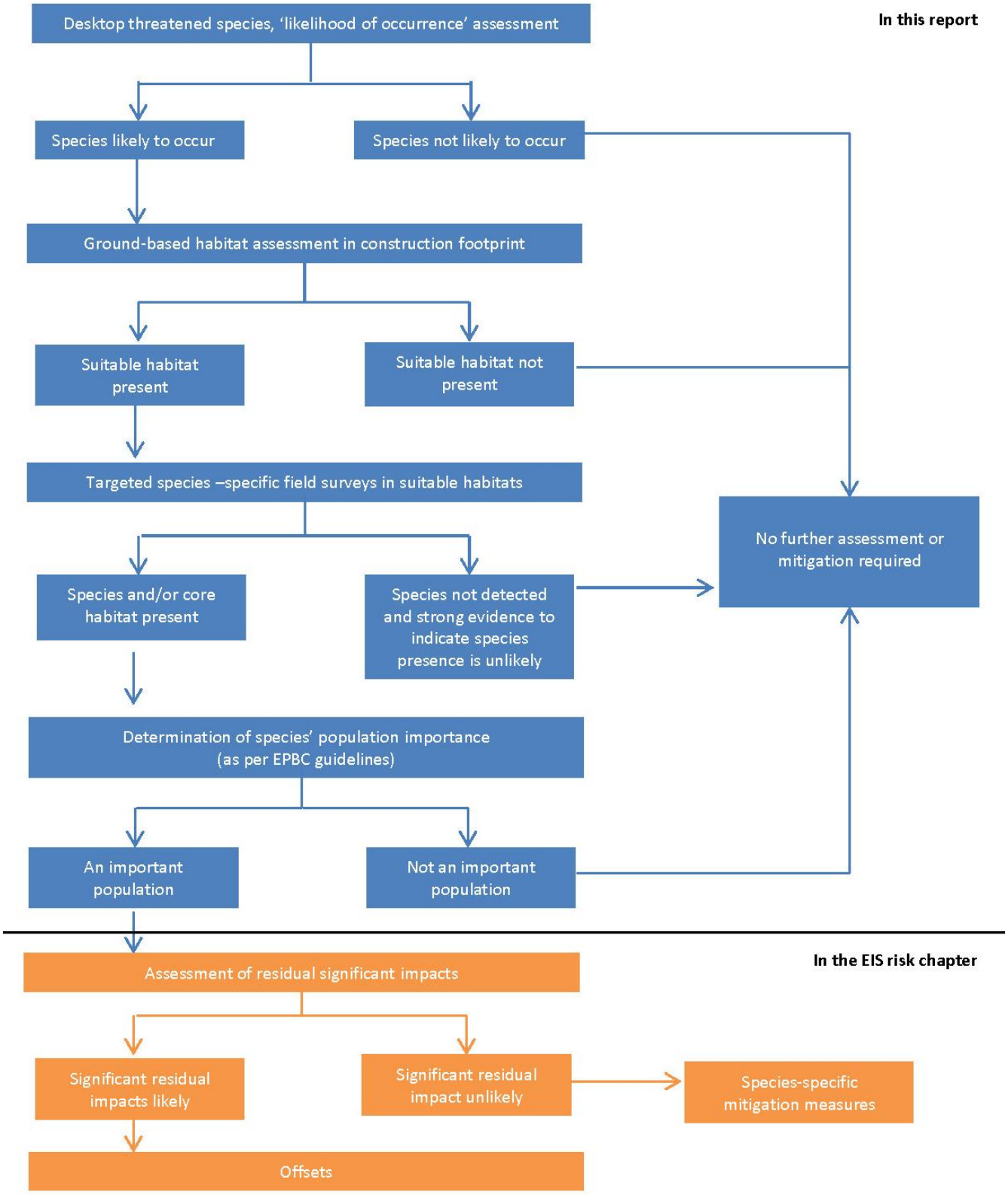



**Figure 1-3. Threatened species impact assessment process**

## 1.3 PURPOSE

In the context presented above, the purpose of this report is to:

c) Describe the methodology and results of surveys undertaken to determine the likelihood that threatened species occur within the Project footprint, and

d) Identify whether each threatened species that occurs, or is likely to occur, does so in an 'important population' as defined in the *EPBC Significant Impact Guidelines 1.1* (DOE 2013).

## 1.4 REPORT STRUCTURE

| | |
|---|---|
| Section 1 | Introduction. |
| Section 2 | Desktop review of the existing environment (climate, bioregions, land types, vegetation communities and threatening processes). |
| Section 3 | Description of the preliminary aerial survey and resultant high-resolution footage. |
| Section 4 | Habitat mapping of the Project footprint to an approximate scale of 1:25 000. |
| Section 5 | 'Likelihood of occurrence' assessment using desktop information to determine which threatened species have a reasonable likelihood of occurring within the Project footprint.<br>Methods and results of targeted threatened species surveys within the Project footprint to identify the presence (or likely presence) of threatened species. |
| Section 6 | 'Likelihood of occurrence' assessment using desktop information to determine which migratory species have a reasonable likelihood of occurring within the Project footprint. |
| Section 7 | Summary of threatened species survey results. |
| Section 8 | A qualitative assessment of the importance of threatened and migratory species populations identified as occurring (or likely to occur) within the Project footprint. |
| Section 9 | References. |

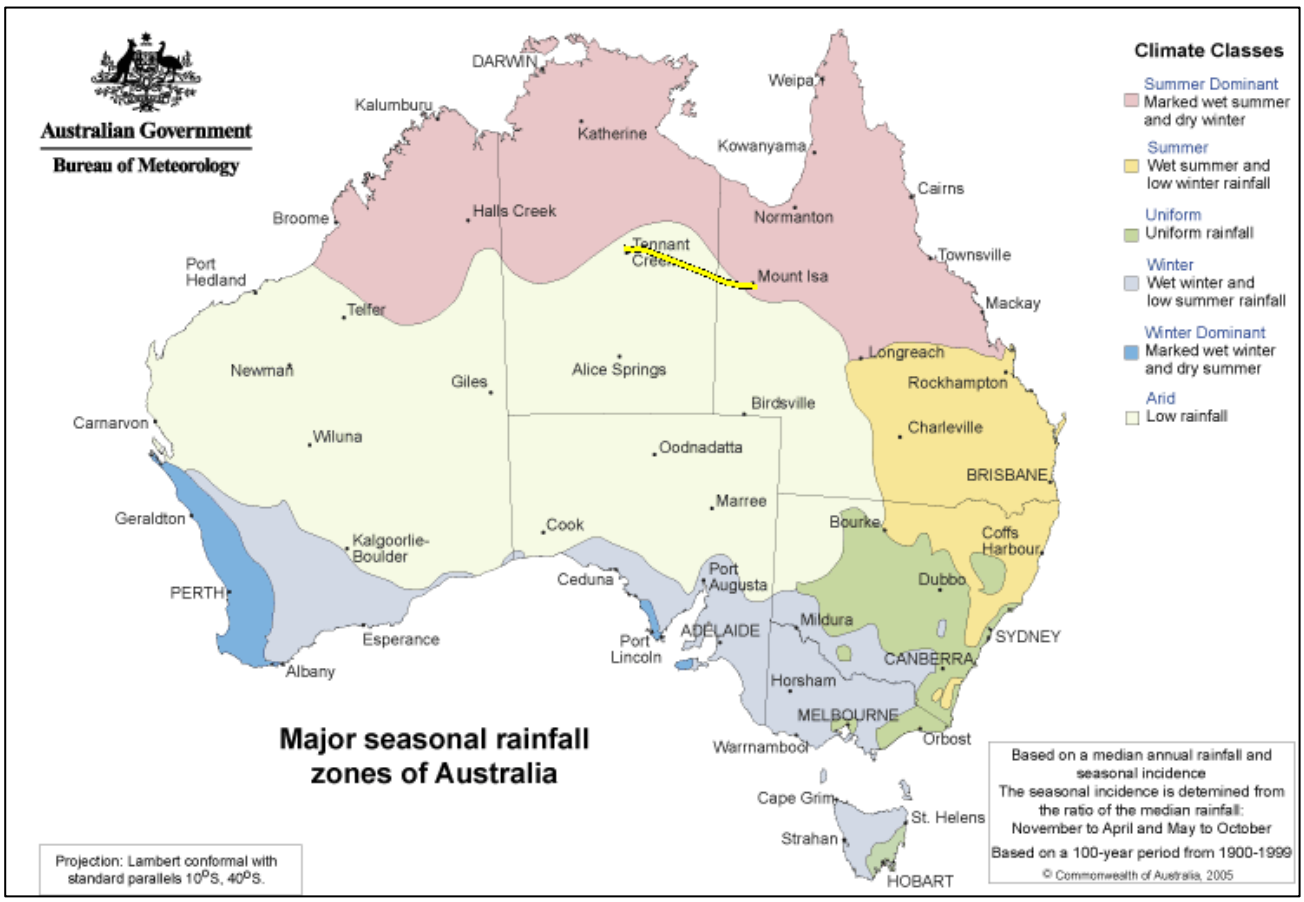
# 2 EXISTING ENVIRONMENT

## 2.1 CLIMATE

In general, the climate of the Project footprint can be described as hot and moderately arid with infrequent and highly unpredictable heavy rainfall. It is positioned on the edge of 'arid zone' and 'summer dominant' climatic classes (as shown in Figure 2-1), which results in summer-dominated rainfall (on average) due to monsoonal influences from the north rather than winter dominant influences from southern Australia (see Figure 2-2).

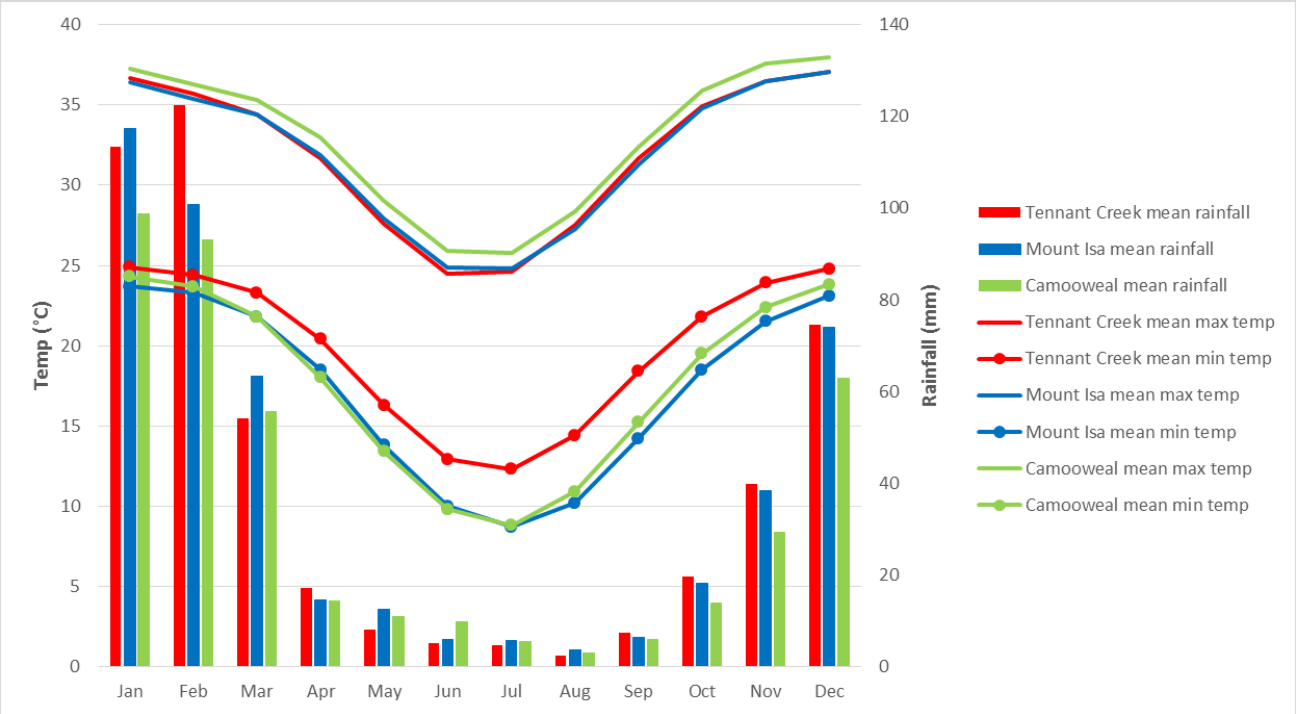
Although average climate statistics for the region indicates summer dominated rainfall (see Figure 2-2), there can be high variability in annual rainfall volumes from year to year. For example, the annual average rainfall in Mount Isa ranges between 93 mm (recorded in 2013) and 1 092 mm (recorded in 2011). This variability in annual rainfall is typical of the arid (and semi-arid) zone. The seasonality and volume of rainfall heavily influence the ecology, surface water flows and watercourse characteristics in the region. Watercourses in the region only flow (and may flood) after heavy rainfall, and can be dry for several years. For this reason, wetlands and watercourses are generally termed ephemeral in the region of the Project footprint.

Temperatures follow the seasonal patterns typical of northern and central Australia (see Figure 2-2), with the hottest average daily maximums occurring in January. The Project footprint is north of the 'frost zone'. Evapo-transpiration is high, with annual evaporation far exceeding annual rainfall.




*Construction ROW depicted by yellow line*

**Figure 2-1. Map of climate zones in Australia**




*Graph was plotted using data from Australian Bureau of Meteorology (sourced March 2016)*

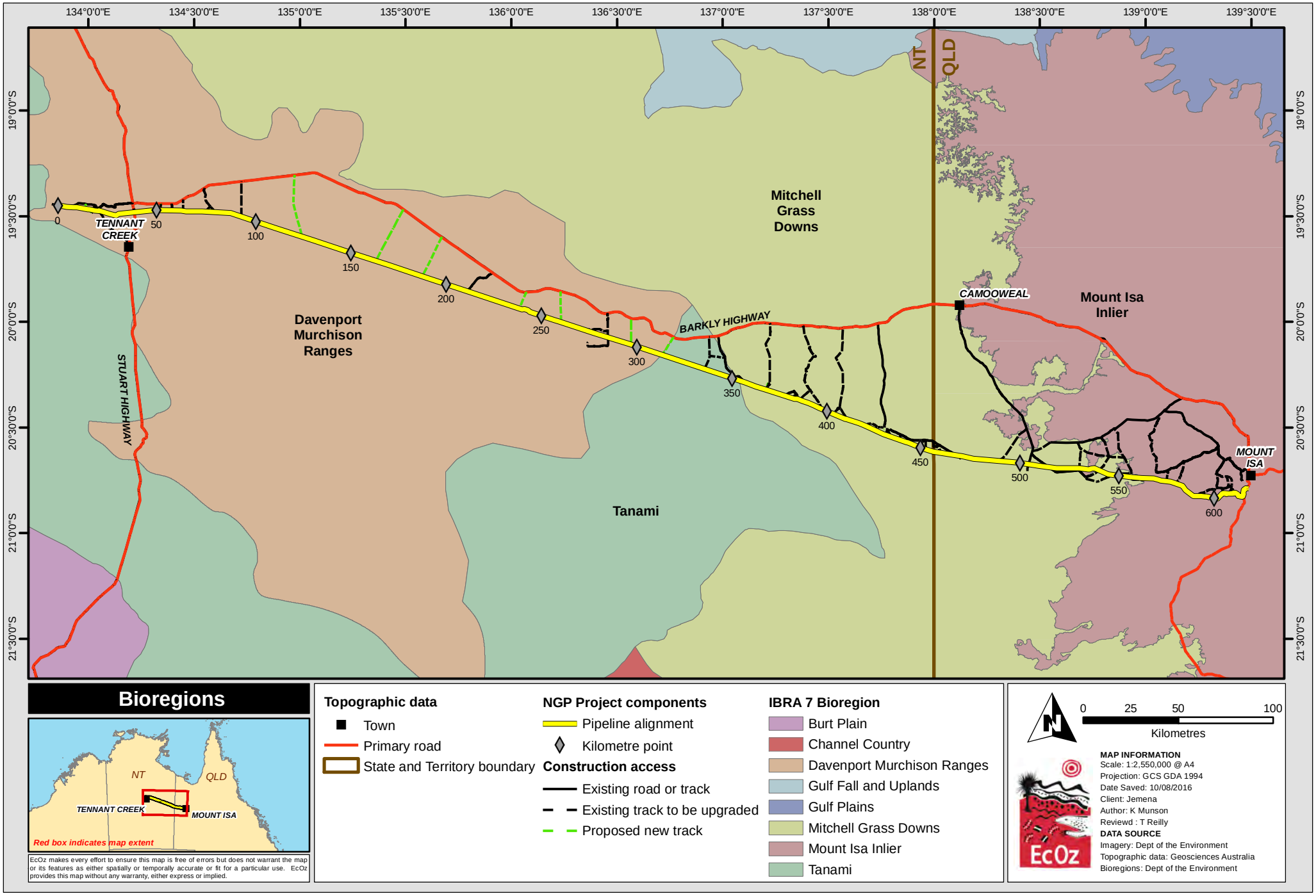
**Figure 2-2. Temperature and rainfall graph for Tennant Creek, Camooweal and Mount Isa**

## 2.2 BIOREGIONS

A bioregion is an area of land with common climate, geology, landform, native vegetation and species (DOE 2009). The Project footprint intersects four bioregions as per Interim Biogeographic Regionalism for Australis (version 7) (also referred to as IBRA7) (DOE 2012). These are described in Table 2-1 and shown in Figure 2-3 .

**Table 2-1. Bioregions intersected by the Project footprint**

| Section of NGP | Bioregion | Sub-bioregions | Characteristics |
|---|---|---|---|
| KP 0 – KP 313 | Davenport and Murchison Ranges | • Ashburton Range<br>• Barkly | • Low, rugged rocky hills with hummock grasslands and low open woodland dominated by *Acacia* species. |
| KP 313 – KP 353 | Tanami | • Sandover | • Sand plains bisected by hills and rocky ranges with hummock grasslands and *Acacia* shrub lands on the rocky ranges. |
| KP 353 – KP 561 | Mitchell Grass Downs | • Barkly Tableland | • Grassland plains on cracking clay soils, with some intermittent lakes. Vegetation includes a variety of grasslands dominated by Mitchell Grasses (*Astrebla* species). |
| KP 561 – KP 622 | Mount Isa Inlier | • South-western Plateaus and Flood-outs | • Rugged hills and ranges bisected by undulating valleys. Vegetation is primarily open woodland with a spinifex hummock grassland understory. |




Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\JEMENA\EIS (NT)\01 Project Files\Ch6\Figure 6-1. Map showing the bioregions intersected by the Project footprint.mxd

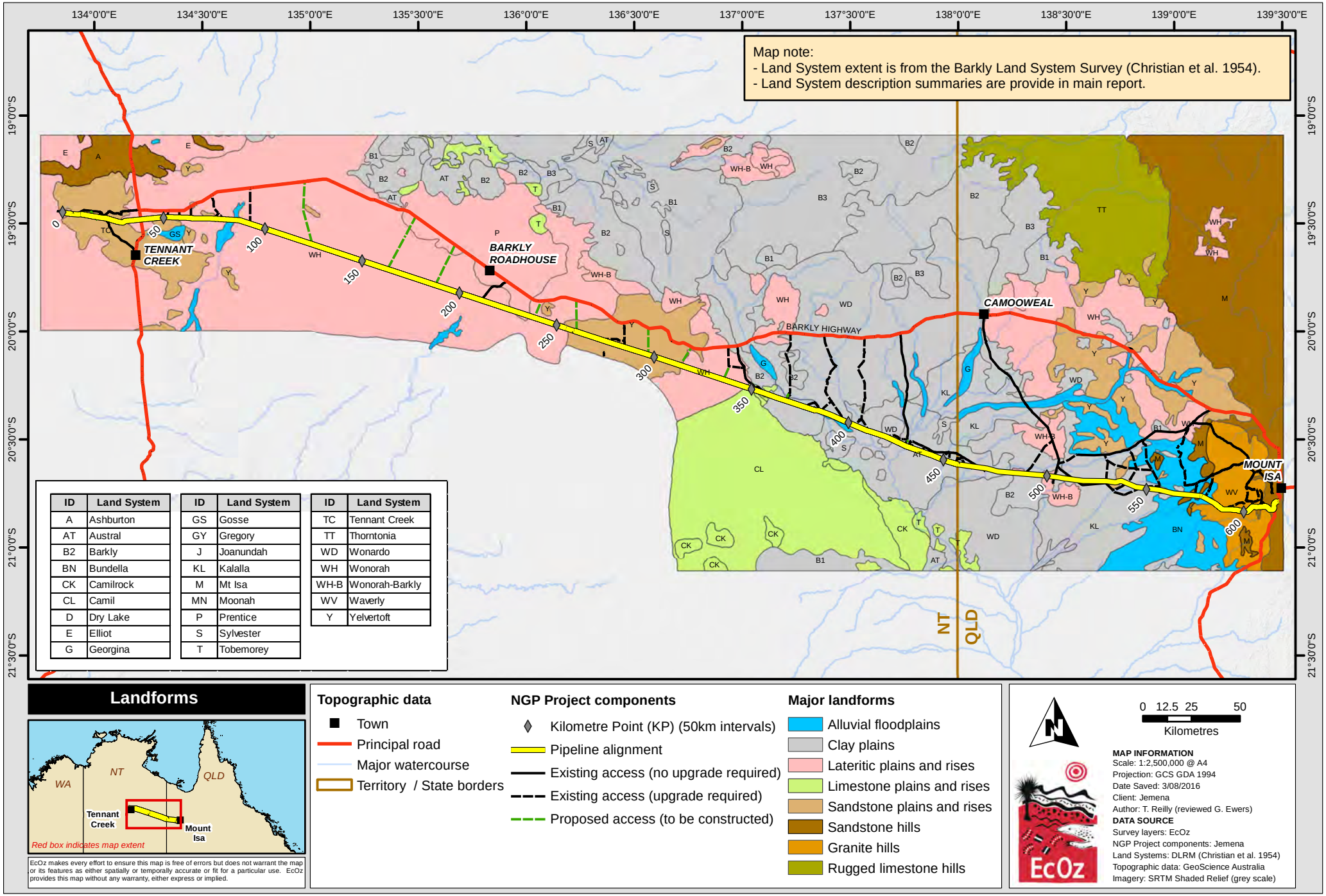
**Figure 2-3. Map of bioregions intersected by the Project footprint**

## 2.3 LANDFORMS & LANDSYSTEMS

Seven major landforms and 15 land systems are traversed by the Project footprint as mapped in Figure 2-4 and described in Table 2-2.

**Table 2-2. Description of major landforms and land systems traversed by the Project footprint**

| Major landform<br>Land system | General description<br>*(based on Land Survey of the Barkly Region, Christian et al. 1954)* |
|---|---|
| **ALLUVIAL FLOODPLAINS** | **River plains, swamps and alluvial fans formed on Quaternary alluvium** |
| Georgina | Gently undulating 'black-soil' plains cut by braided streamlines; heavy grey pedocals; *Astrebla pectinata* grassland (Mitchell Grass). |
| Gosse | Flats; soils of the 'Desert' distributary complex; *Eucalyptus dichromophloia* Woodland, *E. pruinosa* or *E. argillacea – E. terminalis* shrub woodland. |
| Bundella | Undulating; 'Bundella' soils; *Eucalyptus argillacea – E. terminalis* shrub woodland. |
| **CLAY PLAINS** | **Broad level plains (black soil) plains; cracking clay soils** |
| Austral | Very gently undulating; heavy grey pedocals and heavy brown pedocals; *Astrebla pectinata* grassland (Mitchell Grass) and *Acacia georginae – Astrebla pectinata* woodland. |
| Barkly | Very gently undulating; heavy grey pedocals; *Astrebla pectinata* grassland. |
| Kallala | Very gently undulating 'black-soil' plains; heavy brown pedocals; *Astrebla pectinata* grassland (Mitchell Grass) and *Acacia georginae – Astrebla pectinata* woodland. |
| Wonardo | 'Black-soil' plains; heavy grey pedocals or heavy brown pedocals; *Astrebla pectinata* grassland (Mitchell Grass). |
| **LATERITIC PLAINS & RISES** | **Plains and rises on weathered sedimentary rocks; red clayey sands, red earths and texture contrast soils** |
| Prentice | Gently undulating, with low limestone rises; calcified lateritic soils; *Eucalyptus argillacea – E. terminalis* shrub woodland. |
| Wonorah | Gently undulating; lateritic red earths; *Eucalyptus brevifolia* woodland or *Eucalyptus* spp. (low Mallee) – *Acacia* spp. shrubland. |
| **LIMESTONE PLAINS & RISES** | **Plains, rises and plateaux on dolomite, limestone, chalcedony, shale and sandstone; red clay sand, calcareous earth and outcrop with shallow stony soil** |
| Camil | Gently undulating; tertiary non-lateritic soils; *Triodia pungens* shrub grassland. |
| Camilrock | Gently undulating; tertiary non-lateritic soils and many limestone outcrops; *Triodia pungens* shrub grassland. |
| **SANDSTONE PLAINS & RISES** | **Plateaux, plains and rises on sandstone, claystone, shale and limestone; outcrop with shallow stony soils** |
| Tennant Creek | Flat-topped hills and broad valleys; skeletal and alluvial soils; *Eucalyptus brevifolia* woodland. |
| Yelvertoft | Undulating; mostly skeletal soils or truncated gravelly lateritic red earths; *Eucalyptus brevifolia* or *Eucalyptus dichromophloia* woodlands. |
| **SANDSTONE HILLS** | **Stony plateaux, tablelands and hills on sandstone, quartzite, siltstone and conglomerate (deeply weathered in places); outcrop with shallow stony soils** |
| Mount Isa | Rugged, hilly country with north-south ridges; mostly rock outcrops or skeletal soils; *Eucalyptus brevifolia* woodland. |
| **GRANITE HILLS** | **Hills with plains on granite and gneiss with some schist; outcrop with shallow gritty or stony soils** |
| Waverley | Undulating to low hilly granite country; mostly skeletal soils; *Eucalyptus brevifolia* woodland. |




| ID | Land System |
|---|---|
| A | Ashburton |
| AT | Austral |
| B2 | Barkly |
| BN | Bundella |
| CK | Camilrock |
| CL | Camil |
| D | Dry Lake |
| E | Elliot |
| G | Georgina |

| ID | Land System |
|---|---|
| GS | Gosse |
| GY | Gregory |
| J | Joanundah |
| KL | Kalalla |
| M | Mt Isa |
| MN | Moonah |
| P | Prentice |
| S | Sylvester |
| T | Tobemorey |

| ID | Land System |
|---|---|
| TC | Tennant Creek |
| TT | Thorntonia |
| WD | Wonardo |
| WH | Wonorah |
| WH-B | Wonorah-Barkly |
| WV | Waverly |
| Y | Yelvertoft |

## Landforms




EcOz makes every effort to ensure this map is free of errors but does not warrant the map or its features as either spatially or temporally accurate or fit for a particular use. EcOz provides this map without any warranty, either express or implied.

**Topographic data**
- Town
- Principal road
- Major watercourse
- Territory / State borders

**NGP Project components**
- Kilometre Point (KP) (50km intervals)
- Pipeline alignment
- Existing access (no upgrade required)
- Existing access (upgrade required)
- Proposed access (to be constructed)

**Major landforms**
- Alluvial floodplains
- Clay plains
- Lateritic plains and rises
- Limestone plains and rises
- Sandstone plains and rises
- Sandstone hills
- Granite hills
- Rugged limestone hills

0 12.5 25 50
Kilometres

**MAP INFORMATION**
Scale: 1:2,500,000 @ A4
Projection: GCS GDA 1994
Date Saved: 3/08/2016
Client: Jemena
Author: T. Reilly (reviewed G. Ewers)

**DATA SOURCE**
Survey layers: EcOz
NGP Project components: Jemena
Land Systems: DLRM (Christian et al. 1954)
Topographic data: GeoScience Australia
Imagery: SRTM Shaded Relief (grey scale)

Path: C:\01. EcOz GIS Projects (TR)\Jemena\Project files\LandSystems_NGP.mxd

**Figure 6-2. Map of major landforms and land systems within the region of the Project footprint**

## 2.4 VEGETATION COMMUNITIES

Vegetation within the Project footprint has been characterised through analysis of the Native Vegetation Information System (4.2) Major Vegetation Subgroups (MVS) (DoE 2016e). This is the most detailed (and standardised) vegetation dataset available for the study area. MVS groups are broadly described and mapped at a relatively large scale (for example, they do not detail dominant species); consequently, they have not been used as a primary data source for determining presence of threatened species habitat. Instead, they provide contextual purposes and locate general areas of potential threatened species habitat.

The Project footprint traverses 15 MVS – 7 in Northern Territory and 13 in Queensland (described in Table 2-3 and mapped in Figure 2-5 and Figure 2-6. The dominant vegetation groups within the Project footprint are 'Eucalyptus low open woodlands with hummock grass' (MVS 18), 'Mitchell Grass tussock grassland' (MVS 34), and 'Acacia (+/- low) open woodlands and sparse shrublands +/- tussock grass' (MVS 24). These three groups cumulatively cover 88% (2182.5 ha) of the Project footprint.

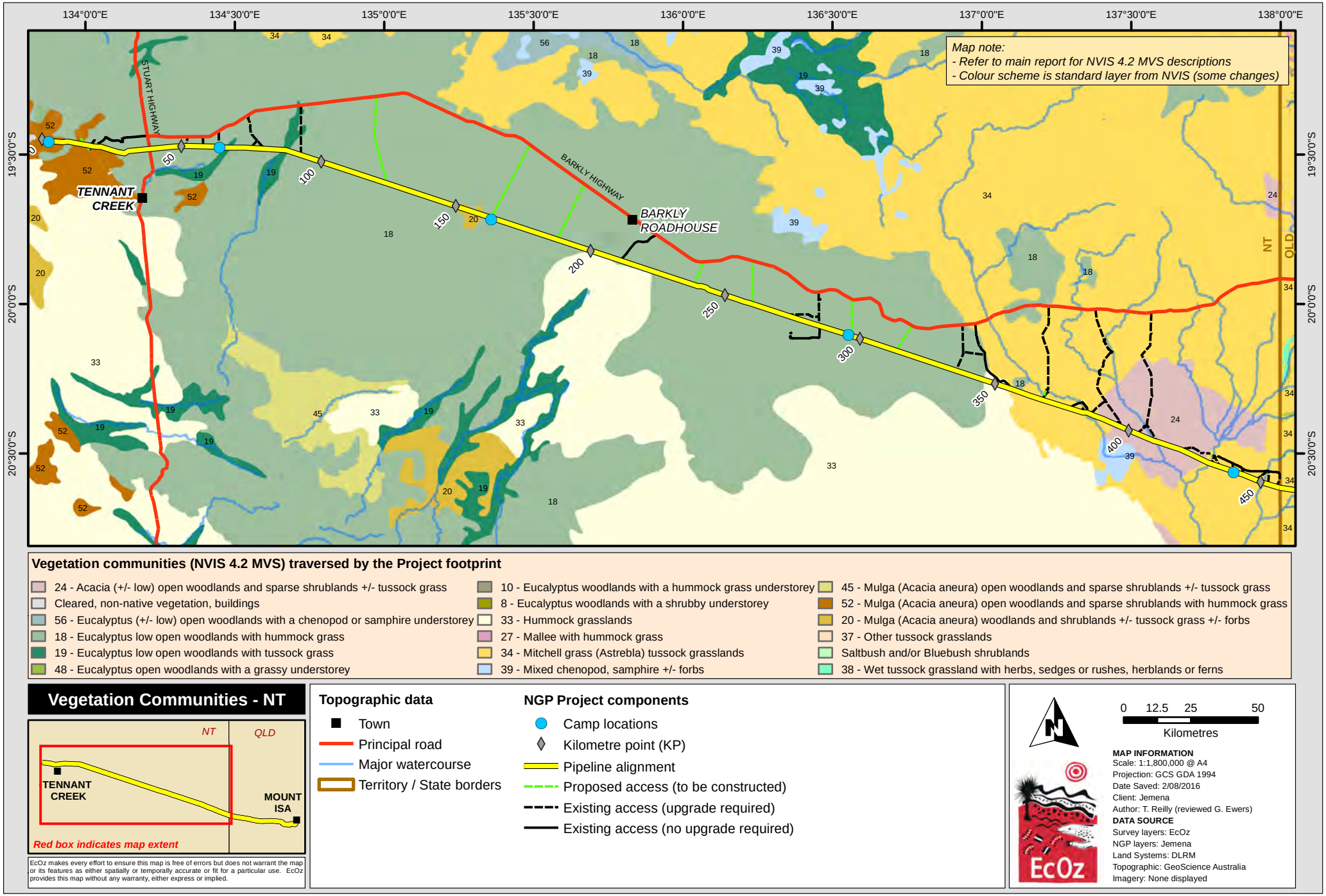
In the Northern Territory, DLRM have produced a Land Type dataset that incorporates a range of attributes at a scale of 1:250,000, which includes vegetation descriptions and dominant species. This information is discussed in Section 4 as part of the Project footprint habitat mapping survey.

In Queensland, Regional Ecosystem mapping is available at an approximate scale of 1:80,000. This dataset includes detailed vegetation descriptions and has been used in Section 4 as part of the Project footprint habitat mapping survey.

**Table 2-3. MVS descriptions and area intersected by the Project footprint**

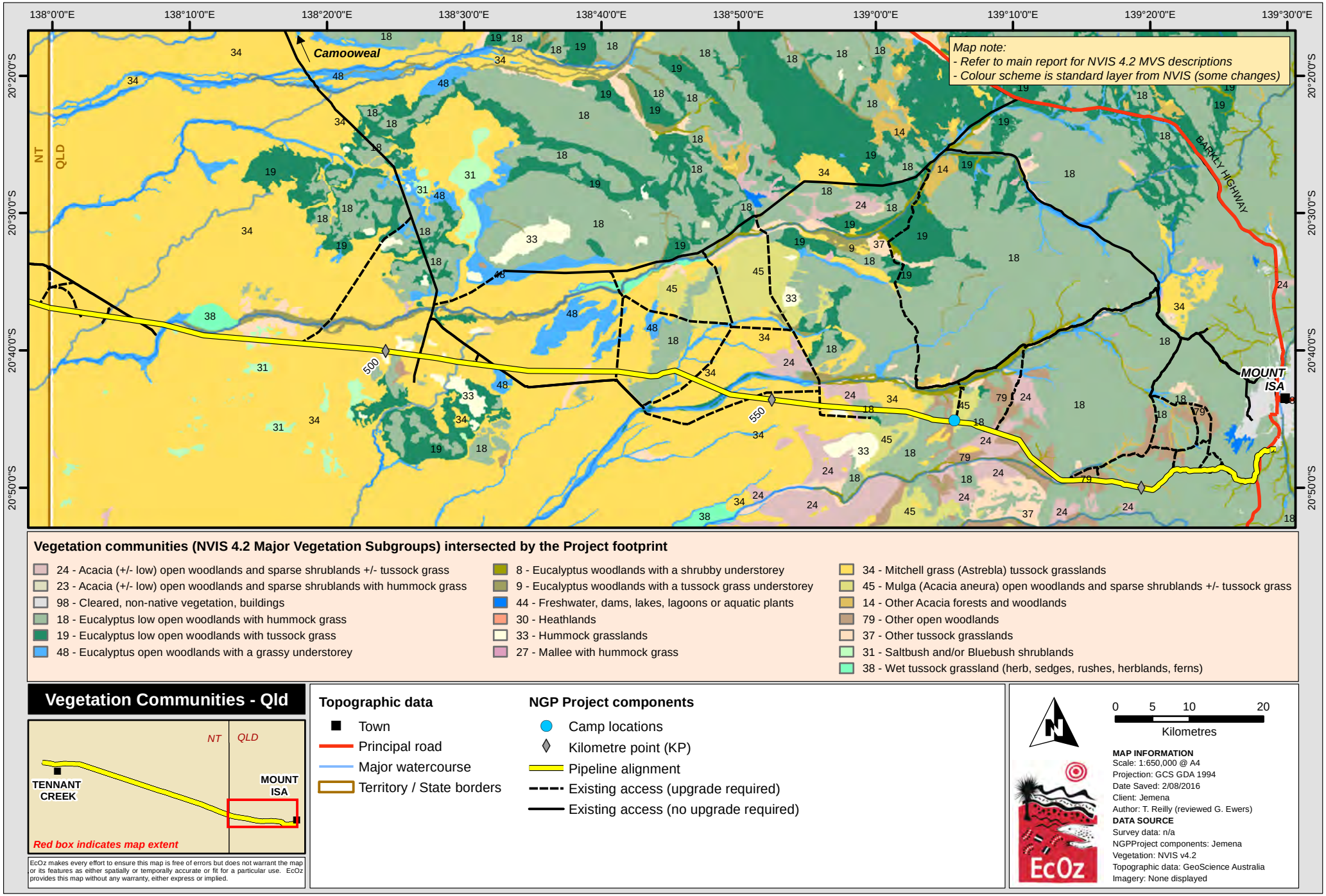
*(listed in order of disturbance area within each community along the Project footprint)*

| MVS No. | Major Vegetation Subgroup (MVS) descriptions | Project footprint (ha) |
|---|---|---|
| **Northern Territory** | | **1753** |
| 18 | *Eucalyptus* low open woodlands with hummock grass | 1191.6 |
| 34 | Mitchell grass (*Astrebla sp.*) tussock grassland | 267.3 |
| 24 | Acacia (+/- low) open woodlands and sparse shrublands +/- tussock grass | 156.3 |
| 52 | Mulga (*Acacia aneura*) open woodlands and sparse shrublands with hummock grass | 67.5 |
| 20 | Mulga (*Acacia aneura*) woodlands and shrublands +/- tussock grass +/- forbs | 26.4 |
| 33 | Hummock grasslands | 25.0 |
| 19 | *Eucalyptus* low open woodlands with tussock grass | 17.5 |
| **Queensland** | | **717** |
| 34 | Mitchell grass (*Astrebla sp.*) tussock grassland | 330.3 |
| 18 | *Eucalyptus* low open woodlands with hummock grass | 216.7 |
| 76 | Regrowth or modified shrublands | 50.5 |
| 24 | Acacia (+/- low) open woodlands and sparse shrublands +/- tussock grass | 20.3 |
| 37 | Other tussock grasslands | 12.1 |
| 33 | Hummock grasslands | 8.6 |
| 48 | *Eucalyptus* open woodlands with a grassy understorey | 14.5 |
| 19 | *Eucalyptus* low open woodlands with tussock grass | 15.5 |
| 8 | *Eucalyptus* woodlands with a shrubby understorey | 10.1 |
| 45 | Mulga (*Acacia aneura*) open woodlands and sparse shrublands +/- tussock grass | 28.3 |
| 31 | Saltbush and/or Bluebush shrublands | 2.7 |
| 9 | *Eucalyptus* woodlands with a tussock grass understorey | 4.6 |
| 14 | Other *Acacia* forests / woodlands | 1.7 |




Path: C:\01. EcOz GIS Projects (TR)\Jemena\Project files\Veg_NT_NVIS42_v2.mxd

**Figure 2-5. Map of vegetation communities proximate to the Project footprint (Northern Territory)**




**Vegetation communities (NVIS 4.2 Major Vegetation Subgroups) intersected by the Project footprint**

- 24 - Acacia (+/- low) open woodlands and sparse shrublands +/- tussock grass
- 23 - Acacia (+/- low) open woodlands and sparse shrublands with hummock grass
- 98 - Cleared, non-native vegetation, buildings
- 18 - Eucalyptus low open woodlands with hummock grass
- 19 - Eucalyptus low open woodlands with tussock grass
- 48 - Eucalyptus open woodlands with a grassy understorey
- 8 - Eucalyptus woodlands with a shrubby understorey
- 9 - Eucalyptus woodlands with a tussock grass understorey
- 44 - Freshwater, dams, lakes, lagoons or aquatic plants
- 30 - Heathlands
- 33 - Hummock grasslands
- 27 - Mallee with hummock grass
- 34 - Mitchell grass (Astrebla) tussock grasslands
- 45 - Mulga (Acacia aneura) open woodlands and sparse shrublands +/- tussock grass
- 14 - Other Acacia forests and woodlands
- 79 - Other open woodlands
- 37 - Other tussock grasslands
- 31 - Saltbush and/or Bluebush shrublands
- 38 - Wet tussock grassland (herb, sedges, rushes, herblands, ferns)

**Vegetation Communities - Qld**






**Topographic data**

- Town
- Principal road
- Major watercourse
- Territory / State borders

**NGP Project components**

- Camp locations
- Kilometre point (KP)
- Pipeline alignment
- Existing access (upgrade required)
- Existing access (no upgrade required)

0 5 10 20
Kilometres

**MAP INFORMATION**
Scale: 1:650,000 @ A4
Projection: GCS GDA 1994
Date Saved: 2/08/2016
Client: Jemena
Author: T. Reilly (reviewed G. Ewers)

**DATA SOURCE**
Survey data: n/a
NGPProject components: Jemena
Vegetation: NVIS v4.2
Topographic data: GeoScience Australia
Imagery: None displayed

Path: C:\01. EcOz GIS Projects (TR)\Jemena\Project files\Veg_QLD_NVIS42_v2.mxd

**Figure 2-6. Map of vegetation communities proximate to the Project footprint (Queensland)**

## 2.5 SENSITIVE VEGETATION TYPES

In the Northern Territory, sensitive vegetation types are those considered significant under the *Land Clearing Guidelines* (DNRETAS 2010). These vegetation types are either unique to the region and/or have inherently high biodiversity values. For this report, sensitive vegetation types have only been assessed for the Northern Territory (Queensland vegetation will be assessed separately).

The region of the Northern Territory in which the Project footprint occurs contains two sensitive vegetation types – riparian vegetation and wetlands.

### 2.5.1 Riparian vegetation

Riparian vegetation is '*a distinct forest community occurring on the banks of rivers or streams that directly influences the adjacent water body*' (DLRM 2013). When in good condition, riparian vegetation is considered as a sensitive vegetation type as it supports a unique selection of habitat features that are relied upon by a range of flora and fauna species. Riparian vegetation provides refugia habitat, important habitat corridors, improve water quality by filtering terrestrial runoff, stabilise banks and reducing erosion, and support terrestrial and aquatic habitats by maintaining natural light, temperature and oxygen levels within waterways (DLRM 2013). The main threats to riparian vegetation are weed invasion, feral animals, fire, over-grazing, erosion, sedimentation and land clearing (DLRM 2013).

In the Northern Territory section of the Project footprint, riparian vegetation occurs along the larger creeks and rivers, of which all are located within the Mitchell Grass Downs bioregion (i.e. black soil plains). Surveys identified riparian vegetation at four intersection points (associated with the Ranken River, James River, Georgina River and Blue Bush Creek). This is mostly comprised of a few reeds on the bank, some with Coolabah (*Eucalyptus coolabah*) – see Figure 2-7. The riparian vegetation in the region is heavily impacted by cattle and weeds. There was no evidence of aquatic vegetation, such as Lilly pads (which were incidentally observed further north in more substantial and less impacted pools within the major river channels). Access tracks do not intersect any major river channels; however, twelve smaller tributaries that support Coolabah trees are intersected by proposed access tracks (and have been subsequently defined as 'riparian' vegetation) (noting that proposed access tracks are positioned on existing tracks that require 5 m widening).

Riparian vegetation communities (as well as floodouts, tributaries, drainages and depressions) in the black soil plains within the Northern Territory may provide habitat for the threatened flora species Tobermorey Melon (*Austrobryonia argillicola*). More detail on this species is provided in Section 5.5.

### 2.5.2 Wetlands

Wetlands are considered a sensitive vegetation type as they provide essential habitat for a diverse range of flora and fauna (including threatened and migratory species) and can be easily impacted upon by poor land management and planning (DNRETAS 2010).

Wetlands that occur in arid Northern Territory are defined as follows by Duguid et al. (2005):

> *"Wetlands are areas of permanent or temporary surface water or waterlogged soil. They may be dry for decades but inundation or waterlogging must be reoccurring and of sufficient duration to be used by macroscopic plants and animals that require such conditions during their lifecycles. They may be natural or artificial, with still or running water which can be fresh or saline. In the inland they may be of any depth or size."*

Wetlands includes waterholes, rivers, swamps, claypans, salt lakes, springs and artificial water sources (such as dams and sewage ponds). They can vary in size and are dry most of the time, but nevertheless, these areas may be important for species conservation. They may support important populations of endemic or threatened species, as well as isolated and relic populations of more widespread species (Duguid et al. 2005) that are important for local biodiversity reasons.

The Project footprint is dry for much of the year and largely includes sandplains with little relief and expansive black soil plains intersected by rivers and creeks. There are temporary swamps and flood-outs in the region of the Project footprint; however, none are directly intersected as it has been aligned to avoid all temporary swamps and subsequently does not pass through (or near to) any wetlands of significance. One swamp in the region (called Frewena Marsh, Figure 2-8) is considered to be of regional significance as it is known to support breeding colonies of water bird species (Fisher et al. 2002). An access track was initially positioned close to this marsh, but was removed from Project footprint plans due to potential ecological impacts that may be have eventuated from construction activities. Wetlands were inspected during the reconnaissance survey discussed in Section 3 and threatened species surveys discussed in Section 5.

Wetlands in the region of KP 150 to KP 300 may provide habitat for the threatened flora species Latz's Grass (*Sporobolus latzii*), and wetlands within the region of KP 350 to KP 457 may provide habitat for the threatened flora species Tobermorey Melon (*Austrobryonia argillicola*). More detail on these species is provided in Section 5.4 and 5.5, respectively.

*Ranken River, Northern Territory (May 2016)*

*Georgina River (near Austral Downs Homestead), Northern Territory (March 2016)*

**Figure 2-7. Photographs of riparian vegetation on Ranken and Georgina Rivers**

*March 2016*

*May 2016*

**Figure 2-8. Photographs of Frewena Marsh, wetland of regional significance near Project footprint**

## 2.6 EXISTING THREATENING PROCESSES

### 2.6.1 Fire

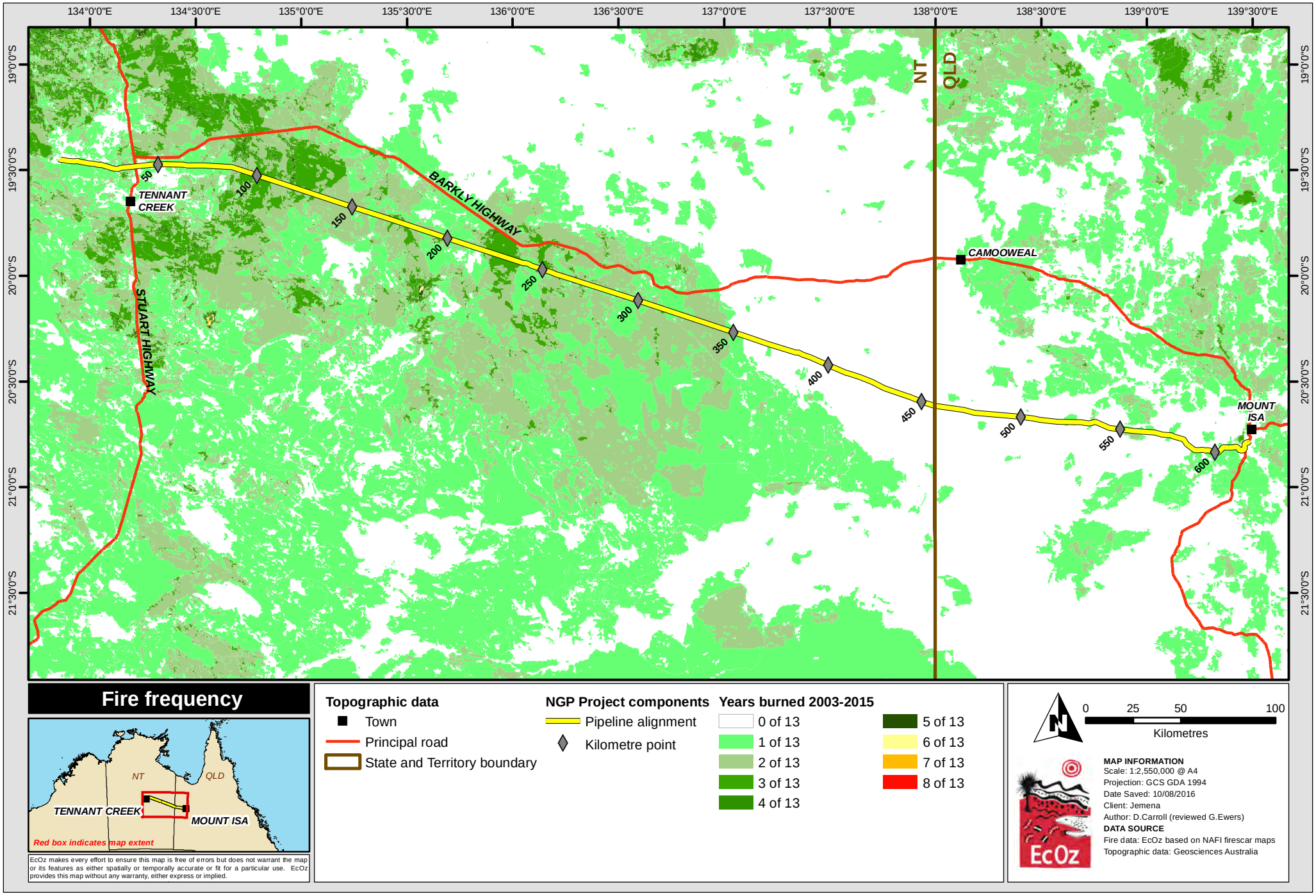
Fire is an essential part of ecosystems within arid and semi-arid Australia (Kershaw et al. 2002) and is caused by natural and anthropogenic sources. It is thought to be a major contributor towards landscape change (Latz 1995 & Latz 2007), particularly within the last 130 years where significant changes in land use have led to more frequent, larger scale fires (Edwards et al. 2008). Fire in the region of the Project area is strongly associated with presence and extent of spinifex-dominated landscapes (i.e. hummock grasslands). Spinifex (*Triodia* sp.) is a fire-tolerant species that creates high fuel-loads and re-establishes after fire (Latz 1995; Edwards et al. 2008). More frequent, large-scale fires often result in further expansion of spinifex grasslands, which can have negative impacts on many flora and fauna. Introduced grasses – such as Buffel Grass (*Cenchrus ciliaris*) – also play a major role in increasing fire frequency and intensities within central Australia.

Regional fire history and fire scar mapping was obtained through the Northern Australia Fire Information website (NAFI 2016). Fire mapping indicates that approximately half of the Project footprint has burnt 2 to 3 times between 2003 and 2015 – as shown in Figure 2-9 (noting that the resolution of this database does not include local, small-scale fires). In general, burnt areas are either located on Aboriginal Land or Vacant Crown Land. This is on the higher scale of burning frequency for central Australia. Spinifex grasslands that dominate the lower strata of vegetation communities in the region are able to re-establish enough fuel-load within a 5- to 7-year period to sustain repeat broad-scale fire events. Therefore, fire intervals within spinifex grasslands are usually between 7 years (high frequency) to > 20 years (low frequency), with fuel-load re-establishment being affected by rainfall and regional fire management (i.e. higher rainfall areas have more rapid re-establishment rates) (Edwards et al. 2008).

The most significant fire period for the Project region (in recent years) was in 2011, when the majority of the western half (KP 0 – KP 354) of the Project footprint was burnt. In that year, there were several large-scale, spinifex-fuelled fires that swept through the region. These fires burnt significant areas of both long unburnt (> 13 years) and previously burnt (with < 7 years) vegetation communities. Part of this area, between KP 150 – KP 354, falls within an area known as the Wakaya Desert, which Latz (2007) refers to as a 'fire-produced desert'. Gibson et al. (1994) and Latz (2007) present evidence that over the years spinifex-dominated grasslands have increased in extent which, through wildfire, has changed the landscape and reduced the diversity of vegetation communities (evidenced by Coolabah trees being reduced to mallee form, lack of tree hollows and fallen logs, presence of red soils on the surface of many clay 'relict' swamps, and only occasional small patches of fire-sensitive species). Consequently, long-term fire impacts are likely to have reduced the overall flora and fauna biodiversity of the region (Latz 2007).

The black soil plains between KP 353 and KP 561 generally experienced no fires between 2003 and 2015 – likely due to cattle grazing (fuel-load reduction) and perhaps the lack of spinifex-dominated grasslands (Figure 2-9). Land is predominantly cattle stations within the black soil country. Pastoral management (through active suppression, access tracks and firebreaks) usually aims to exclude fire from the clay-soil environment to maintain pasture throughout the dry season (DEWHA 2009b).

Low fire frequencies (i.e. between 0 and 1 burn in the last 13 years) are observed on cattle stations outside of the black soil country. Vegetation communities within these stations have a mix of tussock and spinifex hummock grasses (Figure 2-5); therefore a higher fuel-load is present (spinifex is generally not grazed upon by cattle). When conditions are suitable, pastoralists periodically burn hummock (spinifex) grasslands to promote green forage for cattle (as palatable tussock grasses, herbs and forbs often emerge after burns in hummock grasslands if weather conditions are suitable).




Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\JEMENA\EIS (NT)\01 Project Files\Ch6\Figure 6-6. Map of fire frequency in the region of the Project footprint between 2006 and 2016.mxd

**Figure 2-9. Map of fire frequency in the region of the Project footprint between 2006 and 2016**

### 2.6.2 Weeds

In the Northern Territory, weed occurrence data is held by the Weeds Management Branch in the DLRM. Twenty-two weed species (declared under the Northern Territory *Weeds Management Act*) have been recorded within 20 km of the Project footprint.

In Queensland, weed occurrence data is held by Biosecurity Queensland in the Department of Agriculture and Fisheries. Twenty-eight weed species (as declared under the *Land Protection (Pest and Stock Route Management) Act 2002)* have been recorded within 20 km of the Project footprint.

Weed species in the region are expected to be mainly occur within watercourses, alluvial flats, disturbed areas (i.e. roadsides, fences and water-points), and on drainages or depressions within clay plains located within the Mitchell Grass Downs bioregion. Sandplains, rocky rises and clay plains (which represent the majority of the Project footprint) are not expected to support declared weed species. Table 2-4 presents a list of known declared weed species and preferred habitat type; Figure 2-10 shows known weed records in the region.

Although not a declared weed, Buffel Grass (*Cenchrus ciliaris*) is also considered a threat to biodiversity value in the region of the Project footprint. That species can out-compete native tussock and hummock grasses, which often results in more frequent and intense wildfire.

Incidental and opportunistic weed records made during fieldwork conducted in April and May 2016 noted that the following weeds were present within (or close to) the Project footprint.

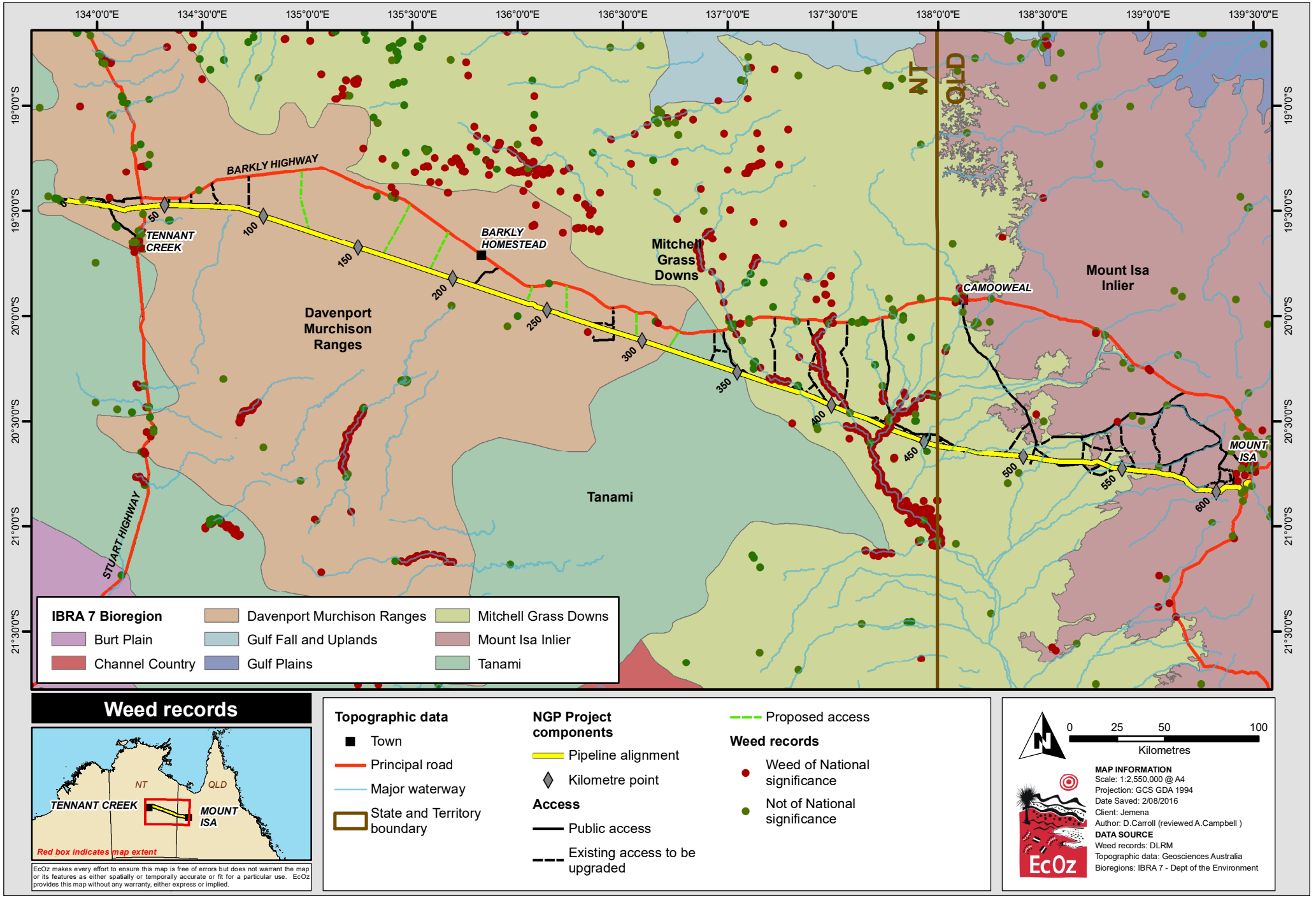
- Noogoora Burr (*Xanthium strumarium*) – dense (but small) infestations recorded on the banks of the Ranken River
- Buffel Grass (*Cenchrus ciliaris*) – recorded along watercourses near Mount Isa, Tennant Creek, and Barkly Homestead
- Kapok Bush (*Aerva javanica*) – recorded near Barkly Homestead
- Parkinsonia (*Parkinsonia aculeata*) – low density of saplings on floodouts of Georgina River
- Mesquite (*Prosopis pallida*) (identification to be confirmed during weed surveys) – located along some small drainages within the black soil plains
- Annual Mission Grass (*Pennisetum pedicellatum*)

A complete weed survey of the Project footprint will occur prior to commencement of works. Survey methods will be in accordance with Northern Territory and Queensland requirements. Details of the approach to field survey and subsequent refinement of weed management controls are provided in the Weed Management Plan (an appendix of the main EIS).

**Table 2-4. Declared weed species recorded within bioregions intersecting the Project footprint**

*Habitat key: **W** – watercourses and drainages; **Dp** – drainages and depressions within Mitchell Grass Downs; **Dt** – disturbed areas; **V** – variable habitat; **Gr** – grasslands; **Pa** – pasture or agriculture.*

| Family | Common Name | Genus | NT | Qld | WoNS | Typical habitat |
|---|---|---|---|---|---|---|
| ACANTHACEAE | Thunbergia | *Thunbergia annua, T. fragrans & T. laurifolia* | - | 1 | No | W |
| | Thunbergia | *Thunbergia grandiflora* | - | 2 | No | W |
| ANACARDIACEAE | Broadleaved pepper tree | *Schinus terebinthifolius* | - | 3 | No | W |
| APOCYNACEAE | Rubber bush | *Calotropis procera* | B/C | - | No | W;Dt |
| | Rubber vine | *Cryptostegia grandiflora* | - | 2 | Yes | W |
| ASTERACEAE | Star burr | *Acanthospermum hispidum* | B/C | - | No | Dt |
| | Parthenium | *Parthenium hysterophorus* | A/C | 2 | Yes | W;Dp |
| | Fireweed | *Senecio madagascariensis* | - | 2 | No | Pa |
| | Noogoora burr | *Xanthium strumarium* | B/C | | No | W;Dt |
| BIGNONIACEAE | Cat's claw creeper | *Macfadyena unguis-cati* | - | 3 | Yes | W;Dt |
| BORAGINACEAE | Patterson's curse | *Echium plantagineum* | A/C | - | No | Dt |
| CACTACEAE | Coral cactus | *Cylindropuntia fulgida var. mamillata* | - | 2 | Yes | V |
| | Harrisia cactus | *Harrisia spp.* | - | 1 | No | V |
| | Prickly pear | *Opuntia spp. (*not *O. stricta)* | - | 1 | No | V |
| | Prickly pear | *Opuntia stricta* | - | 2 | Yes | V |
| CRASSULACEAE | Mother of millions | *Bryophyllum spp.* and hybrids | - | 2 | No | Dt |
| EUPHORBIACEAE | Bellyache bush | *Jatropha gossypiifolia* | A/C | 2 | Yes | W;Dt |
| | Castor oil plant | *Ricinus communis* | B/C | - | No | W;Dt |
| FABACEAE | Parkinsonia | *Parkinsonia aculeata* | B/C | 2 | Yes | W;Dp;Dt |
| | Mesquite | *Prosopis spp.* | A/C | 2 | Yes | W;Dp |
| | Coffee Senna | *Senna occidentalis* | B/C | - | No | W;Dt |
| | Sicklepod | *Senna obtusifolia* | B/C | - | No | Dt |
| | Prickly Acacia | *Vachellia nilotica* | A/C | - | Yes | W;Dp;Dt |
| LAMIACEAE | Hyptis | *Hyptis suaveolens* | B/C | - | No | W;Dt |
| MALVACEAE | Sida – Spiny head | *Sida acuta* | B/C | - | No | Dt |
| | Sida – Flannel weed | *Sida cordifolia* | B/C | - | No | Dt |
| | Sida – Paddy's Lucerne | *Sida rhombifolia* | B/C | - | No | Dt |
| PAPAVERACEAE | Mexican poppy | *Argemone ochroleuca* | B/C | - | No | W |
| POACEAE | Mossman river grass | *Cenchrus echinatus* | B/C | - | No | W;Dt |
| | Mission grass - perennial | *Cenchrus polystachios* | B/C | - | No | Dt |
| | Mexican feather grass | *Nassella tenuissima* | - | 1 | No | Gr |
| | Rats tail grass | *Sporobolus spp.* | - | 2 | No | Pa |
| RHAMNACEAE | Chinee apple | *Ziziphus mauritiana* | - | 2 | No | W |
| SALICACEAE | Pencil Willow | *Salix chilensis* | - | 3 | Yes | W |
| SALVINIACEAE | Salvinia | *Salvinia molesta* | - | 2 | Yes | W |
| SOLANACEAE | Thornapple - Longspine | *Datura ferox* | A/C | - | No | W |
| | African boxthorn | *Lycium ferocissimum* | - | 2 | Yes | W;Dt |
| TAMARICACEAE | Athel pine | *Tamarix aphylla* | A/C | 3 | Yes | W |
| VERBENACEAE | Lantana | *Lantana camara, L. montevidensis* | - | 3 | Yes | V |
| ZYGOPHYLLACEAE | Caltrop | *Tribulus terrestris* | B/C | - | No | Dt |




Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\JEMENA\EIS (NT)\01 Project Files\Ch6\Figure 6-7. Map of declared weed records in the region of the Project footprint.mxd

**Figure 2-10. Map of declared weed records in the region of the construction footprint**

### 2.6.3 Introduced fauna

The following introduced fauna species are expected to occur within the Project footprint:

- **Feral Cat (*Felis catus*)**

  Feral Cats occur throughout the Australian mainland in a wide variety of different habitats – including deserts, forests and grasslands. The species is considered a 'key threatening process' under the *EPBC Act*. Feral Cats play a significant role in the decline of native fauna – an individual is estimated to kill 5 to 30 native species per day (AWC 2012) – and have been recognised as contributing to the decline of several ground-nesting birds and small to medium-sized mammals.

  Previous studies (within the Northern Territory) have recorded Feral Cats in the region of the Project footprint (Gibson et al. 1994; Low Ecological Services 2009), and signs from the species were observed during the EIS field studies for the Greater Bilby (see Section 5.8). According to the Atlas of Living Australia (http://bie.ala.org.au/species/Felis%20catus), there are numerous records within the Northern Territory section of the Project footprint and no records within the Queensland section of the Project footprint.

  It is likely that the Feral Cat is prevalent across the Project footprint.

- **Cane Toad (*Rhinella marina*)**

  Cane Toads are widespread across tropical Queensland and the Northern Territory in a wide variety of habitats, moving westward at an estimated 40 to 60 km per year (DEWHA 2010a). They need constant access to moisture to survive (which can be water, dew or moist sand).

  This species is listed as a 'key threatening process' under the *EPBC Act* because it is lethal to carnivorous native animals if consumed. Cane Toads are known to be a key factor in the decline of a number of native predatory fauna – including monitors and Northern Quoll – and are poisonous to a wide range of snakes (Phillips et al. 2003).

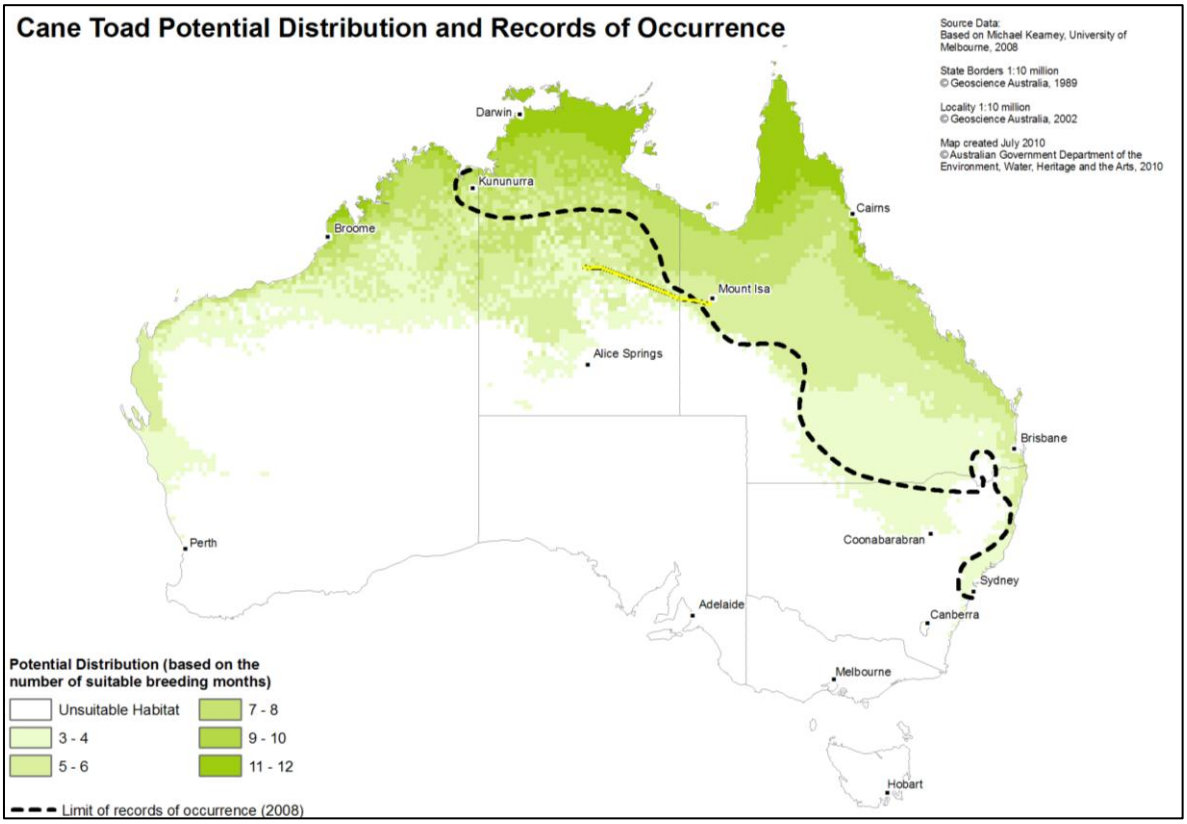
  It is unclear to what extent Cane Toads occur within the Project footprint. The most recent distribution modelling of Cane Toads (see Figure 2-11) includes the channel country to the eastern terminus of the pipeline, with a prediction of an eventual distribution of the species westwards along the entire Project footprint. That region is considered marginal habitat for Cane Toads, with a maximum of 3 to 4 months suitable for breeding (see Figure 2-11). During field surveys for this EIS, ecologists noted the species along the roadside near Camooweal – approximately 80 km north of the construction ROW. Camooweal is higher in the catchment than the Project footprint and so it could be assumed that Cane Toads would be present downstream in that catchment. However, there have been no observations of Cane Toads at either Avon Downs or Austral Downs (advice from pastoral managers), which are both located in black soil country of that catchment (the latter only 4 km north of the construction ROW).

  Two possible conclusions can be drawn from this:

  a) Cane Toads have reached the limits of southerly expansion (as dictated by water availability) in the region, and this expansion does not include the construction ROW (except, perhaps, at the Mount Isa end). This seems the likeliest conclusion given the species is present at Camooweal, but not downstream at Austral Downs.

  b) Cane Toads yet to spread as far south as the construction ROW (except, perhaps, at the Mount Isa end), but suitable (albeit sub-optimal) habitat occurs, and so expansion into that region is inevitable. This is possible if the species only recently expanded to Camooweal and has not yet had the opportunity to travel downstream.

  Where Cane Toads do occur within the footprint, they are likely to be restricted in numbers due to limited water availability.




*Construction ROW depicted by yellow line*

**Figure 2-11. Map of known extent and potential distribution of Cane Toad**

- **Domestic Cattle (*Bos taurus*)**

  Cattle production is one of the primary economic drivers of the region and so cattle are common throughout pastoral properties intersected by the Project footprint. Domestic Cattle can cause land degradation through trampling, soil compaction, erosion, weed spread and decreases in water quality (DLRM 2016b). Addition information on pastoralism is provided in Section 2.6.4.

- **Feral Horse (*Equus caballus*)**

  Feral Horses occur across the Australian mainland in a wide variety of different habitats. The species prefers grassland and shrubland with plentiful water and pasture (DSEWPaC 2011a). The Feral Horse population is highest in the cattle-raising districts of Queensland and the Northern Territory (IACRC 2015). The species causes erosion of soil and watercourses, weed spread, trampling and consumption of native flora, and sedimentation and increased nutrient levels in watercourses (DSEWPaC 2011a).

  Feral Horse were not observed during EIS field studies.

  Distribution mapping from 2000 indicates that Feral Horses are likely in the Queensland section of the Project footprint (DSEWPaC 2011).

- **One-humped Camel (*Camelus dromedarius*)**

  Feral Camels are distributed through much of the Australian rangelands, wandering widely according to conditions. The species utilises most habitats in the arid and semi-arid areas, depending on availability of food and summer shade (DEWHA 2010b). Feral Camels cause environmental damage through trampling and foraging behaviour, suppression of plant recruitment, damage to wetland and riparian areas, and competition with native animals for food

and shelter (NRMMC 2010). Feral Camels are expected to occur within the Project footprint – although camels are sparsely distributed through this area (0 – 0.25 per $km^2$) (NRMMC 2010).

EIS field studies recorded One-humped Camel in the rocky country near Mount Isa (Queensland). Very low numbers of tracks and scats were observed within the desert sandplains in the Northern Territory

- **Feral Pig (*Sus scrofa*)**

  Feral Pigs are a widely-distributed, environmental and agricultural pest. Up to 23.5 million Feral Pigs are spread across about half of the continent – from western Victoria, through New South Wales into Queensland, and across northern Australia (DSEWPaC 2011b).

  This species is listed as a 'key threatening process' under the *EPBC Act* because of native fauna predation, contribution to habitat loss and competition with native fauna. The threats associated with Feral Pig are largely confined to riparian and wetland habitats, where rooting, wallowing, tusking and rubbing impact upon flora and fauna, and water quality.

  The distribution of Feral Pig includes most of the Project footprint when water is present – more commonly in the east, with only occasional low numbers and/or localised occurrences in the west (West 2008).

- **Red Fox (*Vulpes vulpes*)**

  Red Foxes occur across a variety of habitats in most of Australia. The species is absent from north-western WA, northern Northern Territory (north of Tennant Creek), and northern and north-eastern Queensland. (West 2008).

  This species is listed as a 'key threatening process' under the *EPBC Act* due to the species' predation of native fauna. The species is known to prey on ground-nesting birds and small to medium-sized mammals such as the Greater Bilby (DSEWPC 2011b).

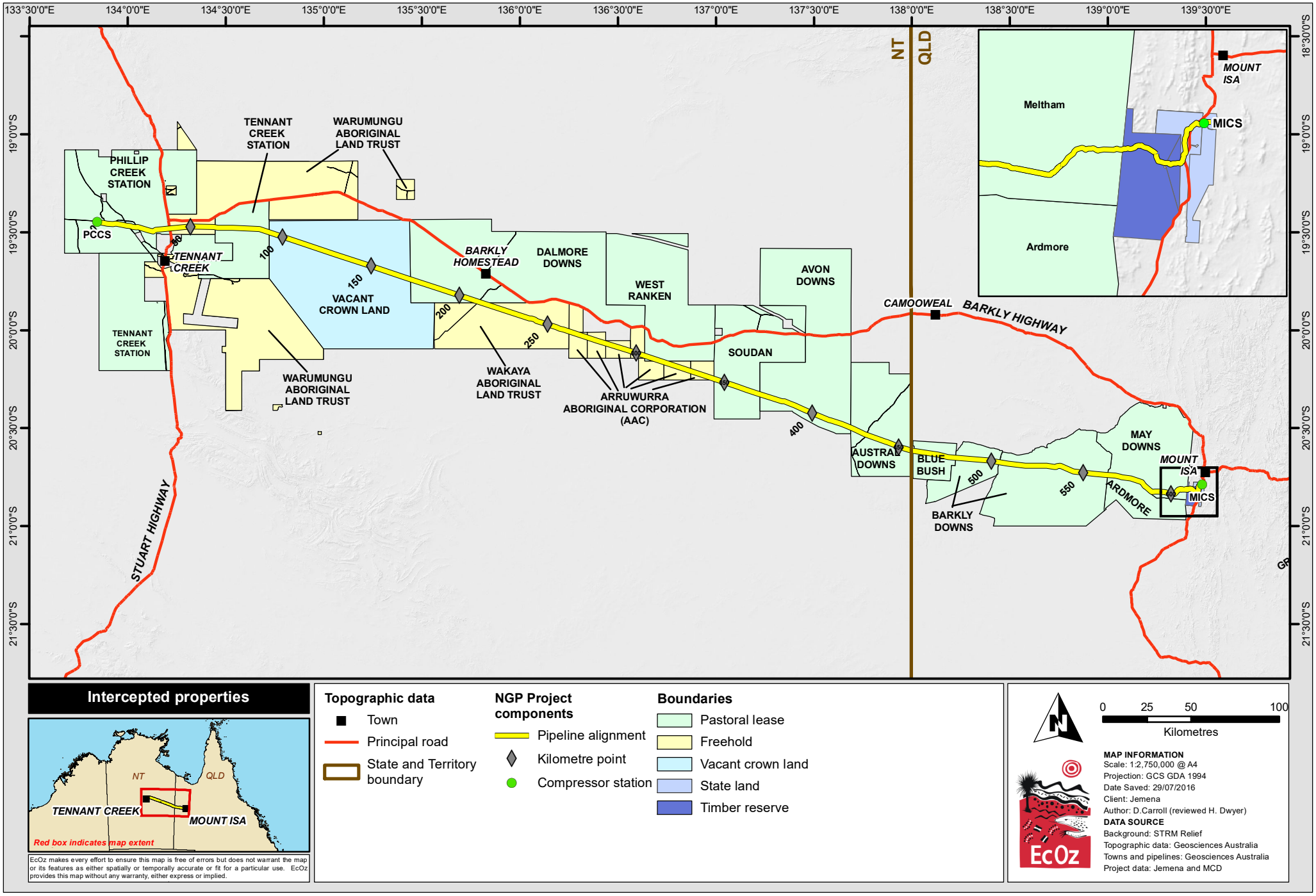
  The Project footprint is at the northern edge of the species' distribution. One Fox track was recorded in desert sandplains within the Northern Territory during EIS studies. According to the Atlas of Living Australia (http://bie.ala.org.au), there are a few records in sandplains within the Northern Territory section of the Project footprint and no records within the black soil plains or Queensland section of the Project footprint.

  It is likely that Red Fox occurs in low densities within the sandplains of the Northern Territory section of the Project footprint, and absent in black soil plains and Queensland.

### 2.6.4 Pastoralism

Pastoral stations cover much of the Project footprint (see Figure 2-12) – the ROW crosses pastoral leases for 99% of the Queensland length and 50% of the Northern Territory length. Consequently, environmental impacts typically associated with pastoralism are expected to occur within the Project footprint (i.e. increased weeds, erosion development, soil surface structure/infiltration, water source degradation and altered fire regimes) (DEWHA 2009b). Cumulatively, these impacts can have a negative influence on biodiversity. It is implicated that pastoral impacts have resulted in the decline of some vertebrate species and changes in plant species composition in the Australian rangelands (Fisher et al. 2002; DEWHA 2009). Pastoral impacts have particularly affected larger dasyurids and rodents, bandicoots and smaller macropods (Woinarski et al. 2001 – cited in DEWHA 2009b).

The level of impacts from pastoral activities on biodiversity values will be dependent on the management of station (i.e. stocking rates, provision of artificial water points and prescribed burns), and also the sensitivity of vegetation communities to grazing. Observations of pastoral impacts within the Project footprint were collected during field studies as part of determining the habitat suitability for targeted threatened species.




Path: Z:\01 EcOz_Documents\04 EcOz Vantage GIS\JEMENA\EIS (NT)\01 Project Files\Ch6\Figure 6-9. Map of the extent of pastoralism within the Project footprint.mxd

**Figure 2-12. Map of the pastoral properties and other tenures intersected by the Project footprint**

# 3 RECONNAISSANCE SURVEY

On the 23 and 24 March 2016, the Project footprint was surveyed (via helicopter) to obtain a preliminary description of habitat types that occur in the general region of the Project footprint (general observations only as the footprint had not be finalised at the time of survey). High-resolution, geo-referenced footage of the construction ROW and a selection of proposed access tracks was also recorded (flight path is provided in Figure 3-3). Footage was recorded at an approximate height of 150 m at a speed of 90 knots.

The survey and footage allowed direct observation of habitat features which were difficult to confidently infer from available desktop resources. The survey and footage also allowed for the identification of sensitive vegetation types (riparian vegetation and wetlands) within the Project footprint. Information collected during the survey was used to inform threatened species surveys design and to conduct validation of draft 'land type' mapping (provided by DLRM) along the Project footprint.

The reconnaissance survey provided valuable preliminary information on the presence of potentially-suitable habitat for the following threatened species:

- Latz's Grass (*Sporobolus latzii*)
- Tobermorey Melon (*Austrobryonia argillicola*)
- Carpentarian Antechinus (*Pseudoantechinus mimulis*)
- Greater Bilby (*Macrotis lagotis*)
- Gouldian Finch (*Erythrura gouldiae*)
- Australian Painted Snipe (*Rostratula australis*).

**Latz's Grass *(Sporobolus latzii)***

Two swamps (also referred to as 'playas') were identified in the region of the Project footprint. At the time, both contained water, and supported stunted Coolabah (*Eucalyptus coolabah*). This confirms that potentially suitable habitat for *S. latzii* occurs in the region of the Project footprint and will require targeted field assessments to confirm its presence.

The swamp where *S. latzii* has been previously recorded (~ 4 km to the south of KP 273) was visited (at >100 m above ground) to record video footage and observe habitat features associated with the swamp to familiarise surveyors with the species 'type locality' (see photos in Figure 3-2). The swamp was mostly dry at the time of survey. There was evidence of recent fire. Later inspection of fire scar mapping (using NAFI and LandSat imagery) indicated that the swamp has burnt in 2007 (broad-scale burn), 2011 (broad-scale burn), and 2014 (small-scale burn which included the swamp). The swamp was comparably large (171.2 ha) compared to swamps observed near the Project footprint. It contained a variety of habitat features, such as many small 'islands', low presence of spinifex hummocks, large single-trunked Coolabah trees, evidence of sedges within the swamps and a variety of tussock grass species on its edges.

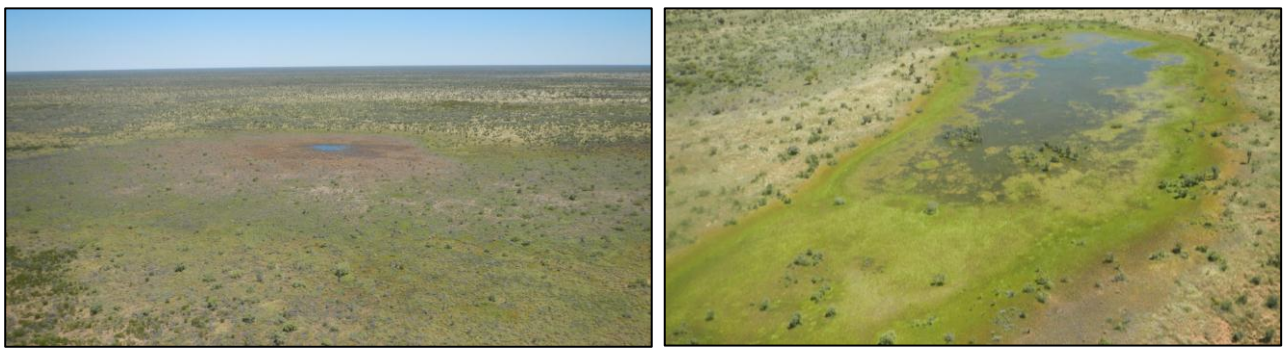


**Figure 3-1. Photographs (aerial) of swamps within the region of the Project footprint**


**Figure 3-2. Photographs (aerial) of the 'type locality' for Latz's Grass (*S. latzii*), March 2016**

**Tobermorey Melon *(Austrobryonia argillicola)***

The Project footprint crosses numerous rivers, creek, drainages and depressions within the Mitchell Grass Downs bioregion (within the Northern Territory) that are likely to support Tobermorey Melon . These areas will be targeted during field surveys to confirm the presence of Tobermorey Melon within the Project footprint.

***Carpentarian Antechinus (Pseudantechinus mimulus)***

Rocky hills and ridges are present in the region of the Project footprint between KP 510 and KP 622. These areas may potentially support Carpentarian Antechinus and will require field surveys to confirm the presence of the species within the Project footprint. Rocky habitat observed was either metamorphic hills and low ridges, or granitic hills with varying levels of exposed outcrop. In most circumstances, the Project footprint avoided direct impact of these rocky areas. Suitable habitat was photographed and a waypoint recorded.

***Greater Bilby (Macrotis lagotis)***

There are large expanses of potentially suitable habitat for Greater Bilby in the western portion of the Project footprint – between KP 0 and KP 355. This area is dominated by sand plains, with smaller areas of lateritic rises, seasonal swamps, and alluvial plains. No palaeodrainage channels were observed within the project footprint or surrounds; however, relic drainage features were observed between KP 200 and KP 355 in areas where laterite rises were more common. Large recent fire scars were observed within the region. Targeted field surveys will be required to determine the presence of Greater Bilby within the Project footprint. These surveys will target habitat types considered to have a high chance of occupancy of Greater Bilby – such as recently burnt sandplains, rocky rises, edges of seasonal swamps, and alluvial plains.

***Gouldian Finch (Erythrura gouldiae)***

Habitat occurs in the eastern part of the Project footprint that may support suitable nesting and feeding opportunities (variety of grasses) for Gouldian Finch. Nesting habitat was focused on identifying the presence of mature Snappy Gum (*Eucalyptus leucophloia*) trees, which were more often established on the slopes of rocky hills and ridges. It is these larger trees that are more likely to provide suitable nesting hollows for Gouldian Finch. Assessment of potential feeding habitat is only assumed, and would more likely occur in run-on areas such as depressions and small drainages. No permanent freshwater pools were observed within the Project footprint. Field surveys will be required to determine the suitability of these areas for Gouldian Finch.

***Australian Painted Snipe (Rostratula australis)***

Small swamps were observed within the region of the Project footprint that may provide stop over habitat for the Australian Painted Snipe; however, none were considered to be core-habitat or important wetlands in regards to population dispersion and species presence in the region. Additionally, all swamp areas will be avoided by the Project footprint, therefore impacts to this species habitat is considered negligible. The large more significant swamps in the region that are more likely to be periodically occupied by the species are distant from Project footprint disturbances. In conclusion, observations confirmed that targeted field surveys for Australian Painted Snipe are not necessary due to absence of preferred habitat within the Project footprint.

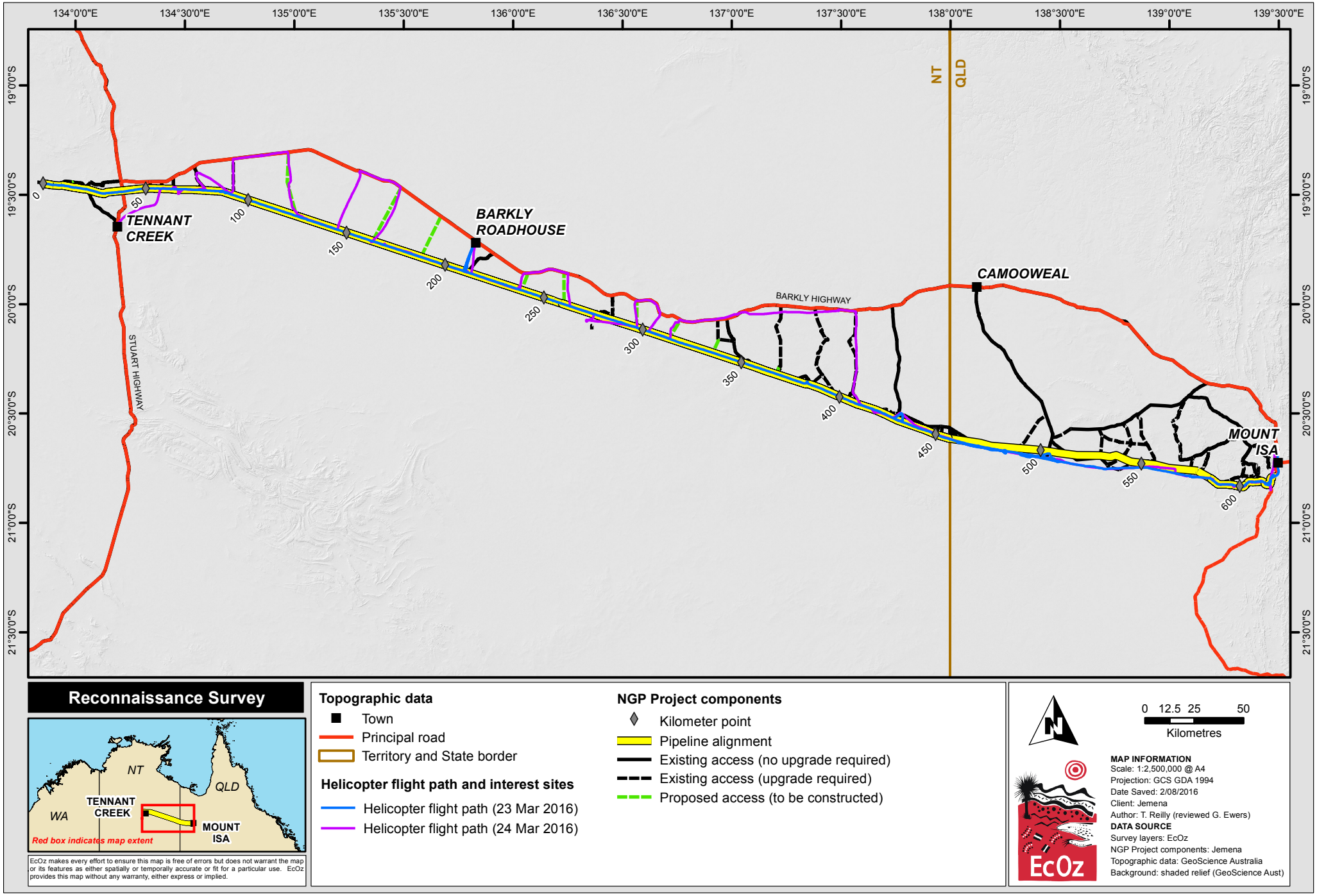



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**Figure 3.3. Map of reconnaissance survey flight paths**

# 4 HABITAT MAPPING

## 4.1 PURPOSE

Habitat mapping of the Project footprint was undertaken to spatially determine the area and location of habitat that may be (generally) suitable for threatened species. This information was essential for targeted threatened species survey design (i.e. site selection) and assists in measuring the potential impact to threatened species habitat (although a more detailed habitat analysis was undertaken specifically threatened species if they were found to potentially occupy an area of the Project footprint).

## 4.2 METHOD

Habitat mapping is predominantly based on delineating landforms along the Project footprint at an approximately scale of 1:10 000. Other key habitat features such as vegetation community and soil types are not specifically mapped; however, typical associations with each landform in the region were identified (and extrapolated further in specific threatened species studies where relevant).

Habitat mapping was produced in ArcGIS by creating polyline shapefiles along the Project footprint. This enabled a spatial representation of habitat types along the Project footprint at a scale fine enough to make accurate inferences on the location of potentially suitable threatened species habitat. Separate maps and descriptions were made for the Northern Territory and Queensland due to different attributes (and scales) within existing datasets.

### 4.2.1 Northern Territory

Land type mapping was available for the Northern Territory section of the Project footprint, which was advised by DLRM to be the most recent and accurate dataset for the region (pers. comm. Peter Brocklehurst 2016). Land type data files were provided by DLRM in March 2016 – *Land Types of the Barkly and Tennant Creek Regions* (Department code: STHNT_250). The dataset is produced at a scale of 1:250 000 and is based on land system 'Survey of the Barkly Region' (Christian et al. 1954). It has the following data attributes applied to each land type polygon – land type name, landscape class, landscape class description, landform unit, soil type, dominant vegetation group, NVIS vegetation structure, dominant flora species (three maximum), and land type region.

Landform units were the most useful component of the dataset in terms of determining the potential presence of threatened species habitat, therefore this survey aims to describe each landform unit traversed by the Project footprint. It was not possible to consistently field-check soil types, vegetation groups, and dominant flora species within each landform unit along the Project footprint; subsequently, habitat descriptions provided in this report included all possibilities as per Land Type mapping dataset.

Habitat mapping for the Northern Territory section of the Project footprint was produced by comparing DLRM land type mapping descriptions against satellite imagery (World Imagery available on ESRI Online) at an approximate scale of 1:10 000. Geo-referenced video footage recorded as part of the reconnaissance survey (see Section 3), as well as habitat descriptions undertaken as part of threatened species surveys (Section 5) was used as part of the landform validation process.

Habitat mapping attributes applied to each polyline segment are 'landscape class' and 'landform unit' (see Table 4-1 for categories applicable to the Project footprint), and also depicts the particular 'land type' region (i.e. Tennant Creek Sandplains or Barkly Clay Plains). Bioregions were also attributed to each polyline – it was assumed that Tennant Creek Sandplains incorporates 'Davenport / Murchison Ranges' and 'Tanami' bioregions, and the Barkly Clay Plains incorporates 'Mitchell Grass Downs' bioregion.

**Table 4-1. Habitat mapping categories – Northern Territory**

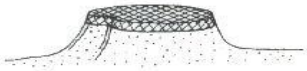
| Landscape class | Landscape class description (general) | Landform units |
|---|---|---|
| *ALLUVIAL FLOODPLAINS* | Alluvial plains, swamps, drainage depressions and alluvial fans; sandy, silty and clay soils on Quaternary alluvium. | Alluvial plains<br>Drainage systems<br>Inland wetlands<br>Swamps |
| *CLAY PLAINS* | Level to gently undulating clay plains (black soil plains); cracking clay soils. | Plains<br>Downs plains<br>Inland wetlands |
| *DESERT SANDPLAINS* | Level to undulating sandplains with red sands. | Plains<br>Sand plains<br>Playas |
| *LATERITIC PLAINS AND RISES* | Plains and rises associated with deeply weathered profiles (laterite) including sand sheets and other depositional products; sandy and earth soils. | Plains<br>Low rises<br>Rises<br>Playas |
| *LIMESTONE PLAINS AND RISES* | Plains, rises and plateaux on dolomite, limestone, chalcedony, shale and sandstone; red clayey sands, calcareous earths and outcrop with shallow stony soils. | Plains<br>Low rises<br>Rises |
| *SANDSTONE PLAINS AND RISES* | Plains, rises and plateaux on mostly on sandstone, siltstone, claystone, shale and some limestone; commonly shallow soils with surface stone and rock outcrop. | Plains<br>Rises<br>Hills |

### 4.2.2 Queensland

Regional ecosystem land zone mapping and descriptions were used for the habitat survey of the Project footprint within Queensland. Land zones are categories that describe major geology, associated landforms and geomorphic processes, and often support different ecosystem function and biodiversity assemblages (Wilson and Taylor 2012). Land zones within the Project footprint are currently available at a scale of 1:80 000. Table  summarises land zones applicable to the Project footprint. Finer scale regional ecosystem mapping is also available which provides detailed vegetation data and describes landform units that are clumped together in the broader land zones. This finer scale habitat data is provided in specific threatened species surveys when appropriate (Section 5). For example, Land Zone 11 (hills and lowland on metamorphic rocks) contains three different sub-units – ranges, hills and lowlands – that are not delineated by habitat mapping presented in this section.

Habitat mapping for the Queensland section of the Project footprint was produced by comparing land zone mapping polygons and descriptions against satellite imagery (World Imagery available on ESRI Online) at an approximate scale of 1:10 000. Geo-referenced video footage recorded as part of the reconnaissance survey (see Section 3), as well as habitat descriptions undertaken as part of threatened species surveys (Section 5) was used as part of the landform validation process. Habitat mapping attributes applied to each polyline segment are ‘land zone number’, ‘land zone description’, and ‘bioregion’ (IBRA v7).

**Table 4-2. Habitat mapping categories – Queensland**

| Land zone | General description | Cross-section sketch *(source: Qld Government)* |
|---|---|---|
| 3 | **Alluvium (river and creek flats)** (includes depressions, inland lakes, and palaeo-estuarine deposits) |  |
| 4 | **Clay plains** (level to gently undulating plains not associated with current alluvium) |  |
| 5 | **Old loamy and sandy plains** (level to gently undulating) |  |
| 7 | **Ironstone jump-ups** (mesas and scarps, present as low rocky rises in Mitchell Grass Downs) |  |
| 9 | **Undulating country** on fine grained sedimentary rock (usually with little or no deformation, outcrops) |  |
| 11 | **Hills and lowlands on metamorphic rocks** (ranges, hills and lowlands that are usually deformed) |  |
| 12 | **Hills and lowlands on granite rock** (ranges, hills and lowlands) |  |

## 4.3 RESULTS

### 4.3.1 Northern Territory habitat mapping

Five landscape classes are traversed by the Project footprint that incorporate 11 landform units (Table 4-3; Figure 4-1). Two land type regions are traversed – the Tennant Creek Sandplains (from KP 0 to KP 350) and Barkly Clay Plains (KP 350 to KP 457).

Lateritic rises and plains, desert sandplains, and clay plains are the dominant landscape classes traversed by the Project footprint (Table 4-3). These three landscape classes cumulatively covered 91% of the Project footprint. The majority of all proposed disturbance is temporary (estimated to be 97% or 1685.3 ha of all disturbance will be temporary; 3.8% or 67.7 ha will be permanent) (Table 4-4).

Detailed descriptions of each landform unit are provided in Appendix A (including representative photographs, landform, soils, drainage, related land systems, regional extent, area traversed by Project footprint and dominant vegetation associations).

**Table 4-3. Habitat mapping summary of the Project footprint within the Northern Territory**

| Landscape Class / Landform Unit / Bioregion | Disturbance Area (ha) | | | Grand Total |
|---|---|---|---|---|
| | ROW | Access tracks | Other | |
| **ALLUVIAL FLOODPLAINS** | **95.9** | **22.0** | **38.9** | **156.8** |
| Alluvial Plains | 93.0 | 21.3 | 38.9 | **153.1** |
| *Mitchell Grass Downs* [1] | *(61.6)* | *(12.8)* | *(28.6)* | ***(103.0)*** |
| *Davenport / Tanami* [2] | *(31.3)* | *(8.5)* | *(10.3)* | ***(50.1)*** |
| Drainage Systems (i.e. riparian area) | 15.3 | 0.8 | 0.0 | **3.7** |
| *Mitchell Grass Downs* [1] | *(2.9)* | *(0.8)* | *(0.0)* | ***(3.7)*** |
| **CLAY PLAINS** | **243.5** | **71.3** | **29.2** | **344.0** |
| Downs Plains | 200.0 | 33.3 | 29.2 | **262.5** |
| *Mitchell Grass Downs* [1] | *(200.0)* | *(33.3)* | *(29.2)* | ***(262.5)*** |
| Plains | 35.9 | 37.4 | 0.0 | **73.2** |
| *Mitchell Grass Downs* [1] | *(35.9)* | *(37.4)* | *(0.0)* | ***(73.2)*** |
| Inland Wetlands | 7.7 | 0.6 | 0.0 | **8.3** |
| *Mitchell Grass Downs* [1] | *(7.7)* | *(0.6)* | *(0.0)* | ***(8.3)*** |
| **DESERT SANDPLAINS** | **459.8** | **40.1** | **41.6** | **541.5** |
| Plains | 51.6 | 4.7 | 19.2 | **75.6** |
| *Davenport / Tanami* [2] | *(51.6)* | *(4.7)* | *(19.2)* | ***(75.6)*** |
| Sand plains | 408.2 | 35.9 | 22.4 | **465.9** |
| *Davenport / Tanami* [2] | *(408.2)* | (35.9) | (22.4) | ***(465.9)*** |
| **LATERITIC PLAINS AND RISES** | **567.1** | **109.6** | **29.2** | **706.0** |
| Plains | 451.5 | 88.0 | 20.1 | **559.6** |
| *Mitchell Grass Downs* [1] | *(5.0)* | *(0.0)* | *(0.0)* | ***(5.0)*** |
| *Davenport / Tanami* [2] | *(446.5)* | *(88.0)* | *(20.1)* | ***(554.6)*** |
| Low Rises | 115.0 | 21.0 | 9.2 | **145.1** |
| *Mitchell Grass Downs* [1] | *(0.0)* | *(1.2)* | *(0.0)* | ***(1.2)*** |
| *Davenport / Tanami* [2] | *(115.0)* | *(19.7)* | *(9.2)* | ***(143.9)*** |
| Playas | 0.6 | 0.7 | 0.0 | **1.3** |
| *Davenport / Tanami* [2] | *(0.6)* | *(0.7)* | *(0.0)* | ***(1.3)*** |
| **SANDSTONE PLAINS AND RISES** | **4.6** | **0.0** | **0.0** | **4.6** |
| Rises | 4.6 | 0.0 | 0.0 | **4.6** |
| *Davenport / Tanami* [2] | (4.6) | (0.0) | (0.0) | ***(4.6)*** |
| **Grand Total** | **1371.0** | **243.0** | **139.0** | **1753.0** |

[1] *Mitchell Grass Downs bioregion (IBRA v7) = Barkly Clay Plains (Land Type Region)*

[2] *Davenport / Murchison Ranges bioregion and Tanami bioregion (IBRA v7) = Tennant Creek Sandplains (Land Type Region)*

**Table 4-4. Habitat mapping Northern Territory – temporary and permanent disturbance area (ha)**

| Landscape Class | | Disturbance Area (ha) | | Grand Total |
|---|---|---|---|---|
| | Landform Class | Permanent | Temporary | |
| **ALLUVIAL FLOODPLAINS** | | **2.3** | **154.5** | **156.8** |
| | *Alluvial Plains* | *(2.3)* | *(106.3)* | ***(108.5)*** |
| | *Drainage Systems* | *(0.0)* | *(48.2)* | ***(48.2)*** |
| **CLAY PLAINS** | | **7.4** | **336.6** | **344.0** |
| | *Downs Plains* | *(7.4)* | *(255.1)* | ***(262.5)*** |
| | *Plains* | *(0.0)* | *(73.2)* | ***(73.2)*** |
| | *Inland Wetlands* | *(0.0)* | *(8.3)* | ***(8.3)*** |
| **DESERT SANDPLAINS** | | **30.1** | **511.5** | **541.6** |
| | *Plains* | *(20.4)* | *(55.2)* | ***(75.6)*** |
| | *Sand plains* | *(9.7)* | *(456.2)* | ***(465.9)*** |
| **LATERITIC PLAINS AND RISES** | | **27.9** | **685.2** | **710.7** |
| | *Plains* | *(25.0)* | *(534.6)* | ***(559.6)*** |
| | *Low Rises* | *(3.0)* | *(142.1)* | ***(145.1)*** |
| | *Playas* | *(0.0)* | *(1.3)* | ***(1.3)*** |
| **SANDSTONE PLAINS AND RISES** | | **0.0** | **4.6** | **4.6** |
| | *Rises* | *(0.0)* | *(4.6)* | ***(4.6)*** |
| **Grand Total** | | **67.7** | **1685.3** | **1753.0** |

### 4.3.2 Queensland habitat mapping

Two bioregions are traversed by the Queensland section of the Project footprint (Figure 4-2) – Mount Isa Inlier (from KP 561 – KP 622) and Mitchell Grass Downs (from KP 353 – KP 561).

The Project footprint crosses six different land zone types (Table 4-5; Figure 4-2). Broadly, rocky areas and sandplains dominate the Mount Isa Inlier bioregion (Land Zones 4, 9, 11 and 12), with the exception of Land Zone 7 that occurs in higher proportions in the Mitchell Grass Downs bioregion (in the form of low rocky rises). Alluvial and clay plain habitats dominated the Mitchel Grass Downs bioregion (Land Zones 3 and 4).

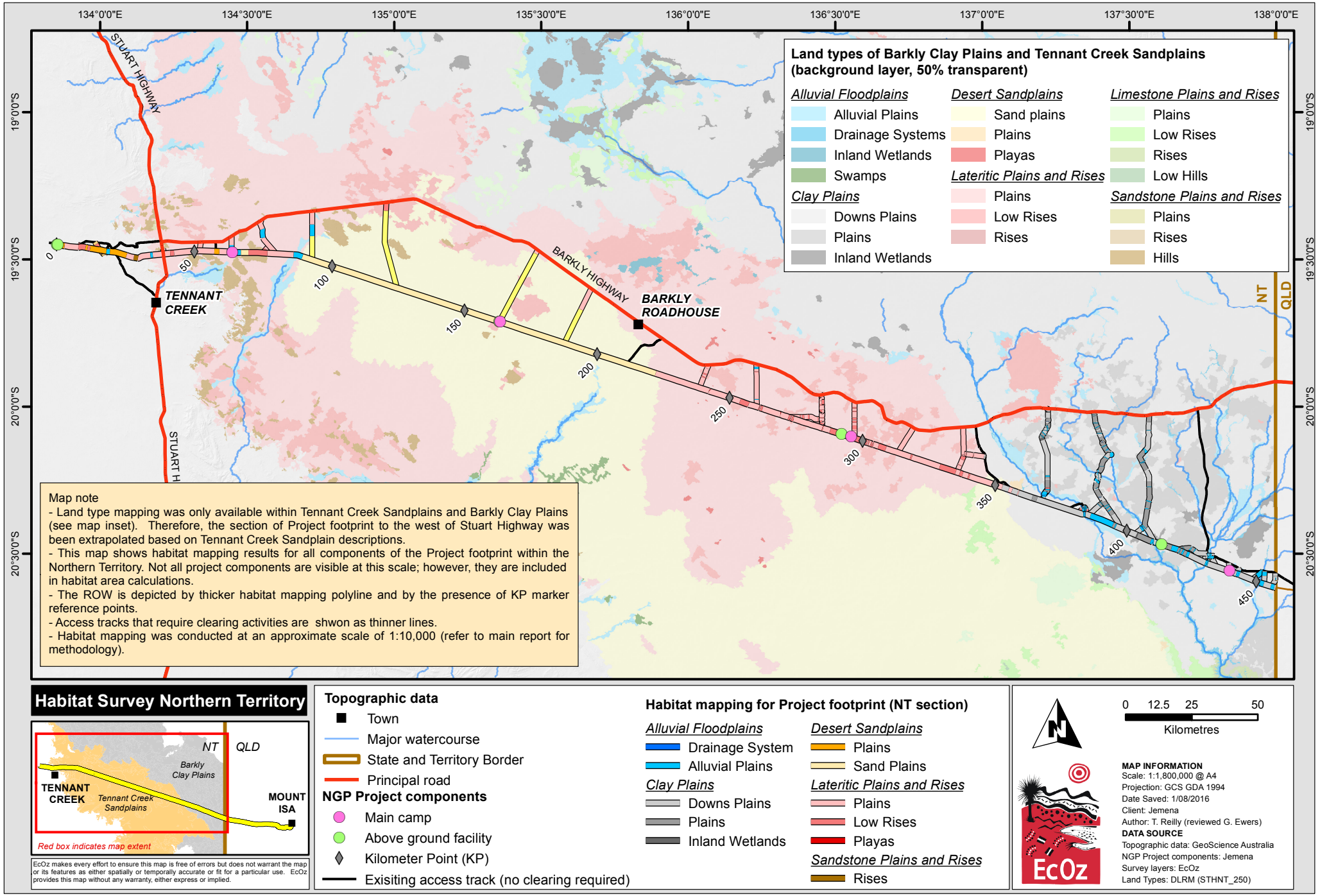
Detailed descriptions of each land zone are provided in Appendix B (including representative photographs, landform, soils, drainage, related land systems, regional extent, area traversed by Project footprint and dominant vegetation associations).

**Table 4-5. Habitat mapping summary of the Project footprint within Queensland**

| Land Zone | | Disturbance Area (ha) | | | Total (ha) |
|---|---|---|---|---|---|
| | Bioregion | ROW | Access | Other | |
| **3** | **Alluvium (river and creek flats)** | **53.2** | **22.1** | **48.9** | **137.3** |
| | *Mitchell Grass Downs* | *34.4* | *11.4* | *23.2* | ***69.1*** |
| | *Mount Isa Inlier* | *18.8* | *10.7* | *25.7* | ***55.2*** |
| **4** | **Clay plains not associated with current alluvium** | **247.7** | **46.6** | **17.2** | **303.5** |
| | *Mitchell Grass Downs* | *246.5* | *44.6* | *9.2* | ***300.4*** |
| | *Mount Isa Inlier* | *1.1* | *2.0* | *0.0* | ***3.1*** |
| **5** | **Old loamy and sandy plains** | **88.2** | **45.3** | **20.2** | **153.7** |
| | *Mitchell Grass Downs* | *10.6* | *0.7* | *0.0* | ***11.3*** |
| | *Mount Isa Inlier* | *77.6* | *44.6* | *20.2* | ***142.4*** |
| **7** | **Ironstone jump-ups** | **26.7** | **1.1** | **0.0** | **27.9** |
| | *Mitchell Grass Downs* | *26.7* | *0.6* | *0.0* | ***27.4*** |
| | *Mount Isa Inlier* | *0.0* | *0.5* | *0.0* | ***0.5*** |
| **11** | **Hills and lowlands on metamorphic rocks** | **51.4** | **6.9** | **16.7** | **75.0** |
| | *Mount Isa Inlier* | *51.4* | *6.9* | *16.7* | ***75.0*** |
| **12** | **Hills and lowlands on granitic rock** | **27.8** | **4.9** | **0.0** | **32.7** |
| | *Mount Isa Inlier* | *27.8* | *4.9* | *0.0* | ***32.7*** |
| **Grand Total** | | **495.0** | **127.0** | **95.0** | **717.0** |

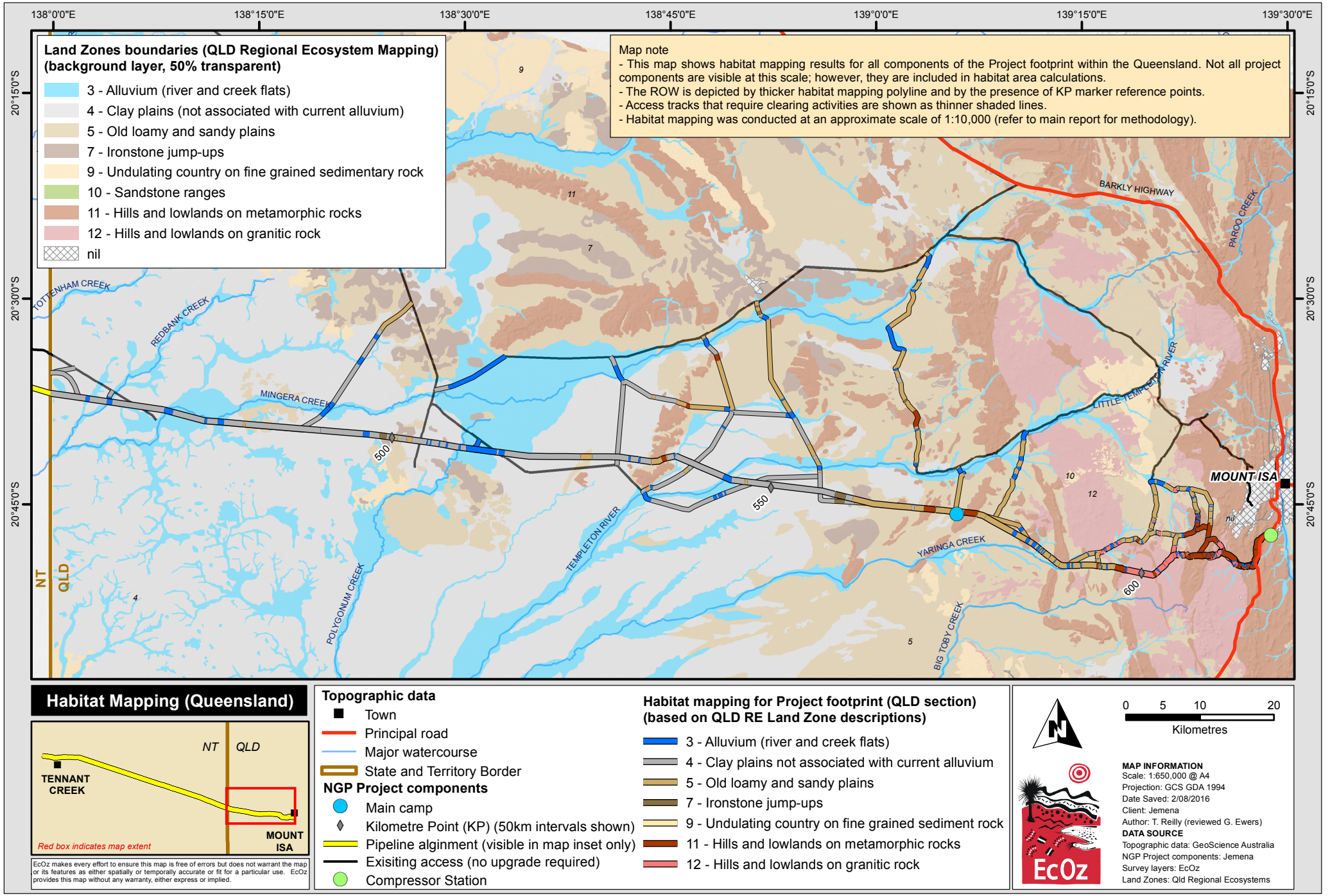
**Table 4-6. Habitat mapping Queensland – temporary and permanent disturbance area (ha)**

| Land Zone | | Disturbance Area (ha) | | Grand Total |
|---|---|---|---|---|
| | Bioregion | Permanent | Temporary | |
| **3** | **Alluvium (river and creek flats)** | **1.2** | **123.1** | **124.3** |
| | *Mitchell Grass Downs* | *1.2* | *67.9* | ***74.0*** |
| | *Mount Isa Inlier* | *0.0* | *55.2* | ***63.3*** |
| **4** | **Clay plains not associated with current alluvium** | **9.0** | **294.5** | **311.5** |
| | *Mitchell Grass Downs* | *9.0* | *291.4* | ***300.4*** |
| | *Mount Isa Inlier* | *0.0* | *3.1* | ***3.1*** |
| **5** | **Old loamy and sandy plains** | **13.2** | **140.5** | **153.7** |
| | *Mitchell Grass Downs* | *0.0* | *11.3* | ***11.3*** |
| | *Mount Isa Inlier* | *22.4* | *123.8* | ***142.4*** |
| **7** | **Ironstone jump-ups** | **0.0** | **27.9** | **27.9** |
| | *Mitchell Grass Downs* | *0.0* | *27.4* | ***27.4*** |
| | *Mount Isa Inlier* | *0.0* | *0.5* | ***0.5*** |
| **11** | **Hills and lowlands on metamorphic rocks** | **11.1** | **63.9** | **75.0** |
| | *Mount Isa Inlier* | *11.1* | *63.9* | ***75.0*** |
| **12** | **Hills and lowlands on granitic rock** | **0.0** | **32.7** | **32.7** |
| | *Mount Isa Inlier* | *0.0* | *32.7* | ***32.7*** |
| **Grand Total** | | **34.5** | **682.7** | **717.1** |




Path: C:\01. EcOz GIS Projects (TR)\Jemena\Project files\HabitatMapping_NT_v2.mxd

**Figure 4-1. Map of habitat mapping survey of the Northern Territory section of the Project footprint**




Path: C:\01. EcOz GIS Projects (TR)\Jemena\Project files\HabitatMapping_QLD_v2.mxd

**Figure 4-2. Map of habitat mapping survey of the Queensland section of the Project footprint**